

**NPTEL : Introduction to Aerospace Propulsion (Aerospace Engineering)**

**Co-ordinators : Prof. Bhaskar Roy, Prof. A M Pradeep**

Lecture 1 - Course Intro & Historical development of flights

Lecture 2 - Early development of aircraft propulsive devices

Lecture 3 - Development of Jet propulsion for aircraft

Lecture 4 - Introduction to thermodynamics, Scope and method, Basic concepts: system, surroundings, property, intensive and extensive, state, equilibrium and state postulate, process, path and cycle

Lecture 5 - Quasi-static processes, zeroth law of thermodynamics and temperature, concept of energy and its various forms, internal energy, enthalpy

Lecture 6 - Specific heats at constant pressure and volume Work and heat transfers

Lecture 7 - Tutorial

Lecture 8 - First law of thermodynamics for closed systems

Lecture 9 - First law of thermodynamics for open systems/flow processes

Lecture 10 - Second law of thermodynamics, heat engines, refrigerators and heat pumps, Kelvin-Planck and Clausius statement of second law of thermodynamics

Lecture 11 - Reversible and irreversible processes, concept of entropy

Lecture 12 - Increase of entropy principle, third law of thermodynamics, absolute entropy, perpetual motion machines

Lecture 13 - Tutorial

Lecture 14 - Carnot cycle, Carnot principle, thermodynamic temperature scale

Lecture 15 - Exergy, availability and second law efficiency

Lecture 16 - Tutorial

Lecture 17 - Gas and vapour power cycles, Otto cycle, Diesel cycle, Dual cycle

Lecture 18 - Rankine cycle, Brayton cycle, Stirling and Ericsson cycles

Lecture 19 - Thermodynamic property relations, Jacobean and Legendre transformations, Maxwell's equations

Lecture 20 - Tutorial

Lecture 21 - Properties of gas and vapour mixtures

Lecture 22 - One-dimensional compressible flows, isentropic flows

Lecture 23 - Flows with friction and heat transfer, normal and oblique shocks

Lecture 24 - Piston-prop engines: Otto cycles; Ideal and Real cycles

Lecture 25 - IC Engines for aircraft application

Lecture 26 - Performance parameters of IC engines

Lecture 27 - Supercharging of aircraft IC engines

Lecture 28 - Tutorial: IC Engines

Lecture 29 - Propeller fundamentals

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[Lecture 30 - Propeller aerodynamic theories - I](#)

[Lecture 31 - Propeller aerodynamic theories - II](#)

[Lecture 32 - Tutorial: Propellers](#)

[Lecture 33 - Ideal cycles for Jet engines](#)

[Lecture 34 - Ideal cycles for variants of jet engines](#)

[Lecture 35 - Tutorial](#)

[Lecture 36 - Fundamentals of Ramjets and Pulsejets](#)

[Lecture 37 - Fundamentals of Rocket engines](#)

[Lecture 38 - Fundamentals of Missile engines](#)

[Lecture 39 - Various space vehicles and their engines](#)

[Lecture 40 - Closure of the lecture series : recap](#)



**NPTEL : Jet Aircraft Propulsion (Aerospace Engineering)**

**Co-ordinators : Prof. A M Pradeep, Prof. Bhaskar Roy**

- Lecture 1 - Introduction & Development of Jet Aircraft Propulsion
- Lecture 2 - How the Aircraft Jet Engines make Thrust
- Lecture 3 - Jet Engine Basic Performance Parameters
- Lecture 4 - Turbojet, Reheat Turbojet and Multi-spool Engines
- Lecture 5 - Turbofan, Turbo-prop and Turboshift engines
- Lecture 6 - Ideal and Real Brayton cycles
- Lecture 7 - Jet Engine Cycles for Aircraft propulsion
- Lecture 8 - Cycle components and component performances
- Lecture 9 - Tute-1
- Lecture 10 - Analysis of engine real cycles
- Lecture 11 - Tute-2
- Lecture 12 - Thermodynamics of Compressors
- Lecture 13 - Thermodynamics of Turbines
- Lecture 14 - Axial Compressors : two dimensional analytical model
- Lecture 15 - Cascade analysis; Loss and Blade performance estimation
- Lecture 16 - Free Vortex theory; Single-Multi-stage characteristics
- Lecture 17 - Tutes-3
- Lecture 18 - Elements of centrifugal compressor
- Lecture 19 - Centrifugal Compressor characteristics: Surging, Choking
- Lecture 20 - Axial flow turbines; Turbine Blade 2-D (cascade) analysis
- Lecture 21 - Multi-staging: Axial Turbine; Turbine Cooling Technology
- Lecture 22 - Radial Turbine Aerodynamics & Thermodynamics; Losses
- Lecture 23 - Tutes-4
- Lecture 24 - Types of combustion chambers: mechanism & parameters
- Lecture 25 - Pr. Loss, Combustion efficiency; Combustion intensity
- Lecture 26 - Practical combustion system ; Stability, Fuel injection
- Lecture 27 - Intakes for Powerplant: Transport / Military Aircraft
- Lecture 28 - Subsonic, Transonic, Supersonic Intake Designs
- Lecture 29 - Nozzle : fixed and variable geometry nozzles
- Lecture 30 - C-D nozzle and their uses
- Lecture 31 - Tute-5

[Lecture 32 - Engine Off Design Operations](#)

[Lecture 33 - Aircraft Engine component matching: Dimensional analysis](#)

[Lecture 34 - Engine component matching and Sizing](#)

[Lecture 35 - Installed Performance of Engine](#)

[Lecture 36 - Tute-6](#)

[Lecture 37 - Use of Ramjets and Pulsejets in Aircraft propulsion](#)

[Lecture 38 - Thermodynamic Cycle & Performance Parameters](#)

[Lecture 39 - Flow in Diffusers, Combustors and Nozzles](#)

[Lecture 40 - Performance and Design of Ramjet & Scramjet Engines](#)

[Lecture 41 - Tute-7](#)

[Lecture 42 - Future of Aircraft Propulsion](#)

**NPTEL : Turbomachinery Aerodynamics (Aerospace Engineering)**

**Co-ordinators : Prof. Bhaskar Roy, Prof. A M Pradeep**

- Lecture 1 - Introduction to Turbo machines Syllabus, References and Schedules
- Lecture 2 - Axial Flow Compressors and Fans : Introduction to Compressor Aerothermodynamics
- Lecture 3 - A two dimensional analytical model : Cascade
- Lecture 4 - 2D losses in Axial flow Compressor Stage : Primary losses
- Lecture 5 - Tutorial 1 : Two Dimensional Axial Flow Compressors
- Lecture 6 - 3D Flows in Blade Passages, Secondary Flows, Tip leakage Flow, Scrubbling
- Lecture 7 - Three Dimensional Flow Analysis : Radial Equilibrium Concept
- Lecture 8 - Classical Blade Design Laws : Free Vortex and other Laws
- Lecture 9 - Three Dimensional Flow Analysis in Axial Flow Compressor
- Lecture 10 - Tutorial 2 : Three Dimensional Axial Flow Compressors
- Lecture 11 - Axial Compressor Characteristics: Single stage, Multi stage and Multi spool Characteristics
- Lecture 12 - Instability in Axial Compressors
- Lecture 13 - Inlet Distortion and Rotating Stall, Control of Instability
- Lecture 14 - Transonic Compressors and Shock Structure Models, Transonic Compressor Characteristics
- Lecture 15 - Axial Flow Compressor Design, Inter Spool Duct
- Lecture 16 - Design of Compressor Blades, Aerofoil Design (Subsonic, Transonic, Supersonic Profiles )
- Lecture 17 - Design of Compressor Blade: 3D Blade Shapes of Rotors and Stators
- Lecture 18 - Noise Problem in Axial Compressors and Fans
- Lecture 19 - Axial Flow Turbines: Introduction to Turbines Aerothermodynamics
- Lecture 20 - Axial Flow Turbines: Turbine Blade 2D (Cascade) Analysis
- Lecture 21 - Axial Flow Turbines: Work done, Degree of Reaction, Losses and Efficiency
- Lecture 22 - Axial Flow Turbines: Blade and Axial Flow Passages, Exit Flow Matching with Nozzle
- Lecture 23 - Tutorial 3 : Axial Flow Turbines
- Lecture 24 - Multi staging and Multi spooling of Turbine
- Lecture 25 - 3D Flow in Turbine: 3D Flow Theories, Free Vortex Theories etc.
- Lecture 26 - Tutorial 4 : 3D Flows in Axial Flow Turbines
- Lecture 27 - Turbine Blade Cooling “ Fundamentals of Heat Transfer, Blade Cooling Requirements
- Lecture 28 - Turbine Blade Cooling Technologies
- Lecture 29 - Turbine Blade Design: Turbine Profiles, Aerofoil Data and Profile Construction
- Lecture 30 - Turbine Blade Design: 3D Blade Shapes
- Lecture 31 - Centrifugal Compressors: Thermodynamics and Aerodynamics

[Lecture 32 - Centrifugal Compressors: Characteristics, Stall, Surge Problems](#)

[Lecture 33 - Tutorial 5 : Centrifugal Compressors](#)

[Lecture 34 - Design of Centrifugal Compressors: Impellers, Vane/Vane less Diffusers, Volute](#)

[Lecture 35 - Radial Turbines: Thermodynamics and Aerodynamics](#)

[Lecture 36 - Tutorial 6 : Radial Turbines](#)

[Lecture 37 - Radial Turbine Characteristics and Design of Radial Turbines](#)

[Lecture 38 - CFD for Turbomachinery: Grid Generation, Boundary Conditions for Flow Analysis](#)

[Lecture 39 - CFD for Turbomachinery: Flow Track and Inter-spool Duct Design using CFD](#)

[Lecture 40 - CFD for Turbomachinery: 2D and 3D Blade Generation and Analysis Using CFD](#)

- Lecture 1 - Course Layout and Brief Introduction of Course Instructor
- Lecture 2 - Introduction to International Standard Atmosphere (ISA)
- Lecture 3 - Pressure, Temperature, Density and Viscosity Variation with Altitude in ISA
- Lecture 4 - Other Standard Atmospheres
- Lecture 5 - Aircraft Component Nomenclature - Wing and its Components
- Lecture 6 - Aircraft Component Nomenclature - Fuselage and its Components
- Lecture 7 - Aircraft Component Nomenclature - Tail Plane and its Components
- Lecture 8 - Tutorial 1 - Aircraft Component Nomenclature
- Lecture 9 - Essentials of Incompressible Flow - Part I
- Lecture 10 - Essentials of Incompressible Flow - Part II
- Lecture 11 - Bernoulli's Equation and Coanda Effect
- Lecture 12 - Mach Number
- Lecture 13 - Tutorial 2 - Incompressible Flow and Flow Visualization
- Lecture 14 - Viscous Flow and Reynolds Number
- Lecture 15 - Introduction to Boundary Layer
- Lecture 16 - Pressure Measurement
- Lecture 17 - Air Speed Measurement - Pitot Static Tube
- Lecture 18 - Air Speed Corrections
- Lecture 19 - Altitude and ROC/ROD Measurement
- Lecture 20 - Measurements in Compressible Flows
- Lecture 21 - Non Pneumatic Instruments
- Lecture 22 - Introduction to Aerofoils and Aerofoil Nomenclature
- Lecture 23 - Aerofoils - A Visit to the Past
- Lecture 24 - Thick Aerofoils
- Lecture 25 - Low Reynolds Number Aerofoils
- Lecture 26 - Lift Generation by Wings - Part I
- Lecture 27 - Lift Generation by Wings - Part II
- Lecture 28 - Coefficient of Lift and Coefficient of Pressure
- Lecture 29 - Tutorial on Aerofoils
- Lecture 30 - Critical Mach Number
- Lecture 31 - Wave Drag

Lecture 32 - Swept Wings

Lecture 33 - Introduction to Drag and Types of Drag

Lecture 34 - Factors Affecting Induced Drag

Lecture 35 - Skin Friction Drag

Lecture 36 - Tutorial on Critical Mach Number and Wave Drag

Lecture 37 - Introduction to Propulsion

Lecture 38 - Gas Turbine Engine Types - Part I

Lecture 39 - Gas Turbine Engine Types - Part II

Lecture 40 - Introduction to Electric Propulsion and Ion Propulsion

Lecture 41 - Steady Level Flight

Lecture 42 - Power Required for the Steady Level Flight

Lecture 43 - Steady Level Flight - A Pilot's View

Lecture 44 - Tutorial on Steady Level Flight

Lecture 45 - Gliding Flight

Lecture 46 - Climbing Flight and Ceiling

Lecture 47 - Introduction to Turning Flight

Lecture 48 - Turning Flight Equations

Lecture 49 - Instantaneous and Sustained Turn

Lecture 50 - Tutorial on Climbing Flight and Turning Flight

Lecture 51 - Introduction to Static Stability: Center of Pressure, Center of Gravity and Neutral Point

Lecture 52 - Aerodynamic Center and Effect of Center of Gravity

Lecture 53 - Effect of Center of Gravity - A Practical Demonstration

Lecture 54 - Introduction to V-n Diagram

Lecture 55 - V-n Diagram as per FAR 23 Regulations

Lecture 56 - Effect of Gusts on V-n Diagram

Lecture 57 - Tutorial on Stability and Control

Lecture 58 - Range

Lecture 59 - Specific Fuel Consumption and Generalized Range Equation

Lecture 60 - Endurance

Lecture 61 - Take-off Performance of Flight - Part I

Lecture 62 - Take-off Performance of Flight - Part II

Lecture 63 - Landing Performance of Flight

Lecture 64 - Tutorial on Range Payload Diagram

[Lecture 65 - Tutorial on Range and Endurance](#)

[Lecture 66 - Flapping Wing Aerodynamics - Part I](#)

[Lecture 67 - Flapping Wing Aerodynamics - Part II](#)

- Lecture 1 - What is Aircraft Design
- Lecture 2 - Aircraft Design Process
- Lecture 3 - Design Stages
- Lecture 4 - Phases in Aircraft Design
- Lecture 5 - The Design Spiral
- Lecture 6 - Importance of Cost in Aircraft Design
- Lecture 7 - Basic Laws of Aircraft Design
- Lecture 8 - Requirements Capture
- Lecture 9 - Quality Function Deployment
- Lecture 10 - House of Quality Chart
- Lecture 11 - Example of HoQ for HALE UAV
- Lecture 12 - Illustration of HOQ-GA aircraft
- Lecture 13 - Airlines
- Lecture 14 - Key Issues in Design of Airlines
- Lecture 15 - Design Considerations - Future Airlines
- Lecture 16 - Supersonic Transport Aircraft
- Lecture 17 - Airliner and Supersonic Aircraft, some additional concepts
- Lecture 18 - Design Considerations - Cargo Aircraft
- Lecture 19 - Design Considerations - GA Aircraft
- Lecture 20 - Types of Military Aircraft
- Lecture 21 - Cargo, GA and Military Aircraft, Some additional concepts
- Lecture 22 - Aircraft Configuration Design
- Lecture 23 - Podded Engines on Wings
- Lecture 24 - Wing Sweep
- Lecture 25 - Canards and Flying Wing
- Lecture 26 - Three Surface Aircraft
- Lecture 27 - Winglets
- Lecture 28 - Thrust Vectoring
- Lecture 29 - Few Novel Concepts\_01
- Lecture 30 - Aircraft Configuration Design - Closing Remarks
- Lecture 31 - Choices in Aircraft Layout



- Lecture 32 - Wing Geometry Definitions
- Lecture 33 - Options for Wing layout
- Lecture 34 - Propulsion System Layout
- Lecture 35 - Tail Plane Layout
- Lecture 36 - Landing Gear Layout - Part 1
- Lecture 37 - Landing Gear Layout - Part 2
- Lecture 38 - Landing Gear of some Famous Aircraft
- Lecture 39 - Tutorial on OpenVSP
- Lecture 40 - Initial Sizing in Aircraft Design
- Lecture 41 - Estimation of Empty Weight Fraction
- Lecture 42 - Estimation of Mission Segment Weights
- Lecture 43 - Estimation of Fuel Weight Fractions
- Lecture 44 - Estimation of maximum L/D
- Lecture 45 - Estimation of engine parameters
- Lecture 46 - Estimation of Design gross weight
- Lecture 47 - Take-off weight build up
- Lecture 48 - Tutorial on Initial Sizing of Transport Aircraft
- Lecture 49 - Tutorial on Initial Sizing of Military Aircraft
- Lecture 50 - Subsonic Parasite Drag Estimation
- Lecture 51 - Component Buildup Method
- Lecture 52 - Drag Estimation of Military Aircraft
- Lecture 53 - Tutorial on Drag Polar Estimation of Military Aircraft
- Lecture 54 - Estimation of Lift Coefficient
- Lecture 55 - Estimation of Maximum Lift Coefficient
- Lecture 56 - Flaps as High Lift Devices
- Lecture 57 - Tutorial on Lift Coefficient Estimation of Transport Aircraft
- Lecture 58 - Tutorial on Lift Coefficient Estimation of Military Aircraft
- Lecture 59 - Constraint Analysis- Introductory Remarks
- Lecture 60 - Constraint Analysis- Transport Aircraft - Part 1
- Lecture 61 - Constraint Analysis- Transport Aircraft - Part 2
- Lecture 62 - Tutorial on Constraint Analysis of Transport Aircraft - Part 1
- Lecture 63 - Tutorial on Constraint Analysis of Transport Aircraft - Part 2
- Lecture 64 - Constraint Analysis- Military Aircraft

- [Lecture 65 - Tutorial on Constraint Analysis of Military Aircraft - Part 1](#)
- [Lecture 66 - Tutorial on Constraint Analysis of Military Aircraft - Part 2](#)
- [Lecture 67 - Refined Sizing](#)
- [Lecture 68 - Tutorial on Refined Sizing of Jet Fighter Aircraft](#)
- [Lecture 69 - Cost Estimation in Aircraft Conceptual Design](#)
- [Lecture 70 - Aircraft Life Cycle Cost Estimation](#)
- [Lecture 71 - Tutorial on RDT&E and Production Cost Estimation of Transport Aircraft](#)
- [Lecture 72 - Tutorial on DT&E and Production Cost Estimation of HALE UAV](#)
- [Lecture 73 - Estimation of Direct Operating Cost](#)
- [Lecture 74 - Fighter Aircraft Life Cycle Cost Estimation Model](#)
- [Lecture 75 - Range Payload Diagram - Part 1](#)
- [Lecture 76 - Range Payload Diagram - Part 2](#)
- [Lecture 77 - Tutorial on Range Payload Diagram of Transport Aircraft](#)
- [Lecture 78 - Environmental issues in Aircraft Design](#)
- [Lecture 79 - Limit Manoeuvre Envelope](#)
- [Lecture 80 - Effect of Gust](#)
- [Lecture 81 - Aircraft Loads](#)
- [Lecture 82 - Tutorial on V-n Diagram of Transport Aircraft](#)
- [Lecture 83 - High Altitude Long Endurance \(HALE\) Aircraft](#)
- [Lecture 84 - Morphing of Aircraft Configurations](#)
- [Lecture 85 - Guest Lectuer on Air Power and Multi-role Fighter Aircraft - Part 1](#)
- [Lecture 86 - Guest Lectuer on Air Power and Multi-role Fighter Aircraft - Part 2](#)

Lecture 1 - Introduction

Lecture 2 - Course Plan

Lecture 3 - Ascent Mission Basics

Lecture 4 - Force and Geometry Models - 1

Lecture 5 - Force and Geometry Models - 2

Lecture 6 - Idealized Performance

Lecture 7 - Trajectory Under Gravity

Lecture 8 - Impact of Gravity

Lecture 9 - Impact of Drag

Lecture 10 - Curvilinear Motion Concept

Lecture 11 - Constant Pitch Rate Solution

Lecture 12 - Constant Velocity Solution

Lecture 13 - Constant (T/m) Solution

Lecture 14 - Ascent Mission Design

Lecture 15 - Multi-stage Rocket Basics

Lecture 16 - Multi-stage Configuration Basics

Lecture 17 - Multi-stage Solution Basics

Lecture 18 - Multi-stage Problem Definition

Lecture 19 - Optimal Staging Strategy

Lecture 20 - Lagrange Solution

Lecture 21 - Approximate Staging Solution

Lecture 22 - Variant Concept

Lecture 23 - Variant Design Solution

Lecture 24 - Parallel Staging Concept

Lecture 25 - Parallel Staging Benefits

Lecture 26 - Jet Damping and Ballistic Missiles

Lecture 27 - Current Rocket Concepts

Lecture 28 - Launch Widow and SSTO Concepts

Lecture 29 - Reentry Concept

Lecture 30 - Ballistic Reentry Solution

Lecture 31 - Lifting and Other Reentry Modes

[Lecture 32 - Concluding Remarks](#)

[Lecture 33 - Rectilinear Trajectories](#)

[Lecture 34 - Curvilinear Trajectories](#)

[Lecture 35 - Multi-stage Rocket Concept](#)

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Lecture 1 - Introduction to the Course Content

Lecture 2 - Differences between LTA and HTA systems

Lecture 3 - The three conventional LTA systems

Lecture 4 - LTA gases, Types of Airships and their components

Lecture 5 - Introduction of Skyship 600 and USP of Airships

Lecture 6 - Applications of Airships

Lecture 7 - Tethered Aerostat systems

Lecture 8 - Why use Aerostats

Lecture 9 - Some Queries on Aerostats

Lecture 10 - Historical developments of LTA systems - Part I

Lecture 11 - Historical developments of LTA systems - Part II

Lecture 12 - Historical developments of LTA systems - Part III

Lecture 13 - Historical developments of LTA systems - Part IV

Lecture 14 - Historical developments of LTA systems - Part V

Lecture 15 - Historical developments of LTA systems - Part VI

Lecture 16 - Overview of PADD

Lecture 17 - Remote Controlled Airships

Lecture 18 - Autonomous Airships

Lecture 19 - Indoor Blimp Projects by students

Lecture 20 - Biomimetic Airships

Lecture 21 - Introduction to Buoyancy

Lecture 22 - Basic Concepts of Aerostatics

Lecture 23 - Ballasting, Weigh off and Fuel weight recovery

Lecture 24 - In flight Ballast Collection methods

Lecture 25 - Static Lift Prediction - Part I

Lecture 26 - Static Lift Prediction - Part II

Lecture 27 - Tutorial Problem 1 on Static Lift Estimation

Lecture 28 - Effect of Humidity and Vapour Pressure

Lecture 29 - Calculation of Ambient Air Density

Lecture 30 - Tutorial Problem 2 and 3 on Static Lift Estimation

Lecture 31 - Effect of Lifting Gas Purity, Superpressure and Superheat

Lecture 32 - Ballonet Air Weight Estimation

Lecture 33 - Net Static Lift of non rigid airships

Lecture 34 - Net Static Lift for other LTA systems

Lecture 35 - Tutorial Problem 4 on Net Static Lift Estimation

Lecture 36 - Parameters affecting Static Lift

Lecture 37 - Effect of change in Atmospheric Pressure

Lecture 38 - Tutorial Problem 5 on Change in Atmospheric Pressure

Lecture 39 - Effect of Superpressure

Lecture 40 - Tutorial Problem 6 on effect of Superpressure

Lecture 41 - Effect of Slow change in Atmospheric Temperature and Superheat

Lecture 42 - Effect of Rapid change in Atmospheric Temperature

Lecture 43 - Tutorial Problem 7 on Change in Atmospheric Temperature and Superheat

Lecture 44 - Revision and Tutorial Problem 08 and 09 on Affecting Parameters of Static Lift

Lecture 45 - Effect of change in Relative Humidity

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Lecture 47 - Effect of change in Lifting Gas Volume

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Lecture 49 - Flight To Lower Ground Elevation

Lecture 50 - Tutorial Problem 10 on Helium Addition

Lecture 51 - Outdoor Hot Air Balloon

Lecture 52 - Pressure Height

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Lecture 54 - Sea Level Inflation Fraction

Lecture 55 - Flight above Pressure Height

Lecture 56 - Effect of Change in Operating Altitude

Lecture 57 - Tutorial Problem 12 on Lifting Gas Loss

Lecture 58 - Descent Following Exceedance

Lecture 59 - Pressure Height for other LTA Vehicles

Lecture 60 - Discussion of Practice Questions

Lecture 61 - Envelope Materials - Part I

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- Lecture 65 - Fabric Testing Machines - Part II
- Lecture 66 - Need for Ground Handling
- Lecture 67 - Aerial Hanger for CL 160 Airship
- Lecture 68 - Ground Handling of Airships
- Lecture 69 - Types of Mooring Masts and Design Requirements
- Lecture 70 - Nose Battens for Envelopes
- Lecture 71 - Need for Airship Design Methodology
- Lecture 72 - Overview of Airship Design Methodology ADM
- Lecture 73 - Details of Airship Design Methodology ADM
- Lecture 74 - Inputs to Airship Design Methodology - Part 1
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- Lecture 76 - Design Constants in Airship Design Methodology
- Lecture 77 - Outputs from Airship Design Methodology
- Lecture 78 - Statistical Data Used in Airship Design Methodology
- Lecture 79 - Validation of Airship Design Methodology
- Lecture 80 - Envelope Shapes for LTA Systems
- Lecture 81 - Example of Application of Airship Design Methodology
- Lecture 82 - Conclusions and Limitations of Airship Design Methodology
- Lecture 83 - Sizing Procedure for Indoor Remotely Controlled Airships - Part 1
- Lecture 84 - Sizing Procedure for Indoor Remotely Controlled Airships - Part 2
- Lecture 85 - Sizing Procedure for Indoor Remotely Controlled Airships - Part 3
- Lecture 86 - Tutorial on Sizing of an Indoor Non Rigid Remotely Controlled Airship
- Lecture 87 - Transportation Problems Faced by Remote Regions
- Lecture 88 - Airships vs Helicopters - Part I
- Lecture 89 - Airships vs Helicopters - Part II
- Lecture 90 - Char Dham Yatra - Part I
- Lecture 91 - Char Dham Yatra - Part II
- Lecture 92 - Char Dham Yatra - Part III
- Lecture 93 - Steam and IC engines for Airships
- Lecture 94 - Electric motors for Airships
- Lecture 95 - Turboprops for Airships
- Lecture 96 - Solar Propulsion and Thrust Vectoring on Airships
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[Lecture 113 - Initial sizing of Stratospheric Airships](#)

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[Lecture 115 - Lockheed Martin's P 791 Hybrid Airship](#)

[Lecture 116 - Aeroscraft ML 866 Hybrid Airship](#)

[Lecture 117 - SkyCat Hybrid Airship](#)

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**NPTEL : Aero elasticity (Aerospace Engineering)**

**Co-ordinators : Prof. C. Venkatesan**

Lecture 1 - Aero elasticity

Lecture 2 - Aero elasticity

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Lecture 10 - Aero elasticity

Lecture 11 - Aero elasticity

Lecture 12 - Aero elasticity

Lecture 13 - Aero elasticity

Lecture 14 - Aero elasticity

Lecture 15 - Aero elasticity

Lecture 16 - Aero elasticity

Lecture 17 - Aero elasticity

Lecture 18 - Aero elasticity

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**NPTEL : Instability and Transition of Fluid Flows (Aerospace Engineering)**

**Co-ordinators : Prof. Tapan K. Sengupta**

Lecture 1 - Instability and Transition of Fluid Flows

Lecture 2 - Instability and Transition of Fluid Flows

Lecture 3 - Instability and Transition of Fluid Flows

Lecture 4 - Instability and Transition of Fluid Flows

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[Lecture 1 - Introduction to Helicopter Aerodynamics and Dynamics](#)

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**NPTEL : Introduction to Propulsion (Aerospace Engineering)**

**Co-ordinators : Dr. D.P. Mishra**

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**NPTEL : Jet and Rocket Propulsion (Aerospace Engineering)**

**Co-ordinators : Dr. A. Kushari**

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- Lecture 1 - General Introduction: Airplane Performance Characteristics
- Lecture 2 - George Cayley: Concept of Lift and Drag
- Lecture 3 - Introduction to airplane and its components
- Lecture 4 - Hansa 3 Aircraft and its Primary Systems
- Lecture 5 - Concept of Lift Aerofoil: Wing : Complete Aircraft
- Lecture 6 - Drag Polar
- Lecture 7 - Revision
- Lecture 8 - Standard Atmosphere: Description and Modeling
- Lecture 9 - Measuring Instruments: Altimeter, Airspeed Indicator
- Lecture 10 - Equations of Motion: Static Performance
- Lecture 11 - Thrust Required, Power Required: Cruise
- Lecture 12 - Excess Thrust and Power: Climb Angle and Rate of Climb
- Lecture 13 - Review
- Lecture 14 - Thrust Required: A Closer Look
- Lecture 15 - Modeling of CL: Dimensional Analysis
- Lecture 16 - A Closer Look: Point Mass Model, Dimensional Analysis
- Lecture 17 - Estimation of Drag Polar Through Flight Test
- Lecture 18 - Estimation of Rate of Climb
- Lecture 19 - Revision.
- Lecture 20 - Range and Endurance
- Lecture 21 - Range and Endurance: (Continued...)
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- Lecture 23 - Accelerated Flight
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- Lecture 26 - V stall: Cruise and Manoeuvr
- Lecture 27 - Flaps:High Lift Devices to Reduce Take off / Landing Distance
- Lecture 28 - Take off
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- Lecture 30 - Take off Performance: (Continued...)
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Lecture 3 - Stability and Trim

Lecture 4 - Stability : Wing Contribution

Lecture 5 - Stability : Tail Contribution and Static Margin

Lecture 6 - Problems : Stability and Wing Contribution Completed

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Lecture 8 - Neutral Point and Fuselage Contribution Completed

Lecture 9 - Longitudinal Control Completed

Lecture 10 - Longitudinal Control (Continued...)

Lecture 11 - Control: Elevator

Lecture 12 -  $C_{L_{trim}}$  Vs  $e_{trim}$

Lecture 13 - Neutral Point: A Closer Look

Lecture 14 - Contribution of Engine towards Stability

Lecture 15 - Revision

Lecture 16 - Trim: Cruise, Climb and Landing

Lecture 17 - Trim: Maneuver

Lecture 18 - Maneuvering Point: Stick Fixed

Lecture 19 - Numerical: Stick Fixed Maneuvering Point and Flight Demonstration

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Lecture 21 - Directional Stability

Lecture 22 - Directional Control

Lecture 23 - Lateral Stability and Control

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Lecture 28 - Hinge Moment and Hinge Moment Derivative

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Lecture 31 - Reversible Control: Stick Free and Trim Tabs

- Lecture 32 - Numericals: Stick Free
- Lecture 33 - Numericals: Stick Free (Continued...)
- Lecture 34 - Handling Qualities: Maneuvering Flight
- Lecture 35 - Determination of Neutral Point and Maneuvering Point by Flight Experiment
- Lecture 36 - Point Mass Equation of Motion
- Lecture 37 - Forces and Moments
- Lecture 38 - Aircraft Equations of Motion
- Lecture 39 - Six Degrees of Freedom of an Aircraft
- Lecture 40 - 6 DoF : Angular Momentum Components
- Lecture 41 - Vector in a Rotating Frame
- Lecture 42 - Euler Angles
- Lecture 43 - Small Perturbation Theory
- Lecture 44 - Small Perturbation Theory (Continued...)
- Lecture 45 - Perturbed Equations of Motion: Longitudinal Case
- Lecture 46 - Perturbed Force :  $f_z$
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- Lecture 48 - Perturbed Pitching Moment
- Lecture 49 - Longitudinal Dimensional Stability Derivatives
- Lecture 50 - Dynamic Stability
- Lecture 51 - Longitudinal Modes
- Lecture 52 - Short Period and Phugoid Approximations
- Lecture 53 - Pure Pitching Motion
- Lecture 54 - Stability Augmentation System (SAS)
- Lecture 55 - Lateral-Directional Motion
- Lecture 56 - Tutorial - 1
- Lecture 57 - Tutorial - 2
- Lecture 58 - Tutorial - 3
- Lecture 59 - Tutorial - 4
- Lecture 60 - History of Aviation



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Lecture 2 - System and its Surroundings

Lecture 3 - Property of System

Lecture 4 - Energy and its Various Forms

Lecture 5 - Concepts of Equilibrium and its State

Lecture 6 - Energy and its Interactions

Lecture 7 - Heat Interactions

Lecture 8 - Thermodynamic Properties of Fluids - 1

Lecture 9 - Thermodynamic Properties of Fluids - 2

Lecture 10 - Thermodynamic Properties of Fluids - 3

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Lecture 13 - First Law of Thermodynamics for Cyclic Process

Lecture 14 - First Law of Thermodynamics for Non-cyclic Process - 1

Lecture 15 - First Law of Thermodynamics for Non-cyclic Process - 2

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Lecture 17 - First Law of Thermodynamics for Steady Flow Processes

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Lecture 19 - First Law of Thermodynamics to Reacting Systems

Lecture 20 - Second Law of Thermodynamics: Basic Concepts - 1

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Lecture 22 - Second Law of Thermodynamics: Carnot Cycle and Efficiency

Lecture 23 - Second Law of Thermodynamics: Clausius Inequality

Lecture 24 - Applications of Second Law of Thermodynamics: Entropy - 1

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Lecture 26 - Exergy

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Lecture 28 - Vapor Power Cycle - 1

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Lecture 31 - Gas Power Cycles - 1

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Lecture 2 - Spring-Mass-Damper System : Underdamped

Lecture 3 - Spring-Mass-Damper System : Over and Critically damped

Lecture 4 - Laplace Transform

Lecture 5 - Pitch Dynamics : 1 D

Lecture 6 - Numericals: Week - 1

Lecture 7 - Aircraft Rigid Body Equation of Motion

Lecture 8 - Six Degree of Freedom Equation of Motion

Lecture 9 - Vector in Rotating Frame

Lecture 10 - Forces and Moments on Aircraft

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Lecture 12 - Trajectory of the Aircraft

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Lecture 15 - U-derivatives

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Lecture 17 - Alpha Dot Derivatives

Lecture 18 - q and delta Derivatives

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Lecture 20 - Longitudinal Characteristic Equation

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Lecture 22 - Longitudinal Modes: Short Period and Phugoid

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Lecture 1 - Introduction to Ancient Indian Civilization

Lecture 2 - Ancient Indian Civilization's Gift to the World

Lecture 3 - Why do we need to look at Ancient Indian Science and Technology?

Lecture 4 - Glimpses of Ancient Indian Science and Technology

Lecture 5 - Brief Review of Ancient Indian Scriptures

Lecture 6 - Basic Principles of carrying out science and technology

Lecture 7 - Arrays of Physics, chemistry and Indoor games

Lecture 8 - Marvels of Ancient Indian Technology

Lecture 9 - Introduction to Indian Agriculture

Lecture 10 - Problems arising due to modern agricultural practices

Lecture 11 - Pesticides and soil degradation

Lecture 12 - Agriculture - A Primary Productive Activity

Lecture 13 - An Agricultural Tools - A Plough

Lecture 14 - Soil and seeds

Lecture 15 - Sowing Methods

Lecture 16 - Indigenous cattle and manuring

Lecture 17 - Ancient Indian Textile Technology

Lecture 18 - Handlooms and Charkha

Lecture 19 - Different types of Handlooms

Lecture 20 - Ancient Rural Indian Housing

Lecture 21 - Thatched Roof House

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Lecture 23 - Indus Valley and Harappan Civilization

Lecture 24 - First and Second of Indian Civilization

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- Lecture 2 - Cruise Experiment (Theory)
- Lecture 3 - Weighment Experiment and cockpit panel description
- Lecture 4 - Drag Polar Experiment
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- Lecture 8 - Introduction to Flight Data Recorder
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- Lecture 11 - Data Acquisition using MEMS devices
- Lecture 12 - Estimation of Stick-Fixed Neutral Point
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- Lecture 14 - Static: Lateral-Directional Stability Test
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- Lecture 16 - Steady Coordinated Turn
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- Lecture 18 - Parameter Estimation using Least Squares Method
- Lecture 19 - Aerodynamic Parameter Estimation using Least Squares Method
- Lecture 20 - Aerodynamic Parameter Estimation using Delta Method
- Lecture 21 - Aerodynamic Parameter Estimation using Delta Method (Continued...)

- Lecture 1 - Fundamental laws of nature, system definitions and applications
- Lecture 2 - Thermodynamic property, state, equilibrium and process
- Lecture 3 - Temperature scale and pressure
- Lecture 4 - Macroscopic and microscopic forms of energy
- Lecture 5 - Different forms of work, energy transfer and sign convention
- Lecture 6 - First law of thermodynamics and energy balance
- Lecture 7 - Efficiency of mechanical and electrical devices
- Lecture 8 - Examples on basic concept and energy balance
- Lecture 9 - Phase change of a pure substance
- Lecture 10 - Property diagrams of pure substances
- Lecture 11 - Thermodynamic properties of a pure substance from a property table
- Lecture 12 - Thermodynamic properties of a pure substance
- Lecture 13 - Equations of state and compressibility chart
- Lecture 14 - Examples on properties of pure substances
- Lecture 15 - Quasi equilibrium, moving boundary work
- Lecture 16 - Polytropic process
- Lecture 17 - Energy analysis of closed system and unrestrained expansion
- Lecture 18 - Internal energy, enthalpy, and specific heats of ideal gas
- Lecture 19 - Internal energy, enthalpy, and specific heats of solids and liquids
- Lecture 20 - Examples on energy balance for closed systems and moving boundary work
- Lecture 21 - Conservation of mass and steady flow processes
- Lecture 22 - Flow work and energy of flowing fluid
- Lecture 23 - Energy balance for steady flow devices
- Lecture 24 - Throttling valve, mixing chamber and heat exchanger
- Lecture 25 - Energy analysis of steady and unsteady flow devices
- Lecture 26 - Examples on mass and energy analysis of open systems
- Lecture 27 - Second law of thermodynamics, heat engine and cyclic devices
- Lecture 28 - COP of refrigerator and heat pump, second law statements
- Lecture 29 - Perpetual motion machines, reversible and irreversible processes, Carnot cycle
- Lecture 30 - Carnot principles, thermodynamic temperature scale, Carnot HE and HP
- Lecture 31 - Examples on second law of thermodynamics



Lecture 32 - Clausius inequality, application of second law

Lecture 33 - Entropy, increase in entropy principle, isentropic process

Lecture 34 - Change in entropy of solids, liquids and ideal gases

Lecture 35 - Reversible flow work, multistage compressor, efficiency of pump and compressors

Lecture 36 - Entropy balance in closed system and control volume

Lecture 37 - Examples on entropy change in a system

Lecture 38 - Exergy and second law efficiency

Lecture 39 - Exergy of a fixed mass and flowing stream

Lecture 40 - Exergy transfer due to heat, mass and work, exergy destruction

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Lecture 45 - Analysis of Diesel cycle

Lecture 46 - Analysis of Brayton cycle

Lecture 47 - Examples on gas power cycles such as Otto, Diesel and Brayton

Lecture 48 - Rankin and Carnot vapour power cycles

Lecture 49 - Ideal regenerative Rankin cycle and combined gas-vapour cycle

Lecture 50 - Refrigeration cycles

Lecture 51 - Examples on vapour power cycles

Lecture 52 - Thermodynamic property relations: Gibbs equation, Mnemonic diagrams and reciprocity relations

Lecture 53 - hermodynamic property relations: Clapeyron equation and Maxwell relations

Lecture 54 - Thermodynamic property relations: Joule-Thomson coefficient and cyclic relations

Lecture 55 - Combustion and conservation of mass in a chemical reaction

Lecture 56 - Energy balance for reacting systems

Lecture 57 - Enthalpy of formation and combustion, adiabatic flame temperature

Lecture 58 - Examples on property relations and reaction thermodynamics

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Lecture 2 - Wing Loading and Thrust Loading

Lecture 3 - Basic Design - Lift and Drag

Lecture 4 - Range and Endurance

Lecture 5 - Mission Requirements

Lecture 6 - Range and Endurance : Propeller-driven Aircraft

Lecture 7 - Fuel Consumption : Cruise Flight

Lecture 8 - L/D for Maximum Range and Endurance

Lecture 9 - Range and endurance for Jet-driven Aircraft

Lecture 10 - Estimation of Fuel for a Mission

Lecture 11 - Design Considerations : Power Plant, Gross Weight

Lecture 12 - Design Considerations : Aerofoil Selection

Lecture 13 - Design Considerations : Wing

Lecture 14 - Wing Design: Aerofoil

Lecture 15 - Wing Design:t/c, Camber and Leading Edge Radius

Lecture 16 - Wing Design: Aspect Ratio

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Lecture 23 - Thrust Loading and Wing Loading

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Lecture 27 - Take off: Wing Loading and Thrust Loading

Lecture 28 - Take off:  $V_{stall}$  and High Lift Devices

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- Lecture 2 - Scope and applications of combustion
- Lecture 3 - Scope of combustion (Continued...) and types of fuel and oxidizers
- Lecture 4 - Characterization of liquid and gaseous fuel
- Lecture 5 - Properties of liquid and solid fuels, various modes of combustion
- Lecture 6 - Thermodynamics of combustion
- Lecture 7 - Thermodynamics of combustion (Continued...)
- Lecture 8 - Laws of thermodynamics and Stoichiometry
- Lecture 9 - Stoichiometric calculations for air-gas mixture
- Lecture 10 - Mixture fraction calculation for diffusion flames
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- Lecture 16 - Chemical equilibrium and Gibbs free energy
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- Lecture 18 - Determination of chemical equilibrium composition
- Lecture 19 - Chemical and reaction kinetics
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- Lecture 21 - Collision Theory
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- Lecture 23 - Collision frequency of molecules
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- Lecture 26 - Classification of chemical reactions
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Lecture 1 - Rules and Regulations for Civil Aviation in India

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Lecture 10 - Aircraft Electrical Circuit

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Lecture 14 - Inspection of Cessna 206

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Lecture 3 - Analysis of One Dimensional Combustion Wave (Continued...)

Lecture 4 - Introduction to Laminar Premixed Flame

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Lecture 6 - Laminar Flame Theory for Premixed Flames

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Lecture 8 - Determination of Laminar Burning Velocity for Premixed Flames

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Lecture 18 - Turbulent Burning Velocity and Premixed Flame Regimes

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Lecture 20 - Phenomenological Analysis of a Laminar Jet Diffusion Flame

Lecture 21 - Theoretical Analysis of a Two-Dimensional Diffusion Flame

Lecture 22 - Theoretical Analysis of a Two-Dimensional Diffusion Flame (Continued...)

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- Lecture 2 - Measurement of Flight Velocity and Standard Atmosphere
- Lecture 3 - Anatomy of Airplane and Airfoil Nomenclature
- Lecture 4 - Examples, Pitot and static tube and differential pressure sensor
- Lecture 5 - Generation of Lift and Drag
- Lecture 6 - Aerodynamic center and center of pressure, Various wing planform
- Lecture 7 - Lifting line theory, NACA airfoil nomenclature
- Lecture 8 - Airfoil and Finite wing, Various wing planform
- Lecture 9 - Interpreting airfoil data,  $C_l$  vs  $\alpha$  and drag polar, selection of airfoil
- Lecture 10 - Introduction to Airplane performance, Equation of motion
- Lecture 11 - Thrust required and Power required
- Lecture 12 - Calculation of Performance parameters and selection of power plant
- Lecture 13 - Climb Performance, Engine Sizing and Power Plant selection
- Lecture 14 - Weight Estimation , Common propulsion systems
- Lecture 15 - Weight Estimation contd., Electric propulsion, Battery Sizing
- Lecture 16 - Iterative weight estimation and Wing sizing
- Lecture 17 - Wing Planform selection and sizing and Flight test of Cropped delta wing UAVs
- Lecture 18 - Effect of variation of CG location and Static Stability
- Lecture 19 - C.G. location and Longitudinal Static stability
- Lecture 20 - Tutorial 1
- Lecture 21 - Contribution of tail in static stability and Neutral point.
- Lecture 22 - Tutorial 2
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- Lecture 5 - Construction of Reciprocating Engine (Continued...)
- Lecture 6 - Lubrication System
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- Lecture 9 - Induction System
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- Lecture 15 - Engine Fuel and Fuel Metering Systems (Continued...)
- Lecture 16 - Engine Fuel and Fuel Metering Systems (Lab Session)
- Lecture 17 - Carburetor troubleshooting and Fuel Injection System
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- Lecture 24 - Aircraft Reciprocating Engine Inspection - Part 1
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Lecture 3 - Types of Rocket Engine

Lecture 4 - Fundamentals of Aero-thermodynamics

Lecture 5 - Control Volume Analysis and Governing Equations

Lecture 6 - Adiabatic Steady 1-D flow and Speed of Sound

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- Lecture 36 - Characteristics of Solid Propellants
- Lecture 37 - Effect of Acceleration and Particle Size on Burning Rate
- Lecture 38 - Erosive Burning, Effect of Propellant Temperature and Thermal Model
- Lecture 39 - Chamber Pressure in Solid Propellant Rocket Engine
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- Lecture 41 - Types of Solid Propellant Grains and Evolution of Burning Surface
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- Lecture 44 - Injection System in LPRE
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- Lecture 56 - Heat Transfer Analysis of Cooling System
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Lecture 4 - Lift and Drag for an Infinite Wing (Continued...)

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Lecture 12 - Example Problems for Wing alone Configuration

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Lecture 14 - Example problems of wing and tail combination

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Lecture 19 - Piston Engines and Propellers (Continued...)

Lecture 20 - Piston Engines and Propellers (Continued...)

Lecture 21 - Piston Engines and Propellers (Continued...)

Lecture 22 - Piston Engines and Propellers (Continued...)

Lecture 23 - Piston Engines and Propellers (Continued...)

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Lecture 25 - Performance/cycle analysis: Pulsejet (Continued...), Ramjet

Lecture 26 - Performance/cycle analysis: Ramjet (Continued...)

Lecture 27 - Performance/cycle analysis: Ramjet (Continued...), and Scramjet Engines

Lecture 28 - Performance/cycle analysis: Turbojet

Lecture 29 - Performance/cycle analysis: Turbojet (Continued...)

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Lecture 31 - Performance/cycle analysis: Turbofan (Continued...)

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Lecture 3 - Linear Algebra: Permutation Matrix, Existence of Solution

Lecture 4 - Linear Algebra: Permutation Matrix, Existence of Solution (Continued...)

Lecture 5 - Linear Algebra: Linear Independence, Basis Vector and Dimensions

Lecture 6 - Linear Algebra: Null Space, Column Space, Row Space, Introduction to Orthogonal System

Lecture 7 - Linear Algebra: Orthogonal System, Projection, Determinant

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Lecture 9 - Linear Algebra: Properties of Determinant, Cramer's Rule, Introduction to Eigen Values

Lecture 10 - Linear Algebra: Eigen Values, Eigen Vectors, SVD

Lecture 11 - Linear Algebra: Eigen Values, Eigen Vectors, SVD (Continued...)

Lecture 12 - ODE: Introduction to ODEs, Initial Value Problem, Separation of Variables

Lecture 13 - ODE: Solution of Exact ODEs, First Order Linear Systems

Lecture 14 - ODE: Solution of Second Order Linear ODEs

Lecture 15 - ODE: Existence and Uniqueness of Solution, Non-Homogeneous System

Lecture 16 - ODE: Higher Order Linear ODEs, Variation of Parameters, System of ODEs

Lecture 17 - ODE: Linear Systems, Superposition for Homogeneous Systems

Lecture 18 - Fourier Analysis, Orthogonality of Trigonometric Systems, Euler's Formula

Lecture 19 - Parseval's Theorem, Fourier Integrals, Laplace Transforms

Lecture 20 - PDE: Introduction to PDEs, Solution of PDEs using Characteristics Curve

Lecture 21 - PDE: First Order PDEs, Dilation Invariant Solution of Differential Equations

Lecture 22 - PDE: Solution of Linear PDEs

Lecture 23 - PDE: Separation of Variables, Eigenvalue Problem, Poisson Integral Representation

Lecture 24 - PDE: Boundary Conditions, Solution of 2D systems

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Lecture 26 - Errors, Numerical Differentiation, Stability

Lecture 27 - Roots of Equations: Graphical Method, Bi-Section Method, False-Position Method

Lecture 28 - Secant Method, Brent's Method, Multipoint Iteration Method, Derivative Free Method

Lecture 29 - Complex Roots, Birge-Vieta Method, Bairstow's method

Lecture 30 - Solution of Linear Algebraic Equations, Gauss Elimination Method

Lecture 31 - Direct Methods: Gauss Elimination, Gauss-Jordan, Crout's Method, Cholesky Method, Iterative Methods: Jacobi Iteration

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Method, Gauss-Seidel

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Lecture 33 - Interpolation: Taylor's Series, Lagrange and Newton Interpolation, Iterated Interpolation, Hermite Interpolation, Finite Difference Operations

Lecture 34 - Piecewise and Spline Interpolation, Bivariate Interpolation, Least Square Approximation, Uniform Polynomial Approximation

Lecture 35 - Numerical Differentiation and Intergration, Methods Based on Finite Differences, Methods based on Undetermined Coefficients, Extrapolation Methods, Partial Differentiation

Lecture 36 - Numerical Integration: Newton-Cotes Method, Gaussian Integration Methods, Lobatto Integration Method, Radau Integration Method, Composite Integration Methods

Lecture 37 - Double Integration: Trapezoidal Rule, Simpson's Rule, Solution of ODEs: Difference Equation, Single Step Methods, Explicit Methods

Lecture 38 - Runge-Kutta Methods, Euler-Cauchy Method, Multi-step Methods, Predictor-Corrector Methods

Lecture 39 - System of Differential Equations, Stability Analysis, Solution of Boundary Value Problem: Shooting Method

Lecture 40 - Numerical Approach to Solution of PDEs: Heat Conduction Equation, Convergence and Stability

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Lecture 9 - One-dimensional waves (Continued...)

Lecture 10 - One-dimensional waves (Continued...)

Lecture 11 - Waves and Supersonic Flow

Lecture 12 - Waves and Supersonic Flow (Continued...)

Lecture 13 - Waves and Supersonic Flow (Continued...)

Lecture 14 - Waves and Supersonic Flow (Continued...)

Lecture 15 - Shock Expansion Theory

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- Lecture 3 - Particle Kinematics (Continued...)
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**NPTEL : Combustion (Aerospace Engineering)**

**Co-ordinators : Prof. S.R. Chakravarthy**

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- Lecture 24 - Derivation of Angular Motion Equations
- Lecture 25 - Description of various forces and moments
- Lecture 26 - Nonlinearities and Associated Aircraft Behavior
- Lecture 27 - Small perturbation method, Linearization of equations
- Lecture 28 - Aerodynamic force and Moment Derivatives
- Lecture 29 - Contribution of Aircraft components to Aerodynamic Derivatives
- Lecture 30 - Linear Model and Aircraft Dynamics Modes
- Lecture 31 - Short Period, Phugoid (Lanchester's formulation)

[Lecture 32 - Short period mode approximation](#)

[Lecture 33 - Flying and Handling Qualities, Cooper Harper Scale](#)

[Lecture 34 - Pure rolling motion, Pure yawing motion, Spiral approximation](#)

[Lecture 35 - Spiral, Roll, Dutch roll Mode approximations](#)

[Lecture 36 - Lateral directional Flying Qualities, Routh's Stability criterion](#)

[Lecture 37 - Stability in Steady Roll Maneuver](#)

[Lecture 38 - Wind Effect on Aircraft Pure Plunging Motion](#)

[Lecture 39 - Wind Profiles, Longitudinal Mode Response to Wind Shear](#)

[Lecture 40 - Stability control/Augmentation](#)

[Lecture 41 - Autopilots, Automatic Landing System](#)

**NPTEL : Gas Dynamics (Aerospace Engineering)**

**Co-ordinators : Dr. T.M. Muruganandam**

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**NPTEL : Introduction to CFD (Aerospace Engineering)**

**Co-ordinators : Prof. M. Ramakrishna**

- Lecture 1 - Introduction, Why and how we need computers
- Lecture 2 - Representing Arrays and functions on computers
- Lecture 3 - Representing functions - Box functions
- Lecture 4 - Representing functions - Polynomials and Hat functions
- Lecture 5 - Hat functions, Quadratic and Cubic representations
- Lecture 6 - Demo - Hat functions, Aliasing
- Lecture 7 - Representing Derivatives - finite differences
- Lecture 8 - Finite differences, Laplace equation
- Lecture 9 - Laplace equation - Jacobi iterations
- Lecture 10 - Laplace equation - Iteration matrices
- Lecture 11 - Laplace equation - convergence rate
- Lecture 12 - Laplace equation - convergence rate Continued
- Lecture 13 - Demo - representation error, Laplace equation
- Lecture 14 - Demo - Laplace equation, SOR
- Lecture 15 - Laplace equation - final, Linear Wave equation
- Lecture 16 - Linear wave equation - Closed form and numerical solution, stability analysis
- Lecture 17 - Generating a stable scheme and Boundary conditions
- Lecture 18 - Modified equation
- Lecture 19 - Effect of higher derivative terms on Wave equation
- Lecture 20 - Artificial dissipation, upwinding, generating schemes
- Lecture 21 - Demo - Modified equation, Wave equation
- Lecture 22 - Demo - Wave equation / Heat Equation
- Lecture 23 - Quasi-linear One-Dimensional. wave equation
- Lecture 24 - Shock speed, stability analysis, Derive Governing equations
- Lecture 25 - One-Dimensional Euler equations - Attempts to decouple
- Lecture 26 - Derive Eigenvectors, Writing Programs
- Lecture 27 - Applying Boundary conditions
- Lecture 28 - Implicit Boundary conditions
- Lecture 29 - Flux Vector Splitting, setup froms averaging
- Lecture 30 - Roes averaging
- Lecture 31 - Demo - One Dimensional flow

[Lecture 32 - Accelerating convergence - Preconditioning, dual time stepping](#)

[Lecture 33 - Accelerating convergence - Intro to Multigrid method](#)

[Lecture 34 - Multigrid method](#)

[Lecture 35 - Multigrid method - final, Parallel Computing](#)

[Lecture 36 - Calculus of Variations - Three Lemmas and a Theorem](#)

[Lecture 37 - Calculus of Variations - Application to Laplace Equation](#)

[Lecture 38 - Calculus of Variations - Final and Random Walk](#)

[Lecture 39 - Overview and Recap of the course](#)



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Lecture 2 - Motion in Space

Lecture 3 - Rotational Frame of Reference and Orbital Velocities

Lecture 4 - Velocity Requirements

Lecture 5 - Theory of rocket propulsion

Lecture 6 - Rocket Equation and Staging of Rockets

Lecture 7 - Review of Rocket Principles: Propulsion Efficiency

Lecture 8 - Examples Illustrating Theory of Rocket Propulsion and Introduction to Nozzles

Lecture 9 - Theory of Nozzles

Lecture 10 - Nozzle Shape

Lecture 11 - Area Ratio of Nozzles: Under Expansion and Over Expansion

Lecture 12 - Characteristic Velocity and Thrust Coefficient

Lecture 13 - Divergence Loss in Conical Nozzles and the Bell Nozzles

Lecture 14 - Unconventional Nozzles and Problems in Nozzles

Lecture 15 - Criterion for Choice of Chemical Propellants

Lecture 16 - Choice of Fuel-Rich Propellants

Lecture 17 - Performance Prediction Analysis

Lecture 18 - Factors Influencing Choice of Chemical Propellants

Lecture 19 - Low energy liquid propellants and Hybrid propellants Chapter 5: Solid Propellant Rockets

Lecture 20 - Introduction to Solid Propellant Rockets

Lecture 21 - Burn Rate of Solid Propellants and Equilibrium Pressure in Solid Propellant Rockets

Lecture 22 - Design Aspects of Solid Propellant Rockets

Lecture 23 - Burning Surface Area of Solid Propellant Grains

Lecture 24 - Ignition of Solid Propellant Rockets

Lecture 25 - Review of Solid Propellant Rockets

Lecture 26 - Feed Systems for Liquid Propellant Rockets

Lecture 27 - Feed System Cycles for Pump Fed Liquid Propellant Rockets

Lecture 28 - Analysis of Gas Generator and Staged combustion cycles and introduction to injectors

Lecture 29 - Injectors, Cooling of Chambers and Mixture Ratio Distribution

Lecture 30 - Efficiencies due to mixture ratio distribution and incomplete vaporization

Lecture 31 - Pumps and Turbines: Propellant Feed System at Zero -g- Conditions

[Lecture 32 - Review of Liquid Bi-propellant Rockets and Introduction to Mono-propellant Rockets](#)

[Lecture 33 - Introduction to Hybrid Rockets and a Simple Illustration of Combustion instability in Liquid Propellant Rockets](#)

[Lecture 34 - Principles of Electrostatic and Electromagnetic Rockets](#)

[Lecture 35 - Electrical Thrusters](#)

[Lecture 36 - Electrical and Nuclear Rockets; Advanced Propulsion](#)

- Lecture 1 - Introduction and Motivation for Advanced Control Design
- Lecture 2 - Classical Control Overview - I
- Lecture 3 - Classical Control Overview - II
- Lecture 4 - Classical Control Overview - III
- Lecture 5 - Classical Control Overview - IV
- Lecture 6 - Basic Principles of Atmospheric Flight Mechanics
- Lecture 7 - Overview of Flight Dynamics - I
- Lecture 8 - Overview of Flight Dynamics - II
- Lecture 9 - Representation of Dynamical Systems - I
- Lecture 10 - Representation of Dynamical Systems - II
- Lecture 11 - Representation of Dynamical Systems - III
- Lecture 12 - Review of Matrix Theory - I
- Lecture 13 - Review of Matrix Theory - II
- Lecture 14 - Review of Matrix Theory - III
- Lecture 15 - Review of Numerical Methods
- Lecture 16 - Linearization of Nonlinear Systems
- Lecture 17 - First and Second Order Linear Differential Equations
- Lecture 18 - Time Response of Linear Dynamical Systems
- Lecture 19 - Stability of Linear Time Invariant Systems
- Lecture 20 - Controllability and Observability of linear Time Invariant Systems
- Lecture 21 - Pole Placement Control Design
- Lecture 22 - Pole Placement Observer Design
- Lecture 23 - Static Optimization: An Overview
- Lecture 24 - Calculus of Variations: An Overview
- Lecture 25 - Optimal Control Formulation using Calculus of Variations
- Lecture 26 - Classical Numerical Methods for Optimal Control
- Lecture 27 - Linear Quadratic Regulator (LQR) Design - 1
- Lecture 28 - Linear Quadratic Regulator (LQR) Design - 2
- Lecture 29 - Linear Control Design Techniques in Aircraft Control - I
- Lecture 30 - Linear Control Design Techniques in Aircraft Control - II
- Lecture 31 - Lyapunov Theory - I

[Lecture 32 - Lyapunov Theory - II](#)

[Lecture 33 - Constructions of Lyapunov Functions](#)

[Lecture 34 - Dynamic Inversion - I](#)

[Lecture 35 - Dynamic Inversion - II](#)

[Lecture 36 - Neuro-Adaptive Design - I](#)

[Lecture 37 - Neuro-Adaptive Design - II](#)

[Lecture 38 - Neuro-Adaptive Design for Flight Control](#)

[Lecture 39 - Integrator Back-Stepping; Linear Quadratic \(LQ\) Observer](#)

[Lecture 40 - An Overview of Kalman Filter Theory](#)

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Lecture 2 - Overview of SS Approach and Matrix Theory

Lecture 3 - Review of Numerical Methods

Lecture 4 - An Overview of Static Optimization - I

Lecture 5 - An Overview of Static Optimization - II

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Lecture 7 - Review of Calculus of Variations - II

Lecture 8 - Optimal Control Formulation Using Calculus of Variations

Lecture 9 - Classical Numerical Methods to Solve Optimal Control Problems

Lecture 10 - Linear Quadratic Regulator (LQR) - I

Lecture 11 - Linear Quadratic Regulator (LQR) - II

Lecture 12 - Linear Quadratic Regulator (LQR) - III

Lecture 13 - Linear Quadratic Regulator (LQR) - III

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Lecture 16 - Overview of Flight Dynamics - II

Lecture 17 - Overview of Flight Dynamics - III

Lecture 18 - Linear Optimal Missile Guidance using LQR

Lecture 19 - SDRE and  $\hat{I}$ , - D Designs

Lecture 20 - Dynamic Programming

Lecture 21 - Approximate Dynamic Programming (ADP), Adaptive Critic (AC) and Single Network Adaptive Critic (SNAC) Design

Lecture 22 - Transcription Method to Solve Optimal Control Problems

Lecture 23 - Model Predictive Static Programming (MPSP) and Optimal Guidance of Aerospace Vehicles

Lecture 24 - MPSP for Optimal Missile Guidance

Lecture 25 - Model Predictive Spread Control (MPSC) and Generalized MPSP (G-MPSP) Designs

Lecture 26 - Linear Quadratic Observer & An Overview of State Estimation

Lecture 27 - Review of Probability Theory and Random Variables

Lecture 28 - Kalman Filter Design - I

Lecture 29 - Kalman Filter Design - II

Lecture 30 - Kalman Filter Design - III

Lecture 31 - Integrated Estimation, Guidance & Control - I

[Lecture 32 - Integrated Estimation, Guidance & Control - II](#)

[Lecture 33 - LQG Design; Neighboring Optimal Control & Sufficiency Condition](#)

[Lecture 34 - Constrained Optimal Control - I](#)

[Lecture 35 - Constrained Optimal Control - II](#)

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[Lecture 37 - Optimal Control of Distributed Parameter Systems - I](#)

[Lecture 38 - Optimal Control of Distributed Parameter Systems - II](#)

[Lecture 39 - Take Home Material: Summary - I](#)

[Lecture 40 - Take Home Material: Summary - II](#)

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Lecture 3 - Chemical Equilibrium - II

Lecture 4 - Chemical Kinetics - I

Lecture 5 - Chemical Kinetics - II

Lecture 6 - Chemical Kinetics - III

Lecture 7 - Chemical Kinetics - IV

Lecture 8 - Oxidation Mechanism of Fuels - I

Lecture 9 - Oxidation Mechanism of Fuels - II

Lecture 10 - Oxidation Mechanism of Fuels - III

Lecture 11 - Oxidation Mechanism of Fuels - IV

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Lecture 17 - Governing Equations - V

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Lecture 19 - Laminar Non-Premixed Flames - II

Lecture 20 - Laminar Non-Premixed Flames - III

Lecture 21 - Laminar Non-Premixed Flames - IV

Lecture 22 - Laminar Premixed Flames - I

Lecture 23 - Laminar Premixed Flames - II

Lecture 24 - Laminar Premixed Flames - III

Lecture 25 - Laminar Premixed Flames - IV

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Lecture 33 - Non-reacting turbulent flows - II  
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Lecture 39 - Turbulent Non-Premixed Flames - I  
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Lecture 53 - Flame Stabilization and Blow off - I  
Lecture 54 - Flame Stabilization and Blow off - II  
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Lecture 58 - Combustion in Scramjets - I  
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Lecture 2 - Flow Regimes

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Lecture 4 - Thermodynamics - 2

Lecture 5 - Thermodynamics - Numerical

Lecture 6 - Flow equations - Integral Form

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Lecture 8 - Quasi-1D Assumption

Lecture 9 - Speed of Sound

Lecture 10 - Speed of Sound - Numerical

Lecture 11 - Stagnation properties

Lecture 12 - Pitot tube

Lecture 13 - Sonic/Star properties

Lecture 14 - Numerical

Lecture 15 - Normal Shock - I

Lecture 16 - Normal Shock - II-a

Lecture 17 - Normal Shock - II-b

Lecture 18 - Normal Shock - III

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Lecture 20 - Normal Shock - Numerical

Lecture 21 - The Shock Tube

Lecture 22 - Waves of infinitesimal Amplitude

Lecture 23 - Waves of finite amplitude

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Lecture 25 - Unsteady Flows - Numerical

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Lecture 29 - Shock Reflection

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Lecture 31 - Varying Area Duct Flows - I

- Lecture 32 - Varying Area Duct Flows - II
- Lecture 33 - Converging Nozzle and Chocking
- Lecture 34 - Converging and Diverging Nozzle Operation
- Lecture 35 - Varying area flow- Numericals - I
- Lecture 36 - Diffusers Intakes/Inlets
- Lecture 37 - Experimental facilities
- Lecture 38 - Varying area flow - Numericals - II
- Lecture 39 - Varying area flow - Numericals - III
- Lecture 40 - Varying area flow - Numericals - IV
- Lecture 41 - 1D flow with friction - Fanno flow - I
- Lecture 42 - 1D flow with friction - Fanno flow - II
- Lecture 43 - 1D flow with friction - Fanno flow - III
- Lecture 44 - 1D flow with friction - Fanno flow - Numericals
- Lecture 45 - 1D Flows with Heat Addition: Rayleigh Flows - I
- Lecture 46 - 1D Flows with Heat Addition: Rayleigh Flows - II
- Lecture 47 - 1D Flows with Heat Addition: Rayleigh Flows - Numericals
- Lecture 48 - Generalized 1D Flows
- Lecture 49 - Small perturbation theory - I
- Lecture 50 - Small perturbation theory - II
- Lecture 51 - Small perturbation theory - III
- Lecture 52 - Method of Characteristics: 2D Supersonic Flow - I
- Lecture 53 - Method of Characteristics: 2D Supersonic Flow - II
- Lecture 54 - Method of Characteristics: Applications
- Lecture 55 - Hypersonic Flows - I
- Lecture 56 - Hypersonic Flows - II
- Lecture 57 - Edney Shock Interaction
- Lecture 58 - Shock Boundary Layer Interaction - I
- Lecture 59 - Shock Boundary Layer Interaction - II
- Lecture 60 - Concluding Remarks

- Lecture 1 - Food Microbiology: Microbial Growth and Concerns in Various Foods
- Lecture 2 - Blanching, Pasteurization, Ultra-pasteurization, Hot fill and UHT
- Lecture 3 - Thermal processing equipment
- Lecture 4 - Milk pasteurization
- Lecture 5 - Canning operations
- Lecture 6 - Temperature distribution and heat penetration
- Lecture 7 - Kinetics of reactions
- Lecture 8 - F value and process requirements
- Lecture 9 - Quality considerations and process optimization
- Lecture 10 - Shelf life studies
- Lecture 11 - Validation of heat processes
- Lecture 12 - Fundamentals of aseptic processing
- Lecture 13 - Aseptic equipment design
- Lecture 14 - Aseptic process design
- Lecture 15 - Microwave and radio frequency heating
- Lecture 16 - Ohmic heating
- Lecture 17 - Overview of non-thermal processing technologies
- Lecture 18 - Advanced separation processes
- Lecture 19 - High pressure dialysis, ultrafiltration and reverse osmosis
- Lecture 20 - Nanofiltration, electrodialysis and membrane separation
- Lecture 21 - Various types of heat exchangers for food process engineering
- Lecture 22 - Various types of driers for food process engineering
- Lecture 23 - Importance and applications of extrusion technology in food processing
- Lecture 24 - Changes of properties and functional components of extruded foods
- Lecture 25 - Food biosensors
- Lecture 26 - Types of functional foods: Probiotics and nutraceuticals
- Lecture 27 - Packaging considerations: Barrier and mechanical properties of food packaging materials
- Lecture 28 - Biocomposite/bionanocomposite materials for food packaging applications
- Lecture 29 - Sanitary components and requirements
- Lecture 30 - Regulatory considerations
- Lecture 31 - Special Lecture: Membrane Separation



- Lecture 1 - Introduction to Natural Resource bases - Part 1
- Lecture 2 - Introduction to Natural Resource bases - Part 2A
- Lecture 3 - Introduction to Natural Resource bases - Part 2B
- Lecture 4 - Introduction to Natural Resource bases - Part 2C
- Lecture 5 - Resource management Paradigms - Part 1
- Lecture 6 - Resource management Paradigms - Part 2
- Lecture 7 - Approaches to NRM
- Lecture 8 - Biodiversity and conservation - Part 1
- Lecture 9 - Biodiversity and conservation - Part 2
- Lecture 10 - Biodiversity and conservation - Part 3
- Lecture 11 - Participatory Rural Appraisal and Rapid Rural Appraisal - Part 1
- Lecture 12 - Participatory Rural Appraisal and Rapid Rural Appraisal - Part 2
- Lecture 13 - Participatory Rural Appraisal and Rapid Rural Appraisal - Part 3
- Lecture 14 - Participatory Rural Appraisal and Rapid Rural Appraisal - Part 4
- Lecture 15 - Introduction to INRM
- Lecture 16 - Learning cycle in Integrated Natural Resources Management
- Lecture 17 - Technologies for Integrated Natural Resources Management
- Lecture 18 - PRA techniques within INRM
- Lecture 19 - Ranking technique
- Lecture 20 - Community Based Natural Resources Management - Part 1
- Lecture 21 - Community Based Natural Resources Management - Benefits from CBNRM
- Lecture 22 - Community Based Natural Resources Management - Part 2
- Lecture 23 - Watershed management
- Lecture 24 - Watershed management: Flood control
- Lecture 25 - National Water Policy
- Lecture 26 - Soil erosion management
- Lecture 27 - Landuse management for flood risk reduction
- Lecture 28 - Drought Management
- Lecture 29 - Common Property Right (CPR)
- Lecture 30 - A Tutorial on Tragedy of the Commons
- Lecture 31 - Environmental Management Systems (EMS)

- Lecture 32 - National Environment Policy (NEP)
- Lecture 33 - Modeling And Simulations Applications in Agriculture for NRM - Part 1
- Lecture 34 - Modeling And Simulations Applications in Agriculture for NRM - Part 2
- Lecture 35 - Modeling And Simulations Applications in Agriculture for NRM - Part 3
- Lecture 36 - Modeling And Simulations Applications in Agriculture for NRM - Part 4
- Lecture 37 - Modeling And Simulations Applications in Agriculture for NRM - Part 5
- Lecture 38 - Precision Farming and Protected Cultivation - Part 1
- Lecture 39 - Precision Farming and Protected Cultivation - Part 2
- Lecture 40 - Precision Farming and Protected Cultivation - Part 3
- Lecture 41 - Environmental Impact Assessment (EIA) - Part 1
- Lecture 42 - Environmental Impact Assessment (EIA) - Part 2
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- Lecture 48 - CBNRM in Kenya
- Lecture 49 - Model sensitivity and Uncertainty
- Lecture 50 - MCDA in Agriculture
- Lecture 51 - MCDM for NRM - Part 1
- Lecture 52 - MCDM for NRM - Part 2
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- Lecture 54 - Remote Sensing and GIS Application in Agriculture and NRM (Introduction)
- Lecture 55 - Remote Sensing and GIS Application in Agriculture and NRM - Part 1
- Lecture 56 - Remote Sensing and GIS Application in Agriculture and NRM - Part 2
- Lecture 57 - Remote Sensing and GIS Application in Agriculture and NRM - Part 3
- Lecture 58 - Climate change; vulnerability; adaptation - Part 1
- Lecture 59 - Climate change; vulnerability; adaptation - Part 2
- Lecture 60 - Climate change; vulnerability; adaptation - Part 3
- Lecture 61 - ICT: Introduction
- Lecture 62 - ICT for Soil management
- Lecture 63 - ICT for Water management
- Lecture 64 - Collective Management of resources



Lecture 1 - Introduction

Lecture 2 - Irrigation and irrigation needs

Lecture 3 - Source of Irrigation

Lecture 4 - Importance of crops and classification

Lecture 5 - Crop rotation principle

Lecture 6 - Importance of vegetable and classification

Lecture 7 - Paddy crop production

Lecture 8 - Sorghum crop production

Lecture 9 - Pearl millet crop production

Lecture 10 - Maize crop production

Lecture 11 - Pigeon pea crop production

Lecture 12 - Green gram crop production

Lecture 13 - Black gram crop production

Lecture 14 - Cowpea crop production

Lecture 15 - Groundnut crop production

Lecture 16 - Sesame crop production

Lecture 17 - Soybean crop production

Lecture 18 - Sunflower crop production

Lecture 19 - Mango crop production

Lecture 20 - Guava crop production

Lecture 21 - Banana crop production

Lecture 22 - Papaya crop production

Lecture 23 - Tomato crop production

Lecture 24 - Brinjal crop production

Lecture 25 - Chili crop production

Lecture 26 - Okra crop production



Lecture 1 - Introduction

Lecture 2 - Our Agriculture Practices and Lessons

Lecture 3 - Climate and Scale of Change

Lecture 4 - Course Corrections

Lecture 5 - Modified Agriculture - Precision Agriculture

Lecture 6 - Modified Agriculture Practice - Climate Smart Agriculture

Lecture 7 - Maps and Information in Practice

Lecture 8 - Geographical Information System (GIS)

Lecture 9 - Types of input

Lecture 10 - Analysis - Map overlay

Lecture 11 - Buffering and Perspective View

Lecture 12 - GIS Type and Available GIS Softwares

Lecture 13 - Village Cadastral Map and Property Card

Lecture 14 - Cadastral Maps and Contents

Lecture 15 - Creation of Cadastral Information Base

Lecture 16 - Land Information System

Lecture 17 - Creation of Village Boundary Based Basin Analysis

Lecture 18 - Village Information System

Lecture 19 - Needs and Weather Forecast

Lecture 20 - Cloud Types and Rain Bearing Clouds

Lecture 21 - Weather Satellites and Cloud Pattern Reading

Lecture 22 - Rainfall and Supplementary Irrigation

Lecture 23 - Synergistic Use

Lecture 24 - Surface Rainfall - Run off Assessment and Model

Lecture 25 - Soil and Water Assessment Tools (SWAT) Model

Lecture 26 - Groundwater Availability

Lecture 27 - Groundwater Potential Mapping

Lecture 28 - Water Storage and Water Availability and Release

Lecture 29 - Growth of Crop Area in Command Area and Impact Climate Change

Lecture 30 - Impact of Climate on Agriculture

Lecture 31 - Crop Water Requirement and Distribution Loss

[Lecture 32 - Village Agriculture and Other Water Demand and Supply Source](#)

[Lecture 33 - Water Security Assessment](#)

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[Lecture 40 - Drought Monitoring: a global perspective](#)

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[Lecture 42 - GIS in Sustainable Agriculture](#)

[Lecture 43 - Assessment of Existing Water Storage Structures and Rehabilitation](#)

[Lecture 44 - Sustainable Development and Agriculture: a confluence of pressures](#)

[Lecture 45 - Climate Change and Drought: a global perspective](#)

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Lecture 1 - Introduction

Lecture 2 - Insect, abundance and diversity

Lecture 3 - Insect classification based on economic importance

Lecture 4 - Pest, causes for outbreaks and categories

Lecture 5 - Pest, causes for outbreaks and categories (Continued...)

Lecture 6 - Pest surveillance and methods of sampling

Lecture 7 - Principles of Pest Management and History

Lecture 8 - IPM, Definition and Concepts

Lecture 9 - Ecological Methods of Pest Management - Legal and Cultural

Lecture 10 - Ecological Methods of Pest Management - Cultural (Continued...)

Lecture 11 - Ecological Methods of Pest Management - Cultural (Continued...)

Lecture 12 - Ecological Methods of Pest Management - Physical

Lecture 13 - Ecological Methods of Pest Management - Mechanical

Lecture 14 - Host Plant Resistance

Lecture 15 - Host Plant Resistance (Continued...)

Lecture 16 - Biological Control - Predators

Lecture 17 - Biological Control - Parasitoids

Lecture 18 - Biological Control - Microbes: Fungi, Bacteria and Viruses

Lecture 19 - Biological Control - Microbes: Entomopathogenic Nematodes

Lecture 20 - Pest management by modifying insect behaviour

Lecture 21 - Use of sex pheromones in pest management

Lecture 22 - Use of attractants and repellants in pest management

Lecture 23 - Pest management through radiation technology - Principles

Lecture 24 - Sterile Insect Technique - case studies

Lecture 25 - Pest management through botanicals

Lecture 26 - Pest management through botanicals (Continued...)

Lecture 27 - Chemical Control - History and classification

Lecture 28 - Mode of Action of different insecticide groups

Lecture 29 - Chemical Control - Considerations for Chemicals Integration

Lecture 30 - Insecticide Resistance and Management

Lecture 31 - Insecticide as component of IPM

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[Lecture 35 - IPM in Paddy \(Continued...\)](#)

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[Lecture 42 - IPM in Sugarcane](#)

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[Lecture 44 - IPM in Tomato](#)

[Lecture 45 - IPM in Cabbage](#)

[Lecture 46 - IPM in Mango](#)

[Lecture 47 - IPM in Grapes](#)

Lecture 1 - Introduction

Lecture 2 - Relationship between Food, Nutrition and Health 1

Lecture 3 - Relationship between Food, Nutrition and Health 2

Lecture 4 - Digestion, absorption and utilization of Nutrients 1

Lecture 5 - Digestion, absorption and utilization of Nutrients 2

Lecture 6 - Recommended dietary allowances

Lecture 7 - Carbohydrate

Lecture 8 - Fiber

Lecture 9 - Protein

Lecture 10 - Protein - health significance

Lecture 11 - Fat

Lecture 12 - Energy 1

Lecture 13 - Energy 2

Lecture 14 - Energy 3

Lecture 15 - Fat Soluble Vitamins 1

Lecture 16 - Fat Soluble Vitamins 2

Lecture 17 - Fat Soluble Vitamins 3

Lecture 18 - Water Soluble Vitamins 1

Lecture 19 - Water Soluble Vitamins 2

Lecture 20 - Water soluble Vitamins 3

Lecture 21 - Water soluble Vitamins 4

Lecture 22 - Major minerals 1

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Lecture 24 - Trace minerals 1

Lecture 25 - Trace minerals 2

Lecture 26 - Water

Lecture 27 - Nutritional Disorders

Lecture 28 - Balanced diet and food groups

Lecture 29 - Food guide for selecting adequate diet, practical aspects of food selection

Lecture 30 - Meal planning

Lecture 31 - Other aspects affecting food selection

[Lecture 32 - Food sanitation and hygiene](#)

[Lecture 33 - Water Purification](#)

[Lecture 34 - Therapeutic adaptation of normal diet](#)

[Lecture 35 - Principles of therapeutic diet](#)

[Lecture 36 - Diet during fevers](#)

[Lecture 37 - Diet in lung disease](#)

[Lecture 38 - Diet in GI disorders – constipation](#)

[Lecture 39 - Diet during diarrhoea](#)

[Lecture 40 - Diet in disorders of liver](#)

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[Lecture 42 - Diet in Diabetes](#)

[Lecture 43 - Diseases of Heart and blood vessels](#)

[Lecture 44 - Diet for myocardial infarction](#)

[Lecture 45 - Diet in kidney disorders](#)

[Lecture 46 - Diet in renal failure](#)

[Lecture 47 - Diet in cancer](#)

[Lecture 48 - Diet in metabolic disorders](#)

[Lecture 49 - Diet in stress, burns and surgery](#)

# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

**NPTEL : NOC:Weather Forecast in Agriculture and Agro-advisory (WF) (Agriculture)**

**Co-ordinators : Dr. R. Nagarajan, Co Faculty, Dr.T.N.Balasubramanian (Rtd.), Instructor Incharge**

Lecture 1 - Introduction

Lecture 2 - Basic aspects of Atmosphere, Climate, Weather

Lecture 3 - Basic aspects of Rainfall and their application in crop production

Lecture 4 - Basic aspects of Temperature and their application in crop production

Lecture 5 - Basic aspects of Relative humidity, Cloud cover and their application in crop production

Lecture 6 - Basic aspects of wind, wind direction and their application in crop production

Lecture 7 - Three weather codes and crop production

Lecture 8 - Crop production risks and their management

Lecture 9 - Weather sensitive crops, stages and farm operations

Lecture 10 - Crop-weather interactions and definition

Lecture 11 - Crop-Weather Interactions: Wheat, Rice and Maize

Lecture 12 - Crop-Weather Interactions: Sorghum, Groundnut and Pigeon pea

Lecture 13 - Crop-Weather Interactions: Cotton and Sugarcane

Lecture 14 - Crop-Weather Interactions: Sugarbeet and Chickpea

Lecture 15 - Crop-Weather Interactions: Sunflower and Mustard

Lecture 16 - Genesis of weather forecast in India and Abroad

Lecture 17 - Types of weather forecast and details

Lecture 18 - Types of weather forecast and details (Continued...)

Lecture 19 - Simple methods of verification of weather forecast with real event

Lecture 20 - Traditional knowledges on weather forecast and their validity

Lecture 21 - Weather thumb rules and their validity

Lecture 22 - Development and component of agro advisory for weather forecast

Lecture 23 - Development and component of agro advisory for weather forecast (Continued...)

Lecture 24 - Model agro advisories for selected five days weather forecast

Lecture 25 - Mass communication mode of agro advisories and their effectiveness

Lecture 26 - Discussion on weather forecast and agro advisory from different website

Lecture 27 - Role of climate manager on farm management decision based on weather forecast at village level and assignment

Lecture 28 - Development of selected weather window for issuing agro advisory - case study from Tamil Nadu

Lecture 29 - Model of agro advisory for 54 selected weather window of Tamil Nadu for rice

Lecture 30 - Response farming- a type of farm planning being practiced in Australia considering seasonal climate forecast

Lecture 31 - Case study in India on the adoption of weather based crop production - Crop management

**HTML Links for 1,14,300+ NPTEL Video Lectures, Created by LinuXpert Systems, Chennai**

[Lecture 32 - Case study in India on the adoption of weather based crop production - Pest and disease management](#)

[Lecture 33 - Case study in India on the adoption of weather based animal production](#)

[Lecture 34 - Cost benefit analysis for the case study done on crop management](#)

[Lecture 35 - Cost benefit analysis for the case study done on animal management](#)

[Lecture 36 - Summary](#)



Lecture 1 - Introduction

Lecture 2 - Highlights Week 0 and 1

Lecture 3 - What is ICT?

Lecture 4 - Architecture of a Computer

Lecture 5 - Architecture of a Phone

Lecture 6 - What is the Internet?

Lecture 7 - What is WWW?

Lecture 8 - Highlights Week 2

Lecture 9 - Phones, Smart Phones, Phablets, Tablets

Lecture 10 - Introduction to Android

Lecture 11 - Network Architectures - Part-1 (Introduction to Computer Networks)

Lecture 12 - Network Architectures - Part-2 (Overview of Network Architecture)

Lecture 13 - Network Architectures - Part-3 (Architecture of Internet)

Lecture 14 - Mobile Wireless Communications - Introduction (Module-1)

Lecture 15 - Mobile Wireless Communication (Module-2)

Lecture 16 - Highlights Week 3

Lecture 17 - Adaptive and Responsive Websites

Lecture 18 - Data management

Lecture 19 - Knowledge Representation

Lecture 20 - Knowledge Representation Techniques

Lecture 21 - Expert Systems

Lecture 22 - Highlights Week - 4

Lecture 23 - Speech Recognition

Lecture 24 - Speech Synthesis

Lecture 25 - Identity Management - Part 1

Lecture 26 - Identity Management - Part 2

Lecture 27 - Location Recognition - Part 1

Lecture 28 - Location Recognition - Part 2

Lecture 29 - Parameter Sensing

Lecture 30 - Highlights Week-5

Lecture 31 - Social Networking - Part 1

[Lecture 32 - Social Networking - Part 2](#)

[Lecture 33 - Blogs](#)

[Lecture 34 - Facebook](#)

[Lecture 35 - Twitter](#)

[Lecture 36 - 3G WCDMA \(Module- 3\)](#)

[Lecture 37 - 4G Mobile Wireless WiMAX \(Module-4\)](#)

[Lecture 38 - Advanced Wireless Technologies \(Module-5\)](#)

[Lecture 39 - LTE, WLAN, Bluetooth and Future](#)

[Lecture 40 - Highlights Week-6](#)

[Lecture 41 - Introduction to Cloud Computing](#)

[Lecture 42 - Introduction to Cloud Services](#)

[Lecture 43 - Cloud Service Providers](#)

[Lecture 44 - GIS Application in Agriculture - Part 1](#)

[Lecture 45 - GIS Application in Agriculture - Part 2](#)

Lecture 1

Lecture 2

Lecture 3

Lecture 4

Lecture 5

Lecture 6

Lecture 7

Lecture 8

Lecture 9

Lecture 10

Lecture 11 - Application of Navier Stoke's equation for finding out viscosity - Part 2

Lecture 12 - Application of Navier Stoke's equation for finding out viscosity - Part 3

Lecture 13 - Flow through pipes

Lecture 14 - Hagen-poiseuille equation from Navier stokes equation

Lecture 15 - Fanning friction factor

Lecture 16 - Moody's chart

Lecture 17 - Laminar and turbulent flow in a pipe

Lecture 18 - Flow through flat and parallel plates

Lecture 19 - Flow of film or film flow

Lecture 20 - Problems and solution of falling film

Lecture 21 - Flow through annulus - Part 1

Lecture 22 - Flow through annulus - Part 2

Lecture 23 - Stoke's law

Lecture 24 - Flow through flat plates or slits

Lecture 25 - Problems and solution for flow through flat plates or slits

Lecture 26 - Compressible fluid flow

Lecture 27 - Flow through nozzle - I

Lecture 28 - Flow through nozzle - II

Lecture 29 - Flow through nozzle - problems and solutions

Lecture 30 - Nozzle flow- problems and solutions

Lecture 31 - Sonic velocity

- Lecture 32 - Sonic velocity - Mach number
- Lecture 33 - Variable fluid flow
- Lecture 34 - Variable fluid flow - problems and solutions
- Lecture 35 - Variable fluid flow - problems and solutions (Continued...)
- Lecture 36 - Pneumatic conveying
- Lecture 37 - Problem on Pneumatic conveying - Part 1
- Lecture 38 - Problem on Pneumatic conveying - Part 2
- Lecture 39 - Non Newtonian fluid flow - Part 1
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- Lecture 41 - Velocity profile for Non Newtonian fluid
- Lecture 42 - Average velocity for Non Newtonian fluid
- Lecture 43 - Problems and solution of Non Newtonian fluid - Part 1
- Lecture 44 - Problems and solution of Non Newtonian fluid - Part 2
- Lecture 45 - Flow of Non Newtonian fluid through slit
- Lecture 46 - Generalized coefficient of Reynolds number
- Lecture 47 - Flow through packed beds
- Lecture 48 - Ergun's equation- derivation - Part 1
- Lecture 49 - Ergun's equation- derivation - Part 2
- Lecture 50 - Solving problems on Ergun's equation
- Lecture 51 - Solving problems on Ergun's equation
- Lecture 52 - Fluidization
- Lecture 53 - Fluidized bed flow
- Lecture 54 - Problem of Fluidized bed condition - Part 1
- Lecture 55 - Problem of Fluidized bed condition - Part 2
- Lecture 56 - Problem and solution
- Lecture 57 - Problem and solution
- Lecture 58 - Problem and solution
- Lecture 59 - Problem and solution
- Lecture 60 - Problem and solution with comprehension of course

Lecture 1 - Importance of Farm Machines in the Contest of Enhance Production, Multiple Cropping, Labour Scarcity etc.

Lecture 2 - Ploughing and first opening of the soil, the design and component details

Lecture 3 - Tractor, implement and soil force consideration for tillage implement design

Lecture 4 - Tractor, implement and soil force consideration for tillage implement design

Lecture 5 - Mechanics of rotavoator or rotary tillers

Lecture 6 - Design of a tractor PTO operated rotavator

Lecture 7 - Tractor implement hitching systems

Lecture 8 - Mechanics of tractor implement hitch system and traction prediction models

Lecture 9 - Laboratory class on traction and tire testing

Lecture 10 - Combination tillage implements for efficient land preparation

Lecture 11 - LASER guided land laveller

Lecture 12 - Introduction of seeding operation

Lecture 13 - Types of seed metering devices and their operation

Lecture 14 - Types of fertilizer metering, furrow opening and soil covering devices

Lecture 15 - Equipment for seeding and planting

Lecture 16 - Equipment for precision planting

Lecture 17 - Equipment for Paddy Transplanting

Lecture 18 - Microcontroller based uniform seed rate application system

Lecture 19 - GPS based automatic Variable rate fertilizer applicator

Lecture 20 - Embedded GPS integrated Variable Rate Fertilizer Applicator

Lecture 21 - Design of a seeding equipment - PART 1

Lecture 22 - Design of a seeding equipment - PART 2

Lecture 23 - Design of a seeding equipment - PART 3

Lecture 24 - Design a tractor drawn seed drill for a 40 hp tractor - I

Lecture 25 - Design a tractor drawn seed drill for a 40 hp tractor - II

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- Lecture 32 - Farm machines for interculture operation
- Lecture 33 - Performance of weeding blades of a push-pull weeder
- Lecture 34 - Advanced level machinery for inter and intra row weeding
- Lecture 35 - Tractor mounted contact type microcontroller based improved variable rate herbicide applicator
- Lecture 36 - Design of manually operated weeding equipment
- Lecture 37 - Plant protection equipment/machinery
- Lecture 38 - Selection and design of plant protection equipment/machinery
- Lecture 39 - Manually operated knapsack-cum-boom sprayer
- Lecture 40 - Performance evaluation of sprayer
- Lecture 41 - Testing and certification of spraying equipment
- Lecture 42 - Problems based on the design and selection of spraying equipment - I
- Lecture 43 - Problems based on the design and selection of spraying equipment - II
- Lecture 44 - Advanced level spraying equipment: Ultrasonic sensor based sprayer
- Lecture 45 - Advanced level spraying equipment: Drone assisted variable rate chemical application system and electrostatic sprayer
- Lecture 46 - Harvesting equipment
- Lecture 47 - Machines for harvesting cereal crops, root and fruit crops
- Lecture 48 - Combine Harvester
- Lecture 49 - Advanced technology approach for cotton harvesting
- Lecture 50 - Threshing operation and equipment
- Lecture 51 - Design of threshing equipment
- Lecture 52 - Performance evaluation and testing of thresher
- Lecture 53 - Conservation Agriculture
- Lecture 54 - Materials for construction of farm machinery
- Lecture 55 - Machinery for Land Drainage, Land Reclamation and Estate Maintenance Part - I
- Lecture 56 - Machinery for Land Drainage, Land Reclamation and Estate Maintenance Part - II
- Lecture 57 - Machinery for Land Drainage, Land Reclamation and Estate Maintenance Part - III
- Lecture 58 - Machinery Selection and Management - Part 1
- Lecture 59 - Machinery Selection and Management - Part 2
- Lecture 60 - Epilogue

Lecture 1 - Introduction

Lecture 2 - Soil Properties - I

Lecture 3 - Soil Properties - II

Lecture 4 - Soil Water

Lecture 5 - Tutorial - I

Lecture 6 - Field water balance

Lecture 7 - Evapotranspiration

Lecture 8 - Crop water requirement

Lecture 9 - Irrigation Scheduling

Lecture 10 - Tutorial

Lecture 11 - Irrigation Water Conveyance System

Lecture 12 - Irrigation Water Conveyance

Lecture 13 - Channel Design Structures

Lecture 14 - Measurement of Irrigation Water: Pipe

Lecture 15 - Tutorial

Lecture 16 - Water Application Methods

Lecture 17 - Surface Irrigation Hydraulics

Lecture 18 - Furrow Irrigation Hydraulics

Lecture 19 - Border Irrigation Design

Lecture 20 - Tutorial

Lecture 21 - Sprinkler Irrigation Design

Lecture 22 - Sprinkler Irrigation : Hydraulic Design

Lecture 23 - Drip Irrigation - I

Lecture 24 - Drip Irrigation Design

Lecture 25 - Tutorial (Week 5)

Lecture 26 - Irrigation Wells

Lecture 27 - Aquifer Properties

Lecture 28 - Well Hydraulics - 1

Lecture 29 - Well Hydraulics - 2

Lecture 30 - Tutorial

Lecture 31 - Introduction

Lecture 32 - Centrifugal Pump: Basics

Lecture 33 - Centrifugal Pumps: Power Requirement

Lecture 34 - Pump Characteristic Curves

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Lecture 36 - Management of salt affected soils: Saline and alkali soils - 1

Lecture 37 - Management of salt affected soils: Saline and alkali soils - 1

Lecture 38 - Agricultural Drainage: Related Concepts

Lecture 39 - Agricultural Drainage: Introduction

Lecture 40 - Tutorial

Lecture 41 - Drainage System Components

Lecture 42 - Drainage System : Drain Pipe

Lecture 43 - Drainage System : Structures

Lecture 44 - Drainage System Design

Lecture 45 - Tutorial

Lecture 46 - Subsurface Drainage Design - 1

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Lecture 48 - Subsurface Drainage Design - 3

Lecture 49 - Subsurface Drainage Design - 4

Lecture 50 - Tutorial

Lecture 51 - Surface drainage system design - 1

Lecture 52 - Surface drainage system design - 2

Lecture 53 - Non-conventional drainage

Lecture 54 - Economics of drainage project

Lecture 55 - Tutorial

Lecture 56 - Case study of drainage system

Lecture 57 - Drainage Model

Lecture 58 - Irrigation Efficiency

Lecture 59 - Irrigation Economics

Lecture 60 - Irrigation model



Lecture 1 - Importance Of Rheology In Food

Lecture 2 - Food Rheology

Lecture 3 - Food Rheology

Lecture 4 - Food Rheology

Lecture 5 - Food Rheology

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Lecture 7 - Measurements of Rheological Properties

Lecture 8 - Rheological Properties of Viscoelastic Food

Lecture 9 - Rheological Properties of Viscoelastic Food

Lecture 10 - Rheological Properties of Viscoelastic Food

Lecture 11 - Thermal Processing And Microbial Death Kinetics

Lecture 12 - Thermal processing and microbial death kinetics

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Lecture 14 - Thermal processing and microbial death kinetics (Continued...)

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Lecture 17 - Evaporation and concentration

Lecture 18 - Evaporation and concentration

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Lecture 22 - Heat Exchangers

Lecture 23 - Heat Exchangers

Lecture 24 - Heat Exchangers

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Lecture 26 - Drying Technology

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Lecture 2 - Soil erosion causes and types

Lecture 3 - Factors affecting soil erosion and effects of soil erosion

Lecture 4 - Soil erosion - Mechanics

Lecture 5 - Water erosion control measures

Lecture 6 - Soil loss estimation

Lecture 7 - Erosivity and Erodibility

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Lecture 12 - Contour Bunds

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Lecture 17 - Bench Terraces

Lecture 18 - Problems on Bench Terraces

Lecture 19 - Broad-base Terraces

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Lecture 27 - Design Considerations- Permanent Gully Control Structures

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- Lecture 2 - What is Food and Nutrients
- Lecture 3 - Nutritional Value of the Nutrients
- Lecture 4 - Best Way of Storage of Food Materials
- Lecture 5 - Preservation Techniques
- Lecture 6 - Temperature Quotient and Its Impact
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- Lecture 8 - Quality of Food
- Lecture 9 - Quality of Food (Continued...)
- Lecture 10 - Emerging Technology
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- Lecture 12 - Food Laws - Why?
- Lecture 13 - Food Laws of India
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- Lecture 16 - Physico-Chemical Properties of Milk
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- Lecture 3 - Organic Farming and its Components
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- Lecture 11 - Principles of Compost Production
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- Lecture 21 - Introduction to Organic Crop Management
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- Lecture 23 - Organic Vegetable Crop Management
- Lecture 24 - Organic Vegetable Crop Management (Cereals)
- Lecture 25 - Organic Vegetable Crop Management (Cereals) (Continued...)
- Lecture 26 - Organic Field Crop Management (Pulse and Oilseed Crop)
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- Lecture 28 - Organic Meat Production
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Lecture 1 - Course Introduction; Food Constituents and Functions

Lecture 2 - Quality and Safety Aspects of Food

Lecture 3 - Factors Affecting Quality During Processing and Storage

Lecture 4 - Role of Water in Food and its Shelf Life

Lecture 5 - Gelatinization and Retrogradation of Starch

Lecture 6 - Browning Reactions

Lecture 7 - Food Proteins

Lecture 8 - Principles of Food Preservation

Lecture 9 - Traditional Food Preservation Technologies - Part 1

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Lecture 13 - Membrane Technology - Part 1

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Lecture 15 - Food Irradiation - Part 1

Lecture 16 - Food Irradiation - Part 2

Lecture 17 - Microwave Heating

Lecture 18 - Radio Frequency Drying

Lecture 19 - Super Critical Fluid Extraction - Part 1

Lecture 20 - Super Critical Fluid Extraction - Part 2

Lecture 21 - Freeze Drying - Part 1

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Lecture 23 - Food Extrusion Technology - Part 1

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Lecture 25 - Textured Vegetable Protein (TVP)

Lecture 26 - Aseptic Processing and Packaging

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**NPTEL : NOC:Post Harvest Operations and Processing of Fruits, Vegetables, Spices and Plantation Crop Products  
(Agriculture)**

**Co-ordinators : Prof. Hari Niwas Mishra**

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[Lecture 38 - Interventions: Technology Based](#)

[Lecture 39 - Interventions: Marketing / Management Based](#)

[Lecture 40 - Summary and Discourse - VIII](#)

Lecture 1 - Introduction to Urbanisation

Lecture 2 - Introduction to Urban Governance

Lecture 3 - Constitutional Provision for Urban Local Governance

Lecture 4 - Legislative Provisions

Lecture 5 - Interfaces

Lecture 6 - People & Community - 1

Lecture 7 - People & Community - 2

Lecture 8 - Land as Basic Resource

Lecture 9 - Urban Environment and Ecology

Lecture 10 - Distinctive Features of Non-Municipal Urban (NMU) and Nagar Panchayats

Lecture 11 - Organisation Development

Lecture 12 - Transparency and Accountability

Lecture 13 - Capacity Building - 1

Lecture 14 - Capacity Building - 2

Lecture 15 - Improving Systems and Processes for Urban Governance

Lecture 16 - Urban Reform and Managing Change - 1

Lecture 17 - Urban Reform and Managing Change - 2

Lecture 18 - Visioning for Cities

Lecture 19 - Resolving Conflicts for Managing Change

Lecture 20 - Leadership and Team Building

Lecture 21 - Basic Concepts of Planning and Development

Lecture 22 - Regional and Metropolitan Planning

Lecture 23 - Urban Planning

Lecture 24 - Urban Infrastructure and Services - 1

Lecture 25 - Urban Infrastructure and Services - 2

Lecture 26 - Overview of Municipal Finance

Lecture 27 - Alternate Sources of Municipal Finance

Lecture 28 - Municipal Accounts

Lecture 29 - Value Capture Financing

Lecture 30 - Public Private Partnership (PPP) in Urban Governance

Lecture 31 - Housing Strategy for Cities

Lecture 32 - Housing & Urban Poverty

Lecture 33 - Real Estate Regulation and Development

Lecture 34 - Urban Land Management

Lecture 35 - Urban Risk and Disaster Management

Lecture 36 - Managing Urban Environment - 1

Lecture 37 - Managing Urban Environment - 2 (Mandates for Blue and Green Infrastructures)

Lecture 38 - Traffic and Transportation Management - 1

Lecture 39 - Traffic and Transportation Management - 2

Lecture 40 - Designing Urban Public Spaces

Lecture 41 - Centrally Sponsored Programmes and Schemes

Lecture 42 - AMRUT

Lecture 43 - Smart City: Concept and Mission

Lecture 44 - Swachh Bharat Mission and HRIDAY

Lecture 45 - PMAY and NULM

Lecture 46 - Fundamentals of Project Planning

Lecture 47 - Formulation of Projects

Lecture 48 - Project Monitoring and Management

Lecture 49 - Essentials of Infrastructure and Engineering Design

Lecture 50 - Managing Trans-municipal and Large Projects

Lecture 51 - Enhancing City Image

Lecture 52 - Essential Competencies of City Managers

Lecture 53 - Problem Solving and Decision Making

Lecture 54 - Effective Negotiation

Lecture 55 - Communication Skills

Lecture 56 - Time Management

Lecture 57 - Stress Management

Lecture 58 - Best Practices in Urban Management

Lecture 59 - Reflective Learning and Excellence

Lecture 60 - Course Summary, Doubt Clearing and Further Reading



Lecture 1 - Introduction

Lecture 2 - User Interface Designer

Lecture 3 - Design methods - I

Lecture 4 - Design Methods - II

Lecture 5 - Human Factor in Interaction Design

Lecture 6 - User Research - I

Lecture 7 - User Research - II

Lecture 8 - Low Fidelity Design - I

Lecture 9 - Low Fidelity Design - II

Lecture 10 - High Fidelity Design

Lecture 11 - Visual Cognition

Lecture 12 - Contemporary Visual Language in Design - I

Lecture 13 - Contemporary Visual Language in Design - II

Lecture 14 - Usage of Typography in User Interface Design - I

Lecture 15 - Usage of Typography in User Interface Design - II

Lecture 16 - Design Semiotics and Visual Perception

Lecture 17 - Visual Communication Design

Lecture 18 - User Testing - I

Lecture 19 - User Testing - II

Lecture 20 - Contemporary Interface Design Technology

**NPTEL : NOC:Disaster Recovery and Build Back Better (Architecture)**

**Co-ordinators : Prof. Subhojyothi Samaddar**

Lecture 1 - Disaster risk: Hazards X Exposure X Vulnerability

Lecture 2 - Disaster Recovery and Build Back Better: Risk Perception and Disaster Risk Preparedness - Part 1

Lecture 3 - Risk Perception and Disaster Risk Preparedness - Part 2

Lecture 4 - Build Back Better - People's Perspectives

Lecture 5 - Architecture at Risk

Lecture 6 - Culture, climate change adaptation and disaster risk reduction

Lecture 7 - Ayutthaya at Risk

Lecture 8 - Disaster vulnerability

Lecture 9 - Cultural Heritage: Reassembled

Lecture 10 - Rock shelters at risk

Lecture 11 - The Built Environment Professions in Disaster Risk Reduction and Response

Lecture 12 - Gadri discussions: social dimension of risk, health and DRM

Lecture 13 - Community Participation in Disaster Risk Governance : Voices from Mumbai and Ghana

Lecture 14 - Community Participation in Disaster Risk Governance : Insights From Mumbai

Lecture 15 - Frameworks

Lecture 16 - Disaster Preparedness from Cognitive and Heuristic Perspectives

Lecture 17 - Information for Disaster Preparedness

Lecture 18 - The Role of Social Networks in Disaster Preparedness

Lecture 19 - Diffusion of Disaster Preparedness Technology : What Pioneers Contribute ?

Lecture 20 - Cities and Climate Change: Adaptation and Mitigation

Lecture 21 - Temporary Shelter Construction in India

Lecture 22 - Temporary shelter construction in Kenya

Lecture 23 - Build back better in Nepal recovery

Lecture 24 - Lessons from Peru

Lecture 25 - Progressive Housing in El Salvador

Lecture 26 - Decentralizing (re)construction in Colombia

Lecture 27 - Tsunami reconstruction in Tamilnadu - Part 1 (Approach)

Lecture 28 - Tsunami reconstruction in Tamilnadu - Part 2 (Findings)

Lecture 29 - Culture and (disaster)risk

Lecture 30 - Cultural theory of risk

Lecture 31 - Guidance to DRR

[Lecture 32 - Self-help housing in Turkey](#)

[Lecture 33 - The Production of refugee place in time: Case of Tibetan refugees](#)

[Lecture 34 - Assessments](#)

[Lecture 35 - Designing culturally responsive built environment in disaster context](#)

[Lecture 36 - Disaster Risk Communication](#)

[Lecture 37 - CAM and CBDRM](#)

[Lecture 38 - How to teach disaster recovery and built back better in-built environment education](#)

[Lecture 39 - Source, Message and Receiver in Disaster Risk Communication](#)

[Lecture 40 - Summary and Conclusion](#)

- Lecture 1 - Introduction to Sustainability
- Lecture 2 - Buildings, Needs and 'Sustainability'
- Lecture 3 - Sustainability and Sustainable Development
- Lecture 4 - Historic Origins of Sustainability
- Lecture 5 - Pioneers of Sustainable Development
- Lecture 6 - Environmental Impacts of Development: Impacts on Water
- Lecture 7 - Environmental Impacts of Development: Impacts on Land and Air
- Lecture 8 - Social and Economic Impacts of Development
- Lecture 9 - Agenda 21 and UN Goals
- Lecture 10 - Established needs for Sustainability in Building Sector
- Lecture 11 - Definition and Characteristics of Sustainability
- Lecture 12 - Flavors of Sustainable Architecture
- Lecture 13 - Indicators and Terminologies in Sustainable Architecture
- Lecture 14 - Process of Designing Green Buildings
- Lecture 15 - Green Building Ratings and Components
- Lecture 16 - Fundamentals of Thermal Comfort
- Lecture 17 - Climatic Considerations, Physiological Objectives of Design
- Lecture 18 - Fundamentals of Climate Responsive Buildings - I
- Lecture 19 - Fundamentals of Climate Responsive Buildings - II
- Lecture 20 - Visual and Acoustic Comfort
- Lecture 21 - Sustainable Sites - I
- Lecture 22 - Sustainable Sites - II
- Lecture 23 - Sustainable Sites - III
- Lecture 24 - Sustainable Sites - IV
- Lecture 25 - Sustainable Sites - V
- Lecture 26 - Water Conservation - I
- Lecture 27 - Water Conservation - II
- Lecture 28 - Water Conservation - III
- Lecture 29 - Water Conservation - IV
- Lecture 30 - Water Conservation - V
- Lecture 31 - Materials and Resources - I

- Lecture 32 - Materials and Resources - II
- Lecture 33 - Materials and Resources - III
- Lecture 34 - Materials and Resources - IV
- Lecture 35 - Materials and Resources - V
- Lecture 36 - Energy Efficiency - I
- Lecture 37 - Energy Efficiency - II
- Lecture 38 - Energy Efficiency - III
- Lecture 39 - Energy Efficiency - IV
- Lecture 40 - Energy Efficiency - V
- Lecture 41 - Indoor Environmental Quality - I
- Lecture 42 - Indoor Environmental Quality - II
- Lecture 43 - Indoor Environmental Quality - III
- Lecture 44 - Indoor Environmental Quality - IV
- Lecture 45 - Indoor Environmental Quality - V
- Lecture 46 - Vernacular Architecture - I
- Lecture 47 - Vernacular Architecture - II
- Lecture 48 - Codes and Standards
- Lecture 49 - Introduction to Whole Building Simulation - I
- Lecture 50 - Introduction to Whole Building Simulation - II
- Lecture 51 - Whole Building Performance - I
- Lecture 52 - Whole Building Performance - II
- Lecture 53 - Whole Building Performance - III
- Lecture 54 - Whole Building Performance - IV
- Lecture 55 - Whole Building Performance - V
- Lecture 56 - Whole Building Performance - VI
- Lecture 57 - Whole Building Performance - VII
- Lecture 58 - Whole Building Performance - VIII
- Lecture 59 - Whole Building Performance - IX
- Lecture 60 - Whole Building Performance - X

Lecture 1 - Introduction to Structure, Form and Architecture

Lecture 2 - Relationship of Structure to Architectural Buildings - Part I

Lecture 3 - Relationship of Structure to Architectural Buildings - Part II

Lecture 4 - Loads on Structures

Lecture 5 - Synthesis of Architectural and Structural Form

Lecture 6 - Connecting Structure and Architecture - Part I

Lecture 7 - Connecting Structure and Architecture - Part II

Lecture 8 - Structural Transformation in Architectural History

Lecture 9 - Factors affecting the Structural Forms

Lecture 10 - Learning from Animal's Architecture

Lecture 11 - Basic Structural Properties

Lecture 12 - Structural Requirements

Lecture 13 - Structural Arrangement

Lecture 14 - Structural Forms and Shapes

Lecture 15 - Structural Materials

Lecture 16 - Structural Typology

Lecture 17 - Compressive Structures

Lecture 18 - Tensile Structures

Lecture 19 - Load Bearing Structures

Lecture 20 - Temporary Structures

Lecture 21 - Framed Structure

Lecture 22 - Arch Structures

Lecture 23 - Vault Structures

Lecture 24 - Dome Structures

Lecture 25 - Grid Structures

Lecture 26 - Shell Structures

Lecture 27 - Trusses and Space Frames

Lecture 28 - Folded Plate Structures

Lecture 29 - Membrane Structures

Lecture 30 - Pneumatic Structures

Lecture 31 - Structure and Architectural Forms in Windy Areas

[Lecture 32 - Structure and Architectural Forms in Seismic Prone Areas](#)

[Lecture 33 - Structure and Architectural Forms in Flood Prone Areas](#)

[Lecture 34 - Cost Effective Structure and Architecture](#)

[Lecture 35 - Structure and Light in Architecture](#)

[Lecture 36 - Evolution of Highrise Structural System](#)

[Lecture 37 - Highrise Structural Components - Part I](#)

[Lecture 38 - Highrise Structural Components - Part II](#)

[Lecture 39 - Mega Structure and Architecture-Case Studies](#)

[Lecture 40 - Architecture and Structure - Past, Present and Future](#)

Lecture 1 - Introduction to Engineering Graphics

Lecture 2 - Drawing Instruments

Lecture 3 - Sheet Layout and Fixing Sheet

Lecture 4 - Types of Lines and Graphic Symbols

Lecture 5 - Lettering

Lecture 6 - Dimensioning

Lecture 7 - Basic Geometrical Construction

Lecture 8 - Scales

Lecture 9 - Curves used in Engineering Practice: Conic Sections

Lecture 10 - Curves used in Engineering Practice: Cycloids, Trochoids and Involute

Lecture 11 - Introduction to Orthographic Projection

Lecture 12 - Orthographic Projections - 1st Quadrant Vs 3rd Quadrant

Lecture 13 - Orthographic Projections - Projection of Points

Lecture 14 - Orthographic Projections - Introduction to Projection of Lines

Lecture 15 - Locus of Points

Lecture 16 - Projection of lines parallel to both the reference planes

Lecture 17 - Projection of line parallel to one and perpendicular to another plane

Lecture 18 - Projection of lines inclined to one plane

Lecture 19 - Projection of lines inclined to both the planes

Lecture 20 - Projection of a point and line on auxiliary plane

Lecture 21 - Projection of a plane perpendicular to both the reference planes

Lecture 22 - Projection of a plane perpendicular to one and parallel to another plane

Lecture 23 - Projection of a plane inclined to one and perpendicular to the other plane

Lecture 24 - Projection of a plane inclined to both the reference planes - I

Lecture 25 - Projection of a plane inclined to both the reference planes - II

Lecture 26 - Introduction to types of solids

Lecture 27 - Projection of solids in simple positions

Lecture 28 - Projection of solids with axis inclined to one of the reference planes and parallel to another

Lecture 29 - Projection of solids with axis inclined to both the reference planes

Lecture 30 - Projection of spheres

Lecture 31 - Orthographic Projections Introduction to Sections of Solids



[Lecture 32 - Orthographic Projections Sections of Prisms](#)

[Lecture 33 - Orthographic Projections Sections of Pyramids](#)

[Lecture 34 - Orthographic Projections Sections of Cylinders](#)

[Lecture 35 - Orthographic Projections Sections of Cones](#)

[Lecture 36 - Orthographic Projections Sections of Spheres](#)

[Lecture 37 - Development of Surfaces - I](#)

[Lecture 38 - Development of Surfaces - II](#)

[Lecture 39 - Intersection of Surfaces - I](#)

[Lecture 40 - Intersection of Surfaces - II](#)

- Lecture 1 - Conceptual Understanding of the Urban Areas
- Lecture 2 - Urbanization and Sustainable Development
- Lecture 3 - Urban Planning and 73-74 Constitution Amendment Acts
- Lecture 4 - Types and Level of Plans
- Lecture 5 - Regional Plan - I
- Lecture 6 - Regional Plan - II
- Lecture 7 - Development Plan - I
- Lecture 8 - Development Plan - II (Case Study- Draft Bhopal Development Plan 2031)
- Lecture 9 - Zonal Plan
- Lecture 10 - Town Planning Scheme
- Lecture 11 - Local Area Plan (Urban Redevelopment Plan)
- Lecture 12 - Special Purpose Plan (AMRUT)
- Lecture 13 - Special Purpose Plan (HRIDAY)
- Lecture 14 - Special Purpose Plan (Smart City)
- Lecture 15 - Perspective Plan (Agenda 2030 SDGs)
- Lecture 16 - Contextualizing Cities (Egyptian, Mesopotamian, and Indus Valley Civilization)
- Lecture 17 - Contextualizing Cities (Vedic Period)
- Lecture 18 - Contextualizing Cities (Greek and Roman)
- Lecture 19 - Contextualizing Cities (Industrial Revolution)
- Lecture 20 - Contextualizing Cities (1900-1939)
- Lecture 21 - Contextualizing Cities (1940-1979)
- Lecture 22 - Contextualizing Cities (1980-2021)
- Lecture 23 - Public Health and Urban Planning - I
- Lecture 24 - Public Health and Urban Planning - II
- Lecture 25 - Public Health and Urban Planning - III
- Lecture 26 - Public Health and Urban Planning - IV
- Lecture 27 - Housing Issues in India
- Lecture 28 - Culture and Planning of Cities
- Lecture 29 - Urbanization and Environmental Problems
- Lecture 30 - Urbanization and Slums
- Lecture 31 - Introduction to Planning Legislation

[Lecture 32 - Evolution and Growth of Planning Legislation - I](#)

[Lecture 33 - Evolution and Growth of Planning Legislation - II \(USA\)](#)

[Lecture 34 - Evolution and Growth of Planning Legislation - III \(India\)](#)

[Lecture 35 - Land Acquisition Act](#)

[Lecture 36 - Legal Requirements for Industrial Development](#)

[Lecture 37 - National Environmental Legal Requirements](#)

[Lecture 38 - Section I - Cantonment Act and Section II - Legal Requirement for Heritage Conservation](#)

[Lecture 39 - Zoning Regulation](#)

[Lecture 40 - Contemplating Learning Outcomes and Future Direction in Urban Planning](#)

- Lecture 1 - Introduction to isometric projection and isometric Scale
- Lecture 2 - Isometric projection of planar figures - quadrilaterals
- Lecture 3 - Isometric projection of planar figures - circles, semi circles and curves
- Lecture 4 - Isometric projection of straight prisms
- Lecture 5 - Isometric projection of straight pyramids
- Lecture 6 - Isometric projection of Straight Cylinders
- Lecture 7 - Isometric projection of Cones
- Lecture 8 - Isometric projection of Frustums of cones and pyramids
- Lecture 9 - Isometric projection of section of solids
- Lecture 10 - Isometric projection of spheres
- Lecture 11 - Isometric projection of combination of solids
- Lecture 12 - Isometric Projection of intersecting solids
- Lecture 13 - Converting orthographic views to isometric drawing - 1
- Lecture 14 - Converting orthographic views to isometric drawing - 2
- Lecture 15 - Converting Isometric drawing to orthographic views
- Lecture 16 - Introduction to axonometric projection
- Lecture 17 - Axonometric projection of planar figures- quadrilaterals, circles and curves
- Lecture 18 - Axonometric projection of prisms and pyramids
- Lecture 19 - Axonometric projection of Cylinders, cones and spheres
- Lecture 20 - Axonometric projection of intersecting solids and combination of solids

Lecture 1 - State of Global Environment (Air)

Lecture 2 - State of Global Environment (Biodiversity)

Lecture 3 - State of Global Environment (Oceans and Coasts)

Lecture 4 - State of Global Environment (Land and Soil)

Lecture 5 - State of Global Environment (Freshwater)

Lecture 6 - Definition, Process and Purpose of EIA

Lecture 7 - EIA Impact Areas, Current and Emerging - Part 1

Lecture 8 - EIA Impact Areas, Current and Emerging - Part II

Lecture 9 - EIA Origin in USA and World-Wide Development

Lecture 10 - EIA in India

Lecture 11 - World Sustainable Development Timeline (1970-1999)

Lecture 12 - World Sustainable Development Timeline (2000-2021)

Lecture 13 - EIA Law, Policy and Institutional arrangements for EIA systems - Part I

Lecture 14 - EIA Law, Policy and Institutional Arrangements for EIA Systems - Part II - Air

Lecture 15 - EIA Law, Policy and Institutional Arrangements for EIA Systems - Part III - Air

Lecture 16 - EIA Law, Policy and Institutional arrangements for EIA Systems - Part IV - Water and Geology

Lecture 17 - EIA Law, Policy and Institutional Arrangements for EIA Systems - Part V - Ecology

Lecture 18 - EIA Law, Policy and Institutional Arrangements for EIA Systems - Part VI - Coastal Ecology and Geomorphology

Lecture 19 - EIA Law, Policy and Institutional arrangements for EIA Systems - Part VII - Noise

Lecture 20 - EIA Law, Policy and Institutional arrangements for EIA Systems - Part VIII - Ecosystem Services

Lecture 21 - EIA Law, Policy and Institutional Arrangements for EIA Systems - Part IX - Cultural Heritage and Health

Lecture 22 - EIA Law, Policy and Institutional Arrangements for EIA Systems - Part X

Lecture 23 - EIA Law, Policy and Institutional Arrangements for EIA Systems - Part XI

Lecture 24 - EIA Law, Policy and Institutional Arrangements for EIA Systems - Part XII

Lecture 25 - EIA Law, Policy and Institutional Arrangements for EIA Systems - Part XIII

Lecture 26 - EIA Process - Starting and Initial Stage

Lecture 27 - EIA Process - Impact Prediction

Lecture 28 - EIA Process - Impact Evaluation, Mitigation and Enhancement

Lecture 29 - EIA Process - Participation, Presentation and Review

Lecture 30 - EIA Process - Follow-Up (Monitoring and Auditing)

Lecture 31 - EIA Methods - Air Assessment - Part I

- Lecture 32 - EIA Methods - Air Assessment - Part II
- Lecture 33 - EIA Methods - Water Assessment
- Lecture 34 - EIA Methods - Soil, Land and Geology
- Lecture 35 - EIA Methods - Climate and Climate Change - Part I
- Lecture 36 - EIA Methods - Climate and Climate Change - Part II
- Lecture 37 - EIA Methods for Ecology (Definitions and Concepts)
- Lecture 38 - EIA Methods for Ecology (Baseline Study)
- Lecture 39 - EIA Methods for Ecology (Impact Prediction and Evaluation)
- Lecture 40 - EIA Methods - Ecosystem Services - Part I
- Lecture 41 - EIA Methods - Ecosystem Services - Part II
- Lecture 42 - EIA Methods - Coastal Ecology and Geomorphology - Part I
- Lecture 43 - EIA Methods - Coastal Ecology and Geomorphology - Part II
- Lecture 44 - EIA Methods - Noise
- Lecture 45 - EIA Methods - Transport
- Lecture 46 - EIA Methods - Landscape and Visuals
- Lecture 47 - EIA Methods - Cultural Heritage
- Lecture 48 - EIA Methods - Health
- Lecture 49 - EIA Methods - Socio-Economic Impacts (SIA) - Part I
- Lecture 50 - EIA Methods - Socio-Economic Impacts (SIA) - Part II
- Lecture 51 - EIA Methods - Land Acquisition, Resettlement and Livelihoods
- Lecture 52 - EIA Methods - Resource Efficiency
- Lecture 53 - EIA Methods - Risk and Risk Assessment
- Lecture 54 - EIA Methods - Cumulative Effects
- Lecture 55 - EIA - Environmental Management Plans
- Lecture 56 - EIA - Widening the scope: Strategic Environmental Assessment
- Lecture 57 - EIA - Reporting and Review of EIA Quality
- Lecture 58 - EIA Case Study - Mumbai Metro Line 3, Colaba - Bandra - SEEPZ
- Lecture 59 - EIA Case Study - Development of Water Aerodrome, Andaman and Nicobar - Part - I
- Lecture 60 - EIA Case Study - Development of Water Aerodrome, Andaman and Nicobar - Part - II

Lecture 1 - Introduction - Part 1

Lecture 2 - Introduction - Part 2

Lecture 3 - Pre-Independence - Part 1: Indo-Saracenic Architecture

Lecture 4 - Pre-Independence - Part 2: Colonial Architecture and Art Deco

Lecture 5 - Pre-Independence to Independence - Part 1

Lecture 6 - Pre-Independence to Independence - Part 2

Lecture 7 - Revivalism

Lecture 8 - The First Generation (1945-1970) - Part 1

Lecture 9 - The First Generation (1945-1970) - Part 2

Lecture 10 - The First Generation (1945-1970) - Part 3

Lecture 11 - The First Generation (1945-1970) - Part 4

Lecture 12 - The First Generation (1945-1970) - Part 5

Lecture 13 - The First Generation (1945-1970) - Part 6

Lecture 14 - Impact of Western Architects: Le Corbusier - Part 1

Lecture 15 - Impact of Western Architects: Le Corbusier - Part 2

Lecture 16 - Impact of Western Architects: Le Corbusier - Part 3

Lecture 17 - Impact of Western Architects: Le Corbusier - Part 4

Lecture 18 - Impact of Western Architects: Le Corbusier - Part 5

Lecture 19 - Impact of Western Architects: Le Corbusier - Part 6

Lecture 20 - Impact of Western Architects: Walter Gropius - Part 1

Lecture 21 - Impact of Western Architects: Walter Gropius - Part 2

Lecture 22 - Impact of Western Architects: Louis I Kahn - Part 1

Lecture 23 - Impact of Western Architects: Louis I Kahn - Part 2

Lecture 24 - Impact of Western Architects: Louis I Kahn - Part 3

Lecture 25 - Impact of Western Architects: Louis I Kahn - Part 4

Lecture 26 - Introduction to Critical Regionalism - Part 1

Lecture 27 - Introduction to Critical Regionalism - Part 2

Lecture 28 - Critical Regionalism in Indian Architecture - Part 1

Lecture 29 - Critical Regionalism in Indian Architecture - Part 2

Lecture 30 - Critical Regionalism in Indian Architecture - Part 3

Lecture 31 - Critical Regionalism in Indian Architecture - Part 4

[Lecture 32 - Critical Regionalism in Indian Architecture - Part 5](#)

[Lecture 33 - Structure: The Works of Mahendra Raj](#)

[Lecture 34 - Point-Blocks and High Rises - Part 1](#)

[Lecture 35 - Point-Blocks and High Rises - Part 2](#)

[Lecture 36 - Search for a new Architecture - Part 1](#)

[Lecture 37 - Search for a new Architecture - Part 2](#)

[Lecture 38 - Search for a new Architecture - Part 3](#)

[Lecture 39 - Search for a new Architecture - Part 4](#)

[Lecture 40 - Search for a new Architecture - Part 5](#)



Lecture 1 - Culture, Identity and Built Environment

Lecture 2 - Space and Meaning in Balinese Vernacular Architecture

Lecture 3 - Adobe Construction and Religious Structures

Lecture 4 - Social System, Beliefs and its Architecture

Lecture 5 - Anthropology of Shelter-Conclusion

Lecture 6 - Stone as a Vernacular Resource Material

Lecture 7 - Earth as Vernacular Resource Material

Lecture 8 - Bamboo as Vernacular Resource Material

Lecture 9 - Timber as Vernacular Resource Material

Lecture 10 - Advanced Material Adaptations: The conclusion

Lecture 11 - Cultural Geography and Vernacular Architecture

Lecture 12 - Cultural Geography and Small-scale Features in the Landscape

Lecture 13 - Acculturation in Architecture

Lecture 14 - Tradition and Transmission

Lecture 15 - Transformation in Vernacular Context

Lecture 16 - Disasters Vulnerability and Traditions

Lecture 17 - Learning Disaster Mitigation from the Vernacular

Lecture 18 - The Second Birth: Lessons from Disaster Recovery

Lecture 19 - Climate Change and Traditions

Lecture 20 - Yonmenkaigi (Four square table system) Method for Collaborative Knowledge Development

Lecture 1 - Introduction to Interaction Design

Lecture 2 - Components of Interaction Design

Lecture 3 - Interaction Design Process

Lecture 4 - Understanding User

Lecture 5 - Conceptual Design - Part 1

Lecture 6 - Conceptual Design - Part 2

Lecture 7 - Role of Cognition

Lecture 8 - Role of Social Interaction

Lecture 9 - Designing for Emotional Interaction

Lecture 10 - Interactive Interfaces

Lecture 11 - Data Gathering

Lecture 12 - Data Analysis

Lecture 13 - Discovering Requirements

Lecture 14 - User Personas and Scenarios

Lecture 15 - Design and Prototyping - Part 1

Lecture 16 - Design and Prototyping - Part 2

Lecture 17 - Visual Interface Design

Lecture 18 - Elements of User Interface

Lecture 19 - Affordances and UI Transformations

Lecture 20 - Component-Based Design Systems

**NPTEL : NOC:Understanding and Reducing Ghg Emissions - Focus on Scope 1 and 2 Emission Reduction through Building Design and Construction (Architecture)**

**Co-ordinators : Prof. Avlokita Agrawal**

- Lecture 1 - Introduction, Sustainability, And Sustainable Development
- Lecture 2 - Sustainable Development And Sustainable Goals
- Lecture 3 - Sustainable Development Goals and Climate Change
- Lecture 4 - Climate Risk
- Lecture 5 - Impact of Development on Climate Natural Components
- Lecture 6 - UNFCCC
- Lecture 7 - Kyoto Protocol
- Lecture 8 - The Paris Agreement
- Lecture 9 - Green House Gases
- Lecture 10 - Carbon Footprint and Calculation
- Lecture 11 - The GHG Protocol
- Lecture 12 - ISO International Standards
- Lecture 13 - Identification and Determination of Scope 1,2 and 3 GHG Emissions
- Lecture 14 - Identification and Determination of Scope 1,2 and 3 GHG Emissions - Part II
- Lecture 15 - Identification and Determination of Scope 1,2 and 3 GHG Emissions - Part III
- Lecture 16 - India Specific GHG Programs - I
- Lecture 17 - India Specific GHG Programs - II
- Lecture 18 - Accounting Methods and Data Collection
- Lecture 19 - Tools for Calculation of GHG
- Lecture 20 - Understanding the Role of Buildings and Related Emissions
- Lecture 21 - Understanding Emissions of Airports
- Lecture 22 - Understanding Emissions of University Campuses
- Lecture 23 - Understanding Emissions of Fuel Supply Companies
- Lecture 24 - Understanding Emissions of IT Companies
- Lecture 25 - Understanding Emissions of Real Estate Companies
- Lecture 26 - Thermal Comfort in Building
- Lecture 27 - Passive Design Measures
- Lecture 28 - Advanced Passive Design Measures
- Lecture 29 - Natural and Mechanical Ventilation
- Lecture 30 - Daylighting and Lighting Design

## DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

[Lecture 31 - Factors Affecting Material Selection in Building?](#)

[Lecture 32 - Material Selection for Emission Reduction](#)

[Lecture 33 - Reducing Emission from purchased Electricity](#)

[Lecture 34 - Strategies of Renovation and Retrofitting for Emission Reduction](#)

[Lecture 35 - Case studies of Various Efficient Building Design](#)

[Lecture 36 - Calculation of Emissions Reduction from HVAC System](#)

[Lecture 37 - Calculation of Emission Reduction from Fenestration](#)

[Lecture 38 - Calculation of Emission Reduction from Building Envelope](#)

[Lecture 39 - Calculation of Emission Reduction from Source of Energy](#)

[Lecture 40 - Course Summary](#)

Lecture 1 - Introduction

Lecture 2 - Types of Research

Lecture 3 - Qualitative vs. Quantitative Research

Lecture 4 - Research Methods vs Research Methodology

Lecture 5 - Issues and Challenges in Planning and Architectural Research

Lecture 6 - Research Process - I

Lecture 7 - Research Process - II

Lecture 8 - Research Process - III

Lecture 9 - Research Writing - I

Lecture 10 - Research Writing - II

Lecture 11 - Basics of Literature Review

Lecture 12 - Bibliometric Analysis

Lecture 13 - Systematic Literature Review

Lecture 14 - Meta Analysis

Lecture 15 - Referencing

Lecture 16 - Types of Data in Research

Lecture 17 - Measurement and Scaling Techniques - I

Lecture 18 - Measurement and Scaling Techniques - II

Lecture 19 - Types of Surveys - I

Lecture 20 - Types of Surveys - II

Lecture 21 - Determining the Sample Size

Lecture 22 - Sampling Techniques - I

Lecture 23 - Sampling Techniques - II

Lecture 24 - Sources of Data

Lecture 25 - Preparation of Survey Questionnaire

Lecture 26 - Methods of Data Collection - I

Lecture 27 - Methods of Data Collection - II

Lecture 28 - Methods of Data Collection - III

Lecture 29 - Ethics in Data Management and Use

Lecture 30 - Similarity vs. Plagiarism

Lecture 31 - Processing of Data and Database Management

[Lecture 32 - Interpreting Data](#)

[Lecture 33 - Descriptive Statistics](#)

[Lecture 34 - Representation of Data and Inferences - I](#)

[Lecture 35 - Representation of Data and Inferences - II](#)

[Lecture 36 - Hypothesis Testing](#)

[Lecture 37 - Parametric Tests](#)

[Lecture 38 - Non-parametric Tests](#)

[Lecture 39 - Quantitative Research Approach](#)

[Lecture 40 - Quantitative Research - Case Study - I](#)

[Lecture 41 - Quantitative Research - Case Study - II](#)

[Lecture 42 - Quantitative Research - Case Study - III](#)

[Lecture 43 - Quantitative Research - Case Study - IV](#)

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[Lecture 45 - Qualitative Research Approach](#)

[Lecture 46 - Qualitative Research - Case Study - I](#)

[Lecture 47 - Qualitative Research - Case Study - II](#)

[Lecture 48 - Qualitative Research - Case Study - III](#)

[Lecture 49 - Qualitative Research - Case Study - IV](#)

[Lecture 50 - Qualitative Research - Case Study - V](#)

[Lecture 51 - Mixed Method Research Approach](#)

[Lecture 52 - Mixed Method Research Approach - Case Study](#)

[Lecture 53 - Spatial Methods in Planning Research](#)

[Lecture 54 - Spatial Methods in Planning Research - Case Study](#)

[Lecture 55 - Research Methods for Behavioral Studies - The Basics](#)

[Lecture 56 - Simulation Based Studies in Planning and Architecture](#)

[Lecture 57 - Handling Big Data Research - The Basics](#)

[Lecture 58 - Role of AI in Architecture and Planning Studies - The Basics](#)

[Lecture 59 - Programming Language and Software for Research in Planning and Architecture](#)

[Lecture 60 - Emerging Research Potential in Planning and Architecture](#)

Lecture 1 - Introduction

Lecture 2 - Atmosphere-A brief survey (Pressure, Temperature and Chemical composition)

Lecture 3 - Atmosphere-A brief survey (Continued...) (Vertical structure of the atmosphere)

Lecture 4 - Vertical structure of atmosphere (Continued...) and The Earth system - Oceans

Lecture 5 - The Earth system - Oceans (Continued...) and Marine biosphere

Lecture 6 - The Earth system - Hydrological cycle

Lecture 7 - The Earth system - Hydrological cycle (Continued...) and Carbon cycle

Lecture 8 - The Earth system - Carbon cycle (Continued...), and Carbon in the oceans Earth's crust

Lecture 9 - The Earth system - Carbon in the oceans Earth's crust

Lecture 10 - Atmospheric Thermodynamics- Introduction

Lecture 11 - The hydrostatic equation

Lecture 12 - Hypsometric equation and pressure at sea level

Lecture 13 - Basic Thermodynamics

Lecture 14 - Concept of air parcel and dry adiabatic lapse rate

Lecture 15 - Potential temperature

Lecture 16 - Skew-T ln-P chart

Lecture 17 - Problems using Skew-T ln-P chart

Lecture 18 - Problems using Skew-T ln-P chart (Continued...)

Lecture 19 - Problems using Skew-T ln-P chart (Continued...)

Lecture 20 - Lifting Condensation Level (LCL)

Lecture 21 - Lifting Condensation Level (LCL) (Continued...)

Lecture 22 - Saturated Adiabatic and Pseudo-adiabatic processes

Lecture 23 - Equivalent potential temperature and wet bulb potential temperature

Lecture 24 - Föhn's rule - Chinook winds

Lecture 25 - Problems on Chinook wind and static stability

Lecture 26 - Static stability-Brunt-Väisälä frequency

Lecture 27 - Conditional and convective instability

Lecture 28 - Static stability - Problems using radiosonde data and skew T ln P chart

Lecture 29 - The second law of thermodynamics – Clausius Clapeyron relation

Lecture 30 - Clausius Clapeyron relation (Continued...)

Lecture 31 - Atmospheric radiation – Radiation laws

[Lecture 32 - Planck's distribution and Inverse square law](#)

[Lecture 33 - Physics of scattering, emission and absorption](#)

[Lecture 34 - Physics of scattering, emission and absorption \(Continued...\)](#)

[Lecture 35 - Radiative Transfer Equation " Derivation](#)

[Lecture 36 - Radiative Transfer Equation \(Continued...\)](#)

[Lecture 37 - Radiative heating profiles of the atmosphere](#)

[Lecture 38 - Climate Dynamics " Introduction](#)

[Lecture 39 - Climate sensitivity and feedback](#)

[Lecture 40 - Climate change](#)

[Lecture 41 - Atmospheric dynamics](#)



Lecture 1 - Introduction

Lecture 2 - Blackbody radiation

Lecture 3 - Properties of real surfaces

Lecture 4 - Spectral and directional variations

Lecture 5 - Shape factor

Lecture 6 - Triangular enclosure

Lecture 7 - Evaluation of shape factors

Lecture 8 - Radiation in enclosures

Lecture 9 - Electrical analogy

Lecture 10 - Applications

Lecture 11 - Non-gray enclosures

Lecture 12 - Enclosure with Specular surfaces

Lecture 13 - Integral method for enclosures

Lecture 14 - Introduction to gas radiation

Lecture 15 - Plane parallel model

Lecture 16 - Diffusion approximation

Lecture 17 - Radiative equilibrium

Lecture 18 - Optically thick limit

Lecture 19 - Radiation spectroscopy

Lecture 20 - Isothermal gas emissivity

Lecture 21 - Band models

Lecture 22 - Total Emissivity method

Lecture 23 - Isothermal gas enclosures

Lecture 24 - Well-stirred furnace model

Lecture 25 - Gas radiation in complex enclosures

Lecture 26 - Interaction between radiation and other modes of heat transfer

Lecture 27 - Radiation heat transfer during flow over flat plate

Lecture 28 - Radiation and Climate

Lecture 29 - Radiative-convective equilibrium

Lecture 30 - Radiative equilibrium with scattering

Lecture 31 - Radiation measurement

[Lecture 32 - Radiation with internal heat source](#)

[Lecture 33 - Particle scattering](#)

[Lecture 34 - Scattering in the atmosphere](#)

[Lecture 35 - Non-isotropic scattering](#)

[Lecture 36 - Approximate methods in scattering : 1](#)

[Lecture 37 - Approximate methods in scattering : 2](#)

[Lecture 38 - Monte Carlo method](#)

**NPTEL : The monsoon and its variability (Atmospheric Science)**

**Co-ordinators : Prof. Sulochana Gadgil**

Lecture 1 - Preamble and Introduction to the Indian Monsoon

Lecture 2 - Nature of the variability of the Indian Monsoon

Lecture 3 - Monsoon variability through the eye in the sky, seasonal variation of the surface wind and pressure

Lecture 4 - Background about the atmosphere and rotating systems

Lecture 5 - Rainfall and clouds over the tropics

Lecture 6 - Organization of clouds over mesoscale, synoptic scale and planetary scales

Lecture 7 - The Indian monsoon: is it a gigantic land-sea breeze?

Lecture 8 - Monsoons and the seasonal variation of tropical circulation and rainfall

Lecture 9 - Evolution of the ideas about the basic system responsible for the Indian monsoon - Part 1

Lecture 10 - Evolution of the ideas about the basic system responsible for the Indian monsoon - Part 2

Lecture 11 - Tropical Convergence Zones and the Indian monsoon - Part 1

Lecture 12 - Tropical Convergence Zones and the Indian monsoon - Part 2

Lecture 13 - Variability of organized convection over the tropical oceans

Lecture 14 - Heat lows and the TCZ

Lecture 15 - Monsoonal regions of the world

Lecture 16 - Seasonal transitions - Part 1 : spring to summer transition

Lecture 17 - Seasonal transitions - Part 2 : spring to summer transition

Lecture 18 - Seasonal transitions - Part 3 : Advance and retreat of the summer monsoon

Lecture 19 - Climatic clusters of the Indian region

Lecture 20 - Active-weak spells and breaks in the monsoon - Part 1

Lecture 21 - Active-weak spells and breaks in the monsoon - Part 2

Lecture 22 - Intraseasonal variation and intraseasonal oscillations

Lecture 23 - The tropical oceans

Lecture 24 - El Nino Southern Oscillation (ENSO) - Part 1

Lecture 25 - El Nino Southern Oscillation (ENSO) - Part 2

Lecture 26 - El Nino Southern Oscillation (ENSO) - Part 3

Lecture 27 - El Nino Southern Oscillation (ENSO) - Part 4

Lecture 28 - El Nino Southern Oscillation (ENSO) - Part 5

Lecture 29 - El Nino Southern Oscillation (ENSO) - Part 6

Lecture 30 - Indian Ocean and the monsoon - Part 1

Lecture 31 - Indian Ocean and the monsoon - Part 2

[Lecture 32 - Indian Ocean Dipole - Part 1](#)

[Lecture 33 - Indian Ocean Dipole - Part 2](#)

[Lecture 34 - Interannual variation of the Indian summer Monsoon rainfall: Links to events over the Pacific and Equatorial Indian Ocean](#)

[Lecture 35 - Monsoon Variability and Agriculture - Part 1](#)

[Lecture 36 - Monsoon Variability and Agriculture - Part 2](#)

[Lecture 37 - Monsoon Variability and Agriculture - Part 3](#)

[Lecture 38 - Monsoon Variability and Agriculture - Part 4](#)

[Lecture 39 - Indian Summer Monsoon, GDP and Agriculture](#)

[Lecture 40 - Monsoon Prediction - Part 1](#)

[Lecture 41 - Monsoon Prediction - Part 2](#)

[Lecture 42 - Concluding Remarks](#)

Lecture 1 - Preliminary Concepts

Lecture 2 - Vector Analysis

Lecture 3 - Analysis of Forces

Lecture 4 - Analysis of Equilibrium

Lecture 5 - Structural Mechanics - Part-1

Lecture 6 - Structural Mechanics - Part-2

Lecture 7 - Friction and its Applications - Part-1

Lecture 8 - Friction and its Applications - Part-2

Lecture 9 - Friction and its Applications - Part-3

Lecture 10 - Properties of Surfaces - Part-1

Lecture 11 - Properties of Surfaces - Part-2

Lecture 12 - Properties of Surfaces - Part-3

Lecture 13 - Moments and Products of Inertia

Lecture 14 - Methods of Virtual Work and Potential Energy - Part-1

Lecture 15 - Methods of Virtual Work and Potential Energy - Part-2

Lecture 16 - Stability of Equilibrium

Lecture 1 - Introduction

Lecture 2 - Motivation

Lecture 3 - Management

Lecture 4 - Work Ethics

Lecture 5 - Comparison Between Theories

Lecture 6 - Job Enrichment

Lecture 7 - Team Building and Participation

Lecture 8 - Other Leadership Styles

Lecture 9 - Empowerment

Lecture 10 - Barriers to Communication

Lecture 11 - Issues in Leadership

Lecture 12 - Participation Management and Team Working Part - 1

Lecture 13 - Participation Management and Team Working Part - 2

Lecture 14 - Participation Management and Team Working Part - 3

Lecture 15 - Participative Management and Team Working Part - 5

Lecture 16 - Organizations

Lecture 17 - Some Management Concepts - Part - 1

Lecture 18 - Some Management Concepts - Part - 2

Lecture 19 - Some Management Concepts - Part - 3

Lecture 20 - Diversity at Work Place and Management Issues

Lecture 21 - Industrial Relations and Conflict Management - Part - 1

Lecture 22 - Industrial Relations and Conflict Management - Part - 2

Lecture 23 - Selection and Training of Employees

Lecture 24 - Performance Management - Part - 1

Lecture 25 - Performance Management - Part - 2

Lecture 26 - Performance Management - Part - 3

Lecture 27 - Management Research: Some Methodological Issues-Part-2

Lecture 28 - Corporate Social Responsibilities

Lecture 29 - Women, Work and Organizations: Management Perspective - Part - 1

Lecture 30 - Women, Work and Organizations: Management Perspective - Part - 2

Lecture 31 - Selection, Recruitment and Training

[Lecture 32 - Management of Change in Organization](#)

[Lecture 33 - Organizational Development](#)

[Lecture 34 - Values, Ethics and Corporate Social Responsibilities - Part - 1](#)

[Lecture 35 - Values, Ethics and Corporate Social Responsibilities - Part - 2](#)

[Lecture 36 - Management: Now and Beyond - Part - 1](#)

[Lecture 37 - Management: Now and Beyond - Part - 2](#)

[Lecture 38 - Management: Now and Beyond - Part - 3](#)

[Lecture 39 - Conclusions](#)

Lecture 1 - Introduction

Lecture 2 - Internal Energy Enthalpy

Lecture 3 - Crystal Geometry

Lecture 4 - Crystal Geometry

Lecture 5 - Crystal Geometry

Lecture 6 - Crystal Structure

Lecture 7 - Close Packing of Spheres of Equal Size

Lecture 8 - Structure of Solid Materials

Lecture 9 - Non Crystalline Solids

Lecture 10 - Polymers (Continued)

Lecture 11 - Crystal Imperfections

Lecture 12 - Crystal Imperfections

Lecture 13 - Crystal Imperfections

Lecture 14 - Crystal Imperfections

Lecture 15 - Crystal Imperfections

Lecture 16 - Phase Diagrams

Lecture 17 - Phase Diagrams

Lecture 18 - Phase Diagrams

Lecture 19 - Diffusion in Solids

Lecture 20 - Diffusion in Solids

Lecture 21 - Phase Transformations

Lecture 22 - Phase Transformations

Lecture 23 - Phase Transformations

Lecture 24 - Transformations in Steels: Eutectoid Steel

Lecture 25 - Phase Transformations; Precipitation Hardening

Lecture 26 - Mechanical Behaviour of Materials

Lecture 27 - Plastic Deformation

Lecture 28 - Plastic Deformation

Lecture 29 - Plastic Deformation

Lecture 30 - Strengthening Mechanisms Creep

Lecture 31 - Fracture



[Lecture 32 - Conductors and Resistors](#)

[Lecture 33 - Conductors and Resistors](#)

[Lecture 34 - Superconductors](#)

[Lecture 35 - Superconductors](#)

[Lecture 36 - Semiconductors](#)

- Lecture 1 - Errors in Computation and Numerical Instability
- Lecture 2 - Solution of Nonlinear Algebraic Equations - Part 1
- Lecture 3 - Solution of Nonlinear Algebraic Equations - Part 2
- Lecture 4 - Solution of Nonlinear Algebraic Equations - Part 3
- Lecture 5 - Solution of Nonlinear Algebraic Equations - Part 4
- Lecture 6 - Solution of Nonlinear Algebraic Equations - Part 5
- Lecture 7 - Solution of Nonlinear Algebraic Equations - Part 6
- Lecture 8 - Solution of Nonlinear Algebraic Equations - Part 7
- Lecture 9 - Solution of Nonlinear Algebraic Equations - Part 8
- Lecture 10 - Solution of Nonlinear Algebraic Equations - Part 9
- Lecture 11 - Solution of a System of Linear Algebraic Equations - Part 1
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- Lecture 13 - Solution of a System of Linear Algebraic Equations - Part 3
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- Lecture 20 - Solution of a System of Linear Algebraic Equations - Part 10
- Lecture 21 - Solution of a System of Linear Algebraic Equations - Part 11
- Lecture 22 - Solution of a System of Linear Algebraic Equations - Part 12
- Lecture 23 - Solution of a System of Linear Algebraic Equations - Part 13
- Lecture 24 - Solution of a System of Linear Algebraic Equations - Part 14
- Lecture 25 - Interpolation and Approximation - Part 1
- Lecture 26 - Interpolation and Approximation - Part 2
- Lecture 27 - Interpolation and Approximation - Part 3
- Lecture 28 - Interpolation and Approximation - Part 4
- Lecture 29 - Interpolation and Approximation - Part 5
- Lecture 30 - Interpolation and Approximation - Part 6
- Lecture 31 - Interpolation and Approximation - Part 7

[Lecture 32 - Interpolation and Approximation - Part 8](#)

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[Lecture 34 - Numerical Differentiation and Integration - Part 1](#)

[Lecture 35 - Numerical Differentiation and Integration - Part 2](#)

[Lecture 36 - Numerical Differentiation and Integration - Part 3](#)

[Lecture 37 - Numerical Differentiation and Integration - Part 4](#)

[Lecture 38 - Numerical Differentiation and Integration - Part 5](#)

[Lecture 39 - Numerical Differentiation and Integration - Part 6](#)

[Lecture 40 - Numerical Differentiation and Integration - Part 7](#)

[Lecture 41 - Numerical Differentiation and Integration - Part 8](#)

Lecture 1 - Engineering Mechanics

Lecture 2 - Equilibrium - I

Lecture 3 - Equilibrium - II

Lecture 4 - Equilibrium - III

Lecture 5 - Plan Trusses - I

Lecture 6 - Plan Trusses - II

Lecture 7 - Friction

Lecture 8 - Properties of Surfaces - I

Lecture 9 - Properties of Surfaces - II

Lecture 10 - Properties of Surfaces - III

Lecture 11 - Method of Virtual Work

Lecture 12 - Motion of Particles Planar Polar Coordinates

Lecture 13 - Motion With Constraints

Lecture 14 - Motion of Particle With Friction

Lecture 15 - Motion of Particles With Drag

Lecture 16 - Momentum

Lecture 17 - Work and Energy - I

Lecture 18 - Work and Energy - II

Lecture 19 - Work and Energy - III

Lecture 20 - Work and Energy - IV

Lecture 21 - Rotational Motion - I

Lecture 22 - Rotational Motion - II

Lecture 23 - Rotational Motion - III

Lecture 24 - Rotational Motion - IV

Lecture 25 - Rotational Motion - V

Lecture 26 - Rotational Motion - VI

Lecture 27 - Simple Harmonic Motion - I

Lecture 28 - Simple Harmonic Motion - II

Lecture 29 - Simple Harmonic Motion - III

Lecture 30 - Motion in Uniformly Accelerating Frames

Lecture 31 - Motion In Rotating Frame



[Module - 1 lecture - 1](#)

[Module - 1 lecture - 2](#)

[Module - 1 lecture - 3](#)

[Module - 1 lecture - 4](#)

[Module - 2 lecture - 1](#)

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[Module - 2 lecture - 3](#)

[Module - 2 lecture - 4](#)

[Module - 2 lecture - 5](#)

[Module - 3 lecture - 1](#)

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[Module - 3 lecture - 3](#)

[Module - 3 lecture - 4](#)

[Module - 3 lecture - 5 \(Lecture Missing\)](#)

[Module - 3 lecture - 6](#)

[Module - 3 lecture - 7](#)

[Module - 3 lecture - 8](#)

[Module - 4 lecture - 1](#)

[Module - 4 lecture - 2](#)

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[Module - 4 lecture - 8](#)

[Module - 4 lecture - 9](#)

[Module - 4 lecture - 10](#)

[Module - 4 lecture - 11](#)

[Module - 4 lecture - 12](#)

Lecture 1 - Real Number

Lecture 2 - Sequences I

Lecture 3 - Sequences II

Lecture 4 - Sequences III

Lecture 5 - Continuous Function

Lecture 6 - Properties of Continuous Function

Lecture 7 - Uniform Continuity

Lecture 8 - Differentiable Functions

Lecture 9 - Mean Value Theorem

Lecture 10 - Maxima - Minima

Lecture 11 - Taylor's Theorem

Lecture 12 - Curve Sketching

Lecture 13 - Infinite Series I

Lecture 14 - Infinite Series II

Lecture 15 - Tests of Convergence

Lecture 16 - Power Series

Lecture 17 - Riemann Integral

Lecture 18 - Riemann Integrable Functions

Lecture 19 - Applications of Riemann Integral

Lecture 20 - Length of a curve

Lecture 21 - Line Integrals

Lecture 22 - Functions of Several Variables

Lecture 23 - Differentiation

Lecture 24 - Derivatives

Lecture 25 - Mean Value Theorem

Lecture 26 - Maxima Minima

Lecture 27 - Method of Lagrange Multipliers

Lecture 28 - Multiple Integrals

Lecture 29 - Surface Integrals

Lecture 30 - Green's Theorem

Lecture 31 - Stokes Theorem

Lecture 32 - Gauss Divergence Theorem



Lecture 1 - Nature and Scope of HRM

Lecture 2 - Analysing and Designing Job - I

Lecture 3 - Analysing and Designing Job - II

Lecture 4 - Human Resource Planning - I

Lecture 5 - Human Resource Planning - II

Lecture 6 - Recruitment and Selection

Lecture 7 - Performance Evaluation and Appraisal - I

Lecture 8 - Performance Evaluation and Appraisal (Continued...)

Lecture 9 - Training and Development

Lecture 10 - Employee Welfare

Lecture 11 - Safety, Health, Environment

Lecture 12 - Industrial Relations

Lecture 13 - Total Quality Management

Lecture 14 - Organization Culture

Lecture 15 - Change Management - Part - I

Lecture 16 - Change Management - Part - II

Lecture 17 - Wage and Salary Administration

Lecture 18 - Career Planning - Part - I

Lecture 19 - Career Planning - Part - II

Lecture 20 - Contemporary Issues in HRM - I

Lecture 21 - Contemporary Issues in HRM - II

Lecture 22 - Contemporary Issues in HRM - III

Lecture 1 - Introduction to Leadership: Functions

Lecture 2 - Leadership Roles: Leaders Vs Managers: Theories

Lecture 3 - Leadership Styles: Effective Vs Successful Managers

Lecture 4 - Leadership Behaviour: Emergence: Leadership and Trust

Lecture 5 - Leadership Styles: Adaptation-Studies/Case: From Sindhi to Siddhi (Part-I)

Lecture 6 - Case: From Sindhi to Siddhi (Part-II) Transformation Leadership

Lecture 7 - Leadership Skills: Leadership and Management

Lecture 8 - Competencies and Skills of Leaders: Issues in Organizational Leadership

Lecture 9 - Case: The DVC Story-A First Person Account - Leadership in Action (Part-I)

Lecture 10 - Case: The DVC Story-A First Person Account- Leadership in Action (Part-II)

Lecture 11 - Case: Rai Bahadur Mohan Singh Oberoi (Part-I) Issues in Institution Building

Lecture 12 - Case: Rai Bahadur Mohan Singh Oberoi (Part-II)

Lecture 13 - Case: Self Regulation-The Key to Institution Building - Framework of Institution Building

Lecture 1 - Introduction - I

Lecture 2 - Introduction - II

Lecture 3 - Introduction - III

Lecture 4 - Concept of Information - I

Lecture 5 - Concept of Information - II

Lecture 6 - Decision Making Process

Lecture 7 - Impact of IS on Management - I

Lecture 8 - Impact of IS on Management - II

Lecture 9 - Hardware Software Overview - I

Lecture 10 - Hardware Software Overview - II

Lecture 11 - Knowledge Management

Lecture 12 - Learning Organization

Lecture 13 - Decision Analysis - I

Lecture 14 - Decision Analysis - II

Lecture 15 - Decision Analysis - III

Lecture 16 - Data Flow Diagrams - I

Lecture 17 - Data Flow Diagrams - II

Lecture 18 - Data Flow Diagrams - III

Lecture 19 - Data Flow Diagrams - IV

Lecture 20 - System Design - I

Lecture 21 - System Design - II

Lecture 22 - DBMS - I

Lecture 23 - DBMS - II

Lecture 24 - DBMS - III

Lecture 25 - DBMS - IV

Lecture 26 - DBMS - V

Lecture 27 - OOAD - I

Lecture 28 - OOAD - II

Lecture 29 - OOAD - III

Lecture 1 - Simple Harmonic Oscillators

Lecture 2 - Damped Oscillator - I

Lecture 3 - Damped Oscillator - II

Lecture 4 - Oscillator With External Forcing - I

Lecture 5 - Oscillator With External Forcing

Lecture 6 - Resonance

Lecture 7 - Coupled Oscillations

Lecture 8 - Sinusoidal Plane Waves - I

Lecture 9 - Electromagnetic waves - I

Lecture 10 - Electromagnetic Waves - II

Lecture 11 - The Vector Nature of Electromagnetic Waves

Lecture 12 - The Electromagnetic Spectrum

Lecture 13 - The Electromagnetic Spectrum - II

Lecture 14 - Interference - I

Lecture 15 - Interference - II

Lecture 16 - Interference - III

Lecture 17 - Interference - IV

Lecture 18 - Coherence

Lecture 19 - Coherence

Lecture 20 - Diffraction - I

Lecture 21 - Diffraction - II

Lecture 22 - Diffraction - III

Lecture 23 - Diffraction - IV

Lecture 24 - X-Ray Diffraction

Lecture 25 - Beats

Lecture 26 - The Wave Equation

Lecture 27 - Solving the Wave Equation

Lecture 28 - Waves

Lecture 29 - Standing Waves

Lecture 30 - Standing Waves

Lecture 31 - Polarization

[Lecture 32 - Compton Effect](#)

[Lecture 33 - Wave - Particle Duality](#)

[Lecture 34 - Wave - Particle Duality](#)

[Lecture 35 - Probability Amplitude](#)

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[Lecture 37 - Schrodinger Wave Equation](#)

[Lecture 38 - Measurements](#)

[Lecture 39 - Particle in a Potential](#)

[Lecture 40 - Potential Well](#)

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[Lecture 42 - Potential Well](#)

[Lecture 43 - Quantum Tunneling](#)

[Lecture 44 - Quantum Tunneling](#)

Lecture 1 - Strategy: Philosophy;Competition;Competitive Advantage - Part - I

Lecture 2 - Strategy: Philosophy;Competition;Competitive Advantage - Part - II

Lecture 3 - Case Study - Group Presentation on Case - I (Baddi's Solvent)

Lecture 4 - Case Study - Group Presentation on Case - II

Lecture 5 - Case Study - Group Presentation on Case - III

Lecture 6 - Case Study - Group Presentation on Case - IV Form

Lecture 7 - Strategy: Implementation in Organizations

Lecture 8 - Strategy: Design: Process: Managing Strategic Change

Lecture 9 - Case Study: The House of Tata

Lecture 10 - Case Study: The House of Tata

Lecture 11 - Group Presentation - II

Lecture 1 - Introduction to Basic Electronics

Lecture 2 - Electronic Devices 1

Lecture 3 - Electronics Devices II Resistor in series and parallel

Lecture 4 - Some Useful Laws in Basic Electronics

Lecture 5 - Some Useful Theorems in Basic Electronics

Lecture 6 - Semi Conductor Diodes

Lecture 7 - Applications of Diodes

Lecture 8 - Wave Shaping using Diodes

Lecture 9 - Zener Diode Characteristics

Lecture 10 - Transistors

Lecture 11 - Transistor Biasing - Common Emitter Circuits, Fixed Bias, Collector to base Bias

Lecture 12 - Transistor Biasing - Emitter Current Bias, Thermal Stability (RC Coupled Amplifier)

Lecture 13 - Basic Characteristic of an Amplifier - Simple Transistor model, Common emitter Amplifier

Lecture 14 - Hybrid Equivalent Circuit, H-Parameters

Lecture 15 - Circuit Analysis using H-Parameters

Lecture 16 - Frequency Response of Amplifiers

Lecture 17 - Frequency Analysis

Lecture 18 - Power Amplifiers

Lecture 19 - Differential Amplifiers Circuit

Lecture 20 - Integrated Chip

Lecture 21 - Typical Characteristic of Operation Amplifier

Lecture 22 - Four Types of Feed Back

Lecture 23 - Four Types of Feed Back

Lecture 24 - Mathematical Operations

Lecture 25 - Mathematical Operations

Lecture 26 - Mathematical Operations

Lecture 27 - Characteristics of Operation Amplifier

Lecture 28 - Characteristics of Operation Amplifier

Lecture 29 - Characteristics of Operation Amplifier

Lecture 30 - Inverter/Non-Inverter Circuits

Lecture 31 - Applications of Op Amps

[Lecture 32 - Non-Linear Op Amp circuits](#)

[Lecture 33 - Applications of Op Amps](#)

[Lecture 34 - Active Diode Circuits](#)

[Lecture 35 - Oscillators](#)

[Lecture 36 - Logarithmic and Anti-Logarithmic Amplifier](#)

[Lecture 37 - Filters](#)

[Lecture 38 - Unit Junction Transistor](#)

[Lecture 39 - Silicon Controlled Rectifier](#)

[Lecture 40 - Field Effect Transistor](#)



- Lecture 1 - Introduction
- Lecture 2 - Newtonian mechanics
- Lecture 3 - Dynamics in phase space
- Lecture 4 - Linear dynamical systems
- Lecture 5 - Autonomous dynamical systems (Part 1)
- Lecture 6 - Autonomous dynamical systems (Part 2)
- Lecture 7 - Lagrangian formalism
- Lecture 8 - Summary of classical electromagnetism
- Lecture 9 - Charged particle in an electromagnetic field
- Lecture 10 - Hamiltonian dynamics (Part 1)
- Lecture 11 - Hamiltonian dynamics (Part 2)
- Lecture 12 - Hamiltonian dynamics (Part 3)
- Lecture 13 - Dynamical symmetry (Part 1)
- Lecture 14 - Dynamical symmetry (Part 2)
- Lecture 15 - Randomness in phase space; chaos
- Lecture 16 - Discrete-time dynamics: maps (Part 1)
- Lecture 17 - Discrete-time dynamics: maps (Part 2)
- Lecture 18 - Problems and solutions (Part 1)
- Lecture 19 - Problems and solutions (Part 2)
- Lecture 20 - Classical statistical mechanics: Introduction
- Lecture 21 - Some probability distributions; isolated system
- Lecture 22 - The microcanonical ensemble
- Lecture 23 - Thermodynamics
- Lecture 24 - The canonical ensemble
- Lecture 25 - Connection between statistical mechanics and thermodynamics
- Lecture 26 - Probability distributions
- Lecture 27 - Probability distributions (concl.). Phase transitions (Part 1)
- Lecture 28 - Phase transitions (Part 2)
- Lecture 29 - Phase transitions (Part 3)
- Lecture 30 - Phase transitions (Part 4); misc. topics
- Lecture 31 - Problems and solutions (Part 3)

[Lecture 32 - Continuous groups in physics \(Part 1\)](#)

[Lecture 33 - Continuous groups in physics \(Part 2\)](#)

[Lecture 34 - Continuous groups in physics \(Part 3\)](#)

[Lecture 35 - Noether's Theorem. Special Relativity \(Part 1\)](#)

[Lecture 36 - Special Relativity \(Part 2\)](#)

[Lecture 37 - Special Relativity \(Part 3\)](#)

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Lecture 1 - Introduction to Chemistry & Quantum Chemical Mechanics

Lecture 2 - Particle in a box (one and two dimensions)

Lecture 3 - Particle in a box (One and Two Dimensions) Continued

Lecture 4 - Harmonic Oscillator and Molecular Vibration

Lecture 5 - Harmonic Oscillator (Continued)

Lecture 6 - Hydrogen Atom - Radial Solution

Lecture 7 - Hydrogen Atom Part III Angular Solutions

Lecture 8 - Hydrogen Atom - Angular Solutions (Continued)

Lecture 9 - Hydrogen Atom - Angular Solutions (Continued)

Lecture 10 - Oppenheimer Approximation and Superposition

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**NPTEL : Proteomics: Principles and Techniques (Biotechnology)**

**Co-ordinators : Prof. Sanjeeva Srivastava**

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**NPTEL : NOC:Introduction to Proteomics (Biotechnology)**

**Co-ordinators : Prof. Sanjeeva Srivastava**

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Lecture 2 - Introduction to proteins

Lecture 3 - Protein folding and misfolding

Lecture 4 - Introduction to proteomics

Lecture 5 - Lab session " Protein-protein interaction using label-free biosensors

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Lecture 5 - Enzyme Nomenclature

Lecture 6 - Primary Structure of Enzyme

Lecture 7 - Determination of Primary Structure

Lecture 8 - Secondary Structure of Protein

Lecture 9 - Tertiary Structure of Enzyme - Part I

Lecture 10 - Tertiary Structure of Enzyme - Part II

Lecture 11 - Molecular Modelling of Enzyme Structure - Part II

Lecture 12 - Identification of Enzyme Gene - Part II

Lecture 13 - Identification of Enzyme Gene - Part II

Lecture 14 - Polymerase Chain Reaction

Lecture 15 - Enzymes in Molecular Cloning

Lecture 16 - Cloning of Enzyme Coding Gene

Lecture 17 - DNA Delivery in host - Part I

Lecture 18 - DNA Delivery in host - Part II

Lecture 19 - Screening of Recombinant Clones

Lecture 20 - Over-expression of Enzyme in host - Part I

Lecture 21 - Over-expression of Enzyme in host - Part II

Lecture 22 - Over-expression of Enzyme in host - Part III

Lecture 23 - Host Cell Disruption Methods

Lecture 24 - Basics of Chromatography

Lecture 25 - Chromatography - Part I

Lecture 26 - Chromatography - Part II

Lecture 27 - Chromatography - Part III

Lecture 28 - Carbohydrate Metabolism

Lecture 29 - Lipid Metabolism

Lecture 30 - Amino acid Metabolism and Detoxification

Lecture 31 - Enzyme-Substrate Interactions - Part I - Chromatographic Methods

[Lecture 32 - Enzyme-Substrate Interactions - Part II - Spectroscopic Methods](#)

[Lecture 33 - Enzyme-Substrate Interactions - Part III - ITC](#)

[Lecture 34 - Enzyme-Substrate Interactions - Part IV - SPR](#)

[Lecture 35 - Enzyme Assay System - Part I](#)

[Lecture 36 - Enzyme Assay System - Part II](#)

[Lecture 37 - Enzyme Assay System - Part III](#)

[Lecture 38 - Enzyme Kinetics](#)

[Lecture 39 - Inhibitor Designing - Part I - Traditional Approach](#)

[Lecture 40 - Inhibitor Designing - Part II - Modern Approach](#)

[Lecture 41 - Inhibitor Designing - Part III - Computational Approach](#)

[Lecture 42 - Enzyme Inhibition - Part I](#)

[Lecture 43 - Enzyme Inhibition - Part II](#)

[Lecture 44 - Application of Enzyme - Part I - Food Industry](#)

[Lecture 45 - Application of Enzyme - Part II - Medical Field](#)

[Lecture 46 - Enzyme in Drug Discovery](#)

[Lecture 47 - Enzymes in Environmental Field](#)

- Lecture 1 - Cellular Structure (Prokaryotic cells)
- Lecture 2 - Cellular Structure (Eukaryotic cells)
- Lecture 3 - Cellular Structure (Eukaryotic cells)
- Lecture 4 - Cell Fractionation - Part 1
- Lecture 5 - Cell Fractionation - Part 2
- Lecture 6 - Cellular Metabolism - Part 1
- Lecture 7 - Cellular Metabolism - Part 2
- Lecture 8 - Cell Cycle and Control - Part 1
- Lecture 9 - Cell Cycle and Control - Part 2
- Lecture 10 - Program Cell Death
- Lecture 11 - Biomolecules - Part 1 : DNA
- Lecture 12 - Biomolecules - Part 2 : DNA Sequencing
- Lecture 13 - Biomolecules - Part 2 : RNA
- Lecture 14 - Amino acids
- Lecture 15 - Protein
- Lecture 16 - Enzymes
- Lecture 17 - Genetic Material - Part 1
- Lecture 18 - Genetic Material - Part 2
- Lecture 19 - Genetic Material - Part 3
- Lecture 20 - Central Dogma of Molecular Biology
- Lecture 21 - Replication - Part 1 : Prokaryotic System
- Lecture 22 - Replication - Part 2 : Prokaryotic System
- Lecture 23 - Replication - Part 2 : Eukaryotic System
- Lecture 24 - Mutagenesis and repair Mechanism
- Lecture 25 - Transcription in Prokaryotic system
- Lecture 26 - Transcription in Eukaryotic System
- Lecture 27 - Post Transcriptional modifications
- Lecture 28 - Gene Control Mechanism - Part 1
- Lecture 29 - Gene Control Mechanism - Part 2
- Lecture 30 - Translation in Prokaryotic system
- Lecture 31 - Translation in Eukaryotic System

[Lecture 32 - Post Translational modifications](#)

[Lecture 33 - Southern Blotting](#)

[Lecture 34 - Northern Blotting](#)

[Lecture 35 - Western Blotting - Part 1](#)

[Lecture 36 - Western Blotting - Part 2](#)

[Lecture 37 - Polymerase Chain Reaction - Part 1](#)

[Lecture 38 - Polymerase Chain Reaction - Part 2](#)

[Lecture 39 - Real-Time PCR](#)

[Lecture 40 - Cloning - Part 1](#)

[Lecture 41 - Cloning - Part 2](#)

[Lecture 42 - Cloning Vectors](#)

[Lecture 43 - DNA Delivery - Part 1](#)

[Lecture 44 - DNA Delivery - Part 2](#)

[Lecture 45 - Screening of Recombinant Clones](#)

[Lecture 46 - Protein Over-expression](#)

[Lecture 47 - Genome Editing - Part 1](#)

[Lecture 48 - Genome Editing - Part 2](#)

[Lecture 49 - Applications of Molecular Biology - Part 1](#)

[Lecture 50 - Applications of Molecular Biology - Part 2](#)

[Lecture 51 - Applications of Molecular Biology - Part 3](#)

[Lecture 52 - Applications of Molecular Biology - Part 4](#)

**NPTEL : Animal Physiology (Biotechnology)**

**Co-ordinators : Prof. Mainak Das**

Lecture 1 - Animal Physiology

Lecture 2 - Animal Physiology

Lecture 3 - Animal Physiology

Lecture 4 - Animal Physiology

Lecture 5 - Animal Physiology

Lecture 6 - Animal Physiology

Lecture 7 - Animal Physiology

Lecture 8 - Animal Physiology

Lecture 9 - Animal Physiology

Lecture 10 - Animal Physiology

Lecture 11 - Animal Physiology

Lecture 12 - Animal Physiology

Lecture 13 - Animal Physiology

Lecture 14 - Animal Physiology

Lecture 15 - Animal Physiology

Lecture 16 - Animal Physiology

Lecture 17 - Animal Physiology

Lecture 18 - Animal Physiology

Lecture 19 - Animal Physiology

Lecture 20 - Animal Physiology

Lecture 21 - Animal Physiology

Lecture 22 - Animal Physiology

Lecture 23 - Animal Physiology

Lecture 24 - Animal Physiology

Lecture 25 - Animal Physiology

Lecture 26 - Animal Physiology

Lecture 27 - Animal Physiology

Lecture 28 - Animal Physiology

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Lecture 30 - Animal Physiology

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[Lecture 35 - Animal Physiology](#)

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[Lecture 37 - Animal Physiology](#)

[Lecture 38 - Animal Physiology](#)

[Lecture 39 - Animal Physiology](#)

[Lecture 40 - Animal Physiology](#)



**NPTEL : Bio electricity (Biotechnology)**

**Co-ordinators : Prof. Mainak Das**

Lecture 1 - Bio electricity

Lecture 2 - Bio electricity

Lecture 3 - Bio electricity

Lecture 4 - Bio electricity

Lecture 5 - Bio electricity

Lecture 6 - Bio electricity

Lecture 7 - Bio electricity

Lecture 8 - Bio electricity

Lecture 9 - Bio electricity

Lecture 10 - Bio electricity

Lecture 11 - Bio electricity

Lecture 12 - Bio electricity

Lecture 13 - Bio electricity

Lecture 14 - Bio electricity

Lecture 15 - Bio electricity

Lecture 16 - Bio electricity

Lecture 17 - Bio electricity

Lecture 18 - Bio electricity

Lecture 19 - Bio electricity

Lecture 20 - Bio electricity

Lecture 21 - Bio electricity

Lecture 22 - Bio electricity

Lecture 23 - Bio electricity

Lecture 24 - Bio electricity

Lecture 25 - Bio electricity

Lecture 26 - Bio electricity

Lecture 27 - Bio electricity

Lecture 28 - Bio electricity

Lecture 29 - Bio electricity

Lecture 30 - Bio electricity

Lecture 31 - Bio electricity

[Lecture 32 - Bio electricity](#)

[Lecture 33 - Bio electricity](#)

[Lecture 34 - Bio electricity](#)

[Lecture 35 - Bio electricity](#)

[Lecture 36 - Bio electricity](#)

[Lecture 37 - Bio electricity](#)

[Lecture 38 - Bio electricity](#)

[Lecture 39 - Bio electricity](#)

[Lecture 40 - Bio electricity](#)

Lecture 1 - Fundamentals of central dogma, Part 1

Lecture 2 - Fundamentals of central dogma, Part 2

Lecture 3 - Fundamentals of central dogma, Part 3

Lecture 4 - Chromosome Structure and Function

Lecture 5 - Pedigree Analysis

Lecture 6 - Complications in Mendelian Pedigree Patterns

Lecture 7 - DNA Cloning and Hybridization Techniques - Part 1

Lecture 8 - DNA Cloning and Hybridization Techniques - Part 2

Lecture 9 - Practice Session 1: Problems Related to Pedigree Analysis

Lecture 10 - Practice Session 2: Restriction Fragment Length Polymorphism and its Applications in Pedigree Analysis

Lecture 11 - Mutations and instability of human DNA (Part 1)

Lecture 12 - Mutations and instability of human DNA (Part 2)

Lecture 13 - Animal Models for Human Diseases

Lecture 14 - Positional cloning of genes for monogenic disorders

Lecture 15 - Human Genome Project and HapMap project

Lecture 1 - Introduction to Functional Genomics

Lecture 2 - The Genomics Era

Lecture 3 - Epigenetics

Lecture 4 - Forward Genetics vs Reverse Genetics

Lecture 5 - Genome Editing Approaches - Part 1

Lecture 6 - Genome Editing Approaches - Part 2

Lecture 7 - Transcriptomics - Part 1

Lecture 8 - Transcriptomics - Part 2

Lecture 9 - Genome Sequence Databases

Lecture 10 - DNA Sequencing Methods - Part 1

Lecture 11 - DNA Sequencing Methods - Part 2

Lecture 12 - Applications of Next-Generation Sequencing (NGS)

Lecture 13 - Tutorial - Session 1

Lecture 14 - Tutorial - Session 2

Lecture 15 - Genomic Insight into Evolution

Lecture 16 - Genome sequence: Different Questions, Different Comparisons

Lecture 17 - Outcome of Comparative Genomics

Lecture 18 - Laboratory - Session 1

Lecture 19 - Laboratory - Session 2

Lecture 1 - Introduction

Lecture 2 - Oil Economy of the World

Lecture 3 - Unit of Energy and Introduction of Bioenergy

Lecture 4 - How Biomass Formed on the Earth

Lecture 5 - Road Map of Bioenergy

Lecture 6 - Basic Biomass Technology (Resources and Production)

Lecture 7 - Basics of Mechanism of Light Reaction

Lecture 8 - Exploration of Photosynthesis Process

Lecture 9 - In Photosynthesis Oxygen Comes from Water Molecule

Lecture 10 - Hill Reaction

Lecture 11 - Electron Transport Process in Light Reaction

Lecture 12 - How Carbon dioxide converted in Carbohydrate

Lecture 13 - From Carbon dioxide to two Molecules of 3 - Phospho Glycerate by RUBISCO

Lecture 14 - RUBISCO enzyme

Lecture 15 - Photo respiration and Calvin Cycle

Lecture 16 - Efficiency Calculation of Photosynthesis Process

Lecture 17 - C3 and C4 Plant Structure and Photosynthesis Process

Lecture 18 - Biomass production System and their Categorization

Lecture 19 - Important Parameters for Selecting Biomass Crops

Lecture 20 - Factors Determining the Conversion Process - I

Lecture 21 - Factors Determining the Conversion Process - II

Lecture 22 - Factors Determining the Conversion Process - III

Lecture 23 - Conversion Technology

Lecture 24 - Conversion Process- (Combustion Process)

Lecture 25 - Pyrolysis Process

Lecture 26 - Classification of Pyrolysis

Lecture 27 - Bio Oil - (Solution for Thermal Instability and Corrosivity)

Lecture 28 - Spark Ignition Engine

Lecture 29 - Compression Ignition Engine

Lecture 30 - Carbonization - Graphene like material

Lecture 31 - Introduction of Gasification

[Lecture 32 - Thermo Chemical Process of Gasification](#)

[Lecture 33 - Feed Stock Treatment of Gasification](#)

[Lecture 34 - Feed Stock Property](#)

[Lecture 35 - Gasification Types - Up Drift Gasifier](#)

[Lecture 36 - Down drift and Cross Flow Gasifier](#)

[Lecture 37 - Operation and Performance of Fixed Bed Gasifier](#)

[Lecture 38 - Fluidized Bed Gasification](#)

[Lecture 39 - Operation and Performance of Fluidized Bed Gasifier](#)

[Lecture 40 - Biological Root of Gasification and Summary of Course](#)

Lecture 1 - An Introduction to Anatomy and Physiology

Lecture 2 - Organization of living system

Lecture 3 - Homeostasis and system integration

Lecture 4 - Positive feedback loop in homeostasis

Lecture 5 - Chemical basis of organization of the body

Lecture 6 - Integumentary System - I

Lecture 7 - Integumentary system - II

Lecture 8 - Integumentary System - III

Lecture 9 - Bone and Cartilage - I

Lecture 10 - Bone and Cartilage - II

Lecture 11 - Introduction of muscle

Lecture 12 - Skeletal muscle formation

Lecture 13 - Anatomy of skeletal muscle

Lecture 14 - Contraction in muscle

Lecture 15 - Function of actin and myosin

Lecture 16 - Length tension relationship of skeletal muscle

Lecture 17 - Excitation contraction coupling with nervous system

Lecture 18 - Stretch reflex phenomena

Lecture 19 - Nervous system anatomy and signaling

Lecture 20 - Structure and circuit of neurons

Lecture 21 - Origin of biological cell

Lecture 22 - Excitability in cell

Lecture 23 - Ion transportation in the cell

Lecture 24 - Signal propagation in neurons

Lecture 25 - Neurotransmitter and action potential

Lecture 26 - Spatial temporal summation of signal in mesh neurons

Lecture 27 - Anatomy of Hippo-campus

Lecture 28 - Epilepsy and memory

Lecture 29 - Long term potentiation

Lecture 30 - Long term depression

Lecture 31 - Alzheimers disease

Lecture 32 - Parkinsons disease

Lecture 33 - Amyotrophic lateral sclerosis

Lecture 34 - Spinal cord injury

Lecture 35 - Glial cells

Lecture 36 - Stretch reflex arc circuit - I

Lecture 37 - Stretch reflex arc circuit - II

Lecture 38 - Neuro muscular junction

Lecture 39 - Hearing system

Lecture 40 - Olfaction system

Lecture 41 - Anatomy of eye

Lecture 42 - Eye lens and cataract

Lecture 43 - Structure of Retina

Lecture 44 - Image formation and processing in eyes

Lecture 45 - Mechanism of photo processing by rods

Lecture 46 - Structure and Function of Heart - I

Lecture 47 - Structure and Function of Heart - II

Lecture 48 - Conduction circuit of heart

Lecture 49 - Contractile system and Conducting system

Lecture 50 - EKG and Comparison of action potential between pace make cell and work cell

Lecture 51 - Respiratory Physiology

Lecture 52 - Anatomy and physiology of Blood vessels - I

Lecture 53 - Anatomy and Physiology of Blood vessels - II

Lecture 54 - Anatomy and physiology of blood vessels - III

Lecture 55 - Anatomy and physiology of blood vessels - IV

Lecture 56 - Endocrine system - I

Lecture 57 - Digestive system and Endocrine system - II

Lecture 58 - Blood

Lecture 59 - Kidney and immune system

Lecture 60 - Reproductive system



- Lecture 1 - Introduction of Cell Culture Technology
- Lecture 2 - Philosophy and complexity in cell culture
- Lecture 3 - To grow the cell outside the body
- Lecture 4 - Cell cycle concept
- Lecture 5 - Dividing cells
- Lecture 6 - Biology of cell culture
- Lecture 7 - Layout(s) and design(s) of cell culture facility
- Lecture 8 - Precautions during designing the lab layout - I
- Lecture 9 - Precautions during designing the lab layout - II
- Lecture 10 - Precautions during designing the lab layout - III
- Lecture 11 - State of the art facility in cell culture lab - I
- Lecture 12 - State of the art facility in cell culture lab - II
- Lecture 13 - Specialized facility in cell culture lab
- Lecture 14 - Interaction of cell and glass/polycarbonate surface - I
- Lecture 15 - Interaction of cell and glass/polycarbonate surface - II
- Lecture 16 - Poly D lysine deposition
- Lecture 17 - Surface chemical analysis
- Lecture 18 - Cell growth process
- Lecture 19 - Cell surface interface
- Lecture 20 - Cell culture substrate patterning
- Lecture 21 - Introduction of define system
- Lecture 22 - Mechanical dissociation of hippocampal tissue
- Lecture 23 - Rules for mechanical dissociation of tissue
- Lecture 24 - Drum molecule testing
- Lecture 25 - Adult hippocampal neuron dissociation
- Lecture 26 - Cell separation and In vitro myelination cell culture mode - I
- Lecture 27 - Cell separation and In vitro myelination cell culture mode - II
- Lecture 28 - Cell separation and In vitro myelination cell culture mode - III
- Lecture 29 - Cell Separation and In vitro myelination cell culture mode - IV
- Lecture 30 - Cell separation and in vitro myelination cell culture mode - V
- Lecture 31 - Fluorescent assisted cell sorting

[Lecture 32 - Condition for regenerated cells](#)

[Lecture 33 - Introduction of skeletal muscle cell culture](#)

[Lecture 34 - Skeletal muscle cell culture](#)

[Lecture 35 - Cardiac muscle cell culture](#)

[Lecture 36 - Advance cell culture modules - I](#)

[Lecture 37 - Advance cell culture modules - II](#)

[Lecture 38 - Advance cell culture modules - III](#)

[Lecture 39 - Advance cell culture modules - IV](#)

[Lecture 40 - Advance cell culture modules - V](#)

Lecture 1 - Introduction

Lecture 2 - Recap of formulae: area and volume

Lecture 3 - Recap of trigonometry

Lecture 4 - Measurement of central tendency and dispersion

Lecture 5 - Graphical presentation of data

Lecture 6 - Shape of a tree: Form and Taper

Lecture 7 - Metzgers theory

Lecture 8 - Form factor and form quotients

Lecture 9 - Taper equations

Lecture 10 - Making the cuts

Lecture 11 - Cross-section of a tree

Lecture 12 - Where to measure the diameter

Lecture 13 - Callipers - Usages and Issues

Lecture 14 - Tape: Usage and issue

Lecture 15 - Measurement of bark and growth rings

Lecture 16 - Tree height: Direct and indirect measurements

Lecture 17 - Method of similar triangles: Shadow and sticks

Lecture 18 - Distance measurements: foot, tape and rangefinder

Lecture 19 - Angular measurement

Lecture 20 - LIDAR

Lecture 21 - Canopy attributes - Part I

Lecture 22 - Canopy attributes - Part II

Lecture 23 - Canopy attributes - Part III

Lecture 24 - Canopy cover and closure

Lecture 25 - Photogrammetry

Lecture 26 - Basal area of a tree and stand

Lecture 27 - Stand basal area, crop diameter and crop age

Lecture 28 - Point sampling - I

Lecture 29 - Point sampling - II

Lecture 30 - Number density and sample calculations

Lecture 31 - Volume: Direct calculations through sections

[Lecture 32 - The Quarter - girth formula](#)

[Lecture 33 - Volume computations in the field](#)

[Lecture 34 - Volume Table](#)

[Lecture 35 - Forest Sampling](#)

[Lecture 36 - Density and mass measurement](#)

[Lecture 37 - Normalized difference vegetation Index \(NDVI\)](#)

[Lecture 38 - Site quality](#)

[Lecture 39 - Recap - I](#)

[Lecture 40 - Recap - II](#)

- Lecture 1 - Introduction to the topic
- Lecture 2 - Where do research ideas come from?
- Lecture 3 - Inductive vs Deductive Reasoning
- Lecture 4 - Scientific Hypothesis
- Lecture 5 - Scientific Hypothesis (Continued...)
- Lecture 6 - Testing the Hypothesis
- Lecture 7 - Introduction to Scientific Writing
- Lecture 8 - Writing an Abstract
- Lecture 9 - Title for a Research Paper
- Lecture 10 - Title and Keywords
- Lecture 11 - Mileposts for the Article Writing
- Lecture 12 - Writing the Methods Section
- Lecture 13 - Writing the Results Section
- Lecture 14 - Writing Results Section (Continued...)
- Lecture 15 - How to Prepare Figures
- Lecture 16 - How to Prepare Schematics
- Lecture 17 - How to write Introduction and Discussion Sections
- Lecture 18 - Finalizing the Manuscript and Ethics in Research
- Lecture 19 - Writing a Research Proposal and Preparing for a Presentation
- Lecture 20 - Tutorial Session : Oral communication

Lecture 1 - Basic Concepts - I

Lecture 2 - Basic Concepts - II

Lecture 3 - Key Terms

Lecture 4 - Galvanic Cells - I

Lecture 5 - Galvanic Cells - II

Lecture 6 - Salt Bridge

Lecture 7 - Standard Potentials - I

Lecture 8 - Standard Potentials - II

Lecture 9 - Standard Potentials - III

Lecture 10 - Nernst Equation

Lecture 11 - Relationship between Standard electrode potential ( $E^{\circ}$ ) and Equilibrium constant (K)

Lecture 12 - Cell as chemical probe and Biochemist's formal potential

Lecture 13 - Concept of Concentration Cell - I

Lecture 14 - Concept of Concentration Cell - II

Lecture 15 - Bio-electrochemistry of excitable cells (nerve cells)

Lecture 16 - Types of electrodes

Lecture 17 - Critical care profile and metal electrode

Lecture 18 - pH measurement: Ion selective electrode

Lecture 19 - Redox indicators amperometry: glucose, oxygen sensors

Lecture 20 - Redox proteins, Metalloproteins and Cyclic Voltammetry

Lecture 1 - Bioenergetics of Life Processes: An Overview

Lecture 2 - Bioenergetics: Origin of life

Lecture 3 - Iron-Sulfur world

Lecture 4 - Evolution of complex cellular membranes

Lecture 5 - Charge transfer across membrane: Key terms

Lecture 6 - Biological order and energy - I

Lecture 7 - Biological order and energy - II

Lecture 8 - Biological order and energy - III

Lecture 9 - Summary of thermodynamical parameters - I

Lecture 10 - Summary of thermodynamical parameters - II

Lecture 11 - Photosynthesis - I

Lecture 12 - Photosynthesis - II

Lecture 13 - Photosynthesis - III

Lecture 14 - Photosynthesis - IV

Lecture 15 - Photosynthesis - V

Lecture 16 - Photosynthesis - VI

Lecture 17 - Photosynthesis - VII

Lecture 18 - Photosynthesis - VIII

Lecture 19 - ATP Synthesis

Lecture 20 - Mitochondria and Chemiosmotic hypothesis

Lecture 1 - Preliminaries

Lecture 2 - A closer look at Biodiversity

Lecture 3 - Economics Valuation of Biodiversity

Lecture 4 - Threats to Biodiversity

Lecture 5 - Preliminaries

Lecture 6 - Basics of Sampling

Lecture 7 - Distance Sampling - I

Lecture 8 - Distance Sampling - II

Lecture 9 - Radio-telemetry

Lecture 10 - Behavioural monitoring

Lecture 11 - What is a habitat

Lecture 12 - Habitat degradation, loss, fragmentation and displacement

Lecture 13 - Reserve selection and design

Lecture 14 - Habitat management and improvement

Lecture 15 - Some terminologies

Lecture 16 - Some common wildlife diseases

Lecture 17 - Principles of disease management

Lecture 18 - Preliminaries

Lecture 19 - Mechanical capture

Lecture 20 - Chemical capture

Lecture 21 - Capture myopathy

Lecture 22 - Care of immobilised animal

Lecture 23 - Legal aspects of capture and restraint

Lecture 24 - Other topics in capture and restraint

Lecture 25 - Preliminaries and introduction to genetics

Lecture 26 - Population genetics

Lecture 27 - Chromosomal and genetic disorders, inbreeding

Lecture 28 - Population viability analysis

Lecture 29 - Reintroductions and outbreeding

Lecture 30 - Fundamentals

Lecture 31 - Zoos and their management



[Lecture 32 - Botanical gardens](#)

[Lecture 33 - Other aspects: cryopreservation, seed banks, etc.](#)

[Lecture 34 - Impacts of climate change](#)

[Lecture 35 - Plastics and biodiversity](#)

[Lecture 36 - Oil spills](#)

[Lecture 37 - Crisis and learnings: The Sariska case-study](#)

[Lecture 38 - Revision - I](#)

[Lecture 39 - Revision - II](#)

[Lecture 40 - Revision - III](#)

Lecture 1 - Introduction

Lecture 2 - What is Nanotechnology

Lecture 3 - An outline

Lecture 4 - Agriculture: Natural versus Modern

Lecture 5 - Modern Agriculture: controlled or out of control

Lecture 6 - A Restart:Utilising Our Discoveries

Lecture 7 - Classifying nanomaterials Based on Shape and Geometry

Lecture 8 - Classifying Nanomaterials Based on Chemical Nature

Lecture 9 - Physical Approaches to Nanomaterial Synthesis

Lecture 10 - Biological and Chemical Approaches to Nanomaterial Synthesis

Lecture 11 - Detailed Physical Techniques - I

Lecture 12 - Detailed Physical Techniques - II

Lecture 13 - Detailed Chemical Techniques

Lecture 14 - Detailed Biological Techniques

Lecture 15 - Basic Characterisation Techniques of Nanomaterials

Lecture 16 - Characterisation techniques for physical and chemical surface properties of a material

Lecture 17 - Nanomaterials in Agriculture

Lecture 18 - Iron pyrite and seed pre-treatment

Lecture 19 - nano-Pyrite and its lab trial with chickpea

Lecture 20 - nano-Pyrite field trial with spinach and its mechanistic details

Lecture 21 - Mechanistic details of the action of Pyrite nano-particle

Lecture 22 - Application of Pyrite nano-particle in different crops

Lecture 23 - Application of different nano-particles in Agriculture - I

Lecture 24 - Benefits of nanoparticles in Agriculture

Lecture 25 - Nanotechnology in animal production

Lecture 26 - Antioxidant nanomaterial in animal production - I

Lecture 27 - Antioxidant nanomaterial in animal production - II

Lecture 28 - Antioxidant nanomaterial in animal production - III

Lecture 29 - Antioxidant nanomaterial in skeletal muscle development - I

Lecture 30 - Antioxidant nanomaterial in skeletal muscle development - II

Lecture 31 - Skeletal muscle development and nanomaterial intervention

[Lecture 32 - Fabrication of nano-micro devices to study force generation in muscles](#)

[Lecture 33 - Summarising role of nanomaterials in animal production](#)

[Lecture 34 - Nanomaterials in food processing and preservation - I](#)

[Lecture 35 - Nanomaterials in food processing and preservation - II](#)

[Lecture 36 - Multifunctionality of nanomaterial: water purification, waste disposal, and energy](#)

[Lecture 37 - Futuristic multifunctional, sustainable and green nanomaterial](#)

[Lecture 38 - Case study of Titanium dioxide - I](#)

[Lecture 39 - Case study of Titanium dioxide - II](#)

[Lecture 40 - The future: evolving nano world](#)

- Lecture 1 - Introduction to the course
- Lecture 2 - A historical overview of Ecology
- Lecture 3 - Ecology and Evolution
- Lecture 4 - The levels of organisation
- Lecture 5 - Species abundance and composition: Biodiversity
- Lecture 6 - Biodiversity - II
- Lecture 7 - Positive Interactions
- Lecture 8 - Negative Interactions
- Lecture 9 - Study of Behaviour and Behavioral Ecology
- Lecture 10 - Food chains, Food webs and trophic levels
- Lecture 11 - Primary Production
- Lecture 12 - Nutrient Cycles
- Lecture 13 - Population parameters and demographic techniques
- Lecture 14 - Population growth and regulation
- Lecture 15 - Population studies and applications
- Lecture 16 - Community nature and parameters
- Lecture 17 - Community changes and ecological succession
- Lecture 18 - Community organisation
- Lecture 19 - Biogeography: Analysis of geographic distributions
- Lecture 20 - Why are things where they are?
- Lecture 21 - Some push and pull factors in greater detail
- Lecture 22 - Threats to species
- Lecture 23 - In-situ conservation
- Lecture 24 - Ex-situ conservation
- Lecture 25 - Introduction and impacts
- Lecture 26 - Human population growth and food requirements
- Lecture 27 - Sustainable development
- Lecture 28 - Oil spills
- Lecture 29 - Plastic and biodiversity
- Lecture 30 - Impacts of climate change
- Lecture 31 - Optimum yield problem

[Lecture 32 - Biological control](#)

[Lecture 33 - Ecotoxicology and pollution management, Restoration ecology](#)

[Lecture 34 - Revision](#)

[Lecture 35 - Revision](#)

[Lecture 36 - Revision](#)

Lecture 1 - What is a forest ?

Lecture 2 - Classification of forests

Lecture 3 - Value of forests

Lecture 4 - What is Silviculture ?

Lecture 5 - Plant Growth Factors

Lecture 6 - Ecological Succession

Lecture 7 - Soil and Soil Profile

Lecture 8 - Major Soil Types

Lecture 9 - Nutrient Cycles

Lecture 10 - Tree Form

Lecture 11 - Measurement of Tree attributes - I

Lecture 12 - Measurement of Tree attributes - II

Lecture 13 - Classical Tools

Lecture 14 - Photogrammetry

Lecture 15 - LiDAR

Lecture 16 - Kinds of Threats

Lecture 17 - Forest Fire

Lecture 18 - Forest Law

Lecture 19 - Regeneration

Lecture 20 - Silvicultural Systems

Lecture 21 - Clear Felling System

Lecture 22 - Shelterwood System - I

Lecture 23 - Shelterwood System - II

Lecture 24 - Selection System and Irregular Shelterwood System

Lecture 25 - Logging and Processing

Lecture 26 - Growing Stock and Increment

Lecture 27 - Yield and Sustained Yield

Lecture 28 - Seed Collection and Treatment

Lecture 29 - Nursery Techniques

Lecture 30 - Planting and Tending

Lecture 31 - NTFP

[Lecture 32 - Social Forestry and Tribal Welfare](#)

[Lecture 33 - Conservation of Wild Animals](#)

[Lecture 34 - Revision - Part 1](#)

[Lecture 35 - Revision - Part 2](#)

[Lecture 36 - Revision - Part 3](#)

Lecture 1 - Introduction to the Course, Making Decisions - I

Lecture 2 - Making Decisions - II and Interactions - I

Lecture 3 - Intecractions-II and Working of the Economy

Lecture 4 - Conservation in the Anthropocene

Lecture 5 - Human population growth and food requirements

Lecture 6 - Unsustainable development

Lecture 7 - Climate change

Lecture 8 - Plastics

Lecture 9 - Oil spills and mining

Lecture 10 - Push and pull factors: Localisation of species

Lecture 11 - Threats to species

Lecture 12 - Developmental Hazards and Ecotoxicology

Lecture 13 - Need to understand controls

Lecture 14 - Thinking as an Economist

Lecture 15 - Interdependence and gains from trade

Lecture 16 - Demand and supply

Lecture 17 - Elasticity

Lecture 18 - Government policy

Lecture 19 - Surplus and market efficiency

Lecture 20 - Market Efficiency and Cost of Taxation

Lecture 21 - International Trade

Lecture 22 - Externalities

Lecture 23 - Public goods and common resources

Lecture 24 - The design of the tax system

Lecture 25 - The Costs of Production

Lecture 26 - Competition

Lecture 27 - Monopoly

Lecture 28 - Markets for factors of production

Lecture 29 - Earnings and discrimination

Lecture 30 - Income inequality and poverty

Lecture 31 - Consumer choice



[Lecture 32 - Asymmetric information, Politics and Behavioural Economics](#)

[Lecture 33 - Valuation of natural resources](#)

[Lecture 34 - Economics of Protected Areas](#)

[Lecture 35 - Economics of Environmental Disasters - 1](#)

[Lecture 36 - Economics of Environmental Disasters - 2](#)

- Lecture 1 - The need for conservation
- Lecture 2 - Geography and conservation
- Lecture 3 - Biogeography
- Lecture 4 - Origin and evolution of the earth
- Lecture 5 - Structure of the earth
- Lecture 6 - Features of the earth
- Lecture 7 - Rocks and minerals
- Lecture 8 - Geomorphology and processes
- Lecture 9 - Evolution of landforms
- Lecture 10 - Structure and composition
- Lecture 11 - Atmospheric circulation and weather
- Lecture 12 - Climate and climate change
- Lecture 13 - Structure and composition
- Lecture 14 - Oceans and water movement
- Lecture 15 - Hydrological cycle
- Lecture 16 - Structure and physiography of India
- Lecture 17 - Climate and habitats of India
- Lecture 18 - Drainage systems
- Lecture 19 - Soil
- Lecture 20 - Life on Earth
- Lecture 21 - Biodiversity
- Lecture 22 - Threats to species
- Lecture 23 - Ex-situ and in-situ conservation
- Lecture 24 - Benefits from conservation
- Lecture 25 - Population and population growth - I
- Lecture 26 - Population and population growth - II
- Lecture 27 - Human development and sustainable development
- Lecture 28 - Resources and Conservation
- Lecture 29 - Water Resources
- Lecture 30 - Mineral and Energy Resources
- Lecture 31 - Economic Geography and Conservation

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[Lecture 34 - Special Topics in Geography and Conservation](#)

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Lecture 2 - L1 Module 2

Lecture 3 - L1 Module 3

Lecture 4 - L1 Module 4

Lecture 5 - L1 Module 5

Lecture 6 - L1 Module 6

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Lecture 1 - Amino Acids - I

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Lecture 3 - Protein Structure - I

Lecture 4 - Protein structure - II

Lecture 5 - Protein Structure - III

Lecture 6 - Protein Structure - IV

Lecture 7 - Enzymes - I

Lecture 8 - Enzymes - II

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Lecture 12 - Myoglobin and Hemoglobin

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Lecture 15 - Membrane Transport

Lecture 16 - Carbohydrates - I

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Lecture 18 - Vitamins and Coenzymes - I

Lecture 19 - Vitamins and Coenzymes - II

Lecture 20 - Nucleic Acids - I

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Lecture 23 - Bioenergetics - I

Lecture 24 - Bioenergetics - II

Lecture 25 - Metabolism - I

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Lecture 27 - Metabolism - III

Lecture 28 - Overview of the Course

Lecture 1 - Industrial Biotechnology

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Lecture 3 - Medium characteristics and biochemical pathways

Lecture 4 - Chemical reaction kinetics

Lecture 5 - Chemical reaction analysis (Continued...)

Lecture 6 - Different types of reactors

Lecture 7 - Reactor analysis

Lecture 8 - Reactor analysis (Continued...)

Lecture 9 - Stoichiometry of bioprocesses

Lecture 10 - Stoichiometry of bioprocesses (Continued...)

Lecture 11 - Enzymatic reaction Kinetics

Lecture 12 - Enzymatic reaction Kinetics (Continued...)

Lecture 13 - Enzymatic reaction Kinetics (Continued...)

Lecture 14 - Immobilization techniques

Lecture 15 - Immobilization techniques (Continued...)

Lecture 16 - Life cycle of the microbial cell, Microbial growth kinetics, product formation and substrate degradation

Lecture 17 - Life cycle of the microbial cell, Microbial growth kinetics, product formation and substrate degradation (Continued...)

Lecture 18 - Life cycle of the microbial cell, Microbial growth kinetics, product formation and substrate degradation (Continued...)

Lecture 19 - Overview of the fermenter

Lecture 20 - Flow diagrams and pumps and valves used in fermentation industries

Lecture 21 - Upstream processing: Air sterilizer

Lecture 22 - Upstream processing: Medium sterilizer

Lecture 23 - Upstream processing: Medium sterilizer (Continued...)

Lecture 24 - Downstream processing: solid-liquid separators

Lecture 25 - Downstream processing: evaporator, crystallizer

Lecture 26 - Downstream processing: liquid-liquid extraction, distillation, chromatography

Lecture 27 - Ethanol fermentation

Lecture 28 - Ethanol fermentation (Continued...)

Lecture 29 - Brewing industry

Lecture 30 - Brewing industry (Continued...)

Lecture 31 - Wine industry

- Lecture 32 - Vinegar production
- Lecture 33 - Citric acid production
- Lecture 34 - Citric acid production (Continued...)
- Lecture 35 - Citric acid production (Continued...)
- Lecture 36 - Lactic acid production
- Lecture 37 - Lactic acid production (Continued...)
- Lecture 38 - Glutamic acid production
- Lecture 39 - Penicillin production
- Lecture 40 - Penicillin production (Continued...)
- Lecture 41 - Cephalosporin production
- Lecture 42 - Streptomycin production
- Lecture 43 - Baker's yeast fermentation
- Lecture 44 - Baker's yeast fermentation (Continued...)
- Lecture 45 - Fodder yeast production
- Lecture 46 - Spirulina production
- Lecture 47 - Alpha amylase production
- Lecture 48 - High fructose corn syrup production
- Lecture 49 - Metal leaching
- Lecture 50 - Cheese production
- Lecture 51 - Cheese production (Continued...)
- Lecture 52 - Biodiesel production
- Lecture 53 - Butanol production
- Lecture 54 - Biofertilizer
- Lecture 55 - Aerobic effluent treatment process
- Lecture 56 - Aerobic effluent treatment process (Continued...)
- Lecture 57 - Anaerobic effluent treatment process: Biomethanation process
- Lecture 58 - Anaerobic effluent treatment process: Biomethanation process (Continued...)
- Lecture 59 - 10 m<sup>3</sup> Pilot Plant operation for Biohydrogen production
- Lecture 60 - Summary and conclusion



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Lecture 2 - Microbiology - I

Lecture 3 - Microbiology - II

Lecture 4 - Fundamentals of Biochemistry

Lecture 5 - Bioproducts and their market values

Lecture 6 - Stoichiometry of Biochemical Processes - I

Lecture 7 - Stoichiometry of Biochemical Processes - II

Lecture 8 - Stoichiometry of Biochemical Processes - III

Lecture 9 - Reaction Thermodynamics - I

Lecture 10 - Reaction Thermodynamics - II

Lecture 11 - Kinetics of homogeneous chemical reactions - I

Lecture 12 - Kinetics of homogeneous chemical reactions - II

Lecture 13 - Kinetics of homogeneous chemical reactions - III

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Lecture 15 - Kinetics of homogeneous chemical reactions - V

Lecture 16 - Different types of reactors

Lecture 17 - Reactor analysis - I

Lecture 18 - Reactor analysis - II

Lecture 19 - Reactor analysis - III

Lecture 20 - Reactor analysis - IV

Lecture 21 - Kinetics of enzyme catalyzed reactions using free enzymes - I

Lecture 22 - Kinetics of enzyme catalyzed reactions using free enzymes - II

Lecture 23 - Kinetics of enzyme catalyzed reactions using free enzymes - III

Lecture 24 - Kinetics of enzyme catalyzed reactions using free enzymes - IV

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Lecture 26 - Kinetics of enzyme catalyzed reactions using free enzymes - VI

Lecture 27 - Immobilization of Enzymes - I

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Lecture 29 - Kinetics of enzyme catalyzed reactions using immobilized enzymes - I

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Lecture 31 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - I

- Lecture 32 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - II
- Lecture 33 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - III
- Lecture 34 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - IV
- Lecture 35 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - V
- Lecture 36 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - VI
- Lecture 37 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - VII
- Lecture 38 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - VIII
- Lecture 39 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - IX
- Lecture 40 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - X
- Lecture 41 - Kinetics of substrate utilization, product formation and biomass production of microbial cells - XI
- Lecture 42 - Design and analysis of activated sludge process - I
- Lecture 43 - Design and analysis of activated sludge process - II
- Lecture 44 - Design and analysis of anaerobic digestion process
- Lecture 45 - Scale up of Bioreactor - I
- Lecture 46 - Scale up of Bioreactor - II
- Lecture 47 - Transport Phenomenon in Bioprocess - I
- Lecture 48 - Transport Phenomenon in Bioprocess - II
- Lecture 49 - Transport Phenomenon in Bioprocess - III
- Lecture 50 - Transport Phenomenon in Bioprocess - IV
- Lecture 51 - Air sterilization - I
- Lecture 52 - Air sterilization - II
- Lecture 53 - Medium sterilization - I
- Lecture 54 - Medium sterilization - II
- Lecture 55 - Operation of industrial fermenter and material analysis
- Lecture 56 - Process control of the biochemical processes
- Lecture 57 - Downstream processing - I
- Lecture 58 - Downstream processing - II
- Lecture 59 - Economic analysis of the biochemical processes
- Lecture 60 - Summary and Conclusion

Lecture 1 - Introduction to Biomicrofluidics

Lecture 2 - Introduction to Biomicrofluidics (Continued...)

Lecture 3 - Engineers' guide to the cell

Lecture 4 - Fluidics in living systems and mechanobiology

Lecture 5 - Pressure Driven Flows

Lecture 6 - Surface tension driven flows

Lecture 7 - Modulating surface tension

Lecture 8 - Lab on a CD

Lecture 9 - Introduction to Electrokinetics - Part I

Lecture 10 - Introduction to Electrokinetics - Part II

Lecture 11 - Microfluidic cell culture - Part I

Lecture 12 - Microfluidic cell culture - Part II

Lecture 13 - On-chip cellular assay techniques - Part I

Lecture 14 - On-chip cellular assay techniques - Part II

Lecture 15 - Microfluidics for understanding biology

Lecture 16 - Organ-on-a-chip

Lecture 17 - Lab-on-a-chip for genetic analysis

Lecture 18 - Microfluidic technology for monoclonal antibody production

Lecture 19 - Microfluidics for Healthcare

Lecture 20 - Microfluidics for Healthcare

Lecture 1 - Basic Concepts in Immunology

Lecture 2 - Basic Concepts in Immunology (Continued...)

Lecture 3 - Basic Concepts in Immunology (Continued...)

Lecture 4 - Basic Concepts in Immunology (Continued...)

Lecture 5 - Basic Concepts in Immunology (Continued...)

Lecture 6 - Innate Immunity

Lecture 7 - Inflammatory Response

Lecture 8 - Adaptive Immunity

Lecture 9 - Adaptive Immunity (Humoral)

Lecture 10 - Effector Mechanisms

Lecture 11 - Structure of antibody

Lecture 12 - Structure of antibody and T-Cell Receptors

Lecture 13 - Generation of diversity (GOD) of lymphocyte antigen receptors (Continued...)

Lecture 14 - Generation of diversity (GOD) of lymphocyte antigen receptors (Continued...)

Lecture 15 - Generation of diversity (GOD) of lymphocyte antigen receptors (Continued...)

Lecture 16 - Generation of diversity (GOD) of lymphocyte antigen receptors (Continued...)

Lecture 17 - Structural variation in immunoglobulin constant regions and isotype switching

Lecture 18 - Structural variation in immunoglobulin constant regions and isotype switching (Continued...)

Lecture 19 - Antigen recognition by T cell : major histocompatibility complex

Lecture 20 - Antigen recognition by T cell : major histocompatibility complex (Continued...)

Lecture 21 - Antigen Recognition by T cell : Major Histocompatibility Complex (Continued...)

Lecture 22 - Antigen Recognition by T cell : Major Histocompatibility Complex (Continued...)

Lecture 23 - The Generation of  $\hat{I}^{\pm}$  :  $\hat{I}^2$  T - Cell receptor ligands

Lecture 24 - The Generation of  $\hat{I}^{\pm}$  :  $\hat{I}^2$  T - Cell receptor ligands (Continued...)

Lecture 25 - Summary of Immune system

Lecture 26 - Tools and Techniques

Lecture 27 - Tools and Techniques (Continued...)

Lecture 28 - Tools and Techniques (Continued...)

Lecture 29 - Tools and Techniques (Continued...)

Lecture 30 - Flow Cytometry

Lecture 31 - Development of T Lymphocytes

- [Lecture 32 - Development of T Lymphocytes \(Continued...\)](#)
- [Lecture 33 - Development of T Lymphocytes \(Continued...\)](#)
- [Lecture 34 - T Cell Mediated Immunity](#)
- [Lecture 35 - T Cell Mediated Immunity \(Continued...\)](#)
- [Lecture 36 - B-Cell Maturation - I](#)
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- [Lecture 38 - B-Cell Activation](#)
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- [Lecture 40 - Effector T - Cells](#)
- [Lecture 41 - Complement System Overview](#)
- [Lecture 42 - Complement System Overview \(Continued...\)](#)
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- [Lecture 44 - Complement Biological Consequences \(Continued...\)](#)
- [Lecture 45 - Cytokines : Introduction](#)
- [Lecture 46 - Cytokines : Introduction \(Continued...\)](#)
- [Lecture 47 - Cytokines in Innate and Adaptive Immunity](#)
- [Lecture 48 - Interferons](#)
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- [Lecture 50 - Hypersensitivity \(Continued...\)](#)
- [Lecture 51 - Autoimmunity](#)
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- [Lecture 53 - Autoimmunity \(Continued...\)](#)
- [Lecture 54 - Transplantation or Graft vs. Host Reaction](#)
- [Lecture 55 - Transplantation or Graft vs. Host Reaction \(Continued...\)](#)
- [Lecture 56 - Active and Passive Immunity and Vaccination](#)
- [Lecture 57 - Active and Passive Immunity and Vaccination \(Continued...\)](#)
- [Lecture 58 - Active and Passive Immunity and Vaccination \(Continued...\)](#)
- [Lecture 59 - Monoclonal Antibody](#)
- [Lecture 60 - Monoclonal Antibody \(Continued...\)](#)

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- Lecture 2 - Essence of Metabolic Engineering - Part A
- Lecture 3 - Essence of Metabolic Engineering - Part B
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- Lecture 6 - Review of Cellular Metabolism - Part A
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- Lecture 8 - Review of Cellular Metabolism - Part C
- Lecture 9 - Review of Cellular Metabolism - Part D
- Lecture 10 - Review of Cellular Metabolism - Part E
- Lecture 11 - Review of Cellular Metabolism - Part F
- Lecture 12 - Introduction to Metabolic Networks
- Lecture 13 - Introduction to Systems Biology
- Lecture 14 - Regulatory Networks
- Lecture 15 - Reconstruction of Metabolic Networks
- Lecture 16 - The Stoichiometric Matrix: Representing Reconstructed Network Mathematically
- Lecture 17 - Flux Balance Analysis (FBA)
- Lecture 18 - Flux Variability Analysis (FVA) and Flux Coupling (FC)
- Lecture 19 - Dynamic Flux Balance Analysis (DFBA) and Gene Deletion Algorithms
- Lecture 20 - Optimization in MATLAB
- Lecture 21 - Robustness Analysis and Phenotypic Phase Planes
- Lecture 22 - Flux Sampling, Optknock and Optstrain
- Lecture 23 - Extreme Pathways and Elementary modes
- Lecture 24 -  $^{13}\text{C}$  Metabolic Flux Analysis ( $^{13}\text{C}$  MFA)
- Lecture 25 -  $^{13}\text{C}$  Metabolic Flux Analysis ( $^{13}\text{C}$  MFA)
- Lecture 26 - Advancement in  $^{13}\text{C}$  Metabolic Flux Analysis
- Lecture 27 - E.coli core metabolic Network Optimization in MATLAB
- Lecture 28 - Application of Metabolic Flux Analysis
- Lecture 29 - CRISPR-Cas system and its application in metabolic engineering - Part I
- Lecture 30 - CRISPR-Cas system and its application in metabolic engineering - Part II
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[Lecture 34 - Metabolic engineering for biofuel production - Part A](#)

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Lecture 2 - Acids, Bases and Salts - Part II

Lecture 3 - Acids, Bases and Salts - Part III

Lecture 4 - Acids, Bases and Salts - Part IV

Lecture 5 - Acids, Bases and Salts - Part V

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Lecture 7 - Chemical Equilibrium - II

Lecture 8 - Chemical Equilibrium - III

Lecture 9 - Chemical Equilibrium - IV

Lecture 10 - Chemical Equilibrium - V

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Lecture 12 - Chemical Kinetics - II

Lecture 13 - Chemical Kinetics - III

Lecture 14 - Chemical Kinetics - IV

Lecture 15 - Chemical Kinetics - V

Lecture 16 - Chemical Kinetics - Reaction Mechanism - Part A

Lecture 17 - Chemical Kinetics - Reaction Mechanism - Part B

Lecture 18 - Chemical Kinetics - Catalysis - Part A

Lecture 19 - Chemical Kinetics - Catalysis - Part B

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Lecture 21 - Nitrogen chemistry - Part A

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Lecture 25 - Chlorine chemistry and disinfection - Part C

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Lecture 27 - Radioactivity - Part B

Lecture 28 - Radioactivity - Part C

Lecture 29 - Radioactivity - Part D

Lecture 30 - Radioactivity - Part E

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Lecture 33 - Overview of microbial life - I  
Lecture 34 - Overview of microbial life - II  
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Lecture 39 - Cell Biology - II  
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Lecture 41 - Cell Biology - IV  
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Lecture 62 - Biogeochemical cycles - I  
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**NPTEL : NOC:Environmental Biotechnology (Biotechnology)**

**Co-ordinators : Prof. Pinaki Sar**

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Lecture 4 - Ecosystem : Basic concepts of structure and function (Continued...)

Lecture 5 - Microbial Ecology

Lecture 6 - Microbial Ecology (Continued...)

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Lecture 11 - Microbial ecology and environmental biotechnology - Part B (Continued...)

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Lecture 16 - Microbial Ecology and Environmental Biotechnology - Part C (Continued...)

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Lecture 20 - Microbiology of Environmental Engineering System (Continued...)

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Lecture 22 - Physiological ecology and Resource Exploitation by Microorganisms (Continued...)

Lecture 23 - Physiological ecology and Resource Exploitation by Microorganisms (Continued...)

Lecture 24 - Physiological ecology and Resource Exploitation by Microorganisms (Continued...)

Lecture 25 - Methods in Microbial Ecology with Relevance to Environmental Biotechnology

Lecture 26 - Methods in Microbial Ecology with Relevance to Environmental Biotechnology (Continued...)

Lecture 27 - Methods in Microbial Ecology with Relevance to Environmental Biotechnology (Continued...)

Lecture 28 - Methods in Microbial Ecology with Relevance to Environmental Biotechnology (Continued...)

Lecture 29 - Methods in Microbial Ecology with Relevance to Environmental Biotechnology (Continued...)

Lecture 30 - Methods in Microbial Ecology with Relevance to Environmental Biotechnology (Continued...)

Lecture 31 - Methods in Microbial Ecology with Relevance to Environmental Biotechnology (Continued...)

[Lecture 32 - Methods in Microbial Ecology with Relevance to Environmental Biotechnology \(Continued...\)](#)

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[Lecture 49 - Carbon capture, Carbon Sequestration and Utilization](#)

[Lecture 50 - Bioenergy and Environmental Biotechnology](#)

[Lecture 51 - Bioremediation case studies](#)

[Lecture 52 - Bioremediation case studies \(Continued...\)](#)

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Lecture 2 - Amino Acids - II

Lecture 3 - Amino Acids - III

Lecture 4 - The Peptide Bond

Lecture 5 - Discussion Class

Lecture 6 - Primary Structure

Lecture 7 - Secondary Structure

Lecture 8 - Tertiary and Quaternary Structure

Lecture 9 - Protein Interactions

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Lecture 12 - Thermodynamics of Protein Folding

Lecture 13 - Protein Structure Methods

Lecture 14 - Protein Denaturation

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Lecture 17 - Protein Purification

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Lecture 19 - Biophysical Methods - II

Lecture 20 - Biophysical Methods - III

Lecture 21 - Types of Protein ligand interactions

Lecture 22 - Kinetics and Thermodynamics of protein-ligand binding

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Lecture 51 - Protein Protein Interactions - I  
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Lecture 4 - Important Signals

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Lecture 11 - Types of Ionizing Radiations

Lecture 12 - EM Radiation

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Lecture 14 - Radiation Dosimetry

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[Lecture 33 - Ultrasound Phys\\_Interactions](#)

[Lecture 34 - US doppler and Instrumentation](#)

[Lecture 35 - US\\_Beampattern](#)

[Lecture 36 - Approximations](#)

[Lecture 37 - US\\_Imaging Equation\\_modes](#)

[Lecture 38 - Parameters of interest](#)

[Lecture 39 - Beam Steering : Phased Array](#)

[Lecture 40 - MRI\\_Intro\\_S1-S9](#)

[Lecture 41 - MRI\\_Phys\\_S10-S16](#)

[Lecture 42 - MRI\\_Phys\\_S17-S20](#)

[Lecture 43 - MRI\\_Phys\\_S21-S28](#)

[Lecture 44 - MRI\\_Phys\\_S29-S39](#)

[Lecture 45 - MRI\\_Phys\\_S40-S44](#)

[Lecture 46 - MRI\\_Phys\\_S45\\_S52](#)

[Lecture 47 - MRI\\_Instru\\_S1\\_S16](#)

[Lecture 48 - MRI\\_Instru\\_s17\\_s26](#)

[Lecture 49 - MRI\\_slice sel\\_S27\\_S41](#)

[Lecture 50 - MRI\\_Freq\\_Encode\\_S42\\_S60](#)

[Lecture 51 - MRI\\_DAQ\\_S61\\_S69](#)

[Lecture 52 - MRI\\_RECON\\_S70\\_S82](#)

[Lecture 53 - MRI\\_IQ\\_S83\\_S96](#)

Lecture 1 - Introduction

Lecture 2 - Next Generation Sequencing Technologies - 454 Sequencing

Lecture 3 - Illumina Sequencing By Synthesis (SBS)

Lecture 4 - Single Molecule Real Time (SMRT) Sequencing

Lecture 5 - Ion Torrent and Nanopore Sequencing

Lecture 6 - Sequencing Coverage, Quality Score and Experiment Design

Lecture 7 - Data Formats

Lecture 8 - Data Formats (Continued...)

Lecture 9 - Data Quality

Lecture 10 - Data QC and Trimming

Lecture 11 - Hands-on: Setting up the system

Lecture 12 - Basic Shell Commands

Lecture 13 - Data Download and Exploration

Lecture 14 - Hands-on 1 - Data exploration and QC

Lecture 15 - Hands-on 1 - Data QC and Trimming

Lecture 16 - Read Mapping

Lecture 17 - Mapping Algorithms

Lecture 18 - Suffix tree-based mapping algorithm

Lecture 19 - Burrows-Wheeler Transform (BWT)

Lecture 20 - Read Mapping with BWT

Lecture 21 - Bowtie2 tool

Lecture 22 - Mapping reads with Bowtie2

Lecture 23 - Bowtie2 output

Lecture 24 - SAM and BAM format

Lecture 25 - SAM format: Alignment section

Lecture 26 - Variant Calling

Lecture 27 - Calling SNP/SNVs and Indels

Lecture 28 - Hands-on analysis : Variant Calling

Lecture 29 - VCF Files

Lecture 30 - Variant Annotation

Lecture 31 - Analysis of CNVs and SVs



- Lecture 32 - Introduction to RNA sequencing
- Lecture 33 - RNA-seq data processing pipeline
- Lecture 34 - Transcriptome Assembly and Quantification
- Lecture 35 - Transcript Abundance Quantification
- Lecture 36 - Biases in RNA-seq experiments
- Lecture 37 - Data Normalization Methods
- Lecture 38 - Data Normalization Methods (Continued...)
- Lecture 39 - Differential Gene Expression (DGE) Analysis
- Lecture 40 - DGE analysis results and visualizations
- Lecture 41 - Multiple hypothesis testing correction
- Lecture 42 - FDR correction and interpretation of DGE analysis results
- Lecture 43 - Functional Enrichment Analysis
- Lecture 44 - RNA-seq data analysis - Hands-on 2
- Lecture 45 - Hands-on 2: Setting up the system
- Lecture 46 - Hands-on 2: Preliminary Data Analysis
- Lecture 47 - Sample Specific Bias Correction
- Lecture 48 - Differential Gene Expression Analysis I
- Lecture 49 - DGE Analysis with spike-ins
- Lecture 50 - DGE Analysis Results and Functional Enrichment Analysis
- Lecture 51 - Genome Assembly
- Lecture 52 - Shortest Common Superstring (SCS) assembly
- Lecture 53 - Overlap-Layout-Consensus (OLC) approach
- Lecture 54 - de Bruijn Graph (DBG) based assembly
- Lecture 55 - Assembly and Quality Control
- Lecture 56 - Applications of NGS in Epigenomics
- Lecture 57 - Detecting DNA Methylations
- Lecture 58 - Genome-wide Transcription Factor(TF) Binding Sites
- Lecture 59 - Chromatin Accessibility
- Lecture 60 - Genome Organization in 3D

Lecture 1 - Neuron Structure

Lecture 2 - Networks of Neurons and Synapses

Lecture 3 - Basic Structures in the Brain

Lecture 4 - Systems of neural processing

Lecture 5 - Methods of Recording Neural Activity

Lecture 6 - Membrane Potential and All or None Spike

Lecture 7 - Patch Clamp Measurements

Lecture 8 - Ion channels

Lecture 9 - Current injection: Synapses

Lecture 10 - Single Neuron Acitivity

Lecture 11 - Point and compartmental models of neurons

Lecture 12 - Hodgkin Huxley Equations - I

Lecture 13 - Hodgkin Huxley Equations - II

Lecture 14 - Reducing the HHE and Moris-Lecar Equations (MLE)

Lecture 15 - Properties of MLE

Lecture 16 - Phase Plane Analysis - I

Lecture 17 - Phase Plane Analysis - II

Lecture 18 - Phase Plane Analysis - III

Lecture 19 - Analysing HHE with Phase Plane Analysis - I

Lecture 20 - Analysing HHE with Phase Plane Analysis - II

Lecture 21 - Random variables and random process

Lecture 22 - Spike train statistics and response measure

Lecture 23 - Receptive fields and models of receptive fields

Lecture 24 - Stimulus to Response mapping (Coding) - I

Lecture 25 - Stimulus to Response mapping (Coding) - II

Lecture 26 - Stimulus to Response Mapping (Coding) - III

Lecture 27 - Response to Stimulus Mapping (Decoding)

Lecture 28 - Basics of Information Theory - I

Lecture 29 - Basics of Information Theory - II

Lecture 30 - Maximally Informative Dimensions

Lecture 31 - Intro to Discrimination based methods

- Lecture 32 - Kullback Leibler Distance
- Lecture 33 - Measuring Spike Train Distances - I
- Lecture 34 - Measuring Spike Train Distances - II
- Lecture 35 - Signal and Noise Correlations
- Lecture 36 - Statistical Methods in Discrimination
- Lecture 37 - Single Cell Decoding - I: Two Alternative Forced Choice task in Monkeys
- Lecture 38 - Single Cell Decoding - II: Using ROC Curves for discrimination
- Lecture 39 - Single Cell Encoding - I: Operant Conditioning Task in Ferrets
- Lecture 40 - Single Cell Encoding - II: Learning in avoidance and approach methods in Ferrets
- Lecture 41 - Plasticity - Synaptic Transmission and Synaptic Strength
- Lecture 42 - Ways of modification of Synaptic Strength
- Lecture 43 - Type of Plasticity
- Lecture 44 - Short Term Plasticity - I
- Lecture 45 - Short Term Plasticity - II
- Lecture 46 - Long Term Plasticity
- Lecture 47 - Spike Time Dependent Plasticity
- Lecture 48 - Hebbian Plasticity
- Lecture 49 - BCM Rule
- Lecture 50 - Synaptic Normalization
- Lecture 51 - Adaptation
- Lecture 52 - Models of Short Term Plasticity
- Lecture 53 - Attention - I
- Lecture 54 - Attention - II
- Lecture 55 - Developmental Cicuits
- Lecture 56 - Optimal Coding in Visual System
- Lecture 57 - Optimal Coding in Auditory System
- Lecture 58 - Optimal Coding of Deviant Stimuli in Development
- Lecture 59 - Spike Timing Dependent Plasticity - a theoretical Perspective
- Lecture 60 - Important Problems in Neuroscience

Lecture 1 - Ionic basis of membrane potential

Lecture 2 - Physiology of voltage gated channels

Lecture 3 - Physiology of voltage gated channels

Lecture 4 - Cardiac muscle physiology

Lecture 5 - Action potential of cardiac muscle - 1

Lecture 6 - Action potential of cardiac muscle - 2

Lecture 7 - Conducting system of heart

Lecture 8 - ECG-Physiological basis

Lecture 9 - ECG-Normal, Technical aspects

Lecture 10 - ECG Interpretation

Lecture 11 - Abnormal ECG - 1

Lecture 12 - Abnormal ECG - 2

Lecture 13 - ECG and Myocardial Infarction

Lecture 14 - Heart rate and Blood pressure - Baroreflex pathway

Lecture 15 - ECG and Hypertension

Lecture 16 - Autonomic regulation of heart

Lecture 17 - Heart rate variability (HRV)

Lecture 18 - Heart rate variability-interpretation and clinical uses, Blood pressure variability

Lecture 19 - Autonomic Function Tests - 1

Lecture 20 - Autonomic Function Tests - 2

Lecture 1 - Pharmacognosy and Medicinal Plants

Lecture 2 - Plant Specialized Metabolites: Waste Products or Ecochemicals?

Lecture 3 - Evolution of Specialized Metabolism from Primary Metabolism

Lecture 4 - Production of specialized metabolites through cell and organ culture

Lecture 5 - Eliciting specialized metabolism in culture

Lecture 6 - Analysis of Specialized Metabolites - Tools and Techniques

Lecture 7 - Metabolic phytochemistry-based approaches for studying plant specialized metabolism

Lecture 8 - Metabolic engineering strategies in plants

Lecture 9 - Plant genetic transformation (through natural genetic engineer)

Lecture 10 - Design of vectors for Agrobacterium-mediated gene transfer; Transformed and co-

Lecture 11 - Introduction to alkaloids

Lecture 12 - Biosynthesis of tropane alkaloids

Lecture 13 - Engineering tropane alkaloid pathways in plants - I

Lecture 14 - Engineering tropane alkaloid pathways in plants - II : Engineering tropane alkaloid pathway

Lecture 15 - Isoquinoline alkaloids - Biosynthesis and tissue localization

Lecture 16 - Isoquinoline alkaloids - Late steps of biosynthetic pathway and tissue localization

Lecture 17 - Benzyloisoquinoline alkaloids - Induced top1 mutant and natural T mutantEngineering

Lecture 18 - Benzyloisoquinoline alkaloids - Metabolic pathway engineering

Lecture 19 - RNAi-mediated replacement of morphine with nonnarcotic alkaloid reticuline in opium

Lecture 20 - Isoquinoline alkaloids - biosynthesis and tissue localization

Lecture 21 - Indole alkaloids - Early steps of biosynthesis

Lecture 22 - Indole alkaloids - Metabolic engineering of early steps of indole alkaloid pathway

Lecture 23 - Indole alkaloids - Environmental factors regulating indole alkaloid biosynthesis

Lecture 24 - Indole alkaloids - Role of elicitors in modulating alkaloids accumulation

Lecture 25 - Indole alkaloids - Late steps of indole alkaloid biosynthesis

Lecture 26 - Indole alkaloids - Regulatory roles of transcription factors in light-induced

Lecture 27 - Engineering indole alkaloid pathways in Catharanthus roseus hairy root cultures

Lecture 28 - Missing enzymes of vindoline biosynthetic pathway

Lecture 29 - Monoterpene indole alkaloid pathway cell and tissue localization

Lecture 30 - Model for biosynthesis and secretion of monoterpene indole alkaloids involving

Lecture 31 - Metabolic reprogramming of periwinkle plant culture

- Lecture 32 - Engineered yeast brews precursors of anticancer drug vinblastine
- Lecture 33 - Recent discovery of strychnine biosynthetic pathway
- Lecture 34 - Indole alkaloid biosynthesis - a final overview
- Lecture 35 - Recent discovery of colchicine biosynthetic pathway
- Lecture 36 - Biosynthesis of terpenoids - an outline
- Lecture 37 - Diversity of monoterpenoids
- Lecture 38 - Biosynthesis of monoterpenoids
- Lecture 39 - Diversity of sesquiterpenes, diterpenes, triterpenes and polyterpenes
- Lecture 40 - Oleoresins and polyterpenes - an outline
- Lecture 41 - Monoterpenoids as components of floral scent volatiles: Metabolic engineering of
- Lecture 42 - Biosynthesis of carotenoids and carotenoid cleavage products
- Lecture 43 - Metabolic engineering of carotenoid pathway
- Lecture 44 - Metabolic engineering of carotenoid pathway: Golden Rice Story
- Lecture 45 - Menthol story: Biosynthesis and pathway manipulation - I
- Lecture 46 - Menthol story: Biosynthesis and pathway manipulation - II
- Lecture 47 - Artemisinin, hyperforin and taxol - three promising candidates for biotechnological
- Lecture 48 - Phenolics: Origin via shikimate pathway
- Lecture 49 - Phenolics: Phenylpropanoids, benzenoids, coumarins, tannins
- Lecture 50 - Phenolics: Monolignols, lignins and lignans
- Lecture 51 - Phenolics: Metabolic engineering of monolignol pathways
- Lecture 52 - Phenolics: Biosynthesis of lignans and podophyllotoxin; Caffeic acid esters
- Lecture 53 - Phenolics: Flavonoids, Flavones, Isoflavonoids, Proanthocyanidins
- Lecture 54 - Phenolics: Biosynthesis of anthocyanins; Metabolic pathway engineering for enhance
- Lecture 55 - Phenolics: Metabolic engineering of anthocyanin pathways in flowers
- Lecture 56 - Phenolics: Alcohol acetyl transferses and volatile phenolics
- Lecture 57 - Phenolics: Biosynthesis of volatile benzenoids
- Lecture 58 - Phenolics: Biosynthesis of vanillin in plants
- Lecture 59 - Phenolics: Metabolic engineering for vanillin
- Lecture 60 - Phenolics: Biosynthesis of shikonin
- Lecture 61 - Phenolics: Metabolic engineering of shikonin pathway
- Lecture 62 - Molecular Pharming: Transplastomic plants
- Lecture 63 - Molecular Pharming: production of human somatotropin in tobacco

Lecture 1 - Introduction

Lecture 2 - Mass balance, Heat Balance, flow sheet

Lecture 3 - Costing

Lecture 4 - Costing (continued), Physical and chemical principles in Down stream

Lecture 5 - Problems in Mass balance, flow sheet

Lecture 6 - Cell Breakage

Lecture 7 - Cell breakage (Continued...)

Lecture 8 - Solid Liquid Separation

Lecture 9 - Solid Liquid Separation (Continued...)

Lecture 10 - Solid Liquid separation-problems

Lecture 11 - Pre-treatment and Filters

Lecture 12 - Adsorption

Lecture 13 - Adsorption

Lecture 14 - Adsorption

Lecture 15 - Adsorption

Lecture 16 - Liquid-Liquid Extraction

Lecture 17 - Liquid-Liquid Extraction

Lecture 18 - Liquid-Liquid Extraction

Lecture 19 - Liquid liquid extraction

Lecture 20 - Reversed micellar and aqueous two phase extraction

Lecture 21 - Membranes

Lecture 22 - Membranes

Lecture 23 - Membranes

Lecture 24 - Membranes

Lecture 25 - Precipitation

Lecture 26 - Chromatography

Lecture 27 - Chromatography

Lecture 28 - Chromatography

Lecture 29 - Chromatography

Lecture 30 - Chromatography

Lecture 31 - Chromatography

[Lecture 32 - Chromatography](#)

[Lecture 33 - Crystallisation](#)

[Lecture 34 - Drying](#)

[Lecture 35 - Drying and distillation](#)

[Lecture 36 - Future trends](#)



Lecture 1 - Introduction and Review

Lecture 2 - Need for Analysis Additional Thermodynamic Functions State and Path Variables

Lecture 3 - Equations for a Closed system Chemical Potential Concept Gibbs-Duhem Equation

Lecture 4 - Maxwell's relations

Lecture 5 - Inter-Relationships between Thermodynamic Variables

Lecture 6 - Some Useful Mathematical Manipulations

Lecture 7 - Thermodynamic Relations for a Closed System with 1 mole of a pure Substances

Lecture 8 - Maximum Work, Lost Work Review of Closed Systems

Lecture 9 - Open Systems

Lecture 10 - Equations of State - Virial Equations

Lecture 11 - Equations of State - Cubic Equations

Lecture 12 - Volume Estimation

Lecture 13 - Volume Estimation (Continued...) Generalized correlations

Lecture 14 - Generalized correlations (Continued...) Residual Properties

Lecture 15 - Residual Properties (Continued...)

Lecture 16 - Generalized Correlations and Residual Properties

Lecture 17 - Fugacity Coefficient Estimation

Lecture 18 - Review of Module 3

Lecture 19 - Learning Aspects Chemical Potential Formulations

Lecture 20 - Lewis and Randall rule partial Molar Properties

Lecture 21 - Partial Molar Property Estimation from Mixing Experiments

Lecture 22 - Partial Molar Property Estimation (Continued...) Excess Property

Lecture 23 - Activity Coefficient from Excess Property

Lecture 24 - Activity Coefficient from Excess Property (Continued...)

Lecture 25 - Activity Coefficient from Excess Property (Continued...) Models for Activity Coefficient in Binary Systems

Lecture 26 - Models for Activity Coefficient in Binary Systems (Continued...)

Lecture 27 - Review of Module 4

Lecture 28 - Criteria for Phase Equilibrium Phase Rule for Non-reacting Biosystems

Lecture 29 - Clausius - Clayperon Equation

Lecture 30 - Clausius - Clayperon Equation (Continued...) vapour-Liquid Equilibrium

Lecture 31 - Vapour-Liquid Equilibrium (Continued...) Estimation of Fugacity coefficient from Equilibrium P-V-T Data

[Lecture 32 - Liquid/Liquid and Solid/Liquid Equilibria](#)

[Lecture 33 - Review of Module 5](#)

[Lecture 34 - Criteria for Bio-reaction Equilibria](#)

[Lecture 35 - Phase rule for Reacting Biosystems Equilibrium constants](#)

[Lecture 36 - Effect of Temperature and Pressure on the Equilibrium constants](#)

[Lecture 37 - Reaction in Liquid or Solid Phases](#)

[Lecture 38 - Free energy Changes for some Bioreactions](#)

[Lecture 39 - Electrolytes](#)

[Lecture 40 - Course Review](#)

Lecture 1 - Introduction

Lecture 2 - Mass balance, Heat Balance, Flow sheet

Lecture 3 - Costing

Lecture 4 - Cell Breakage

Lecture 5 - Solid Liquid Separation

Lecture 6 - Pre-treatment and Filters/centrifuge

Lecture 7 - Liquid-Liquid Extraction

Lecture 8 - Liquid-Liquid extraction (Continued...)

Lecture 9 - Adsorption

Lecture 10 - Reversed micellar and aqueous two phase extraction

Lecture 11 - Membranes

Lecture 12 - Membranes (Continued...)

Lecture 13 - Product stabilization, Drying, Lyophilisation

Lecture 14 - Precipitation and crystallization

Lecture 15 - Electrophoresis / SDS PAGE

Lecture 16 - Chromatography

Lecture 17 - Chromatography (Continued...1)

Lecture 18 - Chromatography (Continued...2)

Lecture 19 - Chromatography (Continued...3)

Lecture 20 - Future trends, Other downstream operations/Summary of the course

Lecture 1 - Introduction

Lecture 2 - Experimental Design Strategy

Lecture 3 - Data types : Binomial distribution

Lecture 4 - Poisson Distribution

Lecture 5 - Normal Distribution

Lecture 6 - Standardized Normal Distribution / t-distribution

Lecture 7 - t-distribution/confidence interval

Lecture 8 - Statistical tests

Lecture 9 - t-Test

Lecture 10 - t-Tests

Lecture 11 - t-test

Lecture 12 - F-tests

Lecture 13 - F-tests

Lecture 14 - ANOVA

Lecture 15 - ANOVA

Lecture 16 - Anova

Lecture 17 - Anova

Lecture 18 - Anova

Lecture 19 - Anova

Lecture 20 - Anova

Lecture 21 - Normality test / Odds ratio

Lecture 22 - Chi square distribution

Lecture 23 - Chi square distribution / test

Lecture 24 - Chi square test

Lecture 25 - Chi square test and Weibull Distribution

Lecture 26 - Weibull Distribution

Lecture 27 - Weibull distribution.

Lecture 28 - Non-parametric test

Lecture 29 - Non parametric test/homogeneity of variance / beta distribution

Lecture 30 - Exponential / hypergeometric distributions

Lecture 31 - Hypergeometric / Log normal distribution

[Lecture 32 - Design of experiments \(DOE\) - Introduction](#)

[Lecture 33 - Factorial Design](#)

[Lecture 34 - Full factorial design](#)

[Lecture 35 - Fractional factorial design](#)

[Lecture 36 - Other designs](#)

[Lecture 37 - Second order designs](#)

[Lecture 38 - Second order design](#)

[Lecture 39 - Regression analysis](#)

[Lecture 40 - Control charts](#)

Lecture 1 - Introduction

Lecture 2 - Sterilization

Lecture 3 - Solution to PP 1.1

Lecture 4 - Some important concepts

Lecture 5 - Enzyme bioreactors, enzyme kinetics

Lecture 6 - Solution to PP 2.1

Lecture 7 - Inhibited enzyme kinetics

Lecture 8 - Solution to PP 2.2

Lecture 9 - Measurement principles and methods

Lecture 10 - Batch growth kinetics

Lecture 11 - Solution to PP 3.1

Lecture 12 - Bioreactor analysis: chemostat and fed-batch

Lecture 13 - Solution to PP 3.2

Lecture 14 - Bioreactor environment parameters

Lecture 15 - Bioreactor env. par. (DO)

Lecture 16 - Solution to PP 4.1

Lecture 17 - Shear stress, scale-up, scale-down

Lecture 18 - Cell view: stoichiometry; degree of reductance

Lecture 19 - Solution to PP 5.1

Lecture 20 - Culture status, metabolic flux analysis

Lecture 21 - Course summary

- Lecture 1 - Introduction to Biomaterials
- Lecture 2 - Background history
- Lecture 3 - History
- Lecture 4 - Properties - Mechanical and Physico-chemical
- Lecture 5 - Properties - Mechanical and Physico-chemical
- Lecture 6 - Mechanical properties
- Lecture 7 - Mechanical Properties (Continued...)
- Lecture 8 - Resorbability, biodegradation
- Lecture 9 - Resorbability, biodegradation (Continued...)
- Lecture 10 - Biofilm
- Lecture 11 - Biofilm (Continued...)
- Lecture 12 - Biofilm (Continued...)
- Lecture 13 - Biofilm (Continued...)
- Lecture 14 - Material characterization - Analytical instruments
- Lecture 15 - Analytical instruments
- Lecture 16 - Analytical instruments (Continued...)
- Lecture 17 - Analytical instruments (Continued...)
- Lecture 18 - Biological responses, compatibility, cytotoxicity
- Lecture 19 - Biological Responses
- Lecture 20 - Cell-biomaterial interaction
- Lecture 21 - Animal trials (in vivo)
- Lecture 22 - Animal trials
- Lecture 23 - Metals-types, classifications, applications
- Lecture 24 - Metals - properties
- Lecture 25 - Metals - properties (Continued...)
- Lecture 26 - Metals - properties (Continued...)
- Lecture 27 - Metals
- Lecture 28 - Polymers-types, classifications, applications
- Lecture 29 - Polymers
- Lecture 30 - Polymers (Continued...)
- Lecture 31 - Polymer blends

[Lecture 32 - Natural biopolymers](#)

[Lecture 33 - Natural biopolymers - \(Continued...\)](#)

[Lecture 34 - Biopolymers- proteins / hydrogels](#)

[Lecture 35 - Hydrogels](#)

[Lecture 36 - Experiments](#)

[Lecture 37 - surface modification-Demonstration](#)

[Lecture 38 - Ceramics](#)

[Lecture 39 - Cardiovascular and ocular biomaterials](#)

[Lecture 40 - Sterilisation/Device failure](#)



Lecture 1 - Concepts and importance of Bioinformatics

Lecture 2 - Complexities in biological systems

Lecture 3 - DNA sequence analysis

Lecture 4 - Sequence based parameters

Lecture 5 - Database

Lecture 6 - Database categories

Lecture 7 - Protein structure and function - I

Lecture 8 - Protein structure and function - II

Lecture 9 - Protein sequence databases - I

Lecture 10 - Protein sequence databases - II

Lecture 11 - Pairwise alignment - I

Lecture 12 - Pairwise alignment - II

Lecture 13 - Uniprot Demo

Lecture 14 - Sequence alignment - I

Lecture 15 - Sequence alignment - II

Lecture 16 - Sequence alignment: Online resources - I

Lecture 17 - Sequence alignment: Online resources - II

Lecture 18 - Conservation score - I

Lecture 19 - Conservation score - II

Lecture 20 - Blast Demo

Lecture 21 - Phylogenetic trees - I

Lecture 22 - Phylogenetic trees - II

Lecture 23 - Protein sequence analysis - I

Lecture 24 - Protein sequence analysis - II

Lecture 25 - Hydrophobicity profiles

Lecture 26 - Patterns and PSSM profiles

Lecture 27 - Construction of Non-redundant datasets - I

Lecture 28 - Non-redundant datasets - II

Lecture 29 - Protein secondary structure

Lecture 30 - Secondary structure prediction - I

Lecture 31 - Secondary structure prediction - II

- Lecture 32 - Secondary structure prediction - III
- Lecture 33 - Protein tertiary structure - I
- Lecture 34 - Protein tertiary structure - II
- Lecture 35 - Protein structure analysis - I
- Lecture 36 - Protein structure analysis - II
- Lecture 37 - Protein structure analysis - III
- Lecture 38 - Demo: PDB or Pymol or PDBParam
- Lecture 39 - Protein structure analysis - IV
- Lecture 40 - Protein structure prediction - I
- Lecture 41 - Protein structure prediction - II
- Lecture 42 - Protein stability - I
- Lecture 43 - Protein stability - II
- Lecture 44 - Demo: Homology Modelling
- Lecture 45 - Stabilizing residues
- Lecture 46 - Thermodynamic database
- Lecture 47 - Stability of proteins upon mutations - I
- Lecture 48 - Stability of proteins upon mutations - II
- Lecture 49 - Demo: ProTherm
- Lecture 50 - Protein folding rate - I
- Lecture 51 - Protein folding rate - II
- Lecture 52 - Protein interactions - I
- Lecture 53 - Protein interactions - II
- Lecture 54 - Computer aided drug design - I
- Lecture 55 - Computer aided drug design - II
- Lecture 56 - Virtual screening - I
- Lecture 57 - Virtual screening - II
- Lecture 58 - QSAR - I
- Lecture 59 - QSAR - II
- Lecture 60 - Demo: Autodock
- Lecture 61 - awk programming - I
- Lecture 62 - awk programming - II
- Lecture 63 - Development of algorithms - I
- Lecture 64 - Development of algorithms - II

[Lecture 65 - Applications of bioinformatics - I](#)

[Lecture 66 - Applications of bioinformatics - II](#)

[Lecture 67 - Overview - I](#)

[Lecture 68 - Overview - II](#)

[Lecture 69 - Demo: Weka](#)

**NPTEL : NOC:Demystifying the Brain (Biotechnology)**

**Co-ordinators : Dr. V Srinivasa Chakravarthy**

- Lecture 1 - The Whole and Its Parts: A History of Ideas about Brain
- Lecture 2 - Understanding Brain's Shape - Segment 1 - Brain size and intelligence
- Lecture 3 - Understanding Brain's Shape - Segment 2 - Save Wire Principle
- Lecture 4 - Understanding Brain's Shape - Segment 3 - Brain Evolution
- Lecture 5 - Neurons and Neural Signaling: Outline
- Lecture 6 - Neural Signalling : Molecular and Cellular Basis
- Lecture 7 - Networks that Learn - Segment 1
- Lecture 8 - Multilayer Perceptrons Applications in Psychology and Neuroscience
- Lecture 9 - Organization of the Central Nervous System-Segment 1 - Cortex
- Lecture 10 - Organization of the Central Nervous System-Segment 2 - Subcortical Structures
- Lecture 11 - Maps in the Brain - Segment 1
- Lecture 12 - Maps in the Brain - Segment 2
- Lecture 13 - Emotions in the Brain - Segment 1
- Lecture 14 - Emotions in the Brain - Segment 2
- Lecture 15 - Memories and Holograms - Segment 1
- Lecture 16 - Memories and Holograms - Segment 2
- Lecture 17 - Consciousness - Segment 1
- Lecture 18 - Consciousness - Segment 2

Lecture 1 - Introduction

Lecture 2 - Introduction to Modelling

Lecture 3 - Introduction to Modelling

Lecture 4 - Fundamentals of Mathematical Modelling

Lecture 5 - Fundamentals of Mathematical Modelling

Lecture 6 - Fundamentals of Mathematical Modelling

Lecture 7 - Some Example Models

Lecture 8 - Representation of Biological Networks

Lecture 9 - Lab: MATLAB Basics

Lecture 10 - Lab: MATLAB Basics

Lecture 11 - Lab: MATLAB Basics

Lecture 12 - Lab: MATLAB Basics

Lecture 13 - Introduction to Networks

Lecture 14 - Introduction to Networks

Lecture 15 - Introduction to Network Biology

Lecture 16 - Introduction to Network Biology

Lecture 17 - Introduction to Network Biology

Lecture 18 - Network Biology

Lecture 19 - Network Models

Lecture 20 - Network Models

Lecture 21 - Biological Networks

Lecture 22 - Network Perturbations

Lecture 23 - Community Detection

Lecture 24 - Network Motifs

Lecture 25 - Lab: Cytoscape

Lecture 26 - Lab: Cytoscape

Lecture 27 - Lab: Network Biology

Lecture 28 - Network Biology: Recap

Lecture 29 - Lab: Network Models and Perturbations

Lecture 30 - Lab: Network Models and Perturbations

Lecture 31 - Reconstruction of Gene Regulatory Networks

- Lecture 32 - Reconstruction of Protein Networks
- Lecture 33 - Reconstruction of Signalling Networks
- Lecture 34 - Reconstruction of Signalling Networks
- Lecture 35 - Introduction to Dynamic Modelling
- Lecture 36 - Introduction to Dynamic Modelling
- Lecture 37 - Introduction to Dynamic Modelling
- Lecture 38 - Lab: Solving ODEs in MATLAB
- Lecture 39 - Lab: Example Biological Model
- Lecture 40 - Parameter Estimation
- Lecture 41 - Parameter Estimation
- Lecture 42 - Parameter Estimation
- Lecture 43 - Methods for Parameter Estimation
- Lecture 44 - Direct Search Methods
- Lecture 45 - Genetic Algorithms
- Lecture 46 - Genetic Algorithms
- Lecture 47 - Other Evolutionary Algorithms
- Lecture 48 - PyGMO
- Lecture 49 - Dynamic Modelling Recap
- Lecture 50 - Lab: Parameter Estimation
- Lecture 51 - Guest Lecture: Modelling in Drug Development
- Lecture 52 - Guest Lecture: Modelling in Drug Development
- Lecture 53 - Guest Lecture: Quantitative Systems Pharmacology
- Lecture 54 - Guest Lecture: Quantitative Systems Pharmacology
- Lecture 55 - Guest Lecture: Quantitative Systems Pharmacology
- Lecture 56 - Constraint-based Modelling of Metabolic Networks
- Lecture 57 - Flux Balance Analysis
- Lecture 58 - Flux Balance Analysis
- Lecture 59 - Flux Balance Analysis
- Lecture 60 - Other Constraint-Based Approaches
- Lecture 61 - Other Constraint-Based Approaches
- Lecture 62 - Lab: FBA using MATLAB
- Lecture 63 - Perturbations to Metabolic Networks: Deletions
- Lecture 64 - Lab: COBRA Toolbox

[Lecture 65 - Understanding FBA](#)

[Lecture 66 - Understanding FBA](#)

[Lecture 67 - Perturbations to Metabolic Networks: Over-expression](#)

[Lecture 68 - Perturbations to Metabolic Networks: Synthetic Lethals](#)

[Lecture 69 - Perturbations to Metabolic Networks: Synthetic Lethals](#)

[Lecture 70 - Constraint-based Modelling of Metabolic Networks](#)

[Lecture 71 - Lab: Gene Deletions](#)

[Lecture 72 - Integrating Regulatory Information into Constraint-Based Models](#)

[Lecture 73 - Elementary Modes](#)

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Lecture 6 - Radionuclide Imaging

Lecture 7 - Basic Image Processing Methods

Lecture 8 - Contrast Enhancement

Lecture 9 - Histogram Equalization

Lecture 10 - Edge Enhancement - Laplacian

Lecture 11 - Noise Reduction

Lecture 12 - Diffusion Filtering

Lecture 13 - Bayesian Image Restoration

Lecture 14 - Registration Introduction

Lecture 15 - Framework

Lecture 16 - Image Coordinates

Lecture 17 - Transforms

Lecture 18 - Metrics

Lecture 19 - NonRigid Registration

Lecture 20 - Demons part - 1

Lecture 21 - Demons part - 2

Lecture 22 - FFDBSplines

Lecture 23 - Endoscopy - Where are we with AI ?

Lecture 24 - Computer vision and DL in the operating room

Lecture 25 - ML in intraoperative tissue identification

Lecture 26 - Basic Image Processing Techniques Using MATLAB

Lecture 27 - Image Registration Using Matlab

Lecture 28 - Basic Image Processing Techniques Using Python

Lecture 29 - Calculus of variations

Lecture 30 - Snakes - Active Contour Models

Lecture 31 - Level Sets, Geodesic Active Contours, Mumford-Shah Functional, Chan-Vese

[Lecture 32 - Mumford-Shah Functional, Chan-Vese](#)

[Lecture 33 - Segmentation Models Demo \[Snakes \(Active Contours \) Chan-Vese segmentation, Geodesic active Contour\]](#)

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[Lecture 38 - Neural Networks Introduction](#)

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[Lecture 41 - Linear Regression Demo](#)

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[Lecture 48 - Semantic Segmentation](#)

[Lecture 49 - Classification Demo in Pytorch](#)

[Lecture 50 - Generative Models](#)

[Lecture 51 - GAN Final Demo](#)

Lecture 1 - Introduction to Organ Printing course and Content Discussion

Lecture 2 - Introduction to 3D Bioprinting

Lecture 3 - Introduction to Inkjet 3D Bioprinting

Lecture 4 - Introduction to Inkjet 3D Bioprinting (Continued...)

Lecture 5 - Introduction to Extrusion Bioprinting

Lecture 6 - Introduction to Extrusion 3D Bioprinting (Continued...)

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Lecture 10 - 3D Bioprinting in Support Bath

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Lecture 12 - Important material requirement for Bioink development

Lecture 13 - Crosslinking of Hydrogels for Bioprinting

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Lecture 15 - Printability for Extrusion Bioprinting

Lecture 16 - What is required and how to print an organ?

Lecture 17 - Level of complexity in Tissues/Organs for Bioprinting

Lecture 18 - Design approaches in Bioprinting

Lecture 19 - Bioprinting of Vasculature

Lecture 20 - Direct printing of vasculature

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Lecture 23 - Design of Cornea Tissue-Specific Bioink and 3D Bioprinting of Cornea (Continued...)

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Lecture 3 - Central Dogma : The DNA Structure - Part 1

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Lecture 5 - Central Dogma : The DNA Structure - Part 3

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Lecture 23 - Introduction to Genetics - Part 1

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Lecture 27 - Mendelian and Non-Mendelian Genetics - Part 2

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- Lecture 32 - Biology of Cells - Part 1
- Lecture 33 - Biology of Cells - Part 2
- Lecture 34 - Complexity and Compartmentalization in Cells - Part 1
- Lecture 35 - Complexity and Compartmentalization in Cells - Part 2
- Lecture 36 - Endosymbiont Theory
- Lecture 37 - Structure of the Cell: Cell Wall and Cell Membrane
- Lecture 38 - Structure of the Cell: Discussion Session
- Lecture 39 - Plasma Membrane: The Boundaries of Life
- Lecture 40 - Plasma Membrane: Discussion Session
- Lecture 41 - Introduction to Cytoskeleton - Part 1
- Lecture 42 - Cytoskeleton: Discussion Session 1
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- Lecture 44 - Cytoskeleton: Discussion Session 2
- Lecture 45 - Motor Proteins in Cell
- Lecture 46 - Motor Proteins in Cell: Discussion Session
- Lecture 47 - Discussion on Directionality of Motor Protein
- Lecture 48 - Endomembrane System of Cells - Part 1
- Lecture 49 - Endomembrane System of Cells: Discussion Session 1
- Lecture 50 - Endomembrane System of Cells - Part 2
- Lecture 51 - Endomembrane System of Cells: Discussion Session 2
- Lecture 52 - Endomembrane System of Cells - Part 3
- Lecture 53 - Endomembrane System of Cells: Discussion Session 3
- Lecture 54 - Endomembrane System of Cells - Part 4
- Lecture 55 - Endomembrane System of Cells: Discussion Session 4
- Lecture 56 - Cell Division
- Lecture 57 - Cell Division: Discussion session
- Lecture 58 - Discussion Session on Organization and Function of a Cell

Lecture 1 - Introduction to RNA Biology and RNA World - The Beginning

Lecture 2 - Introduction to RNA Biology and RNA World - Evidences

Lecture 3 - Introduction to RNA Biology and RNA World - Origin of Monomers

Lecture 4 - Introduction to RNA Biology and RNA World - Shift to DNA

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Lecture 6 - Introduction to RNA Biology and RNA World - Origin of RNA Enzymes

Lecture 7 - RNA as Enzymes: The Ribozymes

Lecture 8 - RNA as Enzymes: Structure and Functions

Lecture 9 - RNA as Enzymes: The Present and Future

Lecture 10 - RNA Transcription: The Central Dogma

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Lecture 12 - RNA Transcription: Different Stages

Lecture 13 - RNA Transcription: Termination and RNA Modification

Lecture 14 - RNA Transcription: Different Polymerases

Lecture 15 - RNA Processing and Life Cycle: RNA Maturation and RNPs

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Lecture 36 - Mechanisms of RNA Decay and Non Coding RNAs: mRNA Surveillance

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Lecture 44 - Dosage Compensation and X-Inactivation: ES Cells and X-Inactivation

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Lecture 46 - Dosage Compensation, Xist and ncRNA in Imprinting: shRNAs and Gene Expression

Lecture 47 - Dosage Compensation, Xist and ncRNA in Imprinting: Mechanism of RNAi in Action

Lecture 48 - Dosage Compensation, Xist and ncRNA in Imprinting: Genomic Imprinting in Action

Lecture 49 - Dosage Compensation, Xist and ncRNA in Imprinting: Different ncRNAs and their Roles

Lecture 50 - Dosage Compensation, Xist and ncRNA in Imprinting: lncRNA-Induced Cancer

Lecture 51 - Dosage Compensation, Xist and ncRNA in Imprinting: Xist and Cancer

Lecture 52 - Telomere, Telomerase and Impact on Genomes: The Importance of Telomeres

Lecture 53 - Telomere, Telomerase and Impact on Genomes: Telomerase and Aging

Lecture 54 - Telomere, Telomerase and Impact on Genomes: Telomere Length as Marker of Aging

Lecture 55 - Telomere, Telomerase and Impact on Genomes: Telomeres and Cancer

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Lecture 57 - Telomere, Telomerase and Impact on Genomes: Maintenance and Manipulation of Telomeres

Lecture 58 - Epitranscriptome and Protein Synthesis: Important RNA Modifications

Lecture 59 - Epitranscriptome and Protein Synthesis: Readers, Writes and Erasers

Lecture 60 - Epitranscriptome and Protein Synthesis: Biological Implications of RNA Modifications

Lecture 61 - Epitranscriptome and Protein Synthesis: Roles of RNAs in Translation

Lecture 62 - Epitranscriptome and Protein Synthesis: Mechanism of Translation

Lecture 1 - Introduction to forces - Resolving forces, principle of transmissibility

Lecture 2 - Statics FBD and EOE

Lecture 3 - Example problems on FBD and EOE

Lecture 4 - Joints in human body

Lecture 5 - Machines and mechanical advantage

Lecture 6 - Levers and types of levers

Lecture 7 - Insertion point and torque

Lecture 8 - Practice problem - 1

Lecture 9 - Practice problem - 2

Lecture 10 - Key terminologies

Lecture 11 - Anatomical planes and axis

Lecture 12 - Sagittal plane movements

Lecture 13 - Coronal plane movements

Lecture 14 - Transverse plane movements

Lecture 15 - Muscles - Muscle fascicles

Lecture 16 - Muscle fibers- Pennation angle

Lecture 17 - More on pennation angle

Lecture 18 - Excitation contraction coupling

Lecture 19 - Sliding filament theory

Lecture 20 - Force length relationship

Lecture 21 - Shoulder joints and muscles

Lecture 22 - Shoulder problem - 1

Lecture 23 - Shoulder problem - 2

Lecture 24 - Elbow theory

Lecture 25 - Elbow problem - 1

Lecture 26 - Elbow problem - 2

Lecture 27 - Elbow problem - 3

Lecture 28 - Wrist theory

Lecture 29 - Finger theory

Lecture 30 - Finger muscles

Lecture 31 - Spine anatomy and movements

Lecture 32 - Spine muscles

Lecture 33 - Spine problem

Lecture 34 - Hip anatomy and movements

Lecture 35 - Hip muscles

Lecture 36 - Hip problem

Lecture 37 - Knee anatomy and movements

Lecture 38 - Knee muscles

Lecture 39 - Knee problem

Lecture 40 - Ankle anatomy and movements

Lecture 41 - Ankle muscles

Lecture 42 - Ankle problem

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Lecture 44 - D.O.F mobility, open/closed chain

Lecture 45 - Forward kinematics and workspace

Lecture 46 - 2R inverse kinematics

Lecture 47 - 3R kinematics forward and inverse

Lecture 48 - D-H parameters

Lecture 49 - Velocity and jacobian

Lecture 50 - 3R velocity

Lecture 51 - Tissues and types of tissues

Lecture 52 - Bone microstructure and cells

Lecture 53 - Properties of bones

Lecture 54 - Wolffs Law and Hookean behavior

Lecture 55 - Elastic properties and stress strain relations

Lecture 56 - Stress strain curve and mechanical properties of biological materials

Lecture 57 - Bending of Bones

Lecture 58 - Viscoelastic modelling

Lecture 59 - Maxwell Model

Lecture 60 - Voight Model

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Lecture 64 - Cartilages, ligaments and tendons

Lecture 65 - Stress strain relations in tendons

Lecture 66 - Tendon forces and factors affecting tendon property

Lecture 67 - Gliding resistance, tendon wrapping and friction forces

Lecture 68 - Enslaving - Intertendinous force transfer and motor units

Lecture 69 - Introduction to enslavement

Lecture 70 - Enslaving effects in finger force production - 1

Lecture 71 - Enslaving effects in finger force production - 2

Lecture 72 - Wrist posture and finger interdependence - 1

Lecture 73 - Wrist posture and finger interdependence - 2

Lecture 74 - Wrist posture and finger interdependence - 3

Lecture 75 - Measurement of orientation in 3D space - Devices

Lecture 76 - Rotation matrices in 2D and 3D

Lecture 77 - Animating using rotation matrices- Matlab Examples

Lecture 78 - Composite rotation matrix and relative orientations

Lecture 79 - Complex numbers and quaternions

Lecture 80 - Singularity, Gimbal Lock, Advantages and disadvantages of parameterization methods

Lecture 81 - Single finger kinematics measurement using IMU's

Lecture 82 - IMU based Full hand kinematics measurement system (HKMS)

Lecture 83 - Demonstration of the Hand Kinematics Measurement System (HKMS)

Lecture 84 - Introduction to Gait and running



**NPTEL : Introduction to Synthetic Biology (Biotechnology)**

**Co-ordinators : Prof. Karthik Raman**

- Lecture 1 - Introduction to Synthetic Biology - Day 1 Part 1
- Lecture 2 - Introduction to Synthetic Biology - Day 1 Part 2
- Lecture 3 - Introduction to Synthetic Biology - Day 1 Part 3
- Lecture 4 - Introduction to Synthetic Biology - Day 1 Part 4
- Lecture 5 - Introduction to Synthetic Biology - Day 2 Part 1
- Lecture 6 - Introduction to Synthetic Biology - Day 2 Part 2
- Lecture 7 - Introduction to Synthetic Biology - Day 2 Part 3
- Lecture 8 - Introduction to Synthetic Biology - Day 2 Part 4
- Lecture 9 - Introduction to Synthetic Biology - Day 3 Part 1
- Lecture 10 - Introduction to Synthetic Biology - Day 3 Part 2
- Lecture 11 - Introduction to Synthetic Biology - Day 3 Part 3
- Lecture 12 - Introduction to Synthetic Biology - Day 3 Part 4
- Lecture 13 - Introduction to Synthetic Biology - Day 4 Part 1
- Lecture 14 - Introduction to Synthetic Biology - Day 4 Part 2
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- Lecture 20 - Introduction to Synthetic Biology - Day 6 Part 1
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- Lecture 31 - Introduction to Synthetic Biology - Day 10 Part 1

[Lecture 32 - Introduction to Synthetic Biology - Day 10 Part 2](#)

[Lecture 33 - Introduction to Synthetic Biology - Day 10 Part 3](#)

- Lecture 1 - Introduction to Different OMICS Approaches and their Applications
- Lecture 2 - Genetic Information in Prokaryotic
- Lecture 3 - Databases and Web Resources to Store and Access the Biological Data
- Lecture 4 - First and Second Generation Sequencing Technologies
- Lecture 5 - Long Read Sequencing and Linked Read Sequencing - Part 1
- Lecture 6 - Long Read Sequencing and Linked Read Sequencing - Part 2
- Lecture 7 - Sequence Formats and Databases for Genomic Analysis
- Lecture 8 - Introduction to Linux
- Lecture 9 - File Handling and Remote Connectivity in Linux
- Lecture 10 - Running Linux Commands and Installation of Genomic Packages
- Lecture 11 - Introduction to R and Applications in Genomic Analysis
- Lecture 12 - Publicly Available Tools and Need for Workstations for Genomic Analysis
- Lecture 13 - Overview of Genomic and Transcriptomic Analysis
- Lecture 14 - Genomic and Transcriptomic Analysis of an Organism with Case Studies
- Lecture 15 - How to Collect and Confirm Sample of the Species to be Sequenced and Transcriptome Sequencing Approaches
- Lecture 16 - Estimating the Amount of Sequencing Coverage for a Genome and Hybrid Sequencing Approaches
- Lecture 17 - Types of Reads, Quality Filtering, Estimating the Genome Complexity and Heterozygosity
- Lecture 18 - Genome Assembly and its Completion Status, Assembly Algorithms
- Lecture 19 - Commonly Used Assembly Tools
- Lecture 20 - Linked-Read Sequencing and Processing
- Lecture 21 - Long Reads Analysis and Assembly Workflow
- Lecture 22 - De novo Assembly Using Genomic and Transcriptomic Reads
- Lecture 23 - Merging Assemblies to Create Hybrid Assembly and Determining the Quality of Assembly
- Lecture 24 - Chromosomal Level Assembly and Case Studies
- Lecture 25 - Identification and Annotation of Repeats in Genomes
- Lecture 26 - De novo Transcriptome Assembly and Making the Coding Gene Set
- Lecture 27 - Prediction of tRNA, rRNA and miRNA in a Genome
- Lecture 28 - Functional Annotation and Identification of Metabolic Pathways in a Genome
- Lecture 29 - Comprehensive Functional Annotation of Predicted Genes in a Genome
- Lecture 30 - Functional Annotation of Predicted Genes by Alternate Methods
- Lecture 31 - Methods and Steps to Perform the Evolutionary Analysis of a Genome

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[Lecture 32 - Methods for Taxonomic Classification and Phylogeny Econstruction and Analysis](#)

[Lecture 33 - Epigenetics, ChIp-seq, Transcriptome and Microarrays for Regulation of Expression](#)

[Lecture 34 - Single Cell Genomics, 10X Chromium Linked-reads and Illumina Sequencing, Single Cell Gene Expression](#)

[Lecture 35 - Application of Multiomics Approaches in Human Health and Diseases Such as Cancer, Diabetes, etc.](#)

[Lecture 36 - Prokaryotic Genome Sequencing and Assembly Approaches](#)

[Lecture 37 - Gene Prediction Approaches and Common Methods for Bacterial Gene Prediction](#)

[Lecture 38 - Common Methods for Annotation of a Bacterial Genome, t-RNA, rRNA, Operon Prediction and Annotation](#)

[Lecture 39 - Phylogenetic Analysis of Bacterial Genomes](#)

[Lecture 40 - Metabolic and Comparative Analysis](#)

[Lecture 41 - Microbiome and Metagenome, Human, Organismal and Environmental Microbiomes](#)

[Lecture 42 - Sequencing and Assembly of Metagenomes, Gene Prediction, Annotation, MAGs - Part 1](#)

[Lecture 43 - Sequencing and Assembly of Metagenomes, Gene Prediction, Annotation, MAGs - Part 2](#)

[Lecture 44 - Taxonomic Analysis Using Amplicon Sequence Variants, Statistical Analysis](#)

Lecture 1 - Introduction to Homeostasis

Lecture 2 - Mechanisms of Homeostasis - Part 1

Lecture 3 - Mechanisms of Homeostasis - Part 2

Lecture 4 - Physiology of muscle - Part 1

Lecture 5 - Physiology of muscle - Part 2

Lecture 6 - Molecular Mechanism of muscle contractility - Part 1

Lecture 7 - Molecular Mechanism of muscle contractility - Part 2

Lecture 8 - How does the heart muscle work? - Part 1

Lecture 9 - How does the heart muscle work? - Part 2

Lecture 10 - Cardiac system : From stimuli to rhythmic muscle contraction - Part 1

Lecture 11 - Cardiac system : From stimuli to rhythmic muscle contraction - Part 2

Lecture 12 - Cardiac system : From stimuli to rhythmic muscle contraction - Part 3

Lecture 13 - Cardiac system : From stimuli to rhythmic muscle contraction - Part 4

Lecture 14 - Rhythmicity of heart beat - Part 1

Lecture 15 - Rhythmicity of heart beat - Part 2

Lecture 16 - Hemodynamics

Lecture 17 - Hemodynamics and Regulation - Part 1

Lecture 18 - Hemodynamics and Regulation - Part 2

Lecture 19 - Hemodynamics and Regulation - Part 3

Lecture 20 - Hemodynamics and Regulation - Part 4

Lecture 21 - Hemodynamics and Regulation - Part 5

Lecture 22 - Hemodynamics and Regulation - Part 6

Lecture 23 - Lymphatic system

Lecture 24 - Excretory system : Kidney - Part 1

Lecture 25 - Excretory system : Kidney - Part 2

Lecture 26 - Excretory system : Kidney - Part 3

Lecture 27 - Kidney and RBC production

Lecture 28 - Excretory system : Nephron - Part 1

Lecture 29 - Excretory system : Nephron - Part 2

Lecture 30 - Excretory system : Nephron - Part 2.1

Lecture 31 - Excretory system : Nephron - Part 3

- Lecture 32 - Excretory system : Regulation of Osmolarity and counter-current mechanism - Part 1
- Lecture 33 - Excretory system : Regulation of Osmolarity and counter-current mechanism - Part 2
- Lecture 34 - Excretory system : Regulation of Osmolarity and counter-current mechanism - Part 3
- Lecture 35 - Physiology and Introduction of Respiration - Part 1
- Lecture 36 - Physiology and Introduction of Respiration - Part 2
- Lecture 37 - Respiration - Part 1
- Lecture 38 - Respiration - Part 2
- Lecture 39 - Respiration - Part 3
- Lecture 40 - Respiration - Part 4
- Lecture 41 - Physiology of smooth muscles and digestive system - Part 1
- Lecture 42 - Physiology of smooth muscles and digestive system - Part 2
- Lecture 43 - Physiology of smooth muscles and digestive system - Part 3
- Lecture 44 - Physiology of smooth muscles and digestive system - Part 4
- Lecture 45 - Secretory functions of alimentary tract - Part 1
- Lecture 46 - Secretory functions of alimentary tract - Part 2
- Lecture 47 - Secretory functions of alimentary tract and Pancreas - Part 1
- Lecture 48 - Secretory functions of alimentary tract and Pancreas - Part 2
- Lecture 49 - Secretory functions of Pancreas and liver
- Lecture 50 - Secretory functions of Liver and Gallbladder
- Lecture 51 - Introduction to Endocrine system
- Lecture 52 - Pituitary gland and growth hormone secretion - Part 1
- Lecture 53 - Pituitary gland and growth hormone secretion - Part 2
- Lecture 54 - Thyroid gland - Part 1
- Lecture 55 - Thyroid gland - Part 2
- Lecture 56 - Hormones of adrenal cortex - Part 1
- Lecture 57 - Hormones of adrenal cortex - Part 2
- Lecture 58 - Physiology of Glucocorticoids - Part 1
- Lecture 59 - Physiology of Glucocorticoids - Part 2
- Lecture 60 - Course Summary

Lecture 1 - What is Biology ?

Lecture 2 - Pillars of Biology

Lecture 3 - Biology and the City

Lecture 4 - The Process of Science

Lecture 5 - A Tale of Forgotten Scientists - Part I

Lecture 6 - A Tale of Forgotten Scientists - Part II

Lecture 7 - Numbers and Scales in Biology - Part I

Lecture 8 - Numbers and Scales in Biology - Part II

Lecture 9 - Experimentation vs Theory\_Discussion

Lecture 10 - How to Find Reliable Information ?

Lecture 11 - How to Read a Scientific Article ?

Lecture 12 - Biomolecules - Part I

Lecture 13 - Biomolecules - Part II

Lecture 14 - Central Dogma

Lecture 15 - Gene Regulation

Lecture 16 - Non-Coding RNA

Lecture 17 - Introduction to Cells

Lecture 18 - Our Favourite Cells - Part I

Lecture 19 - Our Favourite Cells - Part II

Lecture 20 - Cell Cycle

Lecture 21 - Cell Cycle Control

Lecture 22 - Cancer Biology (Guest Lecture) - Dr. Ramray Bhat (IISc)

Lecture 23 - Discussion on Cancer Biology - Dr. Ramray Bhat (IISc) and Dr. Divya Uma (Azim Premji University)

Lecture 24 - Genetics - I

Lecture 25 - Genetics - II

Lecture 26 - Genetics - III

Lecture 27 - Gene Mutations and Genetic Disorders (Guest Lecture) Dr. Antara Das, Azim Premji University

Lecture 28 - Studying Human Genetic Disorders using Transgenic Animals - Research talk (Guest Lecture)

Lecture 29 - Bead Microscopy (Guest Lecture) Dr. Procheta Mallik (ISPF and ThinkTac)

Lecture 30 - Molecular Biology Techniques

Lecture 31 - Bacterial DNA Isolation and PCR - Hands-on (Guest Lecture) Dr. Beena DB (Azim Premji University)

Lecture 32 - BT Cotton - Part 1 (Case study)

Lecture 33 - Molecular Biology Techniques - BT Cotton - Part 2 (Case study)

Lecture 34 - Introduction to Evolution

Lecture 35 - Evidences of Evolution

Lecture 36 - Mechanism of Evolution

Lecture 37 - Misconceptions about Evolution - Discussion

Lecture 38 - Human Evolution

Lecture 39 - Species, Speciation and Biodiversity - I

Lecture 40 - Species, Speciation and Biodiversity - II

Lecture 41 - Measuring Biodiversity (Tutorial)

Lecture 42 - Speciation

Lecture 43 - Speciation (Case studies)

Lecture 44 - Introduction to Ecological Interactions - Part 1

Lecture 45 - Ecological Interactions - Part 2

Lecture 46 - Ecological Interactions - Part 3

Lecture 47 - Mutualism - Figs (Case Study)

Lecture 48 - Seed Dispersal (Case study)

Lecture 49 - Introduction to Public Health (Guest Lecture) Dr. Abha Rao (Public Health Foundation of India)

Lecture 50 - Public Health in India (Guest Lecture) Dr. Abha Rao (Public Health Foundation of India)

Lecture 51 - Discussion on Public Health - Dr. Abha Rao (PHFI) and Mr. Pratush Brahma (University of Florida)

Lecture 52 - Public Health - Rotavirus (Case study)

Lecture 53 - Public Health - Malaria (Case study) - Part 1

Lecture 54 - Public Health - Malaria (Case study) - Part 2

Lecture 55 - Biology and Climate Change - Part 1

Lecture 56 - Biology and Climate Change - Part 2

Lecture 57 - Biology and Climate Change - Part 3

Lecture 58 - Biodiversity Conservation (Guest Lecture) Dr. Krishnapriya Tamma (Azim Premji University)

Lecture 59 - Discussion on Biology and Society

Lecture 60 - Discussion on Art and Science

Lecture 61 - Biology and Society - Case study on Stray Dogs

Lecture 62 - Nature Relatedness

Lecture 63 - Course Wrap-Up



Lecture 1 - History of Neuroscience : Introduction - Part 1

Lecture 2 - History of Neuroscience : Introduction - Part 2

Lecture 3 - Factors that produce discoveries

Lecture 4 - Importance of the 1950s in Neuroscience

Lecture 5 - Advances in Molecular Biology (Genes to DNA)

Lecture 6 - Discovery of the structure of the DNA

Lecture 7 - How DNA works

Lecture 8 - Molecular biology of the human brain

Lecture 9 - Signaling molecule: The First growth Factor

Lecture 10 - Nerve Growth Factor

Lecture 11 - Organizing the Connections

Lecture 12 - Axonal Transport

Lecture 13 - Signaling molecules: The First Neurotransmitter in the brain

Lecture 14 - The concept of Lock and Key

Lecture 15 - The Soup vs Sparks Debate

Lecture 16 - Intracellular Electrode, Neurotransmitter in the Brain, Dales Law

Lecture 17 - Early evidence of Acetylcholine and Glutamate

Lecture 18 - Early evidence of GABA and Serotonin

Lecture 19 - Catecholamine and Hormones

Lecture 20 - Second messengers and Hormones

Lecture 21 - Pheromones

Lecture 22 - Revolution in Cytology

Lecture 23 - Synapse and the 'Neuronism vs Reticularism' debate

Lecture 24 - Contributions by Rene Couteaux and George Koelle

Lecture 25 - Chemical Synapse

Lecture 26 - Synapse and the Neuromuscular Junction

Lecture 27 - The Electrical Synapse and Myelin

Lecture 28 - Physiology: The Action Potential - Part 1

Lecture 29 - Recording nerve impulses and single action potentials

Lecture 30 - Recording from nerve and plant cells

Lecture 31 - Recording Local circuits, Hodgkin and Huxely contributions - Part 1

Lecture 32 - Hodgkin and Huxely model - Part 2 and Kenneth Cole Contributions

Lecture 33 - GHK equation and HH action potentials

Lecture 34 - First Electrophysiological Evidence for Synaptic Transmission

Lecture 35 - Bernard Katz

Lecture 36 - End-Plate Potential and Synaptic Quanta

Lecture 37 - Eccles and Spinal motor neuron

Lecture 38 - Invertebrate simple systems: Aplysia

Lecture 39 - Other studies of sensory responses

Lecture 40 - Legacy of Golgi and Ramo`n y Cajal

Lecture 41 - Dynamic polarization of Neuron

Lecture 42 - Modern Research

Lecture 43 - Synaptic Integration and Action Potential Initiation

Lecture 44 - Active properties of dendrites

Lecture 45 - Dendritic dominance

Lecture 46 - Dendritic spines

Lecture 47 - Rethinking the concept of Neuron Doctrine

Lecture 48 - Muscle spindles

Lecture 49 - Spinal cord pathways

Lecture 50 - Retinal Processing

Lecture 51 - Keffler Hartline

Lecture 52 - Stephen Kuffler and Horace Barlow

Lecture 53 - Expansion of the Reflex concept

Lecture 54 - Central Pptern generators

Lecture 55 - The cortical column

Lecture 56 - Vernon Mountcastle

Lecture 57 - Central Visual Processing

Lecture 58 - Central Visual Processing and Feature Detectors

Lecture 59 - Intracellular recordings from the brain - Part 1

Lecture 60 - Intracellular recordings from the brain - Part 2

Lecture 61 - Two motor systems

Lecture 62 - Auditory cortex and The pattern theory of olfaction

Lecture 63 - Arousal and Reticular activating system

Lecture 64 - Sleep and Rapid Eye Movements

- Lecture 65 - Operant Conditioning by brain stimulation
- Lecture 66 - Hypothalamus and Feeding Behavior
- Lecture 67 - Brain as a gland
- Lecture 68 - Hypothalamic-Neurohypophyseal System
- Lecture 69 - Hypothalamic-Adenohypophyseal System
- Lecture 70 - Founding Modern Neuroanatomy
- Lecture 71 - Psychology and Ethology
- Lecture 72 - Karl Lashley
- Lecture 73 - Donald Hebb
- Lecture 74 - Limbic system- Limbic Lobe and Papez Circuit
- Lecture 75 - Limbic system-Kluver-Bucy Syndrome
- Lecture 76 - The Limbic system and Amygdala
- Lecture 77 - The Hippocampus and Patient H.M
- Lecture 78 - Brenda Milner
- Lecture 79 - Neurology: Foundations of Brain Imaging
- Lecture 80 - The Neurological unit of the Boston City Hospital
- Lecture 81 - Derek Denny-Brown, Raymond Adams and C. Miller Fisher
- Lecture 82 - Montreal Neurological Institute
- Lecture 83 - Cerebral Circulation
- Lecture 84 - Spreading depression of Leo and Migraine
- Lecture 85 - The Eradication of Polio
- Lecture 86 - Origin of Neurosurgery
- Lecture 87 - Harvey Cushing
- Lecture 88 - Pituitary Surgery
- Lecture 89 - Stereotaxy
- Lecture 90 - Epilepsy
- Lecture 91 - Psychosurgery
- Lecture 92 - Antipsychotic Drugs
- Lecture 93 - Reserpine
- Lecture 94 - Monoamine Oxidase Inhibitors
- Lecture 95 - Lithium
- Lecture 96 - Benzodiazepines
- Lecture 97 - Stress



Lecture 1 - Basic concepts in microscopy - 1

Lecture 2 - Basic concepts in microscopy - 2

Lecture 3 - Dark-field and phase contrast microscopy

Lecture 4 - Differential interference contrast and polarization

Lecture 5 - Fluorescence and confocal microscopy

Lecture 6 - Transmission electron microscopy

Lecture 7 - Transmission electron microscopy cont. and scanning electron microscopy

Lecture 8 - Basic concepts - 1

Lecture 9 - Basic concepts - 2

Lecture 10 - GM counting and Scintillation counting

Lecture 11 - Scintillation counting continued

Lecture 12 - Autoradiography and RIA

Lecture 13 - Safety aspects and applications

Lecture 14 - Introduction and Basic concepts in chromatography - 1

Lecture 15 - Basic concepts in chromatography - 2

Lecture 16 - Low-pressure liquid chromatography (LPLC) and high performance liquid chromatography (HPLC)

Lecture 17 - Ion-exchange chromatography

Lecture 18 - Gel-filtration chromatography

Lecture 19 - Affinity chromatography

Lecture 20 - Gas-liquid chromatography

Lecture 21 - Basic concepts in electrophoresis

Lecture 22 - Horizontal and vertical gel electrophoresis

Lecture 23 - Native gel electrophoresis and SDS-PAGE

Lecture 24 - Isoelectric focusing (IEF), 2-D gel electrophoresis and protein detection methods

Lecture 25 - Electrophoresis of nucleic acids

Lecture 26 - Immunoelectrophoresis and capillary electrophoresis

Lecture 27 - Introduction and Basic Concepts - 1

Lecture 28 - Basic concepts - 2

Lecture 29 - Types of centrifuges and analytical ultracentrifugation method

Lecture 30 - Separation methods in preparative ultracentrifuges

Lecture 31 - Types of rotors

[Lecture 32 - Types of rotors cont. and care of rotors](#)

[Lecture 33 - Introduction and basic concepts](#)

[Lecture 34 - UV-Visible spectroscopy](#)

[Lecture 35 - Infrared and fluorescence spectroscopy](#)

[Lecture 36 - Circular dichroism \(CD\) spectroscopy](#)

[Lecture 37 - Nuclear magnetic resonance \(NMR\) spectroscopy and X-ray crystallography](#)

[Lecture 38 - Atomic spectroscopy and mass spectrometry](#)

[Lecture 39 - Polymerase chain reaction\(PCR\)](#)

[Lecture 40 - DNA sequencing methods](#)

[Lecture 41 - Enzyme linked immunosorbent assay \(ELISA\)](#)

Lecture 1 - Introduction to Nano

Lecture 2 - Nano-Biomimicry

Lecture 3 - Synthesis of nanomaterials by Physical and Chemical Methods

Lecture 4 - Synthesis of nanomaterials by Biological Methods

Lecture 5 - Characterisation of Nanomaterials

Lecture 6 - DNA Nanotechnology

Lecture 7 - Protein and Glyco Nanotechnology

Lecture 8 - Lipid Nanotechnology

Lecture 9 - Bio-Nanomachines

Lecture 10 - Carbon nanotubes and Its Bio-Applications

Lecture 11 - Nanomaterials for Cancer Diagnosis

Lecture 12 - Nanomaterials for Cancer therapy

Lecture 13 - Nanotechnology in Tissue Engineering

Lecture 14 - Nano artificial cells

Lecture 15 - Nanotechnology in Organ Printing

Lecture 16 - Nanotechnology in Point-of-Care Diagnostics

Lecture 17 - Nano-Pharmacology and Drug Targeting

Lecture 18 - Cellular uptake mechanisms of nanomaterials

Lecture 19 - In vitro Methods to study antibacterial and anticancer properties of nanomaterials

Lecture 20 - Nanotoxicology

- Lecture 1 - Life Cycle of an Angiosperm
- Lecture 2 - Characteristics of Plant Growth and Development - I
- Lecture 3 - Characteristics of Plant Growth and Development - II
- Lecture 4 - Molecular Genetics of Plant Development - I
- Lecture 5 - Molecular Genetics of Plant Development - II
- Lecture 6 - Molecular Genetics of Plant Development - III
- Lecture 7 - Molecular Genetics of Plant Development - IV
- Lecture 8 - Molecular Genetics of Plant Development (Continued...) - I
- Lecture 9 - Molecular Genetics of Plant Development (Continued...) - II
- Lecture 10 - Molecular Genetics of Plant Development (Continued...) - III
- Lecture 11 - Root Development
- Lecture 12 - Root Development (Continued...)
- Lecture 13 - Root Development (Vascular Development)
- Lecture 14 - Root Branching: Lateral Root Development
- Lecture 15 - Shoot Development: SAM Maintenance
- Lecture 16 - Shoot Development: Organogenesis
- Lecture 17 - Shoot Development: Leaf Development
- Lecture 18 - Shoot Development: Flowering
- Lecture 19 - Cell-Cell Communication During Plant Development
- Lecture 20 - Techniques Used in Lab



Lecture 1 - Introduction: Why to Study Structural Biology

Lecture 2 - Introduction to Biological Macromolecules

Lecture 3 - Introduction: Decoding Biological Macromolecules

Lecture 4 - Introduction: Genome Sequencing

Lecture 5 - Introduction: Post Genomic Era

Lecture 6 - Amino acids and their properties

Lecture 7 - Protein: Protein Chemistry, Chirality, Peptide bond and Levels of protein structures

Lecture 8 - Protein: Dihedral angles, Peptide bond and Ramachandran Plot

Lecture 9 - Protein: Super Secondary Structures, Motif, Domains, Non-covalent interactions

Lecture 10 - Protein: Folding of Protein, Thermodynamics and Kinetics of protein folding, Characterization of Proteins

Lecture 11 - Introduction to Structural Biology Techniques - Part I

Lecture 12 - Introduction to Structural Biology Techniques - Part II

Lecture 13 - X-ray Crystallography: Crystallization - Part I

Lecture 14 - X-ray Crystallography: Crystallization - Part II

Lecture 15 - X-ray Crystallography: Crystal Mounting

Lecture 16 - X-ray Crystallography: Production of X-ray and its properties

Lecture 17 - X-ray Crystallography: Journey to 3D land

Lecture 18 - X-ray Crystallography: Crystal Symmetry

Lecture 19 - X-ray Crystallography: Instrumentation in X-ray Crystallography

Lecture 20 - X-ray Crystallography: Data collection and processing

Lecture 21 - X-ray Crystallography: Data Analysis - Part I

Lecture 22 - X-ray Crystallography: Data Analysis - Part II

Lecture 23 - X-ray Crystallography: Phase Problem - Part I

Lecture 24 - X-ray Crystallography: Phase Problem - Part II

Lecture 25 - X-ray Crystallography: Refinement and Structure deposition to PDB

Lecture 26 - Introduction to Spectroscopy and NMR

Lecture 27 - Basic Principles of NMR and Instrumentation

Lecture 28 - NMR Sample Preparation and Chemical Shift related concepts

Lecture 29 - Factors effecting NMR Spectra (1D and 2D)

Lecture 30 - 2D and 3D NMR Spectroscopy focusing on protein structure

Lecture 31 - Introduction to Spectroscopy

[Lecture 32 - UV-Vis and CD spectroscopy](#)

[Lecture 33 - Fluorescence Spectroscopy and Green Fluorescence Protein \(GFP\)](#)

[Lecture 34 - Infrared and Raman Spectroscopy for protein](#)

[Lecture 35 - Raman Spectroscopy, Raman Microscopy and Raman Crystallography for studying protein](#)

[Lecture 36 - Introduction to Microscopy](#)

[Lecture 37 - Functioning details of Cryo Electron Microscopy \(Cryo EM\)](#)

[Lecture 38 - Cryo Electron Microscopy: Data Collection and Analysis](#)

[Lecture 39 - A concise story of advancement Cryo-EM](#)

[Lecture 40 - Protein Data Bank](#)

[Lecture 41 - History of Molecular Visualizations of Biological Macromolecules](#)

[Lecture 42 - Description of structure related files \(.pdb, .mmCIF, .mtz, etc.\)](#)

[Lecture 43 - Demonstration of COOT](#)

[Lecture 44 - 3D visualization using Pymol](#)

[Lecture 45 - Demonstration of Pymol](#)

[Lecture 46 - Why we need MD Simulation](#)

[Lecture 47 - Molecular Dynamic Simulation Process - Part I](#)

[Lecture 48 - Molecular Dynamic Simulation Process - Part II](#)

[Lecture 49 - Molecular Dynamic Simulation Process - Part III](#)

[Lecture 50 - Application of Molecular Dynamic Simulation](#)

[Lecture 51 - What, How and Which of Protein Engineering](#)

[Lecture 52 - How to make logical Protein Engineering: Process of Rational design](#)

[Lecture 53 - Success story of Rational Protein designing: Focusing on De Novo Process](#)

[Lecture 54 - Designing Protein by mimicking nature: Process of Directed Evolution](#)

[Lecture 55 - Achievement, Challenges, and Future direction in the field of Protein Engineering](#)

[Lecture 56 - Introduction to Structure Based Drug Discovery \(SBDD\)](#)

[Lecture 57 - Rational Drug Discovery](#)

[Lecture 58 - Docking Based Virtual Screening: Progress, Challenges and Future perspective](#)

[Lecture 59 - What makes a small molecule an ideal drug: Developing in silico ADMETox Model](#)

[Lecture 60 - Structure Based Drug Discovery: Case study and Conclusion](#)

Lecture 1 - Introduction to Learning and Memory - I : Historical perspective

Lecture 2 - Introduction to Learning and Memory - II : Classification

Lecture 3 - Associative Learning I : Rules of Associative learning

Lecture 4 - Associative learning II : Garcia and Koelling's Experiment, Kamin's Blocking Experiment

Lecture 5 - Introduction to the Rescorla Wagner Model

Lecture 6 - Application of Rescorla Wagner Model - I

Lecture 7 - Application of Rescorla Wagner Model - II

Lecture 8 - Application of Rescorla Wagner Model - III

Lecture 9 - Application of Rescorla Wagner Model - IV

Lecture 10 - Limitations of Rescorla Wagner Model

Lecture 11 - Introduction of Reinforcement Learning - I : Thorndike's view, Tolman's views, Skinner Box

Lecture 12 - Introduction of Reinforcement Learning - II : Classification, Thorndike's view, Tolman's views, Skinner Box (Continued...)

Lecture 13 - Introduction of Reinforcement Learning - III : Understanding scheduling of reinforcers in operant conditioning

Lecture 14 - Sign Tracking vs Goal Oriented/Tracking; Linking complex behaviors to simple molecules

Lecture 15 - Sign Tracking vs Goal Oriented; Learning Linking complex behaviors to simple molecules - II

Lecture 16 - Memory in Molecular Terms - I : Protein synthesis in memory consolidation

Lecture 17 - Memory in Molecular Terms - II : Long term potentiation

Lecture 18 - Memory in Molecular Terms - III : Properties of a memory molecule

Lecture 19 - Memory in Molecular Terms - IV : Remote memory and its characteristics

Lecture 20 - Memory in Molecular Terms - V : Selective labelling of memory encoding neurons and their manipulation

Lecture 1 - Drug Delivery Introduction and Pharmacokinetics

Lecture 2 - Pharmacokinetics (Continued...)

Lecture 3 - Pro-drugs and Polymers Introduction

Lecture 4 - Polymers - Synthesis

Lecture 5 - Polymers - Properties

Lecture 6 - Biomedical Polymers

Lecture 7 - Biodegradable Polymers and Polymer Drug Conjugates - I

Lecture 8 - Polymer Drug Conjugates - II

Lecture 9 - Research Paper Discussion and Diffusion Controlled Systems

Lecture 10 - Controlled Release: Reservoir System - I

Lecture 11 - Controlled Release: Reservoir Systems and Non-erodible Systems

Lecture 12 - Controlled Release: Non-erodible Systems and Erodible systems

Lecture 13 - Math Exercise

Lecture 14 - Hydrogels - I

Lecture 15 - Hydrogels - II

Lecture 16 - Hydrogels - III

Lecture 17 - Hydrogels - IV

Lecture 18 - Nano and Micro-particles - I

Lecture 19 - Nano and Micro-particles - II

Lecture 20 - Nano and Micro-particles - III

Lecture 21 - Nano and Micro-particles - IV

Lecture 22 - Nano and Micro-particles - V

Lecture 23 - Nano and Micro-particles - VI

Lecture 24 - Nano and Micro-particles - VII

Lecture 25 - Protein Adsorption - I

Lecture 26 - Protein Adsorption - II

Lecture 27 - Protein Adsorption - III

Lecture 28 - Tissue Engineering - I

Lecture 29 - Tissue Engineering - II

Lecture 30 - Tissue Engineering - III

Lecture 31 - Drug Delivery in Tissue Engineering - I

- Lecture 32 - Drug Delivery in Tissue Engineering - II
- Lecture 33 - Implant Associated Infections - I
- Lecture 34 - Implant Associated Infections - II
- Lecture 35 - Route Specific Delivery: Oral Route - I
- Lecture 36 - Route Specific Delivery: Oral Route - II
- Lecture 37 - Route Specific Delivery: Oral and Subcutaneous Route
- Lecture 38 - Route Specific Delivery: Intramuscular, Transdermal - I
- Lecture 39 - Route Specific Delivery: Transdermal - II
- Lecture 40 - Route Specific Delivery: Transdermal and Inhalation Route
- Lecture 41 - Route Specific Delivery: Inhalation - II, Buccal and Rectal Administration
- Lecture 42 - Research Paper Discussion: Dry Powder Particle Delivery
- Lecture 43 - Route Specific Delivery: Intra-articular and Intravenous Administration
- Lecture 44 - Intravenous Administration: Approved Nanocarriers and Immune System
- Lecture 45 - Immune System - II
- Lecture 46 - Complement System and Blood Clotting
- Lecture 47 - Blood Clotting and Hemocompatibility of Materials; Adaptive Immune Response
- Lecture 48 - Adaptive Immune Response and Vaccine
- Lecture 49 - Vaccines
- Lecture 50 - Vaccines and Immuno-isolated Cell Therapy
- Lecture 51 - Immuno-isolated Cell Therapy
- Lecture 52 - Immuno-isolated Cell and Gene Therapy
- Lecture 53 - Gene Delivery: Vectors
- Lecture 54 - Gene Delivery: Polymers
- Lecture 55 - Genes as Vaccines
- Lecture 56 - Vaccines: Gene Delivery and Other Variants
- Lecture 57 - Cancer Vaccines
- Lecture 58 - Cancer Vaccine: Immunotherapy
- Lecture 59 - Responsive Delivery Systems - I
- Lecture 60 - Responsive Delivery Systems - II
- Lecture 61 - Targeted Drug Delivery System
- Lecture 62 - Targeted Drug Delivery System: Research Paper Discussion
- Lecture 63 - Nanotoxicology and Translation Pathways

Lecture 1 - Introduction

Lecture 2 - Substrate

Lecture 3 - Substrate (Continued...)

Lecture 4 - Introduction to cleanroom

Lecture 5 - Contamination and surface cleaning

Lecture 6 - Advanced cleaning techniques

Lecture 7 - Defects

Lecture 8 - Diffusion

Lecture 9 - Diffusion - Advanced Concepts

Lecture 10 - Ion Implantation

Lecture 11 - Ion Implantation (Continued...)

Lecture 12 - Native Films

Lecture 13 - Native Films: Advanced Concepts

Lecture 14 - Native Films: Defects at Si/SiO<sub>2</sub> interface

Lecture 15 - Methods and Some Definitions

Lecture 16 - Chemical Vapor Deposition: Basics

Lecture 17 - Chemical Vapor Deposition: Precursor Transport

Lecture 18 - Chemical Vapor Deposition: Types of CVD Equipment

Lecture 19 - Chemical Vapor Deposition: Nucleation and Growth

Lecture 20 - Chemical Vapor Deposition: Other Details

Lecture 21 - Atomic Layer Deposition

Lecture 22 - Atomic Layer Deposition (Continued...)

Lecture 23 - Physical Vapor Deposition: Basics

Lecture 24 - Physical Vapor Deposition: Evaporation

Lecture 25 - Physical Vapor Deposition: Sputtering

Lecture 26 - Metallization: Contact resistance

Lecture 27 - Metallization: Electromigration and Epilogue

Lecture 28 - Pattern Transfer Basics

Lecture 29 - Optical lithography basics: resist process - 1

Lecture 30 - Optical lithography basics: resist process - 2

Lecture 31 - Optical Lithography: Contact and Proximity printing

- Lecture 32 - Optical Lithography: Stepper and Scanner
- Lecture 33 - Projection Lithography: Image formation basics
- Lecture 34 - Projection Lithography: Image formation in photoresist
- Lecture 35 - Optical lithography: Surface Reflection
- Lecture 36 - Optical Lithography: Mask Technology
- Lecture 37 - Lithography process technology glossary
- Lecture 38 - Optical Lithography: Resolution enhancement
- Lecture 39 - Electron beam lithography: Basics
- Lecture 40 - Electron beam lithography: Resist process
- Lecture 41 - Emerging lithography techniques
- Lecture 42 - Etching Figures of Merit
- Lecture 43 - Wet etching Basics
- Lecture 44 - Wet Etching Recipes
- Lecture 45 - Wet Etching Recipes
- Lecture 46 - Dry etch: Plasma Basics
- Lecture 47 - Dry etch: Plasma etching basics
- Lecture 48 - Dry etch: Plasma tool configuration
- Lecture 49 - Dry etch: Etch mechanism
- Lecture 50 - Dry etch: Etch chemistry
- Lecture 51 - Chemical Mechanical Polishing (CMP): Basics
- Lecture 52 - Chemical Mechanical Polishing (CMP): Tool and process
- Lecture 53 - Design for Manufacturability - 1
- Lecture 54 - Design for Manufacturability - 2
- Lecture 55 - Design for Manufacturability: Case study
- Lecture 56 - Process integration
- Lecture 57 - PV integration
- Lecture 58 - CMOS integration
- Lecture 59 - Lab demo: Silicon Nitride cantilever fabrication - 1
- Lecture 60 - Lab demo: Silicon Nitride cantilever fabrication - 2
- Lecture 61 - CMOS process for photonics application

**NPTEL : NOC:Optical Spectroscopy and Microscopy: Fundamentals of Optical Measurements and Instrumentation  
(Biotechnology)**

**Co-ordinators : Prof. Balaji Jayaprakash**

- Lecture 1 - Optical Focus and Localisation of Light
- Lecture 2 - Relating Photon's Momentum to Spot Size
- Lecture 3 - Shortest Pulse of Light: How fast can we shutter the light?
- Lecture 4 - Behaviour of light through polarizers: Introduction
- Lecture 5 - Nature of Light: Introduction to Photo Multiplier Tubes
- Lecture 6 - Revisiting Polarisation Through Ket Vectors
- Lecture 7 - Light through Polarisers: Detailed Description - I
- Lecture 8 - Light through Polarisers: Detailed Description - II
- Lecture 9 - Time Dependent Perturbation Theory (TDPT): Overview
- Lecture 10 - TDPT in Steps-1: Unperturbed and Perturbed Hamiltonian
- Lecture 11 - TDPT in Steps-2: Introducing the switch and first approximation
- Lecture 12 - TDPT in Steps-3: Finding the co-efficients
- Lecture 13 - Fermi's Golden Rule
- Lecture 14 - Beer Lambert's Law from TDPT
- Lecture 15 - Einstein's Phenomenology
- Lecture 16 - Einstein's Coefficients, Fluorescence and Lifetime
- Lecture 17 - Fock States and Photonic Treatment of Light
- Lecture 18 - Operators in Fock State Space
- Lecture 19 - Light Matter Interaction and Rudimentary Feynman Diagrams
- Lecture 20 - Emergence of Spontaneous and Stimulated Emission Processes
- Lecture 21
- Lecture 22
- Lecture 23
- Lecture 24
- Lecture 25
- Lecture 26 - Introduction to LASER
- Lecture 27 - LASER population dynamics
- Lecture 28 - LASER population dynamics - Part- 2
- Lecture 29 - Real world LASER and characteristics of LASER emission
- Lecture 30 - Temporal and Spatial Coherence



- Lecture 31 - Transverse and Longitudinal modes of LASER
- Lecture 32 - Pulsed LASER
- Lecture 33 - Q-switching in detail
- Lecture 34 - Q-switching in detail - Part 2
- Lecture 35 - Basics of mode locking
- Lecture 36 - Basics of mode locking - Part 2
- Lecture 37 - Pulse compression
- Lecture 38 - Real world system (Mode lock Part-2)
- Lecture 39 - TEM mode
- Lecture 40 - Alignment basics
- Lecture 41 - Non-Linear Optics
- Lecture 42 - Confocal Detection
- Lecture 43 - Interference Filters
- Lecture 44 - Laser Scanning System - 1
- Lecture 45 - Laser Scanning System - 2
- Lecture 46 - Alignment of Moving Beams
- Lecture 47 - Decoding an Objective Lens - 1
- Lecture 48 - Decoding an Objective Lens - 2
- Lecture 49 - Designing Lens Systems
- Lecture 50 - Astigmatism and Field Curvature
- Lecture 51 - Intro to Lab Session
- Lecture 52 - Optics in LAB: Aligning light through an optical fiber - 1
- Lecture 53 - Optics in Lab: Telescope
- Lecture 54 - Kinematic Mounts
- Lecture 55 - Alignment with out iris
- Lecture 56 - Fluorescence Spectrometer - 1
- Lecture 57 - Fluorescence Spectrometer - 2
- Lecture 58 - Ti:Sapphire Laser and Two Photon Fluorescence

Lecture 1 - Introduction to Cell Biology, Cell components, organization and processes - Part I

Lecture 2 - Introduction to Cell Biology, Cell components, organization and processes - Part II

Lecture 3 - DNA: The genetic material - Part I

Lecture 4 - DNA: The genetic material - Part II

Lecture 5 - Regulation of the cell cycle - Part I

Lecture 6 - Regulation of the cell cycle - Part II

Lecture 7 - Checkpoints: The DNA damage and DNA replication checkpoints

Lecture 8 - The Ubiquitin Proteasome system

Lecture 9 - S-phase: Regulation of entry into S-phase and DNA Replication

Lecture 10 - DNA replication - Part I

Lecture 11 - DNA Replication - Part II

Lecture 12 - DNA Replication - Part III

Lecture 13 - DNA Replication - Part IV

Lecture 14 - Mitosis - Part I

Lecture 15 - Cytokinesis

Lecture 16 - Aging and Senescence

Lecture 17 - Apoptosis - Part I

Lecture 18 - Apoptosis - Part II

Lecture 19 - Meiosis - Part I

Lecture 20 - Meiosis - Part II

Lecture 21 - Nuclear organization

Lecture 22 - SMC proteins and chromosome organization - Real-Time imaging of DNA loop-extrusion by SMC complexes

Lecture 23 - The cohesin complex and its functions - The mysterious biological function of chromosome loops

Lecture 24 - Chromatin organization

Lecture 25 - SMC proteins and chromosome organization - Introduction

Lecture 26 - Meiosis - Part III

Lecture 27 - Mitosis - Part II

Lecture 28 - Cell diversity and properties of specialized cells-Budding yeast as a model system

Lecture 29 - The Plant Cell

Lecture 30 - Stem cells - Part I Intro-SL

Lecture 31 - Stem cells - Part II

[Lecture 32 - Nerve cells](#)

[Lecture 33 - The Cancer Cell](#)

- Lecture 1 - Course Introduction - I
- Lecture 2 - Course Introduction - II
- Lecture 3 - Neuro anatomy for Neurosurgery
- Lecture 4 - Neural Implant Fabrication: PVD - I
- Lecture 5 - Neural Implant Fabrication: PVD - II
- Lecture 6 - Rodent Neuroanatomy
- Lecture 7 - Basics of BCI and Signal Processing
- Lecture 8 - Neural Implant Fabrication: Sputtering and CVD
- Lecture 9 - Principles of Stereotactic Rodent MicroNeurosurgery
- Lecture 10 - Neural Signal Processing: Demonstrations
- Lecture 11 - Neural Implant Fabrication: Photolithography - I
- Lecture 12 - Neural Implant Fabrication: Photolithography - II
- Lecture 13 - Craniotomy and Stereotactic Implantation Surgeries
- Lecture 14 - Lithography Numericals
- Lecture 15 - IDE Patterning
- Lecture 16 - Etching
- Lecture 17 - Introduction to Cleanroom and Gowning
- Lecture 18 - E-Beam Evaporation Demonstration
- Lecture 19 - Craniotomy and Cranial Window Surgeries
- Lecture 20 - Flexible MEA: Introduction and Process Flow
- Lecture 21 - Flexible MEA: EIB, Characterization and Analyses
- Lecture 22 - Stereotactic Implantation Surgeries
- Lecture 23 - Sputtering Demonstration
- Lecture 24 - 3D Printing - Part I
- Lecture 25 - Bioresorbable Microelectrode Array-based System
- Lecture 26 - Fundamentals of Spinal Neuroanatomy
- Lecture 27 - 3D Printing - Part II
- Lecture 28 - Neural Implant - Microneedle
- Lecture 29 - Spinal Cord Structure, and Circuits
- Lecture 30 - Surgical Steps in Spinal Surgeries
- Lecture 31 - 3D Printing - Part III

- Lecture 32 - 3D Printing - Demonstration
- Lecture 33 - Wet Etching Demonstration
- Lecture 34 - Neural Implants for Parkinson's Disease
- Lecture 35 - Spinal micro neuro Surgery
- Lecture 36 - Anesthesia in Rodents
- Lecture 37 - Physiological Monitoring in Rodents
- Lecture 38 - Lithography Demonstration
- Lecture 39 - Electronic System Development for Neural Engineering - I
- Lecture 40 - Anesthesia Administration Equipments and Vital Monitoring
- Lecture 41 - Standard Safety Practices
- Lecture 42 - Euthanasia
- Lecture 43 - Euthanasia in Rodents
- Lecture 44 - Electronic System Development for Neural Engineering - II
- Lecture 45 - Rodent Brain and Spinal Cord Harvest
- Lecture 46 - Rodent Behavioural Setups
- Lecture 47 - Study Plan for Behavioural Setups: Stroke Model
- Lecture 48 - PCB Design Demonstration for Neural Systems
- Lecture 49 - Electronic Systems for Brain Stimulation - I
- Lecture 50 - Behavioural Tasks in Rodent Models - I
- Lecture 51 - Behavioural Tasks in Rodent Models - II
- Lecture 52 - Behavioural Setup for Rodents: Parkinsonism Model - I
- Lecture 53 - Behavioural Setup for Rodents: Parkinsonism Model - II
- Lecture 54 - Electronic Systems for Brain Stimulation - II
- Lecture 55 - Course Concluding Remarks

Lecture 1 - Course Overview - I

Lecture 2 - Course Overview - II

Lecture 3 - Design Equations - I

Lecture 4 - Design Equations - Illustrative Examples

Lecture 5 - Design Equations - II : Plug Flow Reactors

Lecture 6 - Illustrative Examples : 1) Plug Flow Reactor 2) Multiple reactions - I

Lecture 7 - Illustrative Examples : 1) Recycle Reactor with Condenser 2) CSTR with Recycle

Lecture 8 - Multiple Reactions - II

Lecture 9 - Modelling Multiple Reactions in Soil Environment - III

Lecture 10 - Semi Continuous Reactor Operation

Lecture 11 - Catalyst Deactivation - I

Lecture 12 - Catalyst Deactivation - II

Lecture 13 - Illustrative Example : 1) Determination of deactivation Parameters 2) Design for Deactivating Catalyst

Lecture 14 - Energy Balance - I

Lecture 15 - Energy Balance - II

Lecture 16 - Reacting Fluids as Energy Carrier

Lecture 17 - Illustrative Example : Energy Balance in Stirred Vessels

Lecture 18 - Energy Balance - III : Design for Constant T Operation

Lecture 19 - Energy Balance - IV : Temperature Effects on Rate & Equilibria

Lecture 20 - Energy Balance - V : Stability Analysis of Exothermic Stirred Tank

Lecture 21 - Illustrative Example : Stability of Exothermic Stirred Tank

Lecture 22 - Energy Balance - VI : 1) Tubular Reactor Heated/Cooled from Wall 2) Transient Behavior of CSTR

Lecture 23 - Illustrative Example : 1) Plug Flow with Heat Effects 2) Multiple Reactions

Lecture 24 - Illustrative Example : 1) Further Considerations in Energy Balance 2) Multiple Reactions

Lecture 25 - Illustrative Example : 1) Hot Spot as Design Basis 2) Design for Instantaneous Reactions

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Lecture 27 - Residence Time Distribution Models

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- Lecture 37 - Return probability estimates in various dimensions and effect of bias in 1-D
- Lecture 38 - Dependence of first time return probability ( $F_k$ ) on steps
- Lecture 39 - Equilibrium solutions in lattice random walk models
- Lecture 40 - Equilibrium solution to Ehrenfest's flea model
- Lecture 41 - Differential equation formulation of stochastic phenomena
- Lecture 42 - Derivation of Fokker-Planck equation
- Lecture 43 - Generalized transition probability functions for Fokker-Planck equation
- Lecture 44 - Solution to 1-D Fokker-Planck equation for free particle: Method of Fourier
- Lecture 45 - General non-gaussian solution to translationally invariant Chapman-Kolmogorov
- Lecture 46 - Cauchy distribution, power-law and other non-gaussian solutions
- Lecture 47 - Wiener process and solution to absorbing barrier problems from Fokker-Planck
- Lecture 48 - Application of Fourier Sine transform for single absorber problem
- Lecture 49 - Setting up Langevin equation for velocity fluctuations of Brownian particles
- Lecture 50 - Understanding the origin of systematic and random parts of force from kinetic
- Lecture 51 - Kinetic derivation of a formula for delta-correlated random force
- Lecture 52 - Mean square velocity, thermal equilibrium and relationship between relaxation
- Lecture 53 - Velocity autocorrelation in Brownian motion
- Lecture 54 - Derivation of Stokes-Einstein relationship between diffusion coefficient and
- Lecture 55 - Alternative derivation of Stokes-Einstein relationship and Brownian motion with
- Lecture 56 - Numerical simulation of the Langevin equation
- Lecture 57 - Derivation of Klein-Kramers equation from Langevin equation for joint
- Lecture 58 - Illustrative solutions to the Klein-Kramers equation
- Lecture 59 - Numerical simulation: Sampling from general distributions and Central
- Lecture 60 - Numerical simulation of Random walk trajectories and method of solving Fokker

[Lecture 1](#)

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[Lecture 40](#)

**NPTEL : Interfacial Engineering (Chemical Engineering)**

**Co-ordinators : Prof. A.N. Bhaskarwar**

Lecture 1 - General Introduction Definitions

Lecture 2 - General Introduction, Definitions, Surface Tension

Lecture 3 - Surface Tension Free Energies and Adsorption

Lecture 4 - Properties over Curved Surfaces

Lecture 5 - Total Surface Energy

Lecture 6 - Interfacial Tension Entropy, Cohesion, Adhesion

Lecture 7 - Cohesion, Adhesion and Spreading

Lecture 8 - Spreading from Liquids and Solids

Lecture 9 - Spreading, Interfacial Tensions, Surface Tensions

Lecture 10 - Spreading, Contact Angles Free Energies

Lecture 11 - Spreading/Contact Angles Rough Surfaces, Free Energies

Lecture 12 - Spreading/Contact Angles Work of Adhesion, De-wetting

Lecture 13 - Work of Adhesion, Surface and Interfacial Tensions

Lecture 14 - Surface and Interfacial Tensions: Drop Weight and Wilhelmy Plate Methods

Lecture 15 - Surface and Interfacial Tensions: Wilhelmy Plate, Pendant Drop and Maximum Bubble Pressure Methods

Lecture 16 - Wetting Balance Method Spreading Coefficient Work of Adhesion Sessile Drop Method, Positive S

Lecture 17 - Indirect and Direct Methods for Positive S, Adhesion Energies Interfacial Potentials

Lecture 18 - Surface and Interfacial Potentials Distribution and Contact Potentials

Lecture 19 - Diffusion Potential Surface and Interfacial Potentials Components of Contact Potential

Lecture 20 - Electrically Charged Monolayers Gouy Theory

Lecture 21 - Equations of State, Cohesion Repulsion, Limiting Area

Lecture 22 - Condensed and Liquid Expanded Monolayers Phase Transformations

Lecture 23 - Films of Polymers Molecular Weight, Surface Viscosity Drag, Canal Method

Lecture 24 - Canal Method Joly's Semi-Empirical Correction Rotational Torsional Surface Viscometer Compressional Moduli

Lecture 25 - Magnitudes of Surface Compressional Moduli Surface Waves and Ripples

Lecture 26 - Surface waves and Ripples, Velocity Effect of Surface Tension and Surface Compressional Modulus Rates of adsorption and absorption Damping

Lecture 27 - Surface waves and ripples, velocity effect of surface tension and surface compressional modulus damping for clean and contaminated, surfaces, fiber from monolayers

Lecture 28 - Shear Elastic Moduli, Yield Stress Fibres from MLs, Surface Reactions

Lecture 29 - Surface Reactions, Comparison with Bulk-Phase Reactions Steric Factors, Inhibition

Lecture 30 - Hydrolyses of Esters by Alkali Acid or Enzyme Photochemical Reactions in Monolayers Polymerization in MLs,

Lactonization

Lecture 31 - Catalytic Effects Reactions in Emulsions Complex Formation

Lecture 32 - Complex Formation Penetration into Monolayers Thermodynamics of Penetration Adsorption from Vapour Phase Mass Transfer

Lecture 33 - Introductory Concepts Resistances and their Magnitudes Evaporation and its Retardation

Lecture 34 - Evaporation and its Retardation Resistances and their Analysis Diffusional Resistance in Gas Phase

Lecture 35 - Resistances in Liquid Phase and Interface and Their Importance Some Effects and Applications, Theory

Lecture 36 - Surface Instability Theories of Mass Transfer Experiments on static and Dynamic Systems

Lecture 37 - Colloida, Aerosols, Emulsions Foams, Coagulation Smoluchowski's Theory

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Lecture 65 (31A)

Lecture 1 - Flowsheet Synthesis - I

Lecture 2 - Flowsheet Synthesis - II

Lecture 3 - Mass Balance - I

Lecture 4 - Mass Balance - II

Lecture 5 - Mass and Energy Balance of Complete Flowsheet

Lecture 6 - Equipment Sizing and Costing

Lecture 7 - Economic Evaluation

Lecture 8 - Design of Batch Plants

Lecture 9 - Simulations for Process Flowsheet

Lecture 10 - Optimization Methods used for Designing

Lecture 11 - Heat Exchanger Network Design - 1

Lecture 12 - Heat Exchanger Network Design - 2

Lecture 13 - Geometric Methods for Reactor Network Synthesis

Lecture 14 - Optimization Methods for Process Design - 1

Lecture 15 - Optimization Methods for Process Design - 2

Lecture 16 - Quantifying Sustainability for Design

Lecture 17 - Process Network Analysis and Footprint Assessment

Lecture 18 - Energy, Exergy and Emergy

Lecture 19 - Ecosystems in Sustainability Assessment

Lecture 1 - Introduction to heat transfer

Lecture 2 - General heat conduction equation

Lecture 3 - One dimensional steady state conduction in rectangular coordinate

Lecture 4 - One dimensional steady state conduction in cylindrical and spherical coordinate

Lecture 5 - Critical and optimum insulation

Lecture 6 - Extended surface heat transfer - 1

Lecture 7 - Extended surface heat transfer - 2

Lecture 8 - Analysis of lumped parameter model

Lecture 9 - Transient heat flow in semi infinite solid

Lecture 10 - Infinite body subjected to sudden convective

Lecture 11 - Graphical solutions of unsteady state heat conduction problem

Lecture 12 - Dimensional analysis for forced convection

Lecture 13 - Dimensional analysis for free convection

Lecture 14 - Heat transfer co-relations for laminar and internal flows

Lecture 15 - Heat transfer co-relations for turbulent and internal flows

Lecture 16 - Co-relation for turbulent and external flows

Lecture 17 - Heat transfer co-relations for flow across tube banks

Lecture 18 - Momentum and heat transfer analogies

Lecture 19 - Boundary layer heat transfer

Lecture 20 - Boundary layer equations

Lecture 21 - Approximate analysis in boundary layer

Lecture 22 - Theoretical concepts of natural / free convection heat transfer

Lecture 23 - Empirical relations for free convection heat transfer

Lecture 24 - Condensation heat transfer over vertical plate

Lecture 25 - Condensation heat transfer for various conditions and geometries

Lecture 26 - Fundamentals of boiling heat transfer

Lecture 27 - Boiling heat transfer co-relations

Lecture 28 - Classification of heat exchangers

Lecture 29 - Various types of shell and tube heat exchangers

Lecture 30 - Various types of compact heat exchangers

Lecture 31 - Effectiveness-NTU, method of heat exchanger analysis

- Lecture 32 - Design of double pipe heat exchanger
- Lecture 33 - Design of shell and tube heat exchanger
- Lecture 34 - Introduction to evaporation and evaporators
- Lecture 35 - Evaporation principles and evaporator performance
- Lecture 36 - Evaporator calculations
- Lecture 37 - Introduction to radiation heat transfer
- Lecture 38 - Radiation intensity and radiation view factor
- Lecture 39 - Radiation heat exchange
- Lecture 40 - Radiation shield and gas radiation

**NPTEL : Mass Transfer Operations I (Chemical Engineering)**

**Co-ordinators : Dr. B. Mandal**

Lecture 1 - Introduction to Mass Transfer

Lecture 2 - Molecular Diffusion

Lecture 3 - Fick's Law of Diffusion

Lecture 4 - Steady state molecular diffusion in fluids - Part I

Lecture 5 - Steady state molecular diffusion in fluids - Part II

Lecture 6 - Diffusion coefficient: Measurement and Prediction - Part I

Lecture 7 - Diffusion Coefficient: Measurement and Prediction - Part II

Lecture 8 - Multicomponent Diffusion and Diffusivity in Solids

Lecture 9 - Concept of Mass Transfer Coefficient

Lecture 10 - Dimensionless Groups and Co-relations for Convective

Lecture 11 - Mass Transfer coefficient in Laminar Flow Condition

Lecture 12 - Boundary Layer Theory and Film Theory in Mass Transfer

Lecture 13 - Mass Transfer Coefficients in Turbulent Flow

Lecture 14 - Interphase Mass Transfer and Mass Transfer Theories - Part I

Lecture 15 - Interphase Mass Transfer and Mass Transfer Theories - Part II

Lecture 16 - Interphase Mass Transfer and Mass Transfer Theories - Part III

Lecture 17 - Agitated and Sparged Vessels

Lecture 18 - Tray Column - Part I

Lecture 19 - Tray Column - Part II

Lecture 20 - Packed Tower

Lecture 21 - Introduction to Absorption and Solvent selection

Lecture 22 - Packed Tower Design - Part I

Lecture 23 - Packed Tower Design - Part II

Lecture 24 - Packed Tower Design - Part III

Lecture 25 - Mass Transfer Coefficients Correlation and HETP Concept

Lecture 26 - Tray Tower Design and Introduction to Multicomponent System

Lecture 27 - Introduction to Distillation and Phase diagrams

Lecture 28 - Azeotropes and Enthalpy Concentration Diagrams

Lecture 29 - Flash Distillation

Lecture 30 - Batch and Steam Distillation

Lecture 31 - Fractional Distillation

[Lecture 32 - Fractional Distillation: McCabe Thiele Method](#)

[Lecture 33 - Fractional Distillation: Minimum Reflux and Pinch Point](#)

[Lecture 34 - Fractional Distillation: Subcooled Reflux ,Tray Efficiency and Use of Open Steam](#)

[Lecture 35 - Fractional Distillation: Multiple Feeds and Side Stream](#)

[Lecture 36 - Multistage Batch Distillation with Reflux](#)

[Lecture 37 - Fractional Distillation: Ponchan and Savarit Method](#)

[Lecture 38 - Ponchan and Savarit Method and Packed Tower Distillation](#)

[Lecture 39 - Multicomponent Distillation](#)

Lecture 1 - General Introduction to the Course and Syllabus

Lecture 2 - Hierarchical Approach to Process Design - I

Lecture 3 - Hierarchical Approach to Process Design - Examples

Lecture 4 - Input Information and Design Aspects of Batch vs. Continuous Process

Lecture 5 - Input / Output Structure of Flowsheet - Part I

Lecture 6 - Input / Output Structure of Flowsheet - Part II

Lecture 7 - Input / Output Structure of Flowsheet - Part III and Recycle Structure of Flowsheet - Part I

Lecture 8 - Recycle Structure of Flowsheet - Part II

Lecture 9 - Recycle Structure of Flowsheet - Part III

Lecture 10 - Recycle Structure of Flowsheet - Part IV and Tutorial - Part I

Lecture 11 - Tutorial - Part II

Lecture 12 - Tutorial - Part III

Lecture 13 - Algorithm and Basic Principles of Reactor Design

Lecture 14 - Reactor Non-ideality, Residence Time Distribution (RTD) and Types of Chemical Reactions & Catalysts

Lecture 15 - Types of Reactors and Selection Criteria

Lecture 16 - Tutorial on Reactor Design and Cost Estimation

Lecture 17 - General Introduction (Types of Separation Processes and Criteria for Selection of the Processes)

Lecture 18 - Guidelines for Design of Separation Systems

Lecture 19 - Design of Distillation Columns - Part I (Sequencing of Columns, Energy Integration / Thermal Coupling of the Columns)

Lecture 20 - Design of Distillation Columns - Part II (Plate and Packed Towers, Number of Plates, Diameter and Height of the Column)

Lecture 21 - Tutorial - Part I (Design of Absorption Column)

Lecture 22 - Tutorial - Part II (Design of Distillation Column)

Lecture 23 - Concepts and Basic Principles of Energy (or Heat) Integration - Part 1 (Composite Curves and  $T_{min}$ )

Lecture 24 - Concepts and Basic Principles of Heat Integration - Part 2 (Problem Table Algorithm and Identification of Energy Targets)

Lecture 25 - Identification of Area and Cost Targets

Lecture 26 - Pinch Technology for Heat Exchanger Network Design

Lecture 27 - Tutorial - I (Composite Curves, Problem Table Algorithm and Enthalpy Intervals)

Lecture 28 - Tutorial - II (Heat Exchanger Network Synthesis Using Pinch Technology)

Lecture 29 - Selection of Process, Design of Flowsheet and Materials Balance

Lecture 30 - Energy Balance, Process Alternatives and Design of the Absorber

Lecture 31 - Rules of Thumb & Their Limitations and Tutorial



[Lecture 32 - General Concepts & Principles and Cost Allocation Procedure](#)

[Lecture 33 - Lumped Cost Diagram and Cost Allocation Diagram \(Case Study of Hydro-dealkylation Process\)](#)

[Lecture 34 - Assessment of Process Alternatives with Cost Allocation Diagram \(Case Study of Hydrodealkylation Process\)](#)

[Lecture 35 - Tutorial on Lumped Cost Diagram and Cost Allocation Diagram](#)

[Lecture 36 - Introduction to Chemical Projects and Their Economic Aspects](#)

[Lecture 37 - Selection of the Process and Project Site - Part I](#)

[Lecture 38 - Selection of the Process and Project Site - Part II](#)

[Lecture 39 - Project Cost Estimation - Part I](#)

[Lecture 40 - Project Cost Estimation - Part II](#)

[Lecture 41 - Simplified Cost Model and Depreciation](#)

[Lecture 42 - Time Value of Money](#)

[Lecture 43 - Measures of Profitability and Project Evaluation - Part I](#)

[Lecture 44 - Measures of Profitability and Project Evaluation - Part II](#)

[Lecture 45 - Tutorial on Project Economics - Part I](#)

[Lecture 46 - Tutorial on Project Economics - Part II](#)

Lecture 1 - Introduction

Lecture 2 - Particle properties

Lecture 3 - Particle / Powder Classifications

Lecture 4 - Minimum Fluidization Velocity: Fluid-solid System

Lecture 5 - Minimum Fluidization Velocity: Liquid-solid and gas-liquid-solid System

Lecture 6 - Flow regime and its map: Gas-solid Fluidization

Lecture 7 - Flow regime and its map: Liquid-solid and Gas-liquid-solid Fluidization

Lecture 8 - Frictional pressure drop in fluidized bed-fluid-solid system

Lecture 9 - Frictional pressure drop in fluidized Bed-Gas-liquid-solid system

Lecture 10 - Analysis of Frictional Pressure Drop in Fluidized Bed By Different Models

Lecture 11 - Gas Distribution Through Distributor

Lecture 12 - Calculation of gas pumping power consumption in fluidized bed

Lecture 13 - Bubbling Fluidization Part 1: Bubble Characteristics

Lecture 14 - Bubbling Fluidization Part 2: Bubble Characteristics (Continued...)

Lecture 15 - Bubbling Fluidization Part 3: Bubble coalescence in three-phase fluidization

Lecture 16 - Bubbling Fluidization Part 4: Bubble breakup in three-phase fluidization

Lecture 17 - Bubbling Fluidization Part 5: Gas and solid movements at bubble

Lecture 18 - Bubbling Fluidization Part 6: Slugging Bed

Lecture 19 - Entrainment Characteristics (Part 1) : Entrainment Characteristics

Lecture 20 - Entrainment Characteristics (Part 2) : Fast fluidization condition

Lecture 21 - Entrainment Characteristics (Part 2) : Elutriation Characteristics

Lecture 22 - Entrainment Characteristics (Part 2) : Attrition in Fluidized Bed (Part 1)

Lecture 23 - Attrition in Fluidized Bed (Part 2)

Lecture 24 - Solid movement, mixing: Gas-fluidized Bed

Lecture 25 - Solid segregation: Gas-fluidized bed

Lecture 26 - Solid mixing and segregation: Liquid-solid fluidized bed

Lecture 27 - Gas Dispersion and Interchange

Lecture 28 - Mass transfer in fluidized Bed-Gas-solid system

Lecture 29 - Mass transfer in fluidized Bed-Gas-liquid-solid system (Continued...)

Lecture 30 - Heat transfer Characteristics

Lecture 31 - Fluidized bed reactor design and its performance



[Lecture 1 - An Introduction](#)

[Lecture 2 - Fluid Mechanics: A Review](#)

[Lecture 3 - Solid Mechanics: A Review](#)

[Lecture 4 - Rheology of blood](#)

[Lecture 5 - Blood morphology](#)

[Lecture 6 - Blood flow in a channel](#)

[Lecture 7 - Viscometers and Rheometers](#)

[Lecture 8 - Viscoelasticity](#)

[Lecture 9 - Flow Bifurcation](#)

[Lecture 10 - Pulsatile Flow 1](#)

[Lecture 11 - Pulsatile Flow 2](#)

[Lecture 12 - Flow in Elastic Tubes](#)

- Lecture 1 - An Introduction
- Lecture 2 - Interface and Surface Tension
- Lecture 3 - Flow Regimes 1
- Lecture 4 - Flow Regimes 2
- Lecture 5 - Taylor Flow 1
- Lecture 6 - Taylor Flow 2
- Lecture 7 - Computational Techniques
- Lecture 8 - Bubble and Droplet Generation
- Lecture 9 - Interface and Surface tension 2
- Lecture 10 - Void Fraction and Pressure Drop
- Lecture 11 - Liquid-Liquid Flow: Flow Regimes
- Lecture 12 - Ideal annular Flow
- Lecture 13 - Taylor Flow : Heat transfer 1
- Lecture 14 - Taylor Flow : Heat transfer 2
- Lecture 15 - Taylor Flow : Meat Transfer 1
- Lecture 16 - Taylor Flow : Meat Transfer 2
- Lecture 17 - Flow boiling in microchannels
- Lecture 18 - Flow boiling in microchannels (Continued...)
- Lecture 19 - Flow Measurement Techniques
- Lecture 20 - Particle image Velocimetry
- Lecture 21 - Inertial Microfluidics
- Lecture 22 - Microfluidic applications
- Lecture 23 - Microfluidic applications (Continued...)
- Lecture 24 - Concluding Remarks

Lecture 1 - Introduction to Multiphase flow Measurement Techniques

Lecture 2 - Invasive and Non-invasive Techniques

Lecture 3 - Hot Wire Anemometry

Lecture 4 - Optical Fiber Probe

Lecture 5 - Laser Doppler Anemometry (LDA)

Lecture 6 - LDA Post Processing and Particle Image Velocimetry (PIV)

Lecture 7 - PIV and Positron Emission Particle Tracking

Lecture 8 - Radioactive Particle Tracking - I

Lecture 9 - Radioactive Particle Tracking - II

Lecture 10 - Capacitance Probe, Optical Fiber Probe and ECT

Lecture 11 - Gamma-ray and X-ray Tomography, MRI

Lecture 12 - Summary

Lecture 1 - Multiphase flow introduction

Lecture 2 - Fundamental definitions and terminology used in Multiphase - I

Lecture 3 - Fundamental definitions and terminology used in Multiphase - II

Lecture 4 - Flow Regime Map for Gas-Liquid System

Lecture 5 - Flow Regime Map for Fluid-Solid System

Lecture 6 - Pneumatic Conveying

Lecture 7 - Momentum Equation through Reynolds Transport Theorem

Lecture 8 - Lockhart Martinelli Correlation

Lecture 9 - Pressure Drop Calculation for Homogeneous Flow

Lecture 10 - Pressure Drop Calculation for Separated and Annular Flow Regime

Lecture 11 - Lagrangian Tracking of Single Particle Under Different Forces

Lecture 12 - Multiphase Interactions: Drag Force

Lecture 13 - Multiphase Interactions: Multi-particle Drag, Virtual Mass Force, Basset Force and Lift Force

Lecture 14 - Introduction to Multiphase Flow Modeling

Lecture 15 - Algebraic Slip Method and Euler-Euler Method

Lecture 16 - KTGF and Euler-Lagrangian Model

Lecture 17 - Measurement Techniques: Velocity Measurement

Lecture 18 - Measurement Techniques: Phase Fraction Measurement

Lecture 19 - Bubble Column

Lecture 20 - Packed Bed Reactor

Lecture 21 - Fluidized Bed Reactor

Lecture 22 - Summary

Lecture 1 - Introduction to Polymers

Lecture 2 - Ideal Chain Models

Lecture 3 - Ideal and Real Chains

Lecture 4 - Thermodynamics of Polymer Solutions - I

Lecture 5 - Thermodynamics of Polymer Solutions - II

Lecture 6 - Thermodynamics of Polymer Solutions - III

Lecture 7 - Phase Behaviour of Polymer Solutions and Blends

Lecture 8 - Phase Behaviour of Polymer Blends and Copolymers

Lecture 9 - Determination of Polymer Molar Mass: Osmometry

Lecture 10 - Determination of Polymer Molar Mass: Static Light Scattering - I

Lecture 11 - Determination of Polymer Molar Mass: Static Light Scattering - II

Lecture 12 - Determination of Polymer Molar Mass: Viscometry and GPC

Lecture 13 - Branching: Hyperbranched Polymers

Lecture 14 - Branching, Network Formation and Gelation

Lecture 15 - Gelation and Swelling of Network Polymers

Lecture 16 - Amorphous State of Polymers

Lecture 17 - Crystalline State of Polymers

Lecture 18 - Mechanical Properties of Polymers

Lecture 19 - Viscoelasticity: Mechanical Models

Lecture 20 - Viscoelasticity, Dynamic Mechanical Analysis and Rheology

Lecture 21 - Rubber Elasticity

Lecture 22 - Unentangled Polymer Dynamics

Lecture 23 - Entangled Polymer Dynamics

Lecture 24 - Review



Lecture 1 - Introduction to Natural Gas - I

Lecture 2 - Introduction to Natural Gas - II

Lecture 3 - Introduction to Natural Gas - III

Lecture 4 - Wellbore Performance Relationship (WPR)

Lecture 5 - Choke Performance Relationship (CPR)

Lecture 6 - Nodal Analysis

Lecture 7 - Inflow Performance Relationship (IPR) - I

Lecture 8 - Inflow Performance Relationship (IPR) - II

Lecture 9 - Gas Well Testing

Lecture 10 - Wellbore Performance Relationship (WPR)

Lecture 11 - Choke Performance Relationship (CPR)

Lecture 12 - Nodal Analysis

Lecture 13 - Natural Gas Separation - I

Lecture 14 - Natural Gas Separation - II

Lecture 15 - Dehydration of Natural Gas

Lecture 16 - Sweetening of Natural Gas

Lecture 17 - Compressor Design

Lecture 18 - Measurement of Natural Gas

Lecture 19 - Transportation of Natural Gas - I

Lecture 20 - Transportation of Natural Gas - II

Lecture 21 - Unconventional production of Natural Gas

Lecture 22 - Review: Concluding Remarks

Lecture 1 - Introduction

Lecture 2 - First law for closed systems

Lecture 3 - First law for open systems

Lecture 4 - Simple processes

Lecture 5 - Processes involving liquids and ideal gases

Lecture 6 - Temperature dependency of  $C_p$  in an ideal gas

Lecture 7 - Efficiency of Heat engines and Statement of Second Law

Lecture 8 - Entropy

Lecture 9 - Lost Work

Lecture 10 - Maxwell's Relations

Lecture 11 - Thermodynamic Diagrams

Lecture 12 - Thermodynamic Tables, Residual Properties

Lecture 13 - Virial Equation of State

Lecture 14 - Residual property relations from EoS

Lecture 15 - Cubic Equation of State

Lecture 16 - Cubic Equation of State

Lecture 17 - Thermodynamic Tables

Lecture 18 - Correlations for Liquids

Lecture 19 - Process Involving Phase Changes

Lecture 20 - Chemical potential

Lecture 21 - Partial molar properties

Lecture 22 - Examples

Lecture 23 - Ideal Solutions

Lecture 24 - Excess Properties

Lecture 25 - Fugacity

Lecture 26 - Calculation of Fugacity using EoS - Part 1

Lecture 27 - Calculation of Fugacity using EoS - Part 2

Lecture 28 - Calculation of Fugacity in Mixtures using Cubic EoS

Lecture 29 - Fugacity in Liquids, Activity Coefficient

Lecture 30 - Models for Excess Gibbs free energy - Part 1

Lecture 31 - Models for Excess Gibbs free energy - Part 2

[Lecture 32 - Vapor Liquid Equilibrium - Part 1](#)

[Lecture 33 - Vapor Liquid Equilibrium - Part 2](#)

[Lecture 34 - Azeotropes](#)

[Lecture 35 - Gamma/Phi Formulation](#)

[Lecture 36 - LLE](#)

[Lecture 37 - VLLE](#)

[Lecture 38 - Enthalpy changes upon reaction](#)

[Lecture 39 - Reaction coordinate](#)

[Lecture 40 - Equilibrium constant](#)

[Lecture 41 - Examples](#)

[Lecture 42 - Conclusion](#)

Lecture 1 - Introduction and Overview of Mass Transfer Operation

Lecture 2 - Molecular and Eddy Diffusion, Diffusion Velocities and Fluxes

Lecture 3 - Fick's First and Second Law

Lecture 4 - Steady State Molecular Diffusion in fluids under stagnant and laminar flow conditions

Lecture 5 - Diffusion through variable cross-sectional area

Lecture 6 - Gas Phase Diffusion Coefficient measurement

Lecture 7 - Gas Phase Diffusion Coefficient prediction and liquid phase diffusion coefficient measurement and prediction

Lecture 8 - Multicomponent diffusion and diffusivity in solids

Lecture 9 - Mass transfer coefficient concept and classifications

Lecture 10 - Dimensionless groups and correlations for convective mass transfer coefficients

Lecture 11 - Mass transfer coefficient in laminar flow

Lecture 12 - Boundary Layer Theory and mass transfer coefficients in turbulent flow

Lecture 13 - Mass transfer theories

Lecture 14 - Interphase mass transfer

Lecture 15 - Interphase mass transfer and material balance for operating line

Lecture 16 - Number of ideal stages in counter current operation: graphical and algebraic methods

Lecture 17 - Introduction, classification, Sparged and agitated vessels design

Lecture 18 - Gas dispersed: Tray tower

Lecture 19 - Sieve Tray

Lecture 20 - Liquid dispersed: Venture scrubber, wetted wall column, Packed tower

Lecture 21 - Introduction to absorption, Equilibrium in gas-liquid system, and minimum liquid rate

Lecture 22 - Design of packed column absorber based on the Individual Mass Transfer Coefficient

Lecture 23 - Design of packed column absorber based on the Overall Mass Transfer Coefficient

Lecture 24 - Height Equivalent to a Theoretical Plate (HETP), Design of packed column absorber for dilute and concentrated gases

Lecture 25 - Absorption in plate column: Method of McCabe and Thiele-graphical determination of ideal trays and Introduction to multicomponent absorption

Lecture 26 - Introduction to distillation, binary equilibrium diagrams and concept of relative volatility

Lecture 27 - Distillation in non-ideal systems and concept of enthalpy-concentration diagram

Lecture 28 - Flash distillation

Lecture 29 - Batch and steam distillation

Lecture 30 - Continuous multistate fractionation

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- Lecture 31 - Number of trays by McCabe and Thiele for distillation
- Lecture 32 - Pinch Points and minimum reflux
- Lecture 33 - Reflux below its bubble point: Sub-cooled reflux and use of open steam
- Lecture 34 - Multiple feeds, multiple product withdrawal or side streams
- Lecture 35 - Multistage batch distillation with reflux
- Lecture 36 - The Ponchon-Savarit method
- Lecture 37 - The Ponchon-Savarit method
- Lecture 38 - Packed Distillation
- Lecture 39 - Introduction to multicomponent distillation and multicomponent flash distillation
- Lecture 40 - Minimum stages and minimum reflux in multicomponent distillation
- Lecture 41 - Multicomponent batch distillation

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Lecture 2 - Classification of Non-Newtonian Fluids

Lecture 3 - Mathematical Models for Non-Newtonian Fluids

Lecture 4 - Viscoelastic Non-Newtonian Fluids

Lecture 5 - Capillary Viscometers: Sources of Errors and Correction Methods

Lecture 6 - Rotational Viscometers

Lecture 7 - Capillary Viscometers - Errors and Corrections II

Lecture 8 - Equation of Change for Non-Isothermal Systems

Lecture 9 - Rotational Viscometers - II

Lecture 10 - Rotational Viscometers - III

Lecture 11 - Transition from Laminar to Turbulent Flow in Pipes for GNF

Lecture 12 - Equations of Change for Isothermal Systems

Lecture 13 - Equations of Change for Non-Isothermal Systems

Lecture 14 - Power-law Fluids Flow in Concentric Annulus

Lecture 15 - Power-law and Ellis Model Fluids Flow Through Pipes

Lecture 16 - Bingham Plastic Fluids Flow through Pipes

Lecture 17 - Herschel Bulkley Fluids Flow through Pipes

Lecture 18 - Transition and Turbulent Flow of GNF in Pipes - I

Lecture 19 - Transition and Turbulent Flow of GNF in Pipes - II

Lecture 20 - Laminar flow of GNFs between Parallel Plates and along Inclined Surface

Lecture 21 - Laminar flow of GNFs along Inclined Surface and Concentric Annulus

Lecture 22 - Flow of Non-Newtonian Fluids through Packed Beds

Lecture 23 - Dispersion in Packed Beds: Non-Newtonian Effects

Lecture 24 - Liquid-Solid Fluidization by Power-law Liquids

Lecture 25 - Free Convection between Two Vertical Plates

Lecture 26 - Viscous Heat Generation

Lecture 27 - Temperature distribution in fluids confined between co-axial cylinders

Lecture 28 - Temperature distribution for FDF of Newtonian fluids in tubes

Lecture 29 - Heat Transfer Combined with Chemical Reactions

Lecture 30 - Transpiration Cooling

Lecture 31 - Basics of MT; Diffusion Through Stagnant Gas Film

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Lecture 3 - Fluid Statics

Lecture 4 - Fluid Statics (Continued...)

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Lecture 6 - Fundamentals of flow - Part 2

Lecture 7 - One dimensional flow - Part 1

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Lecture 10 - Flow of Viscous fluid - Introduction

Lecture 11 - Velocity distribution in laminar flow

Lecture 12 - Velocity distribution in turbulent flow

Lecture 13 - Boundary layer theory

Lecture 14 - Theory of lubrication

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Lecture 17 - Losses in geometric change (Continued...)

Lecture 18 - Flow Velocity and Optimum Shape

Lecture 19 - Equation of Energy and Discharge of Water Channel

Lecture 20 - Drag

Lecture 21 - Lift and Cavitation

Lecture 22 - Dimensional Analysis

Lecture 23 - Dimensional Analysis: Buckingham's  $\pi$  Theorem

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Lecture 31 - Hydrodynamics in multiphase flow



[Lecture 32 - Hydrodynamics in multiphase flow \(Continued...\)](#)

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Lecture 17 - Cavitation Reactor Configurations and activity

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Lecture 20 - Preparation of monolithic catalyst

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- Lecture 2 - Kinetics of Homogeneous Reactions
- Lecture 3 - Kinetic Model and Temperature Dependency
- Lecture 4 - Introduction and Stoichiometry for the Batch System
- Lecture 5 - Stoichiometry for Constant Volume Flow and Variable Volume Batch Systems
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- Lecture 7 - Analysis of Batch Reactor Kinetic Data
- Lecture 8 - Intregal Method of Analysis of Batch Reactor Data - Part 1
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- Lecture 10 - Differential Method of Analysis and Variable Volume Batch Reactor Data
- Lecture 11 - Introduction and Ideal Batch Reactor Design
- Lecture 12 - Ideal Mixed Flow Reactor Design
- Lecture 13 - Ideal Plug Flow Reactor Design
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- Lecture 15 - Size Comaprison Multiple Reactors
- Lecture 16 - Recycle and Autocatalytic Reactors
- Lecture 17 - Design for Parallel Reactions
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- Lecture 19 - Design for Series-Parallel Reactions
- Lecture 20 - Denbigh Reactions and Their Special Cases
- Lecture 21 - Heats of Reaction and Equilibrium Conversion from Thermodynamics
- Lecture 22 - General Graphical Reactor Design Procedure
- Lecture 23 - Material and Energy Balances in Batch Reactor
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- Lecture 25 - Material and Energy Balances in Flug Flow and Mixed Flow Reactors
- Lecture 26 - Ideal and Non-Ideal Mixed Flow Reactor Design and Multiple Steady States
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- Lecture 28 - RTD Measurement and Moments of RTD
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- Lecture 30 - Reactor Modeling using the RTD

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- Lecture 2 - Design calculations of cooling tower
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- Lecture 5 - Air conditioning, Example problems on dehumidification
- Lecture 6 - Mechanism of drying and drying equilibria, drying rate curve
- Lecture 7 - Drying: rate of drying for batch dryers
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- Lecture 9 - Drying time calculation from drying rate curve
- Lecture 10 - Introduction to liquid-liquid extraction, liquid-liquid equilibria
- Lecture 11 - Effect of temperature on LLE and Design of single stage extraction
- Lecture 12 - Design Calculation of Multistage Operation
- Lecture 13 - Design calculation of multistage cross-current extraction
- Lecture 14 - Design calculation of multistage counter-current extraction, Selection of extractors
- Lecture 15 - Leaching: single stage operation
- Lecture 16 - Leaching: multistage operation
- Lecture 17 - Supercritical Fluid Extraction, equipment for leaching
- Lecture 18 - Fundamentals of membrane separation processes
- Lecture 19 - Manufacturing of membranes, advantages and limitations
- Lecture 20 - Various models and applications: design aspects
- Lecture 21 - Various models and applications: design aspects
- Lecture 22 - Electric field enhanced membrane separation processes
- Lecture 23 - Micellar-enhanced ultrafiltration
- Lecture 24 - Adsorption: types and nature, isotherm
- Lecture 25 - Stage wise and continuous adsorption
- Lecture 26 - Fluidized bed and teeter bed
- Lecture 27 - Unsteady state fixed bed adsorbers, ion exchange
- Lecture 28 - Crystallization, types of crystal geometry
- Lecture 29 - Solid-liquid phase equilibrium, Theory of crystallization
- Lecture 30 - Design of crystallizer, crystallization equipment
- Lecture 31 - Concluding remarks - Part 1



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Lecture 2 - Particle Size

Lecture 3 - Particle Shape and Density

Lecture 4 - Screening

Lecture 5 - Size Analysis by Screening

Lecture 6 - Screening Equipment, Effectiveness and Capacity

Lecture 7 - Methods of Size Reduction

Lecture 8 - Equipment for Size Reduction - Crushers

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Lecture 2 - Membrane Processes and Classifications, Advantages, Disadvantages, Applications

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Lecture 4 - Inorganic Materials for Membrane Preparation, their Advantages and Disadvantages

Lecture 5 - Membrane Modules and Selection, Flow Types

Lecture 6 - Preparation of Synthetic Membrane, Phase Inversion Membranes

Lecture 7 - Composite membranes: Interfacial polymerization, dip-coating, plasma polymerization

Lecture 8 - Inorganic membranes: Sol-Gel process, ceramic membrane preparation, membrane modification

Lecture 9 - Porous and non-porous membranes, characterization of porous membranes and MF membrane

Lecture 10 - MF membrane characterization: Bubble point, Mercury intrusion, Permeability method

Lecture 11 - UF membrane characterization: Gas adsorption-desorption, Thermoporometry, MWCO method

Lecture 12 - Passive transport, active transport, description of transport process

Lecture 13 - Transport through porous membrane and nonporous membrane

Lecture 14 - Concept of osmosis and reverse osmosis, thermodynamic analysis

Lecture 15 - Revision of concepts and fundamentals

Lecture 16 - HP and LP RO, membrane materials, modules, models for RO transport

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Lecture 18 - Nanofiltration basics, transport mechanism, fouling model and applications

Lecture 19 - Basic principles of UF, membranes and modules, UF configurations

Lecture 20 - Models for UF transport, mass transfer coefficient, membrane rejection and sieving coefficient

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Lecture 22 - Micellar-enhanced UF, affinity UF, UF based bioseparation

Lecture 23 - Basic principles, advantages of MF, cross-flow and dead-end MF, membranes and modules

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Lecture 27 - Dialysis, membranes and modules, mass transport in dialysis, diffusion analysis, applications

Lecture 28 - Ion-exchange membranes, ED process, energy requirement, applications, reverse ED

Lecture 29 - PV principle, advantages, mass transfer and applications, hybrid distillation/PV

Lecture 30 - Problems and solutions based on ED and PV

Lecture 31 - Concept, types of LM, mechanism of mass transfer in LM, choice of solvent and carrier, applications

[Lecture 32 - Basic principle of gas separation, transport mechanism, factors affecting gas separation, applications](#)

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Lecture 9 - Supplementary: Preliminary Statistical analysis - MATLAB implementation

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Lecture 28 - MATLAB inbuilt functions: Nonlinear and Mixed Integer Nonlinear Programming

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- Lecture 5 - Pressure and Temperature of Flow Process
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- Lecture 15 - Humidity, Saturation Psychrometric chart
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- Lecture 20 - The mechanical energy balance
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- Lecture 30 - Fischer Tropsch Process: SASOL and SDMS
- Lecture 31 - Methanol to Gasoline: Haldor Topsoe and TIGAS



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Lecture 3 - Unit Operations and Other General Principles

Lecture 4 - General Principles and Chemical Plant Design

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Lecture 6 - Natural Gas, LPG and Syngas

Lecture 7 - Synthesis gas

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Lecture 12 - Sulfur and sulfuric acid

Lecture 13 - Sulfuric Acid

Lecture 14 - Nitrogen Industries - Ammonia

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Lecture 16 - Nitrogen Industries - Urea

Lecture 17 - Nitrogen Industries - Ammonium Nitrate

Lecture 18 - Phosphorus Industries - Phosphorus and Phosphoric Acid Production

Lecture 19 - Phosphorus Industries - Phosphoric Acid Production by Wet Processes

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Lecture 28 - Surface Coating Industry

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- Lecture 1 - Introduction to Organic Chemical Technology
- Lecture 2 - Basic Unit Processes and Unit Operations of OCT
- Lecture 3 - Introduction to Chemical Plant Design
- Lecture 4 - Edible and Essential Oils
- Lecture 5 - Vegetable Oils and Processing
- Lecture 6 - Processing of Oils and Waxes
- Lecture 7 - Soaps and Glycerine Manufacture
- Lecture 8 - Detergents Manufacture
- Lecture 9 - Carbohydrates Industry - Sugar
- Lecture 10 - Carbohydrates Industry - Refined Sugar
- Lecture 11 - Carbohydrates Industry - Beet Sugar and Starch
- Lecture 12 - Fermentation Industry
- Lecture 13 - Fermentation Industry – Ethanol
- Lecture 14 - Fermentation Industry – Citric Acid and Penicillin
- Lecture 15 - Pulp and Paper Industry
- Lecture 16 - Pulp and Paper Industry - 2
- Lecture 17 - Pulp and Paper Industry - 3
- Lecture 18 - Petroleum Industry
- Lecture 19 - Petroleum Refinery Products, Characteristics and Processes
- Lecture 20 - Petroleum Refinery Processes
- Lecture 21 - Petroleum Refinery Processes - 2
- Lecture 22 - Chemicals from C1 Compounds: Methanol and Formaldehyde
- Lecture 23 - Chemicals from C1 and C2 Compounds
- Lecture 24 - Chemicals from C2 Compounds
- Lecture 25 - Chemicals from C2 Compounds - 2
- Lecture 26 - Chemicals from C3 Compounds
- Lecture 27 - Chemicals from C3 Compounds - 2
- Lecture 28 - Chemicals from C4 Compounds
- Lecture 29 - Chemicals from Aromatic Compounds
- Lecture 30 - Chemicals from Aromatic Compounds - Phenol
- Lecture 31 - Chemicals from Aromatic Compounds - 3

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Lecture 2 - Characteristics of Single particle

Lecture 3 - Particle size and Its distribution in mixture

Lecture 4 - Mechanism of Size Reduction

Lecture 5 - General Machines for Size Reduction

Lecture 6 - Laws of Energy for Size Reduction

Lecture 7 - Introduction on Size Enlargement

Lecture 8 - Mechanism of Size Enlargement

Lecture 9 - Equipment for Size Enlargement

Lecture 10 - Flow Past a Cylinder and Spherical Particle

Lecture 11 - Terminal velocity of single particle

Lecture 12 - Multiple particle Interaction/Sedimentation: Hindered settling velocity

Lecture 13 - Basic law and terminology of flow through granular bed

Lecture 14 - General expressions for flow through packed beds-Ergun Equation

Lecture 15 - Two-phase flow through packed bed

Lecture 16 - Mixing of Solids: Introduction

Lecture 17 - Degree of mixing and Its Assessment

Lecture 18 - Mixing and agitation of fluids/slurries

Lecture 19 - Basic understandings and applications of fluidization

Lecture 20 - Minimum Fluidization Velocity

Lecture 21 - Basic understanding of froth flotation

Lecture 22 - Separation of particles by Screening

Lecture 23 - Particulate Matter Separation by Gravity Settling Chamber

Lecture 24 - Particle Separation by Cyclone and Centrifuge

Lecture 25 - Particle Separation by Electrostatic Precipitator

Lecture 26 - Separation by Industrial Fabric (Bag) Filters

Lecture 27 - Wet Scrubber for Particle Removal

Lecture 28 - Filtration

Lecture 29 - Dead-End and Continuous Filtration

Lecture 30 - Reverse Osmosis

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Lecture 2 - Sources of energy

Lecture 3 - Energy scenario

Lecture 4 - Environmental aspects of energy

Lecture 5 - Environmental aspects of energy

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Lecture 7 - Environmental aspects of energy

Lecture 8 - Solid fuels - Part I

Lecture 9 - Solid fuels - Part II

Lecture 10 - Liquid fuels - Part I

Lecture 11 - Liquid fuels - Part II

Lecture 12 - Practice problems - Part I

Lecture 13 - Practice problems - Part II

Lecture 14 - Energy from Bio-based Feedstock

Lecture 15 - Thermal/Thermochemical processes

Lecture 16 - Practice problems (Pelletization)

Lecture 17 - Practice problems (Torrefaction Mass and Energy Yield)

Lecture 18 - Pyrolysis and Hydrothermal Liquefaction

Lecture 19 - Gasification

Lecture 20 - Practice examples (Pyrolysis, Gasification)

Lecture 21 - Biochemical conversion processes - Anaerobic Digestion in Landfills

Lecture 22 - Bioethanol Production

Lecture 23 - Practice examples (Biogas and Bio-ethanol production)

Lecture 24 - Chemical Conversion Processes - Types of Feedstock and Pretreatment

Lecture 25 - Mechanism of trans-esterification and biodiesel production

Lecture 26 - Green diesel synthesis from bio-based feedstocks

Lecture 27 - Energy from Coal (Carbonization, Gasification and Liquefaction)

Lecture 28 - Practice Example (Combustion of Biomass and Coal)

Lecture 29 - Combustion Process (Biomass and Coal)

Lecture 30 - Concept of integration of energy system



Lecture 1 - Introduction to Petroleum Reservoir Engineering

Lecture 2 - Petroleum Reserves

Lecture 3 - Petroleum Geology

Lecture 4 - Well Drilling Methods

Lecture 5 - Thermodynamics of Hydrocarbons

Lecture 6 - Natural Gas Properties

Lecture 7 - Properties of Crude Oil

Lecture 8 - Reservoir Rock Properties

Lecture 9 - Relative Permeability

Lecture 10 - Primary Drive Mechanisms

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Lecture 12 - Volumetric Balance in Oil and Gas Reservoir

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Lecture 14 - General Equations for radial Flow in Reservoir

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Lecture 18 - Secondary Oil Recovery Methods

Lecture 19 - Enhanced Oil Recovery Methods

Lecture 20 - Introduction to Reservoir Simulation

Lecture 21 - Unconventional Natural Gas Production

- Lecture 1 - Introduction to Statistical Thermodynamics
- Lecture 2 - Postulates and Boltzmann Distribution
- Lecture 3 - Properties of Canonical Partition Function
- Lecture 4 - Canonical Partition Function and Thermodynamic Properties
- Lecture 5 - Thermodynamic Properties of Ideal Monoatomic Gases
- Lecture 6 - Monoatomic Gases and Gibbs Entropy Equation
- Lecture 7 - Energy Fluctuations for Monoatomic Gases
- Lecture 8 - Partition Function for Diatomic Gases
- Lecture 9 - Vibrational Partition Function
- Lecture 10 - Partition Function for Ideal Polyatomic Gas
- Lecture 11 - Normal Mode Analysis
- Lecture 12 - Illustrations
- Lecture 13 - Non-reacting Ideal Gas Mixture
- Lecture 14 - Chemically Reacting Gas Mixture
- Lecture 15 - Degree of Ionization of Gas Molecules
- Lecture 16 - Problems on Ionization of Gas Molecules
- Lecture 17 - Microcanonical and Grand Canonical Ensemble
- Lecture 18 - Isobaric Isothermal Ensemble
- Lecture 19 - Fluctuations in Grand canonical and Isothermal Isobaric Ensembles
- Lecture 20 - Semi Grand Canonical Ensemble and Comparison of Ensembles
- Lecture 21 - Problems and Adsorption Isotherms
- Lecture 22 - Virial Equation of State for Polyatomic Molecules
- Lecture 23 - Virial Equation of State
- Lecture 24 - Virial Equation of State with Higher Order Terms
- Lecture 25 - Thermodynamic Properties from Virial Equation of State
- Lecture 26 - Interaction Potentials for Spherical Molecules
- Lecture 27 - Inferences from Intermolecular Potentials
- Lecture 28 - Engineering Application of Virial Equation of State
- Lecture 29 - Einstein Model
- Lecture 30 - Einstein Model (Continued...)
- Lecture 31 - Debye Model

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**NPTEL : Fluid Mechanics (Chemical Engineering)**

**Co-ordinators : Dr. V. Shankar**

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**NPTEL : Mass Transfer II (Chemical Engineering)**

**Co-ordinators : Prof. Nishith Verma**

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- Lecture 1 - Introduction to the course
- Lecture 2 - Process Dynamics and Negative Feedback
- Lecture 3 - PID control
- Lecture 4 - Common Industrial Control Loops and advanced loops
- Lecture 5 - Advanced loops (Continued...) and multivariable systems
- Lecture 6 - Systematic Tuning Using Frequency Domain Analysis
- Lecture 7 - Frequency Domain Analysis
- Lecture 8 - Multivariable Systems
- Lecture 9 - RGA and dynamic decoupling
- Lecture 10 - Model based control
- Lecture 11 - Dynamic Matrix Control
- Lecture 12 - Control of Distillation Columns
- Lecture 13 - Temperature inferential distillation control
- Lecture 14 - Considerations in temperature inferential control
- Lecture 15 - Control of Complex Column Configurations
- Lecture 16 - Control of Heat Integrated Columns
- Lecture 17 - Homogenous extractive distillation
- Lecture 18 - More on complex columns and reactive distillation
- Lecture 19 - Control of reactors
- Lecture 20 - PFR controls (Continued..) & CSTRs
- Lecture 21 - CSTR heat management
- Lecture 22 - Heat Exchangers and Miscellaneous Systems
- Lecture 23 - Degrees of freedom analysis
- Lecture 24 - Degrees of freedom (Continued...)
- Lecture 25 - Illustration of considerations in control structure synthesis
- Lecture 26 - Two column recycle process
- Lecture 27 - Throughput manipulator selection
- Lecture 28 - Plantwide control structure design
- Lecture 29 - Systematizing plantwide control design
- Lecture 30 - The Luyben design procedure
- Lecture 31 - Role of equipment capacity constraints



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[Lecture 33 - Recycle process case study \(Continued...\)](#)

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[Lecture 35 - C4 isomerization process case study \(Continued...\)](#)

[Lecture 36 - C4 isomerization process case study](#)

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[Lecture 38 - Ethyl benzene process case study](#)

[Lecture 39 - C4 isomerization process revisited](#)

[Lecture 40 - Contrasting conventional and top-down approach](#)

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Lecture 2 - Review - Temperature and Pressure

Lecture 3 - Review - Energy Conservation

Lecture 4 - Properties - Part 1

Lecture 5 - Properties - Part 2

Lecture 6 - Mass-energy analysis of open system

Lecture 7 - Energy analysis of closed system

Lecture 8 - The Second Law of Thermodynamics

Lecture 9 - Entropy

Lecture 10 - Thermodynamic Calculus - 1

Lecture 11 - Thermodynamic Calculus - 2

Lecture 12 - Thermodynamic Calculus - 3

Lecture 13 - Thermodynamic Calculus - 4

Lecture 14 - Legendre Transformation and Free-energy

Lecture 15 - Criteria for phase equilibria

Lecture 16 - Maxwell Relation

Lecture 17 - Stability Criteria

Lecture 18 - Thermodynamics of phase equilibrium

Lecture 19 - Chemical potential and fugacity

Lecture 20 - General discussion on fugacity

Lecture 21 - Ideal Gas Mixture - Part 1

Lecture 22 - Ideal Gas Mixture - Part 2

Lecture 23 - Partial Molar Properties

Lecture 24 - Partial Molar Properties from experimental data

Lecture 25 - Thermodynamics properties from volumetric data - 1

Lecture 26 - Thermodynamics properties from volumetric data - 2

Lecture 27 - Fugacity of pure liquids and solids

Lecture 28 - Thermodynamics properties from volumetric data: effect of V and T

Lecture 29 - Approaches to phase equilibria calculation

Lecture 30 - Traditional Approaches to phase equilibria calculations

Lecture 31 - Algorithms for vapor-liquid equilibria

- Lecture 32 - Probability and Multiplicity
- Lecture 33 - Multiplicity and maximising the multiplicity
- Lecture 34 - Introduction to statistical mechanics
- Lecture 35 - Partition function for independent particles
- Lecture 36
- Lecture 37 - Models of Molecular Pair Potentials
- Lecture 38 - Molecular Theory of Corresponding States
- Lecture 39 - Molecular Interactions in Dense Fluid Media
- Lecture 40 - Models for Electrolyte Systems
- Lecture 41 - Membrane Osmometry
- Lecture 42 - Fugacity of liquid mixture - 1
- Lecture 43 - Fugacity of liquid mixture - 2
- Lecture 44 - Models for fugacity of liquid mixtures - 1
- Lecture 45 - Models for fugacity of liquid mixtures - 2
- Lecture 46 - Examples of Fugacity of liquids
- Lecture 47 - Stability of the Fluid Phases
- Lecture 48 - Theories of Solution - I
- Lecture 49 - Theories of Solution - II
- Lecture 50 - Polymer Solutions
- Lecture 51 - Example Problems on Polymer Solutions

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Lecture 3 - Postulates of thermodynamics - I

Lecture 4 - Postulates of thermodynamics - II

Lecture 5 - Definition of intensive variables and driving forces for temperature and pressure flow

Lecture 6 - Driving force for the matter flow

Lecture 7 - Basic properties, phase diagram, and thermodynamic table

Lecture 8 - Work, and heat

Lecture 9 - First law of thermodynamics for closed system: Ideal gas behavior

Lecture 10 - First law of thermodynamics: Example 1

Lecture 11 - First law of thermodynamics for open system

Lecture 12 - First law of thermodynamics: Example 2

Lecture 13 - The second law of the thermodynamics: Review

Lecture 14 - Carnot cycle and thermodynamic temperature

Lecture 15 - The concept of entropy

Lecture 16 - Maximum work and entropy of ideal gas

Lecture 17 - Power cycles and examples

Lecture 18 - Mathematical properties of fundamental equations

Lecture 19 - Generalized thermodynamic potential - I

Lecture 20 - Generalized thermodynamic potential - II

Lecture 21 - Multivariable Calculus

Lecture 22 - Maxwell's relations and examples

Lecture 23 - Jacobian method and its applications

Lecture 24 - Equilibrium and stability - I

Lecture 25 - Equilibrium and stability - II

Lecture 26 - Stability criteria

Lecture 27 - Intrinsic stability of thermodynamic system

Lecture 28 - Phase transitions

Lecture 29 - Clapeyron Equation and Vapour Pressure Correlations

Lecture 30 - Equation of state

Lecture 31 - Equation of state (Continued...)

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[Lecture 34 - Thermodynamics of mixtures](#)

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- Lecture 1 - Fundamentals of Biology & Biotechnology
- Lecture 2 - Glimpses of Microbial World - Bacteria
- Lecture 3 - Virus and Cell Organelles
- Lecture 4 - Carbohydrate
- Lecture 5 - Nucleic Acid
- Lecture 6 - Lipids
- Lecture 7 - Proteins
- Lecture 8 - Biochemistry & Thermodynamics of Enzymes
- Lecture 9 - Enzyme Kinetics : Michealis-Menten Kinetics
- Lecture 10 - Regulation of Enzyme Activity : Inhibition
- Lecture 11 - Regulation of Enzyme Activity : Inhibition (Continued...)
- Lecture 12 - Effects of Substrate and Inhibition, pH and Temperature on Enzyme Activity
- Lecture 13 - Immobilized Enzymes
- Lecture 14 - Immobilized Enzymes (Continued...)
- Lecture 15 - Interphase Mass Transfer and Reaction in Immobilized Enzymes
- Lecture 16 - Interphase Mass Transfer and Reaction in Immobilized Enzymes (Continued...)
- Lecture 17 - Effectiveness Factor in Immobilized Enzymes
- Lecture 18 - Bioenergetics and Glycolysis
- Lecture 19 - TCA Cycle
- Lecture 20 - Electron Transport Chain & Oxidative Phosphorylation
- Lecture 21 - Pentose Phosphate Pathways Glycogenesis & Glycogenolysis
- Lecture 22 - Urea Cycle, Gluconeogenesis and Glyoxalate Cycle
- Lecture 23 - Microbial Growth : Phases and Models
- Lecture 24 - Effect of Mass Transfer on Microbial & Fungal Growth
- Lecture 25 - Effect of Multiple Substrates and Inhibition on Microbial Growth
- Lecture 26 - Design of Bioreactors
- Lecture 27 - Design of Chemostats
- Lecture 28 - Stability of Bioreactors
- Lecture 29 - Stability of Bioreactors (Continued...)
- Lecture 30 - Introduction to Receptor - Ligand Binding
- Lecture 31 - Effects of Ligand Depletion and Multiple Receptors on Binding Kinetics

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Lecture 2 - Introduction (Continued...)

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Lecture 7 - Photolithography (Continued...)

Lecture 8 - Deposition

Lecture 9 - Plastic microfluidic devices

Lecture 10 - Mixing

Lecture 11 - Micro Heat Pipes

Lecture 12 - Mixing (Continued...)

Lecture 13 - Mixing (Continued...)

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Lecture 20 - Electro osmosis

Lecture 21 - Electrowetting (Continued...)

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Lecture 24 - Dielectrophoresis (Continued...)

Lecture 25 - Dielectrophoresis (Continued...)

Lecture 26 - Scaling dimension and issues

Lecture 27 - Slip flow

Lecture 28 - Microstructured reactor

Lecture 29 - Immiscible flow in microchannel

Lecture 30 - Immiscible flow in microchannel (Continued...)

Lecture 31 - Immiscible flow in microchannel (Continued...)



[Lecture 32 - Scaling dimension and issues \(Continued...\)](#)

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[Lecture 39 - Electrohydrodynamic atomization \(Continued...\)](#)

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**NPTEL : Multiphase Flow (Chemical Engineering)**

**Co-ordinators : Prof. P.K. Das, Prof. Gargi Das**

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Lecture 2 - Estimation of Flow Patterns

Lecture 3 - Estimation of Flow Patterns (Continued...)

Lecture 4 - Flow Pattern Maps Fascinating Taylor Bubbles

Lecture 5 - Definitions and Common Terminologies

Lecture 6 - Definitions and Common Terminologies (Continued...)

Lecture 7 - Simple Analytical Models

Lecture 8 - The Homogeneous Flow Theory

Lecture 9 - The Homogeneous Flow Theory (Continued...)

Lecture 10 - Compressible Flow A Recapitulation

Lecture 11 - Compressible Flow A Recapitulation (Continued...)

Lecture 12 - Choked Flow Condition for Homogeneous Flow

Lecture 13 - Drift Flux Model

Lecture 14 - Drift Flux Model (Continued...)

Lecture 15 - Drift Flux Model (Continued...)

Lecture 16 - Drift Flux Model (Continued...)

Lecture 17 - Separated Flow Model

Lecture 18 - Separated Flow Model (Continued...)

Lecture 19 - Separated Flow Model (Continued...)

Lecture 20 - Separated Flow Model - Condition of Choking

Lecture 21 - Separated Flow Model - Condition of Choking (Continued...)

Lecture 22 - Separated Flow Model - Estimation of Frictional Pressure Drop and Void Fraction

Lecture 23 - Separated Flow Model - Estimation of Frictional Pressure Drop and Void Fraction (Continued...)

Lecture 24 - Separated Flow Model - Estimation of Frictional Pressure Drop and Void Fraction (Continued...)

Lecture 25 - Separated Flow Model - Estimation of Frictional Pressure Drop and Void Fraction (Continued...)

Lecture 26 - Analysis of Specific Flow Regimes

Lecture 27 - Analysis of Specific Flow Regimes (Continued...)

Lecture 28 - Analysis of Specific Flow Regimes - Slug Flow (Continued...)

Lecture 29 - Two Phase Flow with Phase Change - An Introduction to Boiling Heat Transfer

Lecture 30 - Bubble Growth

Lecture 31 - Different Types of Nucleation

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[Lecture 36 - Critical Heat Flux, Film Boiling](#)

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[Lecture 40 - Measurement Techniques for Two Phase flow Parameters - Estimation of Flow Patterns](#)

**NPTEL : Novel Separation Processes (Chemical Engineering)**

**Co-ordinators : Prof. S. De**

[Lecture 1 - Fundamentals of Separation Processes](#)

[Lecture 2 - Identification of Novel Separation Processes](#)

[Lecture 3 - Membrane Separation Processes](#)

[Lecture 4 - Membrane Separation Processes \(Continued...1\)](#)

[Lecture 5 - Membrane Separation Processes \(Continued...2\)](#)

[Lecture 6 - Membrane Separation Processes \(Continued...3\)](#)

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**NPTEL : NOC:Metallocene and Metal-Carbene based Organometallic Compounds as Industrially Important Advanced Polyolefin Catalysts (Chemical Engineering)**

**Co-ordinators : Prof. Sanjib K. Patra**

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Lecture 2 - A Brief Introduction to Polymers (Continued...)

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Lecture 4 - Polyethylene and Polypropylene: Chemical structure and properties (Continued...)

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Lecture 7 - Common polymerization protocol and mechanism: Controlled Polymerization

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Lecture 10 - Metallocene compounds: Structure and Bonding

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Lecture 22 - Coordination polymerization of olefin by Metallocene Catalysts: A new avenue in polyolefin catalysts (Continued...)

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Lecture 24 - Symmetry of metallocene and Stereoregularity in polyolefin (Continued...)

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Lecture 26 - Metallocene to Post-metallocene catalysts for olefin polymerization (Continued...)

Lecture 27 - Polymerization strategy for industrial preparation of LLDPE

Lecture 28 - Polymerization strategy for industrial preparation of LLDPE (Continued...)

Lecture 29 - Metallocene and Post-metallocene Catalysts: Homogeneous to Heterogeneous and Lab to Industry

Lecture 30 - Metallocene and Post-metallocene Catalysts: Homogeneous to Heterogeneous and Lab to Industry (Continued...)

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[Lecture 31 - Depolymerization of synthetic polymers: Role of organometallic and metallocene based catalysts](#)

[Lecture 32 - Depolymerization of synthetic polymers: Role of organometallic and metallocene based catalysts](#)

[Lecture 33 - Metal-carbene complexes as versatile catalysts for multiple useful reactions: A short introduction](#)

[Lecture 34 - Metal-carbene complexes as versatile catalysts for multiple useful reactions: A short introduction \(Continued...\)](#)

[Lecture 35 - Bonding and Electronic properties in Metal-carbene complexes](#)

[Lecture 36 - General synthetic protocol of Metal-carbene complexes](#)

[Lecture 37 - N-Heterocyclic carbene \(NHC\) complex: Bonding and General synthetic protocol](#)

[Lecture 38 - Alkene metathesis by metal-carbene catalysts and its mechanism](#)

[Lecture 39 - Utility of metal-carbene catalysts in alkene polymerization](#)

[Lecture 40 - Industrially important polymers by ROMP: Recent development and scope; Overall summary of this course](#)

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- Lecture 3 - Kinematics - 3
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- Lecture 5 - Kinematics - 5 - Shear Stress
- Lecture 6 - Kinematics - 6 and Conservation Equation - 1
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[Lecture 34 - Fundamentals and Mechanism of Heat Transfer \(Continued...\)](#)

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Lecture 11 - Identification by Chemical Techniques, Implication of National and International Standards alongwith Practical Demonstration

Lecture 12 - Identification by Chemical Techniques, Implication of National and International Standards alongwith Practical Demonstration (Continued...)

Lecture 13 - Identification by Chemical Techniques, Implication of National and International Standards alongwith Practical Demonstration (Continued...)

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Lecture 16 - Introduction of UV-Vis and infrared spectroscopy for polymers, elastomers and composites

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Lecture 18 - Introduction of UV-Vis and infrared spectroscopy for polymers, elastomers and composites (Continued...)

Lecture 19 - Introduction of UV-Vis and infrared spectroscopy for polymers, elastomers and composites (Continued...)

Lecture 20 - Introduction of UV-Vis and infrared spectroscopy for polymers, elastomers and composites (Continued...)

Lecture 21 - Application of infrared spectroscopy for blends, modification of polymers, compatibilizaion, coupling etc.

Lecture 22 - Application of infrared spectroscopy for blends, modification of polymers, compatibilizaion, coupling etc.

Lecture 23 - Application of infrared spectroscopy for blends, modification of polymers, compatibilizaion, coupling etc.

Lecture 24 - Practical demonstration on UV-Visible spectroscopy

Lecture 25 - Practical demonstration on FTIR spectroscopy and Sulphur analyzer

Lecture 26 - Introduction to Photoacoustic spectroscopy (PA), Raman spectroscopy, Atomic absorption spectroscopy and Electron spin response (ESR) spectroscopy

Lecture 27 - Introduction to Photoacoustic spectroscopy (PA), Raman spectroscopy, Atomic absorption spectroscopy and Electron spin response (ESR) spectroscopy (Continued...)

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Lecture 28 - Introduction to Photoacoustic spectroscopy (PA), Raman spectroscopy, Atomic absorption spectroscopy and Electron spin response (ESR) spectroscopy (Continued...)

Lecture 29 - Introduction to Photoacoustic spectroscopy (PA), Raman spectroscopy, Atomic absorption spectroscopy and Electron spin response (ESR) spectroscopy (Continued...)

Lecture 30 - Introduction to Photoacoustic spectroscopy (PA), Raman spectroscopy, Atomic absorption spectroscopy and Electron spin response (ESR) spectroscopy (Continued...)

Lecture 31 - NMR Spectroscopy- principles and fundamentals. Application of NMR in polymer, elastomer and composites

Lecture 32 - NMR Spectroscopy- principles and fundamentals. Application of NMR in polymer, elastomer and composites (Continued...)

Lecture 33 - NMR Spectroscopy- principles and fundamentals. Application of NMR in polymer, elastomer and composites (Continued...)

Lecture 34 - NMR Spectroscopy- principles and fundamentals. Application of NMR in polymer, elastomer and composites (Continued...)

Lecture 35 - NMR Spectroscopy- principles and fundamentals. Application of NMR in polymer, elastomer and composites (Continued...)

Lecture 36 - Thermal analysis techniques and application in polymer, elastomer and composites

Lecture 37 - Thermal analysis techniques and application in polymer, elastomer and composites (Continued...)

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Lecture 40 - XRD, XPS and XRF. Principles, Fundamentals and Application in Polymer, Elastomer and Composites

Lecture 41 - XRD, XPS and XRF. Principles, Fundamentals and Application in Polymer, Elastomer and Composites (Continued...)

Lecture 42 - XRD, XPS and XRF. Principles, Fundamentals and Application in Polymer, Elastomer and Composites (Continued...)

Lecture 43 - XRD, XPS and XRF. Principles, Fundamentals and Application in Polymer, Elastomer and Composites (Continued...)

Lecture 44 - XRD, XPS and XRF. Principles, Fundamentals and Application in Polymer, Elastomer and Composites (Continued...)

Lecture 45 - Introduction to microscopy (Optical, AFM) with special reference to electron microscopy (SEM, FESEM and HRTEM)

Lecture 46 - Introduction to microscopy (Optical, AFM) with special reference to electron microscopy (SEM, FESEM and HRTEM) (Continued...)

Lecture 47 - Introduction to microscopy (Optical, AFM) with special reference to electron microscopy (SEM, FESEM and HRTEM) (Continued...)

Lecture 48 - Introduction to microscopy (Optical, AFM) with special reference to electron microscopy (SEM, FESEM and HRTEM) (Continued...)

Lecture 49 - Introduction to microscopy (Optical, AFM) with special reference to electron microscopy (SEM, FESEM and HRTEM) (Continued...)

Lecture 50 - Applications of microscopy in polymers, elastomers and composites

Lecture 51 - Applications of microscopy in polymers, elastomers and composites (Continued...)

Lecture 52 - Practical demonstration on optical microscopy

Lecture 53 - Practical demonstration on atomic force microscopy (AFM)

Lecture 54 - Practical demonstration on image processing using standard software (Image)

Lecture 55 - Chromatography, DETA, Quantification from Rate Dependent Methods, Reverse Engineering and Recent Advances

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[Lecture 57 - Chromatography, DETA, Quantification from Rate Dependent Methods, Reverse Engineering and Recent Advances \(Continued...\)](#)

[Lecture 58 - Chromatography, DETA, Quantification from Rate Dependent Methods, Reverse Engineering and Recent Advances \(Continued...\)](#)

[Lecture 59 - Chromatography, DETA, Quantification from Rate Dependent Methods, Reverse Engineering and Recent Advances \(Continued...\)](#)

[Lecture 60 - Chromatography, DETA, Quantification from Rate Dependent Methods, Reverse Engineering and Recent Advances \(Continued...\)](#)



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Lecture 2 - Analysis of the Need of Computers in Process Industries

Lecture 3 - Analysis of the Need of Computers in Process Industries (Continued...)

Lecture 4 - Discussion on Computational Tools available to Chemical Engineers

Lecture 5 - Analysis and Comparison of different Programming Languages

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Lecture 7 - MATLAB Primer - Writing Codes

Lecture 8 - MATLAB Primer - Coding (Continued...)

Lecture 9 - MATLAB Primer - Coding (Continued...)

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Lecture 12 - LAB 1 - Analysis of Frictional Losses in Pipe Flows Theory and Solution Strategy

Lecture 13 - LAB 1 - Analysis of Frictional Losses in Pipe Flows Solution of the Problem under ...

Lecture 14 - LAB 1 - Analysis of Frictional Losses in Pipe Flows Solution of the Problem under ...

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Lecture 20 - LAB 2 - Steady-state Operation of a Diabatic CSTR Analysis and Presentation ...

Lecture 21 - LAB 3 - Analysis of multicomponent distillation Problem definition and analysis

Lecture 22 - LAB 3 - Analysis of Multicomponent Distillation Theory and Solution Strategy

Lecture 23 - LAB 3 - Analysis of Multicomponent Distillation Solution of the Problem under Various ...

Lecture 24 - LAB 3 - Analysis of Multicomponent Distillation Solution of the Problem under Various ...

Lecture 25 - LAB 3 - Analysis of Multicomponent Distillation Presentation and Analysis of Results

Lecture 26 - LAB 4 - Analysis of Cooling of a Solid Body in a Reservoir Problem Definition ...

Lecture 27 - LAB 4 - Analysis of Cooling of a Solid Body in a Reservoir Theory and Solution ...

Lecture 28 - LAB 4 - Analysis of Cooling of a Solid Body in a Reservoir Solution of the Problem ...

Lecture 29 - LAB 4 - Analysis of Cooling of a Solid Body in a Reservoir Solution of the Problem ...

Lecture 30 - LAB 4 - Analysis of cooling of a solid body in a reservoir Presentation ...

Lecture 31 - LAB 5 - Analysis of unsteady-state operation of cascade CSTR's Problem Definition ...

Lecture 32 - LAB 5 - Analysis of unsteady-state operation of cascade CSTR's Theory and Solution ...

Lecture 33 - LAB 5 - Analysis of unsteady-state operation of cascade CSTR's Solution of the Problem

Lecture 34 - LAB 5 - Analysis of unsteady-state operation of cascade CSTR's Solution of the problem

Lecture 35 - LAB 5 - Analysis of unsteady-state operation of cascade CSTR's Presentation ...

Lecture 36 - LAB 6 - Analysis of Steady-state Heat Conduction in a 1-D rod

Lecture 37 - LAB 6 - Analysis of Steady-state Heat Conduction in a 1-D rod

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Lecture 41 - LAB 7 - Reaction-diffusion in a spherical catalyst pallet Problem definition and ...

Lecture 42 - LAB 7 - Reaction-diffusion in a spherical catalyst pallet Theory and solution strategy

Lecture 43 - LAB 7 - Reaction-diffusion in a spherical catalyst pallet Solution of the problem ...

Lecture 44 - LAB 7 - Reaction-diffusion in a spherical catalyst pallet Solution of the problem ...

Lecture 45 - LAB 7 - Reaction-diffusion in a spherical catalyst pallet Analysis and interpretation ...

Lecture 46 - LAB 8 - Heat conduction in higher dimensions Problem definition and analysis

Lecture 47 - LAB 8 - Heat conduction in higher dimensions Background theory and solution strategy

Lecture 48 - LAB 8 - Heat conduction in higher dimensions Problem solution

Lecture 49 - LAB 8 - Heat conduction in higher dimensions Problem solution (Continued...)

Lecture 50 - LAB 8 - Heat conduction in higher dimensions Problem solution and analysis

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Lecture 53 - LAB 9 - Process economics and optimisation Solution of the problem

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Lecture 55 - LAB 9 - Process economics and optimisation Solution of the problem and analysis of ...

Lecture 56 - LAB 10 - Regression and curve - fitting of data Problem definition and analysis

Lecture 57 - LAB 10 - Regression and curve - fitting of data Background theory and solution strategy

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Lecture 59 - LAB 10 - Regression and curve - fitting of data Problem solution (Continued...)

Lecture 60 - Review of the course

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Lecture 2 - Concept of Seismic Reflection, Introduction to Drilling

Lecture 3 - Drilling Mud and Mechanisms of Recovery of Petroleum

Lecture 4 - Composition of Crude Petroleum and Evaluation of Oil Stocks

Lecture 5 - Evaluation of Oil Stocks: Vaporization Characteristics

Lecture 6 - Primary Processing of Crude Oil: Desalting

Lecture 7 - Primary Processing of Crude Oil: Atmospheric Distillation Unit (ADU)

Lecture 8 - Primary Processing of Crude Oil: Reflux Systems, Vacuum Distillation Unit (VDU)

Lecture 9 - Products and Process Utilities in Primary Processing, Pipe Still Heater

Lecture 10 - Refinery Units

Lecture 11 - Secondary Processing: Decomposition of Residues: Thermal Cracking

Lecture 12 - Coking, Gasification and Steam Cracking

Lecture 13 - Secondary Processing: Decomposition of Residues: Hydrocracking

Lecture 14 - Secondary Processing: Decomposition of Residues: Catalytic Cracking

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Lecture 16 - Properties and Testing of Petroleum Products

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Lecture 21 - Petroleum fractions from distillation units

Lecture 22 - Petroleum fractions from distillation units (Continued...)

Lecture 23 - Petroleum fractions from distillation units (Continued...)

Lecture 24 - Petroleum fractions from distillation units (Continued...)

Lecture 25 - Petroleum fractions from distillation units (Continued...)

Lecture 26 - Upgradation of straight run cuts from atmospheric distillation unit

Lecture 27 - Upgradation of straight run cuts from atmospheric distillation unit (Continued...)

Lecture 28 - Upgradation of straight run cuts from atmospheric distillation unit (Continued...)

Lecture 29 - Upgradation of straight run cuts from atmospheric distillation unit (Continued...)

Lecture 30 - Upgradation of straight run cuts from distillation unit

Lecture 31 - Purification processes

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[Lecture 33 - Bitumen preparation processes](#)

[Lecture 34 - Grease: preparation, description and application](#)

[Lecture 35 - Emission control and effluent treatment in refinery](#)

[Lecture 36 - Fundamentals of thermochemistry: Combustion](#)

[Lecture 37 - Fundamentals of thermochemistry: Flame](#)

[Lecture 38 - Fundamentals of thermochemistry: Adiabatic flame temperature](#)

[Lecture 39 - Fundamentals of thermochemistry: Burner](#)

[Lecture 40 - Fundamentals of thermochemistry: Internal Combustion engine](#)

Lecture 1 - Basic Introduction to Polymer

Lecture 2 - Structure Process Correlation

Lecture 3 - Basic Rheology

Lecture 4 - Classification of Fluids

Lecture 5 - Flow of Liquids Through Various Channels - 1

Lecture 6 - Flow of Liquids Through Various Channels - 2

Lecture 7 - Flow of Liquids Through Various Channels - 3

Lecture 8 - Introduction to Viscometers and Rheometers

Lecture 9 - Ostwald Viscometer, Brookfield Viscometer, Falling Piston Viscometers

Lecture 10 - ODR, MDR, RPA, PPR

Lecture 11 - DMA -In-Light of rheology

Lecture 12 - Master Curve and its Implications

Lecture 13 - Capillary Rheometer

Lecture 14 - Introduction to Paints and importance of rheology in paints

Lecture 15 - Rheology of paints - 1

Lecture 16 - Rheology of paints - 2

Lecture 17 - Rheology of Adhesives and Sealants

Lecture 18 - Rheology of Fiber and Plastics

Lecture 19 - Practical demonstration on Brookfield viscometer and Oswald viscometer

Lecture 20 - Practical demonstration on Mooney viscometer, ODR and MDR

Lecture 21 - Practical demonstration on RPA

Lecture 22 - Practical demonstration on PPR and DMA

Lecture 23 - Practical demonstration on Capillary Rheometer

Lecture 24 - Numerical Problems related to basic rheology

Lecture 25 - Importance of compounding and introduction to various compounding ingredients

Lecture 26 - Properties and role of various compounding ingredients

Lecture 27 - Surface treatment of reinforcing elements

Lecture 28 - Rheology of Elastomers

Lecture 29 - Importance of die swell (correlating with normal force differences)

Lecture 30 - Melt Fracture and other extrudate instabilities

Lecture 31 - Introduction to plastic and rubber mixing and blending

Lecture 32 - Various mixing equipment and their importance

Lecture 33 - Introduction to Two-Roll Mill and Mixing on Two - Roll Mill 1

Lecture 34 - Introduction to Two-Roll Mill and Mixing on Two - Roll Mill 2

Lecture 35 - Introduction to Internal mixture Kneaders and Mixing using Internal mixture and Kneaders

Lecture 36 - Practical demonstration of Rubber mixing on a two roll and using an internal mixer

Lecture 37 - Molding Techniques

Lecture 38 - Calendering

Lecture 39 - Extrusion

Lecture 40 - Rheology of Injection moulding process

Lecture 41 - Plastic and fiber-related processing

Lecture 42 - Numerical problems related to various processing techniques

Lecture 43 - Wire coating, Garvey die, Profile Extrusion

Lecture 44 - Introduction to FEA based computationalfluid mechanics on extrusion - 1

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Lecture 46 - Introduction to FEA based computationalfluid mechanics on extrusion - 3

Lecture 47 - Practical demonstartion on FEA

Lecture 48 - Concluding remarks and commentson applied rheology for advanced learners

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[Lecture 2 - Mud Logging](#)

[Lecture 3 - Mud Logging \(Continued...\)](#)

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[Lecture 6 - Wireline Logging](#)

[Lecture 7 - Resistivity Log](#)

[Lecture 8 - Resistivity Log \(Continued...\)](#)

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- [Lecture 34 - Neutron Porosity Log \(Continued...\)](#)
- [Lecture 35 - Sonic \(Acoustic\) Porosity Log](#)
- [Lecture 36 - Sonic Porosity Log \(Continued...\)](#)
- [Lecture 37 - Sonic Porosity Log \(Continued...\)](#)
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Lecture 3 - Elementary Framework (Continued...)

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Lecture 17 - Use of NS Equation for Solving Previous Problems

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Lecture 22 - Motion of fluid particles (Continued...)

Lecture 23 - Motion of fluid particles (Continued...)

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- Lecture 39 - Bernoulli's Equation Fundamentals - 1
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- Lecture 52 - Flow meters
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[Lecture 33 - Summary of Classical Thermodynamics](#)

[Lecture 34 - Molecular basis of Thermodynamics - I](#)

[Lecture 35 - Molecular basis of Thermodynamics - II](#)

Lecture 1 - Motivation for CFD and Introduction to the CFD approach

Lecture 2 - Illustration of the CFD approach through a worked out example

Lecture 3 - Eulerian approach, Conservation Equation, Derivation of Mass Conservation Equation and Statement of the momentum conservation equation

Lecture 4 - Forces acting on a control volume; Stress tensor; Derivation of the momentum conservation equation ; Closure problem; Deformation of a fluid element in fluid flow

Lecture 5 - Kinematics of deformation in fluid flow; Stress vs strain rate relation; Derivation of the Navier-Stokes equations

Lecture 6 - Equations governing flow of incompressible flow; Initial and boundary conditions; Wellposedness of a fluid flow problem

Lecture 7 - Equations for some simple cases; Generic scalar transport equation form of the governing equations; Outline of the approach to the solution of the N-S equations.

Lecture 8 - cut out the first 30s; Spatial discretization of a simple flow domain; Taylor's series expansion and the basis of finite difference approximation of a derivative; Central and one-sided difference approximations; Order of accuracy of finite difference ap

Lecture 9 - Finite difference approximation of pth order of accuracy for qth order derivative; cross -derivatives; Examples of high order accurate formulae for several derivatives

Lecture 10 - One -sided high order accurate approximations; Explicit and implicit formulations for the time derivatives

Lecture 11 - Numerical solution of the unsteady advection equation using different finite difference approximations

Lecture 12 - Need for analysis of a discretization scheme; Concepts of consistency, stability and convergence and the equivalence theorem of Lax ; Analysis for consistency

Lecture 13 - Statement of the stability problem; von Neumann stability analysis of the first order wave equation

Lecture 14 - Consistency and stability analysis of the unsteady diffusion equation; Analysis for two- and three -dimensional cases; Stability of implicit schemes

Lecture 15 - Interpretation of the stability condition; Stability analysis of the generic scalar equation and the concept of upwinding ; Diffusive and dissipative errors in numerical solution; Introduction to the concept of TVD schemes

Lecture 16 - Template for the generic scalar transport equation and its extension to the solution of Navier-Stokes equations for a compressible flow.

Lecture 17 - Illustration of application of the template using the MacCormack scheme for a three-dimensional compressible flow

Lecture 18 - Stability limits of MacCormack scheme; Limitations in extending compressible flow schemes to incompressible flows ; Difficulty of evaluation of pressure in incompressible flows and listing of various approaches

Lecture 19 - Artificial compressibility method and the streamfunction-vorticity method for the solution of NS equations and their limitations

Lecture 20 - Pressure equation method for the solution of NS equations

Lecture 21 - Pressure-correction approach to the solution of NS equations on a staggered grid; SIMPLE and its family of methods

Lecture 22 - Need for efficient solution of linear algebraic equations; Classification of approaches for the solution of linear algebraic equations.

Lecture 23 - Direct methods for linear algebraic equations; Gaussian elimination method

Lecture 24 - Gauss-Jordan method; LU decomposition method; TDMA and Thomas algorithm

Lecture 25 - Basic iterative methods for linear algebraic equations: Description of point -Jacobi, Gauss-Seidel and SOR methods

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Lecture 26 - Convergence analysis of basic iterative schemes; Diagonal dominance condition for convergence; Influence of source terms on the diagonal dominance condition; Rate of convergence

Lecture 27 - Application to the Laplace equation

Lecture 28 - Advanced iterative methods: Alternating Direction Implicit Method; Operator splitting

Lecture 29 - Advanced iterative methods; Strongly Implicit Procedure; Conjugate gradient method; Multigrid method

Lecture 30 - Illustration of the Multigrid method for the Laplace equation

Lecture 31 - Overview of the approach of numerical solution of NS equations for simple domains; Introduction to complexity arising from physics and geometry

Lecture 32 - Derivation of the energy conservation equation

Lecture 33 - Derivation of the species conservation equation; dealing with chemical reactions

Lecture 34 - Turbulence; Characteristics of turbulent flow; Dealing with fluctuations and the concept of time-averaging

Lecture 35 - Derivation of the Reynolds -averaged Navier -Stokes equations; identification of the closure problem of turbulence; Boussinesq hypothesis and eddy viscosity

Lecture 36 - Reynolds stresses in turbulent flow; Time and length scales of turbulence; Energy cascade; Mixing length model for eddy viscosity

Lecture 37 - One-equation model for turbulent flow

Lecture 38 - Two -equation model for turbulent flow; Numerical calculation of turbulent reacting flows

Lecture 39 - Calculation of near-wall region in turbulent flow; wall function approach; near-wall turbulence models

Lecture 40 - Need for special methods for dealing with irregular flow geometry; Outline of the Body-fitted grid approach ; Coordinate transformation to a general, 3-D curvilinear system

Lecture 41 - Transformation of the governing equations; Illustration for the Laplace equation; Appearance and significance of cross - derivative terms; Concepts of structured and unstructured grids.

Lecture 42 - Finite volume method for complicated flow domain; Illustration for the case of flow through a duct of triangular cross - section.

Lecture 43 - Finite volume method for the general case

Lecture 44 - Generation of a structured grid for irregular flow domain; Algebraic methods; Elliptic grid generation method

Lecture 45 - Unstructured grid generation; Domain nodalization; Advancing front method for triangulation

Lecture 46 - Delaunay triangulation method for unstructured grid generation

Lecture 47 - Co -located grid approach for irregular geometries; Pressure correction equation for a co -located structured grid; Pressure correction equation for a co-located unstructured grid.

Lecture 1 - Introduction

Lecture 2 - Computational and Error Analysis

Lecture 3 - Linear Equations - Part 1

Lecture 4 - Linear Equations - Part 2

Lecture 5 - Linear Equations - Part 3

Lecture 6 - Linear Equations - Part 4

Lecture 7 - Linear Equations - Part 5

Lecture 8 - Linear Equations - Part 6

Lecture 9 - Non Linear Algebraic Equations - Part 1

Lecture 10 - Non Linear Algebraic Equations - Part 2

Lecture 11 - Non Linear Algebraic Equations - Part 3

Lecture 12 - Non Linear Algebraic Equations - Part 4

Lecture 13 - Non Linear Algebraic Equations - Part 5

Lecture 14 - Non Linear Algebraic Equations - Part 6

Lecture 15 - Regression and Interpolation - Part 1

Lecture 16 - Regression and Interpolation - Part 2

Lecture 17 - Regression and Interpolation - Part 3

Lecture 18 - Regression and Interpolation - Part 4

Lecture 19 - Regression and Interpolation - Part 5

Lecture 20 - Differentiation and Integration - Part 1

Lecture 21 - Differentiation and Integration - Part 2

Lecture 22 - Differentiation and Integration - Part 3

Lecture 23 - Differentiation and Integration - Part 4

Lecture 24 - Differentiation and Integration - Part 5

Lecture 25 - Ordinary Differential Equations (initial value problems) - Part 1

Lecture 26 - Ordinary Differential Equations (initial value problems) - Part 2

Lecture 27 - Ordinary Differential Equations (initial value problems) - Part 3

Lecture 28 - Ordinary Differential Equations (initial value problems) - Part 4

Lecture 29 - Ordinary Differential Equations (initial value problems) - Part 5

Lecture 30 - Ordinary Differential Equations (initial value problems) - Part 6

Lecture 31 - Ordinary Differential Equations (initial value problems) - Part 7

[Lecture 32 - Ordinary Differential Equations \(initial value problems\) - Part 8](#)

[Lecture 33 - Ordinary Differential Equations \(initial value problems\) - Part 9](#)

[Lecture 34 - Ordinary Differential Equations \(boundary value problems\) - Part 1](#)

[Lecture 35 - Ordinary Differential Equations \(boundary value problems\) - Part 2](#)

[Lecture 36 - Ordinary Differential Equations \(boundary value problems\) - Part 3](#)

[Lecture 37 - Partial Differential Equations - Part 1](#)

[Lecture 38 - Partial Differential Equations - Part 2](#)

[Lecture 39 - Partial Differential Equations - Part 3](#)

[Lecture 40 - Partial Differential Equations - Part 4](#)



- Lecture 1 - Introduction: Why study particle characterization?
- Lecture 2 - Introduction: Classification of particle characteristics
- Lecture 3 - Morphological Characterization: Shape analysis methods
- Lecture 4 - Morphological Characterization: Techniques of shape assessment
- Lecture 5 - Morphological Characterization: Decision rules
- Lecture 6 - Morphological Characterization: Static vs dynamic methods of size analysis
- Lecture 7 - Morphological Characterization: Static methods of size analysis
- Lecture 8 - Morphological Characterization: Light scattering from spherical particles
- Lecture 9 - Morphological Characterization: Particle counters
- Lecture 10 - Morphological Characterization: Particle size distributions
- Lecture 11 - Morphological Characterization: Acoustic Attenuation Spectroscopy
- Lecture 12 - Morphological Characterization: Nano-particle size analysis
- Lecture 13 - Structural Characterization
- Lecture 14 - Interfacial Characterization
- Lecture 15 - Surface Adhesion: Forces
- Lecture 16 - Surface Adhesion: Electrostatic & Surface-Tension Forces
- Lecture 17 - Surface Adhesion: Adhesion Force Measurement
- Lecture 18 - Particle Removal: Methods
- Lecture 19 - Particle Removal: Wet Cleaning
- Lecture 20 - Particle Cohesion: Forces
- Lecture 21 - Particle Cohesion: Flowability Implications
- Lecture 22 - Transport Properties: Diffusion & Electrostatic Field Effects
- Lecture 23 - Transport Properties: Drag & Inertia
- Lecture 24 - Transport Properties: Deposition Fluxes & Rates
- Lecture 25 - Transport Properties: Illustrative Application
- Lecture 26 - Chemical & Compositional Characterization: Reactivity
- Lecture 27 - Chemical & Compositional Characterization: Analytical Methods
- Lecture 28 - Chemical & Compositional Characterization: XRD & AFM
- Lecture 29 - Nano-particle Characterization: Bottom-Up Synthesis Methods
- Lecture 30 - Nano-particle Characterization: Top-Down Synthesis Methods
- Lecture 31 - Nano-particle Characterization: Dispersion

[Lecture 32 - Nano-particle Characterization: Properties & Techniques](#)

[Lecture 33 - Practical Relevance of Particle Characterization: Nano-Fluids](#)

[Lecture 34 - Practical Relevance of Particle Characterization: Filtration](#)

[Lecture 35 - Practical Relevance of Particle Characterization: Cleanrooms](#)

[Lecture 36 - Practical Relevance of Particle Characterization: High-Technology Manufacturing](#)

[Lecture 37 - Practical Relevance of Particle Characterization: Explosivity](#)

[Lecture 38 - Practical Relevance of Particle Characterization: Environment & Human Health](#)

[Lecture 39 - Practical Relevance of Particle Characterization: Other Applications](#)

[Lecture 40 - Summary](#)

Lecture 1 - Introduction

Lecture 2 - Random Variables

Lecture 3 - Discrete Probability Distributions

Lecture 4 - Example Set - I

Lecture 5 - Continuous probability distributions

Lecture 6 - Normal probability distribution

Lecture 7 - Exploratory Data Analysis - Part A

Lecture 8 - Exploratory Data Analysis - Part B

Lecture 9 - Example Set - II

Lecture 10 - Example Set - III

Lecture 11 - Random samples: Sampling distribution of the mean (Part A)

Lecture 12 - Random samples: Sampling distribution of the mean (Part B)

Lecture 13 - Point Estimation

Lecture 14 - Sampling distributions and the Central Limit Theorem

Lecture 15 - Example Set - IV Part A

Lecture 16 - Estimation of Population Parameters Using Moments

Lecture 17 - Confidence Intervals (Part A)

Lecture 18 - Confidence Intervals (Part B)

Lecture 19 - The T-distribution

Lecture 20 - Chi-square distribution

Lecture 21 - F-Distribution

Lecture 22 - Example Set - V

Lecture 23 - Hypothesis Testing - Part A

Lecture 24 - Hypothesis Testing - Part B

Lecture 25 - Hypothesis Testing - Part C

Lecture 26 - Analysis of Experiments involving Single Factor - Part A

Lecture 27 - Analysis of Experiments involving Single Factor - Part B

Lecture 28 - Blocking and Randomization

Lecture 29 - Example Set - VI - Part A

Lecture 30 - Example Set - VI - Part B

Lecture 31 - Factorial Design of Experiments - Part A

[Lecture 32 - Factorial Design of Experiments - Part B: 22 Factorial Design](#)

[Lecture 33 - Fractional Factorial Design - Part A](#)

[Lecture 34 - Fractional Factorial Design - Part B](#)

[Lecture 35 - Factorial Design of Experiments: Example Set \(Part A\)](#)

[Lecture 36 - Factorial Design of Experiments: Example Set \(Part B\)](#)

[Lecture 37 - Factorial Design of Experiments: Example Set \(Part C\)](#)

[Lecture 38 - Regression Analysis: Part A](#)

[Lecture 39 - Regression Analysis: Part B](#)

[Lecture 40 - Hypothesis Testing in Linear Regression](#)

[Lecture 41 - Discussion on Regression Output](#)

[Lecture 42 - Regression Analysis: Example Set 8](#)

[Lecture 43 - Regression Analysis: Example Set 8 \(Continued...\)](#)

[Lecture 44 - Regression Analysis: Example Set 8 \(Continued...\)](#)

[Lecture 45 - Orthogonal Model Fitting Concepts - Part A](#)

[Lecture 46 - Orthogonal Model Fitting Concepts - Part B](#)

[Lecture 47 - Experimental Design Strategies - A](#)

[Lecture 48 - Experimental Design Strategies - B](#)

[Lecture 49 - Experimental Design Strategies - C](#)

[Lecture 50 - Response Surface Methodology - A](#)

[Lecture 51 - Response Surface Methodology - B](#)

[Lecture 52 - Optimal Designs - Part A](#)

[Lecture 53 - Optimal Designs - Part B](#)

[Lecture 54 - Statistics for Experimentalists - Summary Part A](#)

[Lecture 55 - Statistics for Experimentalists - Summary Part B](#)

- Lecture 1 - Introduction and overview of the course: Multiphase flows
- Lecture 2 - Stratified flow in a micro channel: Velocity profiles
- Lecture 3 - Stratified flow in a micro channel: Effects of physical parameters
- Lecture 4 - Flow regimes in microchannels: Modeling and Experiments
- Lecture 5 - Scaling Analysis: Introduction
- Lecture 6 - Scaling Analysis: Worked Examples
- Lecture 7 - Interfacial tension and its role in Multiphase flows
- Lecture 8 - Eulerian and Lagrangian approaches
- Lecture 9 - Reynolds Transport Theorem and the Equation of Continuity
- Lecture 10 - Derivation of Navier-Stokes equation
- Lecture 11 - Vector operations in general orthogonal coordinates: Grad., Div., Lapacian
- Lecture 12 - Normal and shear stresses on arbitrary surfaces: Force balance
- Lecture 13 - Normal and shear stresses on arbitrary surfaces: Stress Tensor formulation
- Lecture 14 - Stresses on deforming surfaces: Introduction to Perturbation Theory
- Lecture 15 - Pulsatile flow: Analytical solution
- Lecture 16 - Pulsatile flow: Analytical solution and perturbation solution for  $R_w = 1$
- Lecture 17 - Pulsatile flow: Perturbation solution for  $R_w = 1$
- Lecture 18 - Viscous heating: Apparent viscosity in a viscometer
- Lecture 19 - Domain perturbation methods: Flow between wavy walls
- Lecture 20 - Flow between wavy walls: Velocity profile
- Lecture 21 - Introduction to stability of dynamical systems: ODEs
- Lecture 22 - Stability of distributed systems (PDEs): reaction diffusion example
- Lecture 23 - Stability of a reaction-diffusion system (Continued...)
- Lecture 24 - Rayleigh-Benard convection: Physics and governing equations
- Lecture 25 - Rayleigh-Benard convection: Linear stability analysis - Part 1
- Lecture 26 - Rayleigh-Benard convection: Linear stability analysis - Part 2
- Lecture 27 - Rayleigh-Benard convection: Linear stability analysis - Part 3
- Lecture 28 - Rayleigh Benard convection: Discussion of results
- Lecture 29 - Rayleigh-Taylor heavy over light instability
- Lecture 30 - Rayleigh-Taylor instability (Continued...)
- Lecture 31 - Capillary jet instability: Problem formulation

[Lecture 32 - Capillary jet instability: Linear stability analysis](#)

[Lecture 33 - Capillary jet instability: Rayleigh's Work Principle](#)

[Lecture 34 - Tutorial Session: Solution of Assignment 4 on linear stability](#)

[Lecture 35 - Turing patterns: Instability in reaction-diffusion systems](#)

[Lecture 36 - Turing patterns: Results](#)

[Lecture 37 - Marangoni convection: Generalised tangential and normal stress boundary conditions](#)

[Lecture 38 - Marangoni convection: Stability analysis](#)

[Lecture 39 - Flow in a circular curved channel: Governing equations and scaling](#)

[Lecture 40 - Flow in a circular curved channel: Solution by regular perturbation](#)

[Lecture 41 - Stability of flow through curved channels: Problem formulation](#)

[Lecture 42 - Stability of flow through curved channels: Numerical calculation](#)

[Lecture 43 - Viscous Fingering: Darcy's law](#)

[Lecture 44 - Viscous Fingering: Stability analysis](#)

[Lecture 45 - Shallow Cavity flows](#)

Lecture 1 - Introduction - Lecture 1.1 A

Lecture 2 - Introduction - Lecture 1.1 B

Lecture 3 - Introduction - Lecture 1.2 A

Lecture 4 - Introduction - Lecture 1.2 B

Lecture 5 - Basic Definitions and concepts - Lecture 2.1 (Basic Definitions and concepts - Part I)

Lecture 6 - Basic Definitions and concepts - Lecture 2.2 (Basic Definitions and concepts - Part II)

Lecture 7 - Basic Definitions and concepts - Lecture 2.3 (Basic Definitions and concepts - Part III)

Lecture 8 - A review of Fourier transforms - Lecture 3.1 (Continuous time Fourier series)

Lecture 9 - A review of Fourier transforms - Lecture 3.2 (Continuous time Fourier transform)

Lecture 10 - A review of Fourier transforms - Lecture 3.3 (Discrete time Fourier series)

Lecture 11 - A review of Fourier transforms - Lecture 3.4 (Discrete time Fourier transform)

Lecture 12 - A review of Fourier transforms - Lecture 3.5 (Properties of Fourier transforms)

Lecture 13 - A review of Fourier transforms - Lecture 3.6 (Discrete Fourier transform)

Lecture 14 - A review of Fourier transforms - MATLAB demo of Fourier transform and periodogram

Lecture 15 - Duration and Bandwidth - Duration and Bandwidth

Lecture 16 - Duration and Bandwidth - Bandwidth equation and Instantaneous frequency

Lecture 17 - Duration and Bandwidth - Instantaneous frequency and analytic signals

Lecture 18 - Duration and Bandwidth - Duration-Bandwidth principle

Lecture 19 - Duration and Bandwidth - Requirements of time-frequency analysis techniques

Lecture 20 - Duration and Bandwidth - Requirements of time-frequency analysis and techniques

Lecture 21 - Short-time Fourier transform - Short-time Fourier transform

Lecture 22 - Short-time Fourier transform - Auxillary (MATLAB demonstration)

Lecture 23 - Short-time Fourier transform - Properties of STFT

Lecture 24 - Practical aspects of STFT

Lecture 25 - Closing Remarks

Lecture 26 - Wigner-Ville Distributions

Lecture 27 - Properties of WVD

Lecture 28 - Properties of WVD 2

Lecture 29 - Discrete WVD

Lecture 30 - Pseudo and Smoothed WVD

Lecture 31 - Cohens class and smoothed WVD

- Lecture 32 - Cohens class and smoothed WVD
- Lecture 33 - Cohens class and Ambiguity functions
- Lecture 34 - Affine class and closing remarks
- Lecture 35 - Continuous Wavelet Transform
- Lecture 36 - Continuous Wavelet Transforms
- Lecture 37 - Scale to Frequency
- Lecture 38 - Computational aspects of CWT
- Lecture 39 - Scalogram and MATLAB demonstration
- Lecture 40 - Scalogram and MATLAB demonstration
- Lecture 41 - Scaling function
- Lecture 42 - Scaling Function
- Lecture 43 - Wavelets
- Lecture 44 - Wavelets
- Lecture 45 - Applications of CWT
- Lecture 46 - Applications of CWT
- Lecture 47 - Discrete Wavelet Transform
- Lecture 48 - Discrete Wavelet Transform.
- Lecture 49 - Orthogonal scaling function bases and MRA
- Lecture 50 - Orthogonal scaling function bases and MRA.
- Lecture 51 - Wavelet Filters and Fast DWT Algorithm
- Lecture 52 - Wavelet Filters and Fast DWT Algorithm (Continued...)
- Lecture 53 - Wavelet Filters and Fast DWT Algorithm (Continued...)
- Lecture 54 - Wavelets for DWT
- Lecture 55 - Wavelets for DWT (Continued...)
- Lecture 56 - Wavelets for DWT (Continued...)
- Lecture 57 - DWT computation
- Lecture 58 - DWT computation (Continued...)
- Lecture 59 - DWT computation (Continued...)



Lecture 1 - Introduction

Lecture 2 - CVD Reactor and Process Design Fundamentals

Lecture 3 - Overview of CVD Process Fundamentals

Lecture 4 - Basics of Chemical Equilibrium Calculations and Flow Dynamics

Lecture 5 - Introduction to CVD Films

Lecture 6 - Film Structure and Properties

Lecture 7 - Pressure Effects on CVD Processes

Lecture 8 - CVD of Metals

Lecture 9 - CVD of Coatings

Lecture 10 - CVD Film Property Measurements

Lecture 11 - CVD Film Property Measurements: Qualitative and Quantitative

Lecture 12 - CVD in Tungsten Filament Lamps

Lecture 13 - CVD in Tungsten Filament Lamps: Design Aspects

Lecture 14 - CVD in Hot Corrosion

Lecture 15 - CVD Transport Phenomena: Conservation Equations

Lecture 16 - CVD Transport Phenomena: Constitutive Laws

Lecture 17 - CVD Transport Phenomena: Mass Transfer Mechanisms

Lecture 18 - CVD Transport Phenomena: Mass Transfer Analogy Condition (MTAC)

Lecture 19 - CVD Transport Phenomena: Effect of Homogeneous Reactions on MTAC

Lecture 20 - CVD Applications: Hot Filament CVD (HFCVD)

Lecture 21 - CVD Applications: Aerosol CVD (ACVD)

Lecture 22 - CVD Applications: CVD of Silicon

Lecture 23 - CVD Applications: CVD in Free-Molecular Flow Regime (FMFR)

Lecture 24 - CVD Applications: CVD of nano-Structured Films

Lecture 25 - CVD Overview

Lecture 26 - Review of CVD Basics: Part-I (PDF Lecture)

Lecture 27 - Review of CVD Basics: Part-II (PDF Lecture)

Lecture 28 - CVD Question Bank (PDF Lecture)

Lecture 29 - Basics of Nano-Structured Material Synthesis: Part-I

Lecture 30 - Basics of Nano-Structured Material Synthesis: Part-II

Lecture 31 - Undesirable CVD: Bulb-Blackening (Adobe Presenter)

[Lecture 32 - Undesirable CVD: Moolten Salt Deposition in Combustion Systems \(Adobe Presenter\)](#)

[Lecture 33 - Undesirable CVD: Hot Corrosion \(Adobe Presenter\)](#)

[Lecture 34 - Multi-component Transport Fundamentals: Assumptions and Control Volumes \(Adobe Presenter\)](#)

[Lecture 35 - Multi-component Transport Fundamentals: Mass Conservation Equations \(Adobe Presenter\)](#)

[Lecture 36 - Multi-component Transport Fundamentals: Momentum and Energy Conservation \(Adobe Presenter\)](#)

[Lecture 37 - Multi-component Transport Fundamentals: Entropy conservation \(Adobe Presenter\)](#)

[Lecture 38 - Multi-component Transport Fundamentals: Constitutive Laws for Mass and Momentum \(Adobe Presenter\)](#)

[Lecture 39 - Multi-component Transport Fundamentals: Constitutive Laws for Energy and Entropy \(Adobe Presenter\)](#)

Lecture 1 - Motivation and Introduction - Part I

Lecture 2 - Motivation and Introduction - Part II

Lecture 3 - What is Chemical Engineering - Part I

Lecture 4 - What is Chemical Engineering - Part II

Lecture 5 - What is Chemical Reaction Engineering - Part I

Lecture 6 - What is Chemical Reaction Engineering - Part II

Lecture 7 - Homogeneous and Heterogeneous Reactions - Part I

Lecture 8 - Homogeneous and Heterogeneous Reactions - Part II

Lecture 9 - Basics of Kinetics and Contacting

Lecture 10 - Design of Batch reactors - Part I

Lecture 11 - Design of Batch reactors - Part II

Lecture 12 - Basics of Plug Flow Reactor - Part I

Lecture 13 - Basics of Plug Flow Reactor - Part II

Lecture 14 - Design of Plug Flow Reactors - Part I

Lecture 15 - Design of Plug Flow Reactors - Part II

Lecture 16 - Basics of Mixed Flow Reactors

Lecture 17 - Design of Mixed Flow Reactors

Lecture 18 - Basics of Kinetics

Lecture 19 - Kinetics of Heterogeneous reactions - Part I

Lecture 20 - Kinetics of Heterogeneous reactions - Part II

Lecture 21 - Kinetics of Heterogeneous reactions - Part III

Lecture 22 - Kinetics of Homogeneous reactions

Lecture 23 - Reaction rate for Homogeneous reactions

Lecture 24 - Gas Phase Homogeneous reactions

Lecture 25 - (Continued...) And later Reactor Design of PFR

Lecture 26 - Reactor Design for MFR and Combination of reactors

Lecture 27 - PFR and MFR in series.

Lecture 28 - Unsteady state MFR and PFR

Lecture 29 - Recycle Reactors

Lecture 30 - Recycle Reactors (Autocatalytic reactions) - Part I

Lecture 31 - Recycle Reactors (Autocatalytic reactions) - Part II

[Lecture 32 - Multiple Reactions - Part I](#)

[Lecture 33 - Multiple Reactions - Part II](#)

[Lecture 34 - Multiple Reactions - Part III](#)

[Lecture 35 - Multiple Reactions - Part IV](#)

[Lecture 36 - Multiple Reactions - Part V](#)

[Lecture 37 - Multiple Reactions - Part VI](#)

[Lecture 38 - Non-Isothermal Reactors - Part I](#)

[Lecture 39 - Non-Isothermal Reactors - Part II](#)

[Lecture 40 - Non-Isothermal Reactors \(Graphical Design\)](#)

[Lecture 41 - Non-Isothermal Reactors contd. & Adiabatic Reactors](#)

[Lecture 42 - Non-Isothermal Reactors \(Graphical Design\) \(Continued...\)](#)

[Lecture 43 - Non-Isothermal Batch Reactors](#)

[Lecture 44 - Non-isothermal Plug Flow Reactors - Part I](#)

[Lecture 45 - Non-isothermal Plug Flow Reactors - Part II](#)

[Lecture 46 - Adiabatic Plug Flow Reactors](#)

[Lecture 47 - Non-isothermal Mixed Flow Reactors](#)

[Lecture 48 - Non-isothermal Mixed Flow Reactors \(Continued...\) \(Multiple steady states\) - Part I](#)

[Lecture 49 - Non-isothermal Mixed Flow Reactors \(Continued...\) \(Multiple steady states\) - Part II](#)

[Lecture 50 - Non-Ideal Flow and Residence Time Distributions \(RTD\) basics - Part I](#)

[Lecture 51 - Non-Ideal Flow and Residence Time Distributions \(RTD\) basics - Part II](#)

[Lecture 52 - RTD for various reactors \(Continued...\) Part I](#)

[Lecture 53 - RTD for various reactors \(Continued...\) Part II](#)

[Lecture 54 - Diagnosing the ills of equipments and Various RTD Models](#)

[Lecture 55 - Dispersion Model](#)

[Lecture 56 - Dispersion with reaction Model and Tanks in Series Model](#)

[Lecture 57 - Multi-parameter model \(MFR with dead space and bypass\)](#)

[Lecture 58 - Direct use of RTD to predict conversion \(Macro and Micro-fluid as well as Macro & Micro-mixing Concept\) Part I](#)

[Lecture 59 - Direct use of RTD to predict conversion \(Macro and Micro-fluid as well as Macro & Micro-mixing Concept\) Part II](#)

[Lecture 60 - Direct use of RTD to predict conversion \(Macro and Micro-fluid as well as Macro & Micro-mixing Concept\) Part III](#)

Lecture 1 - Introduction to Kinetics (Gas solid non-catalytic reaction)

Lecture 2 - Intro to Kinetics (Continued...) for catalytic reactions in different reactors

Lecture 3 - Heterogeneous rate of reactions and different types of kinetic models for non-catalytic reactions

Lecture 4 - Basics of Kinetics of type A & B reactions (Shrinking core model & Porous particle homogeneous model)

Lecture 5 - Shrinking Core Model (Continued...)

Lecture 6 - Shrinking Core Model (Continued...)

Lecture 7 - (Continued...) & Proof of Pseudo steady state assumption

Lecture 8 - Shrinking core model (Continued...) for type D reactions

Lecture 9 - Shrinking core model (Continued...) for type D reactions (Continued...)

Lecture 10 - Reactors, Homogeneous reaction model, Design of non-catalytic gas solid reactors

Lecture 11 - Design of non-catalytic gas solid reactors (Continued...)

Lecture 12 - Design of non-catalytic gas solid reactors (Continued...)

Lecture 13 - Design equation for MF of solids, uniform gas composition, const. single particle size, Shrinking core model.

Lecture 14 - Design equation for MF of solids, mixture of particles for different sizes but unchanging size, uniform gas composition, SCM

Lecture 15 - Design equation for MF of solids with elutriation, mixture of particles of different size, uniform gas composition, SCM

Lecture 16 - General Performance equation for non-catalytic gas solid reactions

Lecture 17 - Catalytic reactions (LHHW Kinetic model)

Lecture 18 - LHHW Kinetic model (Continued...) - Part I

Lecture 19 - LHHW Kinetic model (Continued...) - Part II

Lecture 20 - Industrially important catalytic reaction models

Lecture 21 - Inter and Intraphase effectiveness factor

Lecture 22 - Interface effectiveness factor & Generalized nonisothermal effectiveness factor for external mass transfer step

Lecture 23 - Generalized nonisothermal effectiveness factor for external mass transfer step (Continued...)

Lecture 24 - Mass transfer correlations for various reactors

Lecture 25 - Isothermal intraphase effectiveness factor - Part I

Lecture 26 - Isothermal intraphase effectiveness factor - Part II

Lecture 27 - Non-isothermal intraphase effectiveness factor

Lecture 28 - Inter and Intraphase effectiveness factor (Continued...)

Lecture 29 - Inter and Intraphase Mass transfer

Lecture 30 - Packed (fixed) bed catalytic reactor design

[Lecture 31 - Graphical design of Fixed bed reactors](#)

[Lecture 32 - Packed Bed Design \(Continued...\)](#)

[Lecture 33 - Design equations for Packed bed reactor design](#)

[Lecture 34 - Conservative Equations for Packed bed Reactor design](#)

[Lecture 35 - Problem solving session](#)

[Lecture 36 - Fluidized Bed Reactor Design - Part I](#)

[Lecture 37 - Fluidized Bed Reactor Design - Part II](#)

[Lecture 38 - Fluidized Bed Reactor Design - Part III](#)

[Lecture 39 - Fluidized Bed Reactor Design - Part IV](#)

[Lecture 40 - Continued... \(Fluidized bed reactor Models\)](#)

[Lecture 41 - Continued... \(Davidson Harrison model and Kunii Levenspiel model\)](#)

[Lecture 42 - Continued... \(Kunii Levenspiel Model\)](#)

[Lecture 43 - Slurry Reactor Design](#)

Lecture 1 - Course Introduction

Lecture 2 - Basics of Programming using MATLAB

Lecture 3 - Array Operations in MATLAB

Lecture 4 - Loops and Execution Control

Lecture 5 - Tutorial: Using Arrays

Lecture 6 - MATLAB Files -- Scripts and Functions

Lecture 7 - Plotting and Output

Lecture 8 - How to submit MATLAB Assignment

Lecture 9 - Errors in Numerical Computation

Lecture 10 - Truncation Errors and Taylors Series

Lecture 11 - Round-Off Errors; and Iterative Methods

Lecture 12 - Step-wise Methods and Error Propagation

Lecture 13 - How to get MATLAB Online access (for all enrolled students of this course)

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**NPTEL : System Identification (Chemical Engineering)**

**Co-ordinators : Dr. Arun K.Tangirala**

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Lecture 28 - Characterization Of Particles - 1

Lecture 29 - Characterization Of Particles - 2

Lecture 30 - Motion of a Particle in a fluid

Lecture 31 - Brownian motion and electrophoresis



- Lecture 32 - Sedimentation and Separation
- Lecture 33 - Settling velocity - Stoke's regime and Newton's regime
- Lecture 34 - Applications of settling - I
- Lecture 35 - Applications of settling - II
- Lecture 36 - Colloidal aggregates - Introduction
- Lecture 37 - Settling of colloidal aggregates
- Lecture 38 - Tutorial 5
- Lecture 39 - Settling of colloidal aggregates - free settling
- Lecture 40 - Settling in Multiple Particles System
- Lecture 41 - Flow Through Packed Bed
- Lecture 42 - Pressure Drop Through Packed Bed
- Lecture 43 - Tutorial 6
- Lecture 44 - Pressure Drop Through Packed bed Continue
- Lecture 45 - Fluidized Bed - 1
- Lecture 46 - Fluidized Bed - 2
- Lecture 47 - Filtration - 1
- Lecture 48 - Filtration - 2
- Lecture 49 - Tutorial 7
- Lecture 50 - Laminar and Turbulent Flows - 1
- Lecture 51 - Laminar and Turbulent Flows - 2
- Lecture 52 - Laminar and Turbulent Flows - 3
- Lecture 53 - Turbulent Stress and Turbulent Shear Layer
- Lecture 54 - Turbulent Flow near a wall and in a pipe
- Lecture 55 - Effect of rough Walls
- Lecture 56 - Roughness in Turbulent Pipe Flow
- Lecture 57 - Pipes of non-circular cross section
- Lecture 58 - Minor Losses, Sudden Expansion and Contraction
- Lecture 59 - Friction Losses in Sudden Expansion
- Lecture 60 - Tutorial 8
- Lecture 61 - Momentum and Kinetic Energy Correction Factor
- Lecture 62 - pressure drop in pipes which connected in series
- Lecture 63 - Pressure Drop in Pipes Which Connected in Parallel
- Lecture 64 - Pressure Drop in Pipes Which Connected at Junction

[Lecture 65 - Boundary Layer](#)

[Lecture 66 - Boundary Layer - Momentum Integral Analysis - 1](#)

[Lecture 67 - Boundary Layer - Momentum Integral Analysis - 2](#)

[Lecture 68 - Boundary Layer - Differential Approach](#)

[Lecture 69 - Laminar and Turbulent Boundary Layer](#)

[Lecture 70 - Tutorial 9](#)

- Lecture 1 - Measurement and Prediction - Part 1
- Lecture 2 - Measurement and Prediction - Part 2
- Lecture 3 - Overview of Transport Phenomena
- Lecture 4 - Scope of Course
- Lecture 5 - Continuum Hypothesis
- Lecture 6 - Lagrangian and Eulerian Descriptions - Part 1
- Lecture 7 - Lagrangian and Eulerian Descriptions - Part 2
- Lecture 8 - Substantial Derivative - Part 1
- Lecture 9 - Substantial Derivative - Part 2
- Lecture 10 - Substantial Derivative Example - 1
- Lecture 11 - Substantial Derivative Example - 2
- Lecture 12 - Visualization of Flow Patterns: Streamline, Pathline
- Lecture 13 - Visualization of Flow Patterns: Streakline
- Lecture 14 - Streamline, Pathline: Steady Flow Example
- Lecture 15 - Streamline, Pathline, Streakline: Unsteady Flow Example
- Lecture 16 - System and Control Volume
- Lecture 17 - Reynolds transport theorem : Introduction
- Lecture 18 - Reynolds transport theorem : Simplified form
- Lecture 19 - Reynolds transport theorem : General form - Part 1
- Lecture 20 - Reynolds transport theorem : General form - Part 2
- Lecture 21 - Integral and differential balances
- Lecture 22 - Integral total mass balance
- Lecture 23 - Integral total mass balance : Simplification
- Lecture 24 - Integral total mass balance : Examples
- Lecture 25 - Differential total mass balance - Part 1
- Lecture 26 - Differential total mass balance - Part 2
- Lecture 27 - Differential total mass balance : Examples - Part 1
- Lecture 28 - Differential total mass balance : Examples - Part 2
- Lecture 29 - Integral linear momentum balance - Part 1
- Lecture 30 - Integral linear momentum balance - Part 2
- Lecture 31 - Integral linear momentum balance : Examples - Part 1

- Lecture 32 - Integral linear momentum balance : Examples - Part 2
- Lecture 33 - Integral linear momentum balance : Examples - Part 3
- Lecture 34 - Differential linear momentum balance : Introduction
- Lecture 35 - Differential linear momentum balance : Transient, convection and body force terms
- Lecture 36 - Stress vector - Part 1
- Lecture 37 - Stress vector - Part 2
- Lecture 38 - Stress tensor - Part 1
- Lecture 39 - Stress tensor - Part 2
- Lecture 40 - Cauchy's formula
- Lecture 41 - Components of Stress Vector : Example
- Lecture 42 - Properties of stress tensor - Part 1
- Lecture 43 - Properties of stress tensor - Part 2
- Lecture 44 - Total stress tensor for fluids
- Lecture 45 - Comparison of solids and fluids
- Lecture 46 - Fluids at rest
- Lecture 47 - Differential linear momentum balance : Surface force terms
- Lecture 48 - Differential linear momentum balance : All terms
- Lecture 49 - Convective momentum flux tensor
- Lecture 50 - Differential linear momentum balance : Closure problem
- Lecture 51 - Normal Strain and Shear Strain - Part 1
- Lecture 52 - Normal Strain and Shear Strain - Part 2
- Lecture 53 - Displacement Field and Displacement Gradient - Part 1
- Lecture 54 - Displacement Field and Displacement Gradient - Part 2
- Lecture 55 - Strain Displacement Gradient Relation : Example
- Lecture 56 - Strain Displacement Gradient Relation : Normal and shear strain
- Lecture 57 - Strain Displacement Gradient Relation : Rotation and volumetric strain
- Lecture 58 - Strain Displacement Gradient Relation : Examples
- Lecture 59 - Displacement Gradient Tensor
- Lecture 60 - Components of Total Displacement - Part 1
- Lecture 61 - Components of Total Displacement - Part 2
- Lecture 62 - Strain Tensor and Rotation Tensor - Part 1
- Lecture 63 - Components of Total Displacement : Example
- Lecture 64 - Normal and Shear Strain Rate

- Lecture 65 - Strain Rate Velocity Gradient Relation
- Lecture 66 - Volumetric Strain Rate
- Lecture 67 - Velocity Gradient Tensor
- Lecture 68 - Strain Rate : Example 1
- Lecture 69 - Strain Rate : Example 2
- Lecture 70 - Stress Strain Relation : Introduction
- Lecture 71 - Material Properties
- Lecture 72 - Hooke's Law - Strain-stress Relation
- Lecture 73 - Relation Between Material Properties
- Lecture 74 - Hooke's Law - Stress-strain Relation
- Lecture 75 - Hooke's Law : Examples
- Lecture 76 - Stress Strain Rate Relation : Introduction
- Lecture 77 - Newton's Law of Viscosity : 1D Form
- Lecture 78 - Newton's Law of Viscosity : 3D Form
- Lecture 79 - Navier Stokes Equation
- Lecture 80 - Fluid at Rest : Pressure Distribution
- Lecture 81 - Hydrostatic Pressure Distribution in Liquid
- Lecture 82 - Hydrostatic Pressure Distribution in Gas
- Lecture 83 - Fluid in Rigid Body Motion : Pressure Distribution
- Lecture 84 - Flow Regimes : Laminar and Turbulent flow
- Lecture 85 - Euler Equation
- Lecture 86 - Bernoulli Equation : Inviscid Flow
- Lecture 87 - Bernoulli Equation : Example 1
- Lecture 88 - Bernoulli Equation : Irrotational Flow
- Lecture 89 - Bernoulli Equation : Example 2
- Lecture 90 - Planar Couette Flow - Governing Equations
- Lecture 91 - Planar Couette Flow - Velocity and Pressure Distribution
- Lecture 92 - Planar Couette Flow - Shear Force
- Lecture 93 - Planar Poiseuille Flow : Governing Equations
- Lecture 94 - Planar Poiseuille Flow : Velocity and Pressure Distribution
- Lecture 95 - Planar Poiseuille Flow : Shear force
- Lecture 96 - Planar Poiseuille Flow : Shear Stress Distribution
- Lecture 97 - Viscous Stress vs. Molecular Momentum Flux - Part 1

- [Lecture 98 - Viscous Stress vs. Molecular Momentum Flux - Part 2](#)
- [Lecture 99 - Linear Momentum Balance : Fluid Mechanics vs. Momentum Transport - Part 1](#)
- [Lecture 100 - Linear Momentum Balance : Fluid Mechanics vs. Momentum Transport - Part 2](#)
- [Lecture 101 - Viscous Stress vs. Molecular Momentum Flux - Part 3](#)
- [Lecture 102 - Integral Energy Balance - Part 1](#)
- [Lecture 103 - Integral Energy Balance - Part 2](#)
- [Lecture 104 - Simplification of Integral Energy Balance](#)
- [Lecture 105 - Integral Energy Balance : Examples](#)
- [Lecture 106 - Differential Energy Balance : Introduction](#)
- [Lecture 107 - Differential Total Energy Balance - Part 1](#)
- [Lecture 108 - Differential Total Energy Balance - Part 2](#)
- [Lecture 109 - Differential Energy Balance - Part 1](#)
- [Lecture 110 - Differential Energy Balance - Part 2](#)
- [Lecture 111 - Differential Energy Balance - Part 3](#)
- [Lecture 112 - Fourier's Law of Heat Conduction](#)
- [Lecture 113 - Simplifications of Differential Energy Balance](#)
- [Lecture 114 - Heat Conduction in Slab](#)
- [Lecture 115 - Heat Conduction in Furnace Wall](#)
- [Lecture 116 - Non Isothermal Planar Couette Flow](#)

Lecture 1 - Introduction

Lecture 2 - Chemicals of Concern

Lecture 3 - Water Quality Screening Parameters

Lecture 4 - Water Quality Parameters

Lecture 5 - Air quality parameters; Sustainability

Lecture 6 - PM - Particulate Matter

Lecture 7 - Physical/Chemical properties of interest

Lecture 8 - Partition Constants

Lecture 9 - Soil-air partition constants

Lecture 10 - Application/Example of Equilibrium Partitioning

Lecture 11 - Introduction to Environmental Monitoring and Sampling

Lecture 12 - Environmental Sampling

Lecture 13 - Environmental Analysis: Quality Control - Part 1

Lecture 14 - Environmental Analysis: Quality Control - Part 2

Lecture 15 - Environmental Analysis of Organics in Water

Lecture 16 - Environmental Analysis: Quality Control - Part 3

Lecture 17 - Tutorial

Lecture 18 - Tutorial (Continued...)

Lecture 19 - Analysis Methods - Introduction and Water Quality Parameters

Lecture 20 - Analysis Methods - Water Quality Parameters

Lecture 21 - Analysis Methods - Review of Standard Methods

Lecture 22 - Analysis Methods - Organics in water

Lecture 23 - Analysis Methods - Overall Methodology for Organics

Lecture 24 - Analysis Methods - Chromatography Fundamentals

Lecture 25 - Analysis Methods - Gas Chromatography

Lecture 26 - Analysis Methods - Gas Chromatography (Mass Spectrometry)

Lecture 27 - Analysis Methods - Liquid Chromatography

Lecture 28 - Monitoring methods for Air - PM - Part 1

Lecture 29 - Monitoring methods for Air - PM - Part 2

Lecture 30 - Monitoring methods for Air - Vapor - Part 1

Lecture 31 - Monitoring methods for Air - Vapor - Part 2

- Lecture 32 - Monitoring methods for Air - Vapor - Part 3
- Lecture 33 - Monitoring and Measurement of Microorganisms
- Lecture 34 - Transport of Pollutants - Introduction
- Lecture 35 - Transport of Pollutants - Box Models in Water
- Lecture 36 - Transport of Pollutants - Box Models in Air
- Lecture 37 - Transport of Pollutants - Dispersion
- Lecture 38 - Transport of Pollutants - Gaussian Dispersion Model
- Lecture 39 - Dispersion Model - Parameters - Part 1
- Lecture 40 - Dispersion Model - Parameters - Part 2
- Lecture 41 - Gaussian Dispersion Model
- Lecture 42 - Gaussian Dispersion Model - Example, Additional topics
- Lecture 43 - Regulatory Models
- Lecture 44 - Introduction to Interphase Mass Transfer
- Lecture 45 - Interphase mass transfer - Application to Environmental Interfaces
- Lecture 46 - Interphase mass transfer - Flux and mass transfer resistance
- Lecture 47 - Interphase mass transfer - Boundary Layer and Mass Transfer Coefficient
- Lecture 48 - Interphase mass transfer - Individual and Overall Mass Transfer Coefficients
- Lecture 49 - Overall Mass Transfer Coefficient
- Lecture 50 - Estimation of the Mass Transfer Coefficients
- Lecture 51 - Air-Water Exchange
- Lecture 52 - Evaporation from different surfaces
- Lecture 53 - Sediment-Water exchange
- Lecture 54 - Application of Interphase mass transfer
- Lecture 55 - Contamination of Sediments
- Lecture 56 - Release from Sediments
- Lecture 57 - Unsteady state release from sediments
- Lecture 58 - Other mechanisms of chemical release from sediments - Part 1
- Lecture 59 - Other mechanisms of chemical release from sediments - Part 2
- Lecture 60 - Soil - Air Transfer
- Lecture 61 - Remediation of contaminated sediments - Application of transport models



**NPTEL : Synthetic and Natural Supramolecular Architectures: An Approach Towards Molecular Technology (Chemical Engineering)**

**Co-ordinators : Prof. Chebrolu Pulla Rao**

Lecture 1 - Impetus

Lecture 2 - Introduction to Supramolecular Science and Technology

Lecture 3 - Introduction to Supramolecular Science and Technology

Lecture 4 - A quickwalk - through the Supramolecular Architectures

Lecture 5 - A quickwalk - through the Supramolecular Architectures

Lecture 6 - A quickwalk - through the Supramolecular Architectures

Lecture 7 - Weak intermolecular forces : What, Where, When and How?

Lecture 8 - Weak intermolecular forces : What, Where, When and How?

Lecture 9 - Weak intermolecular forces : What, Where, When and How?

Lecture 10 - Weak intermolecular forces : What, Where, When and How?

Lecture 11 - Weak intermolecular forces : What, Where, When and How?

Lecture 12 - Weak intermolecular forces : What, Where, When and How?

Lecture 13 - Chemistry concepts of Immediate relevance - Part 1

Lecture 14 - Chemistry concepts of Immediate relevance - Part 2

Lecture 15 - Chemistry concepts of Immediate relevance - Part 3

Lecture 16 - Chemistry concepts of Immediate relevance - Part 4

Lecture 17 - Chemistry concepts of Immediate relevance - Part 5

Lecture 18 - Chemistry concepts of Immediate relevance - Part 6

Lecture 19 - Chemistry concepts of Immediate relevance - Part 7

Lecture 20 - Molecular recognition - Part 1

Lecture 21 - Molecular recognition - Part 2

Lecture 22 - Molecular recognition - Part 3

Lecture 23 - Molecular recognition - Part 4

Lecture 24 - Molecular recognition - Part 5

Lecture 25 - Molecular recognition - Part 6

Lecture 26 - Molecular recognition - Part 7

Lecture 27 - Molecular recognition - Part 8

Lecture 28 - Molecular recognition - Part 9

Lecture 29 - Molecular recognition - Part 10

Lecture 30 - Property driven functions of Supramolecular assembly

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33 - Metal coordinated architectures](#)

[Lecture 34 - Engineering Supramolecular devices : Sensors,Switches,Devices and Molecules - Part 1](#)

[Lecture 35 - Engineering Supramolecular devices : Sensors,Switches,Devices and Molecules - Part 2](#)

[Lecture 36 - Engineering Supramolecular devices : Sensors,Switches,Devices and Molecules - Part 3](#)

[Lecture 37 - Engineering Supramolecular devices : Sensors,Switches,Devices and Molecules - Part 4](#)

[Lecture 38 - Engineering Supramolecular devices : Sensors,Switches,Devices and Molecules - Part 5](#)

[Lecture 39 - Engineering Supramolecular devices : Sensors,Switches,Devices and Molecules - Part 6](#)

[Lecture 40 - From molecules to machines : A glimpse at the travel](#)

- Lecture 1 - Introduction to oil and gas
- Lecture 2 - Drilling and Completion
- Lecture 3 - Well completion
- Lecture 4 - Oil and gas production systems
- Lecture 5 - Pumps, compressors and flow through pipes
- Lecture 6 - Reservoir fluid
- Lecture 7 - Fluid properties and Phase diagram - Part 1
- Lecture 8 - Fluid properties and Phase diagram - Part 2
- Lecture 9 - Nodal analysis
- Lecture 10 - Reservoir deliverability - Single phase flow
- Lecture 11 - Reservoir deliverability - Two phase flow
- Lecture 12 - Flow over a flat surface or flow through pipe - Part 1
- Lecture 13 - Flow over a flat surface or flow through pipe - Part 2
- Lecture 14 - Single-Phase, Multi-Phase-Emulsion
- Lecture 15 - Emulsification and demulsification
- Lecture 16 - Single and Multi Phase flow-flow regimes
- Lecture 17 - Multi phase flow-flow models
- Lecture 18 - Choke Performance
- Lecture 19 - Pump classifications
- Lecture 20 - Classification of artificial lifts - Part 1
- Lecture 21 - Classification of artificial lifts - Part 2
- Lecture 22 - Sucker rod pump (SRP) - Part 1
- Lecture 23 - Sucker rod pump (SRP) - Part 2
- Lecture 24 - Sucker rod pump (SRP) - Part 3
- Lecture 25 - Sucker rod pump (SRP) - Part 4
- Lecture 26 - Sucker rod pump (SRP) - Part 5
- Lecture 27 - Sucker rod pump (SRP) - Part 6
- Lecture 28 - SRP-Pump performance analysis - Part 1
- Lecture 29 - SRP-Pump performance analysis - Part 2
- Lecture 30 - SRP-Pump performance analysis - Part 3
- Lecture 31 - Introduction to progressive cavity pump

- Lecture 32 - Progressive cavity Pump - Part 1
- Lecture 33 - Progressive cavity Pump - Part 2
- Lecture 34 - Progressive cavity Pump - Part 3
- Lecture 35 - Progressive cavity Pump - Part 4
- Lecture 36 - Progressive cavity Pump - Part 5
- Lecture 37 - Electric submersible pump - Part 1
- Lecture 38 - Electric submersible pump - Part 2
- Lecture 39 - Electric submersible pump - Part 3
- Lecture 40 - ESP- basic electrical systems - Part 1
- Lecture 41 - ESP- basic electrical systems - Part 2
- Lecture 42 - ESP- basic electrical systems - Part 3
- Lecture 43 - ESP- numerical problems - Part 1
- Lecture 44 - ESP- numerical problems - Part 2
- Lecture 45 - ESP- numerical problems - Part 3
- Lecture 46 - ESP- numerical problems - Part 1
- Lecture 47 - ESP- numerical problems - Part 2
- Lecture 48 - Gas lift basics - Part 1
- Lecture 49 - Gas lift basics - Part 2
- Lecture 50 - Gas lift valves and installartion - Part 1
- Lecture 51 - Gas lift valves and installartion - Part 2
- Lecture 52 - Plunger lift and design
- Lecture 53 - Hydraulic jet pump fundamentals - Part 1
- Lecture 54 - Hydraulic jet pump fundamentals - Part 2
- Lecture 55 - Hydraulic engine pumps and design - Part 1
- Lecture 56 - Hydraulic engine pumps and design - Part 2
- Lecture 57 - Surface pump units for jet pump - Part 1
- Lecture 58 - Surface pump units for jet pump - Part 2
- Lecture 59 - Surface pump units for jet pump - Part 3
- Lecture 60 - Surface compressor for gas lift - Part 1
- Lecture 61 - Surface compressor for gas lift - Part 2
- Lecture 62 - Surface compressor for gas lift - Part 3

Lecture 1 - Introduction to Chemical process Industries

Lecture 2 - Raw material for Organic Chemical Industries

Lecture 3 - Unit processes and unit operations in organic chemical Industries

Lecture 4 - Coal and coal as chemicals feed stock

Lecture 5 - Coal carbonization and Coke oven plant

Lecture 6 - Gasification of Coal,Petrocoke and Biomass

Lecture 7 - Introduction to Pulp and paper Industry, Raw material for paper industry and Technological development

Lecture 8 - Pulping and Bleaching

Lecture 9 - Recovery of Chemicals

Lecture 10 - Stock preparation and paper making

Lecture 11 - Introduction to Soap and detergent, Soap making and Recovery of Glycerine

Lecture 12 - Synthetic detergent and Linear alkyl benzene

Lecture 13 - Sugar and Fermentation industry

Lecture 14 - Ethanol as Biofuel and Chemical feed stock

Lecture 15 - Introduction : Staus of Petroleum refinery, Crude oil and Natural gas origin, occurrence, exploration, drilling and processing, Fuel norms

Lecture 16 - Evaluation of Crude oil,Petroleum Products and Apetrochemicals

Lecture 17 - Crude oil Distillation

Lecture 18 - Thermal Cracking: Visbreaking and Delayed Coking

Lecture 19 - Catalytic cracking: Fluid Catalytic cracking and Hydro cracking

Lecture 20 - Catalytic reforming

Lecture 21 - Alkylation, Isomerisation and Polymerisation

Lecture 22 - Desulphurisation Processes and Recovery of Sulphur

Lecture 23 - Profile of petrochemical Industry and its structure

Lecture 24 - Naphtha and gas cracking for production of olefins

Lecture 25 - Recovery of chemicals from FCC and steam cracking

Lecture 26 - Synthesis gas and its derivatives: Hydrogen, CO, Methanol, Formaldehyde

Lecture 27 - Ethylene derivatives: Ethylene Oxide, Ethylene glycol, Ethylene dichloride and Vinyl chloride

Lecture 28 - Propylene, Propylene oxide and Isopropanol

Lecture 29 - Aromatics Production

Lecture 30 - Aromatics product profile, Ethyl benzene & Styrene, Cumene and phenol, Bisphenol, Aniline

## DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

Lecture 31 - Introduction to polymer, Elastomer and Synthetic Fibre, Polymerisation

Lecture 32 - Polymers: Polyolefins, Polyethylene, Polypropylene Polystyrene

Lecture 33 - Polyvinylchloride, polycarbonate, thermoset resin: phenolformaldehyde, uriaformaldehyde and melamineformaldehyde

Lecture 34 - Elastomers: Styrene butadiene Rubber(SBR), Poly butadiene, Nitrile rubber

Lecture 35 - Polyamides or Nylons(PA)

Lecture 36 - DMT and Terephthalic Acid, Polyester, PET resin, PTB resin

Lecture 37 - Acrylic Fibre, Modified Acrylic Fibre, Acrylonitrile, Acrolein, Propylene Finber, Polyurethane

Lecture 38 - Viscose Rayon and Acetate rayon

Lecture 39 - Pesticide

Lecture 40 - Dye and Intermediates

**NPTEL : Process Integration (Chemical Engineering)**

**Co-ordinators : Dr. B. Mohanty**

Lecture 1 - Process integration, methods and area of application

Lecture 2 - Fundamental concepts related to heat integration - Part 1

Lecture 3 - Fundamental concepts related to heat integration - Part 2

Lecture 4 - Data extraction

Lecture 5 - Hot composite curves

Lecture 6 - Cold composite curves

Lecture 7 - Hot and cold composite curves and the pinch

Lecture 8 - Threshold problems

Lecture 9 - Energy targeting procedure

Lecture 10 - Problem Table Algorithm - Part 1

Lecture 11 - Grand composite curve

Lecture 12 - Problem Table Algorithm - Part 2

Lecture 13 - Number of units target

Lecture 14 - Shell targeting - Part 1

Lecture 15 - Area targeting - Part 1

Lecture 16 - Area targeting - Part 2

Lecture 17 - Coast targeting - Part 1

Lecture 18 - Coast targeting - Part 2

Lecture 19 - Supertargeting- optimization of  $\hat{I}^*_{t \min}$

Lecture 20 - Global & stream specific  $\hat{I}^*_{t \min}$  and its relevance

Lecture 21 - Topology Trap

Lecture 22 - Rules for Pinch Design Method (PDM) - Part 1

Lecture 23 - Rules for Pinch Design Method (PDM) - Part 2

Lecture 24 - Application of PDM for MER Hen Synthesis

Lecture 25 - Design for threshold problems

Lecture 26 - Design for single pinch problems

Lecture 27 - Design for multi pinch problems

Lecture 28 - HEN optimization

Lecture 29 - Remaining problem analysis

Lecture 30 - Driving Force Plot

Lecture 31 - Low Temperature process Design - Part 1

[Lecture 32 - Low Temperature process Design - Part 2](#)

[Lecture 33 - Integration of Gas turbine with process - Part 1](#)

[Lecture 34 - Integration of Gas turbine with process - Part 2](#)

[Lecture 35 - Placement and Integration of Distillation Column](#)

[Lecture 36 - Heat Integration of evaporators](#)

[Lecture 37 - Integration of heat pump](#)

[Lecture 38 - Placement of Heat Engine, Heat pump and Reactors](#)

[Lecture 39 - Integration of Furnace](#)

[Lecture 40 - Problem solving using HINT Software - Part 1](#)

[Lecture 41 - Problem solving using HINT Software - Part 2](#)

[Lecture 42 - Problem solving using HINT Software - Part 3](#)

[Lecture 43 - Problem solving using HINT Software - Part 4](#)



**NPTEL : Mechanical Operations (Chemical Engineering)**

**Co-ordinators : Prof. Shabina Khanam**

Lecture 1 - Introduction

Lecture 2 - Characterization of a single particle - 1

Lecture 3 - Characterization of a single particle - 2

Lecture 4 - Characterization of collection of particles - 1

Lecture 5 - Characterization of collection of particles - 2

Lecture 6 - Fine grain size distribution

Lecture 7 - Effectiveness of screen - 1

Lecture 8 - Effectiveness of screen - 2

Lecture 9 - Industrial screening equipment

Lecture 10 - Size reduction

Lecture 11 - Laws of comminution

Lecture 12 - Examples of Laws of comminution - 1

Lecture 13 - Examples of Laws of comminution - 2

Lecture 14 - Size reduction equipment - 1

Lecture 15 - Size reduction equipment - 2

Lecture 16 - Particle dynamics - 1

Lecture 17 - Particle dynamics - 2

Lecture 18 - Particle dynamics-Examples

Lecture 19 - Classification and Jigging - 1

Lecture 20 - Classification and Jigging - 2

Lecture 1 - Introduction - 1

Lecture 2 - Introduction - 2

Lecture 3 - Characterization of wastes - 1

Lecture 4 - Characterization of wastes - 2

Lecture 5 - Characterization of wastes - 3

Lecture 6 - Tutorial on Characterization of wastes

Lecture 7 - Energy production from wastes through incineration - 1

Lecture 8 - Energy production from wastes through incineration - 2

Lecture 9 - Tutorial on incineration

Lecture 10 - Energy production from wastes through gasification - 1

Lecture 11 - Energy production from wastes through gasification - 2

Lecture 12 - Syngas utilization - 1

Lecture 13 - Syngas utilization - 2

Lecture 14 - Energy production from wastes through pyrolysis - 1

Lecture 15 - Energy production from wastes through pyrolysis - 2

Lecture 16 - Tutorial on gasification

Lecture 17 - Tutorial on Pyrolysis

Lecture 18 - Densification of solids - 1

Lecture 19 - Densification of solids - 2

Lecture 20 - Efficiency improvement of power plant - 1

Lecture 21 - Efficiency improvement of power plant - 2

Lecture 22 - Energy production from waste plastics - 1

Lecture 23 - Energy production from waste plastics - 2

Lecture 24 - Gas clean up - 1

Lecture 25 - Gas clean up - 2

Lecture 26 - Energy production from organic wastes through anaerobic digestion - 1

Lecture 27 - Energy production from organic wastes through anaerobic digestion - 2

Lecture 28 - Design of anaerobic digester

Lecture 29 - Introduction to Microbial fuel cells

Lecture 30 - Energy production from organic wastes through fermentation - 1

Lecture 31 - Energy production from organic wastes through fermentation - 2

[Lecture 32 - Tutorial on anaerobic digestion](#)

[Lecture 33 - Tutorial on fermentation](#)

[Lecture 34 - Energy production from wastes through transesterification - 1](#)

[Lecture 35 - Energy production from wastes through transesterification - 2](#)

[Lecture 36 - Tutorial on transesterification](#)

[Lecture 37 - Cultivation of algal biomass and treatment of waste water - 1](#)

[Lecture 38 - Cultivation of algal biomass and treatment of waste water - 2](#)

[Lecture 39 - Energy production form algal biomass - 1](#)

[Lecture 40 - Energy production form algal biomass - 2](#)

Lecture 1 - Introduction

Lecture 2 - Sedimentation and Batch Sedimentation Test - 1

Lecture 3 - Sedimentation and Batch Sedimentation Test - 2

Lecture 4 - Centrifugal Sedimentation and Equipment - 1

Lecture 5 - Centrifugal Sedimentation and Equipment - 2

Lecture 6 - Filtration - 1

Lecture 7 - Filtration - 2

Lecture 8 - Filtration - 3

Lecture 9 - Continuous Filtration - 1

Lecture 10 - Continuous Filtration - 2

Lecture 11 - Fluidisation - 1

Lecture 12 - Fluidisation - 2

Lecture 13 - Liquid Fluidisation

Lecture 14 - Gas Fluidisation - 1

Lecture 15 - Gas Fluidisation - 2

Lecture 16 - Flotation - 1

Lecture 17 - Flotation - 2

Lecture 18 - Transportaion of solids - 1

Lecture 19 - Transportaion of solids - 2

Lecture 20 - Transportaion of solids - 3

Lecture 1 - Introduction to the course, Macromolecules and Life, Molecular flexibility

Lecture 2 - Classification of polymers, Types of polymerization, Average molecular weights and polydispersity

Lecture 3 - Motivation to study polymer physics

Lecture 4 - Random Walk Models of Single Chain I: end-to-end distance of a polymer chain, freely jointed chain, drunkard walk

Lecture 5 - Random Walk Models of Single Chain II: general random walk on a lattice

Lecture 6 - Random Walk Models of Single Chain III: Freely rotating chain, definition of persistence length

Lecture 7 - Models of semiflexible chains (Kratky Porod Model) - Part I

Lecture 8 - Models of semiflexible chains (Kratky Porod Model) - Part II

Lecture 9 - Probability density of an ideal chain - Part I

Lecture 10 - Probability density of an ideal chain - Part II

Lecture 11 - Entropic Elasticity, Bead-Spring Model, Simulations of random walk models

Lecture 12 - Derivation of Diffusion equation, Einstein notation

Lecture 13 - Definition of Radius of gyration

Lecture 14 - Radius of gyration for an ideal chain, concept of ideality

Lecture 15 - Nonbonded interactions, hydrophobic and hydrophilic behaviour

Lecture 16 - Definition of excluded volume; good, bad, and theta solvent

Lecture 17 - Virial expansion, Flory theory for good solvent

Lecture 18 - Flory theory for bad solvent, self-similarity and fractal nature of polymers

Lecture 19 - Derivation of fractal dimension, concentration regimes and overlap concentration

Lecture 20 - Size, shape, and structure. Gyration tensor and measures of asphericity.

Lecture 21 - Order-disorder transition

Lecture 22 - Scattering experiments, Pair correlation function

Lecture 23 - Structure of polymer chain, Introduction to Monte Carlo simulations of polymer chains

Lecture 24 - Monte Carlo algorithm: Detailed Balance, Metropolis algorithm

Lecture 25 - Practical aspects of Monte Carlo simulation

Lecture 26 - Molecular Dynamics Simulations, Review of Thermodynamics

Lecture 27 - Solution Thermodynamics - I

Lecture 28 - Solution Thermodynamics - II

Lecture 29 - Solution Thermodynamics - III

Lecture 30 - Solution Thermodynamics - IV

Lecture 31 - Phase separation regime, Introduction to lattice model of solutions

[Lecture 32 - Lattice Model of Solutions - I](#)

[Lecture 33 - Lattice Model of Solutions - II](#)

[Lecture 34 - Phase behaviour of liquid solutions](#)

[Lecture 35 - Lattice models of polymeric systems](#)

[Lecture 36 - Brownian motion - I](#)

[Lecture 37 - Brownian motion - II](#)

[Lecture 38 - Brownian motion - III](#)

[Lecture 39 - Brownian motion - IV](#)

[Lecture 40 - Brownian motion - V](#)

[Lecture 41 - Rouse Model - I](#)

[Lecture 42 - Rouse Model - II](#)

[Lecture 43 - Rouse Model - III](#)

[Lecture 44 - Rouse Model - IV](#)

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- Lecture 50 - Jaipur Terminal Fire, India: October 29, 2009
- Lecture 51 - The Flixborough UK, Cyclohexane Disaster: June 01, 1974
- Lecture 52 - Seveso Accident: July 10, 1976
- Lecture 53 - The Chernobyl Nuclear Disaster: April 26, 1986
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- Lecture 56 - Nuclear Radiation
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Lecture 3 - A Short History of polymerization process, monomers and its distribution

Lecture 4 - Gradient and graft copolymer, polymer and its compositions, isomerism in polymers - I

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Lecture 5 - Basic Design Parameters - 2

Lecture 6 - Double Pipe Heat Exchanger - 1

Lecture 7 - Double Pipe Heat Exchanger - 2

Lecture 8 - Double Pipe Heat Exchanger - 3

Lecture 9 - Types of Shell and Tube exchangers

Lecture 10 - Exchanger Tubes

Lecture 11 - Exchanger Shell

Lecture 12 - STE design - Kern's method - 1

Lecture 13 - STE design - Kern's method - 2

Lecture 14 - STE design - Kern's method - 3

Lecture 15 - STE design - Kern's method: Example - 4

Lecture 16 - STE design - Kern's method: Example - 5

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Lecture 20 - STE design - Bell's method: Example - 4

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Lecture 24 - Design of Condenser - 3

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- Lecture 32 - Design of Reboiler - 6
- Lecture 33 - Design of Reboiler - 7
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- Lecture 36 - Design of Evaporator - 3
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- Lecture 40 - Design of Crystallizer - 2
- Lecture 41 - Design of Crystallizer - Examples
- Lecture 42 - Design of Crystallizer - Types
- Lecture 43 - Design of Packed Column - 1
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- Lecture 45 - Design of Packed Column - 3
- Lecture 46 - Design of Packed Column - 4
- Lecture 47 - Design of Packed Column - 5
- Lecture 48 - Distillation Column - 1
- Lecture 49 - Distillation Column - 2
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- Lecture 55 - Distillation Column - 8
- Lecture 56 - Distillation Column - Mechanical Design - 1
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- Lecture 60 - Distillation Column - Mechanical Design - 5

Lecture 1 - Introduction to the course

Lecture 2 - Molecular basis of energy and entropy

Lecture 3 - Probability and probability distributions

Lecture 4 - Probability distributions and thermodynamic equilibrium

Lecture 5 - Energy distribution in molecular systems

Lecture 6 - First and second law of thermodynamics

Lecture 7 - Reversible and irreversible processes; third law of thermodynamics; legendre transformation; thermodynamic functions for one component system

Lecture 8 - Thermodynamic functions for multi-component systems; chemical potential; why do we minimize thermodynamic functions?

Lecture 9 - Extensive and intensive variables; gibbs duhem relation; euler theorem; maxwell relations

Lecture 10 - Discrete and continuous probabilities; stirling approximation

Lecture 11 - Binomial distribution approaches Gaussian distribution for large n; definition of drunkard walk

Lecture 12 - Solution of drunkard walk; Lagrange multipliers

Lecture 13 - Energy distribution in molecular system revisited; introduction to thermodynamic ensembles

Lecture 14 - Canonical ensemble: most probable distribution, partition function

Lecture 15 - Definition of temperature; third law of thermodynamics

Lecture 16 - Canonical ensemble: Helmholtz free energy, averages and fluctuations, specific heat, deriving ideal gas law

Lecture 17 - Partition function of a dense gas; grand canonical ensemble: partition function, most probable distribution

Lecture 18 - Computing properties in grand canonical ensemble

Lecture 19 - Isothermal isobaric ensemble

Lecture 20 - Summary of thermodynamic ensembles; partition function of an ideal gas

Lecture 21 - Mixing and phase separation, phase equilibrium of a multiphase multicomponent system, Gibbs phase rule

Lecture 22 - Pure component phase diagram; solution thermodynamics: Helmholtz free energy density

Lecture 23 - Characterizing mixing and phase separation using Helmholtz free energy density

Lecture 24 - Common tangent construction, definition of binodal, spinodal, and critical point

Lecture 25 - Osmotic pressure and chemical potential

Lecture 26 - Lattice model of liquid solutions - I

Lecture 27 - Lattice model of liquid solutions - II

Lecture 28 - Lattice model of liquid solutions - III

Lecture 29 - Critical review of Lattice model, theoretical basis of molecular dynamics simulation

Lecture 30 - Theoretical basis of molecular dynamics simulation



- Lecture 31 - Interaction energy and force field
- Lecture 32 - Liouville theorem; theoretical basis of Monte Carlo simulation
- Lecture 33 - Introduction to Monte Carlo simulation method
- Lecture 34 - Markov chain algorithm, condition for equilibrium and detailed balance
- Lecture 35 - Metropolis algorithm, periodic boundary condition
- Lecture 36 - Numerical implementation of Monte Carlo simulation: Python Examples - I
- Lecture 37 - Numerical implementation of Monte Carlo simulation: Python Examples - II
- Lecture 38 - Numerical implementation of Monte Carlo simulation: Python Examples - III
- Lecture 39 - Numerical implementation of Monte Carlo simulation: Python Examples - IV
- Lecture 40 - Numerical implementation of Monte Carlo simulation: Python Examples - V
- Lecture 41 - Particle simulations: comparison with quantum chemical and continuum simulations; bridging length and time scales
- Lecture 42 - Pair potentials
- Lecture 43 - Saving CPU time: short range and long range interactions
- Lecture 44 - Bonded and non-bonded interactions, force fields
- Lecture 45 - Practical aspects of molecular simulations
- Lecture 46 - Numerical implementation of MD; thermostat and barostat
- Lecture 47 - MD simulations - efficiency and parallelization, sampling and averaging, analysis of simulation trajectories
- Lecture 48 - MD simulations - analysis of simulation trajectories (continued), Case Studies - I
- Lecture 49 - MD simulations - Case Studies - II
- Lecture 50 - MD simulations - Case Studies - III
- Lecture 51 - Free energies and phase behavior; extension of canonical ensemble Monte Carlo to other ensembles
- Lecture 52 - Extension of canonical ensemble Monte Carlo to other ensembles (Continued...)
- Lecture 53 - Monte Carlo in Gibbs ensemble and semi-grand canonical ensemble, thermodynamic integration
- Lecture 54 - Thermodynamic integration (continued); Widom's particle insertion; overlapping distribution method
- Lecture 55 - Multiple histogram method; umbrella sampling; thermodynamic cycle; potential of mean force; pulling simulations; metadynamics; tackling time scale issues
- Lecture 56 - Tackling time scale issues (continued); nonequilibrium molecular dynamics; mesoscale simulations: Langevin dynamics and Brownian dynamics, kinetic Monte Carlo simulations; dissipative particle dynamics
- Lecture 57 - Multiparticle collision dynamics; lattice Boltzmann method; coarse-graining
- Lecture 58 - Case studies
- Lecture 59 - Simulations of chemical reactions using Kinetic Monte Carlo simulations
- Lecture 60 - Reactive force fields; Ab initio molecular dynamics and other advanced methods; molecular simulations in chemical engineering; concluding remarks

Lecture 1 - Introduction to Chemical Process Utilities

Lecture 2 - Energy Perspective to the Utilities

Lecture 3 - Power Cycle

Lecture 4 - Fuel Analysis

Lecture 5 - Practice problems related to power cycle and fuel analysis

Lecture 6 - Heat Transfer Utilities - I

Lecture 7 - Heat Transfer Utilities - II

Lecture 8 - Plate and Frame Heat Exchangers Types

Lecture 9 - Solar Energy - I

Lecture 10 - Solar Energy - II

Lecture 11 - Heat Transfer Media and Solar energy

Lecture 12 - Water

Lecture 13 - Water Chemistry

Lecture 14 - Inhibition and Water Treatment

Lecture 15 - Boiler Water treatment

Lecture 16 - Water Governance

Lecture 17 - Water Quality standards - I

Lecture 18 - Water Quality Standards - II

Lecture 19 - Steam

Lecture 20 - Boilers

Lecture 21 - Industrial Boiler Types

Lecture 22 - Boilers

Lecture 23 - Boilers- Question Practice

Lecture 24 - Steam Generation Unit

Lecture 25 - Steam Generation Unit-Heaters

Lecture 26 - Attemperator and Steam Drum

Lecture 27 - Steam Traps, Centralization, and Fuel Selection

Lecture 28 - Economizer, Super heaters, and Safety devices

Lecture 29

Lecture 30 - Insulation of Steam Generators

Lecture 31 - Air

Lecture 32 - Air Filtration and Pneumatic Conveying

Lecture 33 - Introduction to Pneumatic Conveying System

Lecture 34 - Conveying System Types

Lecture 35 - Material Properties and Pipeline Feeding Devices

Lecture 36 - Feeding devices

Lecture 37 - Gas-solid flows

Lecture 38 - Design of Pipelines Elements of Pipeline Design

Lecture 39 - Natural Gas Transmission - I

Lecture 40 - Natural Gas Transmission - II

Lecture 41 - Natural Gas Transmission - III

Lecture 42 - Pipeline Mechanical design - Natural Gas Transmission - IV

Lecture 43 - Cooling Tower; Theory and Some Basic Calculations

Lecture 44 - Concept of Heat Transfer in Cooling Tower and its Components

Lecture 45 - Types and Components of Cooling Tower

Lecture 46 - Components and Materials of Construction and Applications of Cooling Tower

Lecture 47 - Control and Maintenance in cooling towers

Lecture 48 - Pressure Levels and Terminology - I

Lecture 49 - Pressure Levels and Terminology - II

Lecture 50 - Gauges for Pressure Measurement

Lecture 51 - Refrigerants and Refrigeration

Lecture 52 - Introduction to Refrigeration

Lecture 53 - Refrigeration System Components

Lecture 54 - Refrigeration System Components and Refrigeration Cycle

Lecture 55 - Refrigeration Systems

Lecture 56 - Refractories

Lecture 57 - Thermodynamic Principles and Corrosion in Refractories

Lecture 58 - Slag Attack and Kinds of Refractories in Uses

Lecture 59 - Brief history of Insulations and its fundamental principles

Lecture 60 - Heat transfer in Insulations materials

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Lecture 2 - Environmental Acts and Standards

Lecture 3 - Water Quality Monitoring: Physical Parameters

Lecture 4 - Water Quality Monitoring: Physical and Chemical Parameters

Lecture 5 - Water Quality Monitoring: Chemical Parameters - I

Lecture 6 - Water Quality Monitoring: Chemical Parameters - II

Lecture 7 - Water Quality Monitoring: Biological/Biochemical Parameters - I

Lecture 8 - Water Quality Monitoring: Biological/Biochemical Parameters - II

Lecture 9 - Water Quality Monitoring: Bacteriological Parameters

Lecture 10 - Treatment of Water and Wastewater

Lecture 11 - Flow Equalization

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Lecture 14 - Aeration - III

Lecture 15 - Aeration - IV

Lecture 16 - Aeration - V

Lecture 17 - Aeration - VI

Lecture 18 - Coagulation and Flocculation - I

Lecture 19 - Coagulation and Flocculation - II

Lecture 20 - Coagulation and Flocculation - III

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Lecture 22 - Settling and Sedimentation - I

Lecture 23 - Settling and Sedimentation - II

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Lecture 31 - Adsorption - I

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- Lecture 33 - Adsorption - III
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- Lecture 37 - Ion-exchange - I
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- Lecture 39 - Ion-exchange - III
- Lecture 40 - Ion-exchange - IV
- Lecture 41 - Wastewater treatment by membrane processes - I
- Lecture 42 - Wastewater treatment by membrane processes - II
- Lecture 43 - Wastewater treatment by membrane processes - III
- Lecture 44 - Wastewater treatment by membrane processes - IV
- Lecture 45 - Wastewater treatment by membrane processes - V
- Lecture 46 - Advanced Oxidation Processes (AOP) - Introduction
- Lecture 47 - AOP - Photocatalytic wastewater treatment
- Lecture 48 - AOP - Fenton, ozone and catalytic treatment
- Lecture 49 - AOP - Electrochemical wastewater treatment - I
- Lecture 50 - AOP - Electrochemical wastewater treatment - II
- Lecture 51 - AOP - Sono-hybrid wastewater treatment
- Lecture 52 - Disinfection - I
- Lecture 53 - Disinfection - II
- Lecture 54 - Disinfection - III
- Lecture 55 - Case Study - Wastewater treatment in sugar industry
- Lecture 56 - Case Study - Wastewater treatment in distillery
- Lecture 57 - Case Study - Wastewater treatment in fertilizer industry
- Lecture 58 - Case Study - Wastewater treatment in petroleum refining industry
- Lecture 59 - Case Study - Common effluent treatment plant (CETP)
- Lecture 60 - Choice of technology and summary

Lecture 1 - Introduction

Lecture 2 - Ecology, Environment and Biodiversity

Lecture 3 - Ecosystem services and its risks - 1

Lecture 4 - Ecosystem services and its risks - 2

Lecture 5 - Tutorial-1

Lecture 6 - Pollution types and sources

Lecture 7 - Pollution: Impacts/Consequences

Lecture 8 - Transmission of pollutants in environment - 1

Lecture 9 - Transmission of pollutants in environment - 2

Lecture 10 - Tutorial-2

Lecture 11 - Environmental quality and standards - 1

Lecture 12 - Environmental quality and standards - 2

Lecture 13 - Instrumental techniques of environmental analysis - 1

Lecture 14 - Instrumental techniques of environmental analysis - 2

Lecture 15 - Tutorial-3

Lecture 16 - Sampling and characterization - 1 (Gas, air ,emission)

Lecture 17 - Sampling and characterization - 2 (water, wastewater, effluents)

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Lecture 19 - Environmental laws and regulatory framework

Lecture 20 - Tutorial-4

Lecture 21 - Air pollution control - 1

Lecture 22 - Air pollution control - 2

Lecture 23 - Air pollution control - 3

Lecture 24 - Air pollution control - 4

Lecture 25 - Tutorial-5

Lecture 26 - Treatment of surface and ground water for drinking water generation

Lecture 27 - Treatment of domestic and industrial wastewater: Schemes

Lecture 28 - Primary treatment equipment

Lecture 29 - Secondary treatment processes

Lecture 30 - Tutorial-6

Lecture 31 - Secondary treatment equipment - 1

- Lecture 32 - Secondary treatment equipment - 2
- Lecture 33 - Advanced secondary processes - 1
- Lecture 34 - Advanced secondary processes - 2
- Lecture 35 - Tutorial-7
- Lecture 36 - Advanced secondary processes - 3
- Lecture 37 - Tertiary treatment - 1
- Lecture 38 - Tertiary treatment - 2
- Lecture 39 - Tertiary treatment - 3
- Lecture 40 - Tutorial-8
- Lecture 41 - Sludge management - 1
- Lecture 42 - Sludge management - 2
- Lecture 43 - Sludge management - 3
- Lecture 44 - Industrial Pollution Control in GPI - 1 (General aspect and pollution control in sugar industry)
- Lecture 45 - Tutorial-9
- Lecture 46 - Industrial Pollution Control in GPI - 2 (Pollution control in Distillery)
- Lecture 47 - Industrial Pollution Control in GPI - 3 (Pollution control in Tannery)
- Lecture 48 - Pollution control in Petroleum refinery and petrochemicals industry
- Lecture 49 - Industrial Pollution Control in GPI - 4
- Lecture 50 - Tutorial 10
- Lecture 51 - Solid waste and hazardous waste management - 1
- Lecture 52 - Solid waste and hazardous waste management - 2
- Lecture 53 - Solid waste and hazardous waste management - 3
- Lecture 54 - Solid waste and hazardous waste management - 4
- Lecture 55 - Tutorial-11
- Lecture 56 - Air Pollution Management, Air quality survey, NAAQI - 1
- Lecture 57 - Air Pollution Management, Air quality survey, NAAQI - 2
- Lecture 58 - Management of special category wastes - 1
- Lecture 59 - Management of special category wastes - 2
- Lecture 60 - Tutorial-12

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Lecture 2 - Microorganisms in Biological Wastewater Treatment

Lecture 3 - Fundamentals of Biochemical Operations

Lecture 4 - Wastewater Characterization - I

Lecture 5 - Wastewater Characterization - II

Lecture 6 - Wastewater Characterization - III

Lecture 7 - Wastewater Characterization - IV

Lecture 8 - Wastewater Characterization - V

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Lecture 10 - Stoichiometry of Microbial Growth - II

Lecture 11 - Stoichiometry of Microbial Growth - III

Lecture 12 - Reaction Kinetics

Lecture 13 - Bacterial Growth Kinetics - I

Lecture 14 - Bacterial Growth Kinetics - II

Lecture 15 - Reactor Hydraulics - I

Lecture 16 - Reactor Hydraulics - II

Lecture 17 - Treatment of Water and Wastewater - I

Lecture 18 - Treatment of Water and Wastewater - II

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Lecture 20 - Coagulation, Flocculation, and Sedimentation - II

Lecture 21 - Lagoon

Lecture 22 - Activated Sludge Process

Lecture 23 - Sequential Batch Reactor

Lecture 24 - Trickling Filter

Lecture 25 - Rotating Disc Reactor

Lecture 26 - Up-flow Anaerobic Sludge Blanket (UASB) reactor

Lecture 27 - UASB and Biotower

Lecture 28 - Advanced Biological Wastewater Treatment: Fluidized Bed Bioreactors

Lecture 29 - Advanced Biological Wastewater Treatment: Membrane Bioreactors

Lecture 30 - Advanced Biological Wastewater Treatment: Moving Bed Biofilm Reactor (MBBR)

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[Lecture 35 - Sludge Management - V](#)

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[Lecture 38 - Management of Wastewater from Dairy Industry](#)

[Lecture 39 - Management of Wastewater from Slaughterhouse](#)

[Lecture 40 - Common Effluent Treatment Plant \(CETP\)](#)

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Lecture 2 - Introduction\_Various Reactors\_BR

Lecture 3 - Design Equation\_Continuous reactor (CSTR\_PFR\_PBR)

Lecture 4 - Design Equation\_Continuous reactor (CSTR\_PFR\_PBR)\_Sizing

Lecture 5 - Reaction Rate with Conversion, Temperature, and pressure (Batch/Flow system)

Lecture 6 - Space time Space velocity and CSTRs in series/parallel

Lecture 7 - Effect of Pressure Drop on reactor design (PBR)\_(X vs W) and (P vs W)

Lecture 8 - Effect of Pressure Drop on Reactor design (PBR)\_(X vs W)\_(P vs W)

Lecture 9 - Effect of Pressure Drop in PBR reactor\_Analytical solution of Differential equation

Lecture 10 - Effect of Pressure Drop in PBR reactor\_Analytical solution for Reaction With Pressure drop

Lecture 11 - Effect of Pressure Drop in PBR reactor\_Example

Lecture 12 - Differential Reactor\_rate of reaction\_catalyst deactivation

Lecture 13 - Catalyst deactivation

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**NPTEL : Chemical Reaction Engineering (Chemical Engineering)**

**Co-ordinators : Prof. Jayant M Modak**

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[Lecture 12 - Reaction of Carbene \(Continued...\)](#)

[Lecture 13 - Reaction of Carbene \(Continued...\)](#)

[Lecture 14 - Reaction of Carbene \(Continued...\)](#)

[Lecture 15 - Reaction of Carbene \(Continued...\)](#)

[Lecture 16 - Nitrene](#)

[Lecture 17 - Nitrene \(Continued...\)](#)

[Lecture 18 - Reaction of Nitrene](#)

[Lecture 19 - Reaction of Nitrene \(Continued...\)](#)

[Lecture 20 - Reaction of Nitrene \(Continued...\)](#)

Lecture 1 - A brief introduction to Molecules of Life: Structure of Amino acids and their various charged forms

Lecture 2 - Biological Macromolecules and Small molecules: Importance and functions

Lecture 3 - Amino Acids: The building block of proteins

Lecture 4 - Amino acids: separation and detection, Electrophoresis and Ninhydrin reaction

Lecture 5 - Method of determination of Amino acid sequence: primary structure of polypeptide/protein

Lecture 6 - Selective peptide bond cleavage: Enzymatic and Non-enzymatic methods

Lecture 7 - Peptide synthesis: Protecting groups for amine and carboxyl functionality

Lecture 8 - Peptide synthesis (Continued...) Protection, coupling and deprotection method

Lecture 9 - Recent development of coupling agents; Merrifield's method of solid phase peptide synthesis

Lecture 10 - Hierarchical structure of proteins: Secondary, tertiary and quaternary structure

Lecture 11 - Ramachandran plot and protein purification techniques

Lecture 12 - Protein purification techniques (Continued...)

Lecture 13 - Introduction to Enzymes and its kinetics

Lecture 14 - Enzyme catalysed reactions and introduction to catalytic activity of proteases

Lecture 15 - Enzyme Kinetics (Continued...)

Lecture 16 - Concept of Enzyme Inhibition

Lecture 17 - Concept of Enzyme Inhibition (Continued...)

Lecture 18 - Problems on Enzyme Kinetics and Enzyme Inhibition

Lecture 19 - Synthetic Biology

Lecture 20 - Synthetic Biology (Continued...)

Lecture 21 - Synthetic Biology (Continued...)

Lecture 22 - Nucleic Acid

Lecture 23 - Nucleic Acid (Continued...)

Lecture 24 - DNA sequencing method

Lecture 25 - DNA sequencing method (Continued...)

Lecture 26 - DNA sequencing method (Continued...)

Lecture 27 - Synthesis of oligonucleotide

Lecture 28 - Central dogma: DNA replication, transcription and translation

Lecture 29 - Central dogma: DNA replication, transcription and translation (Continued...)

Lecture 30 - Central dogma: DNA replication, transcription and translation (Continued...)

Lecture 31 - Central dogma: DNA replication, transcription and translation (Continued...)

[Lecture 32 - Central dogma: DNA replication, transcription and translation \(Continued...\)](#)

[Lecture 33 - Molecular Biology](#)

[Lecture 34 - Molecular Biology \(Continued...\)](#)

[Lecture 35 - Chemistry of cofactors/coenzymes](#)

[Lecture 36 - Chemistry of cofactors/coenzymes \(Continued...\)](#)

[Lecture 37 - Chemistry of cofactors/coenzymes \(Continued...\)](#)

[Lecture 38 - Chemistry of cofactors/coenzymes \(Continued...\)](#)

[Lecture 39 - Chemistry of cofactors/coenzymes \(Continued...\)](#)

[Lecture 40 - Chemistry of cofactors/coenzymes \(Continued...\)](#)

[Lecture 41 - Introduction to Drug Discovery Process](#)

[Lecture 42 - Fundamental Principles of Drug Development Process](#)

[Lecture 43 - Combinatorial chemistry](#)

[Lecture 44 - Neurotransmitters](#)

[Lecture 45 - Catechol amine based and GABA neurotransmitters](#)

[Lecture 46 - Hypertension: humoral mechanism and renin/angiotensin system](#)

[Lecture 47 - Inhibitor design of angiotensin converting enzyme](#)

[Lecture 48 - Antimicrobial drugs](#)

[Lecture 49 - Chemistry of penicillins](#)

[Lecture 50 - Resistance to beta-lactam antibiotics](#)

[Lecture 51 - Mechanistic studies of beta-lactamase](#)

[Lecture 52 - Non beta-lactam antibiotics](#)

[Lecture 53 - Mechanistic enzymology of Isopenicillin N synthase](#)

[Lecture 54 - Polyketide Biosynthesis](#)

[Lecture 55 - Biosynthesis of macrolide polyketides and introduction to virus](#)

[Lecture 56 - Anti-viral drugs](#)

[Lecture 57 - Cancer and Chemotherapy](#)

[Lecture 58 - Anti-cancer drugs \(Continued...\)](#)

[Lecture 59 - Aromatase inhibition and Anti-ulcer drugs](#)

[Lecture 60 - Cholesterol lowering agents](#)

[Lecture 61 - Cholesterol Biosynthesis](#)

[Lecture 62 - Pharmacokinetics and pharmacodynamics](#)

[Lecture 63 - QSAR principles](#)

Lecture 1 - Importance of Polymer Science and Brief Historical background

Lecture 2 - Definitions/Terminologies, Classifications

Lecture 3 - Classifications, Nomenclature

Lecture 4 - Classification by Polymerization Mechanism, Nomenclature

Lecture 5 - Molecular Weight, Big Picture of Polymer Science, Common Polymers

Lecture 6 - Examples of Step Polymers, Linear Step Polymerization

Lecture 7 - Linear Step Polymerization: MW Control, MW Distribution, Kinetics

Lecture 8 - Linear Step Polymerization: Kinetics (Continued...), Equilibrium Consideration, General Requirements for Achieving High MW; Non-linear Step Polymerization

Lecture 9 - Linear Step Polymerization: Summary - General Requirement, Non-Linear Step Polymerization

Lecture 10 - Types of Chain polymerization, Mechanism and Kinetics of Radical Chain Polymerization

Lecture 11 - Kinetics of Radical Chain Polymerization (Continued...), Various Types of Initiators

Lecture 12 - Thermal Initiation (Continued...), Molecular Weight and Kinetic Chain Length, Other Types of Radical Initiators, Transfer Reactions

Lecture 13 - Transfer Reactions, Effect of Temperature on Rate and MW, MW Distribution, ceiling Temperature

Lecture 14 - Energetics and Thermodynamics of Chain Polymerization, MW Distribution, Common Polymers

Lecture 15 - Thermodynamics of Chain Polymerization, MW Distribution, Common Polymers

Lecture 16 - Process Conditions, Emulsion Polymerization

Lecture 17 - Emulsion Polymerization (Continued...), Common Polymers by Radical Chain Polymerization, RDRP

Lecture 18 - Reversible - Deactivation Radical Polymerizations (RDRP)

Lecture 19 - RAFT Polymerization (Continued...), Ionic Polymerization

Lecture 20 - Polymer Stereochemistry and Zeigler - Natta Coordination Polymerization

Lecture 21 - Ring Opening Polymerization, Copolymers

Lecture 22 - Copolymerization (Continued...)

Lecture 23 - Polymers in Solution : Flory - Huggins Theory

Lecture 24 - Polymers in Solution : Application of Flory - Huggins Theory

Lecture 25 - Polymers in Solution : Solubility Parameter, Polymer Phase Separation and Fractionation

Lecture 26 - Polymers Chain Dimensions

Lecture 27 - Frictional Properties of Polymer Molecules in Dilute Solution, Determination of Polymer MW (Overview)

Lecture 28 - Membrane Osmometry, End Group Analysis, Dilute Solution Viscometry

Lecture 29 - Dilute Solution Viscometry, Light Scattering Techniques for MW

Lecture 30 - Gel Permeation Chromatography

[Lecture 31 - Light Scattering Techniques for MW and Size Measurements \(Continued...\)](#)

[Lecture 32 - Mass Spectroscopy of Polymers](#)

[Lecture 33 - Polymer Processing](#)

[Lecture 34 - Mechanical Properties, Amorphous State](#)

[Lecture 35 - Thermal Properties: Amorphous State](#)

[Lecture 36 - Thermal Properties: Crystalline State](#)

[Lecture 37 - Thermal Properties: Factors Influencing  \$T\_m\$ , Determination of  \$T\_g\$  and  \$T\_m\$ , Other Thermal Properties](#)

[Lecture 38 - Thermomechanical Properties, Viscoelasticity](#)

[Lecture 39 - Thermomechanical Properties, Viscoelasticity \(Continued...\)](#)

[Lecture 40 - Optical, Electrical, Barrier Properties; Chemical Resistance and Weathering of Polymers](#)

[Lecture 41 - Polymer Additives](#)

[Lecture 42 - Polymer Blends, Concluding Remarks](#)

**NPTEL : NOC:Structure, Stereochemistry and Reactivity of Organic Compounds and Intermediates: A Problem Solving Approach (Chemistry and Biochemistry)**

**Co-ordinators : Prof. A. Basak**

Lecture 1 - Introduction to structure and stereochemistry of organic molecules: salient features of symmetry elements; Role of principal axis, sigma plane, centre of symmetry, and alternating axis of symmetry in deciding chirality

Lecture 2 - Introduction to point group notation, classification, symmetry number and order

Lecture 3 - Examples of various point group notations, chiral and achiral point groups, examples of various point groups

Lecture 4 - Solving problems on point groups ( $C_n$ ,  $C_{nv}$ ,  $C_{nh}$ ,  $D_{nd}$ )

Lecture 5 - Conformational Analysis of Perhydrophenanthrene

Lecture 6 - Concept Clearing Session on Achiral Point Groups

Lecture 7 - Axial, Planar and Helical Chirality, assignment of absolute configuration to such molecules

Lecture 8 - Concept of pseudoasymmetry; Reflection variance/invariance problem; methods of nomenclature system

Lecture 9 - Conformational analysis of bicyclic systems: the Decalins

Lecture 10 - Conformational analysis of Perhydrophenanthrene

Lecture 11 - Conformational analysis of Perhydroanthracene

Lecture 12 - Revisiting conformational analysis of Perhydrophenanthrene

Lecture 13 - Revisiting conformational analysis of Perhydroanthracene

Lecture 14 - Introduction to Linear Polarized light and interaction with chiral materials; Circular Birefringence, Circular Dichroism

Lecture 15 - ORD, CD and Cotton Effect (CE); Empirical rule to determine the sign of CE, 2-axial haloketone rule

Lecture 16 - Octant rule: application to substituted cyclohexanone and decalone system

Lecture 17 - Application of Octant rule to tricyclic system; drawing of octant projection

Lecture 18 - Application of Octant rule to steroidal ketones; drawing of octant projection

Lecture 19 - Stereoelectronic effects on conformation and reactivity

Lecture 20 - Examples of anomeric effect and Stereoelectronic effect

Lecture 21 - Baldwin rules

Lecture 22 - Cyclization in enolic systems

Lecture 23 - Problem solving on Baldwin rules

Lecture 24 - Reactive Functionalities: Chemistry of Alkynes

Lecture 25 - Reactive Functionalities: Chemistry of Alkynes (Continued...), arynes and enediynes

Lecture 26 - Reactive Functionalities: Eneidyne (Continued...), allenes and Ketenes

Lecture 27 - Beta - Lactam Synthesis

Lecture 28 - Chemistry of radicals

Lecture 29 - Reactivity of radicals: Frontier orbital approach.

Lecture 30 - Radical mediated C-C bond formation



- Lecture 31 - Radical mediated C-C bond formation (Continued...).
- Lecture 32 - Radical mediated decarboxylation and deoxygenation
- Lecture 33 - Dynamic Stereochemistry: Conformationally rigid and mobile systems
- Lecture 34 - Dynamic Stereochemistry: Conformational analysis of elimination and addition
- Lecture 35 - Dynamic Stereochemistry: Stereoselectivity in carbonyl reduction
- Lecture 36 - Dynamic Stereochemistry: Reactivity of unsaturated carbonyl and enolate systems
- Lecture 37 - Dynamic Stereochemistry: Enolate as nucleophile
- Lecture 38 - Dynamic Stereochemistry: stereochemical issues in cyclohexenone reduction and alpha-electrophilic substitution in carbonyls
- Lecture 39 - Dynamic Stereochemistry: Asymmetric aldol reactions
- Lecture 40 - Dynamic Stereochemistry: Asymmetric aldol reaction (Continued...)

Lecture 1 - Review of Quantum Chemistry

Lecture 2 - Postulates of Quantum Mechanics - I

Lecture 3 - Postulates of Quantum Mechanics - II

Lecture 4 - Exactly Solvable Models - I

Lecture 5 - Exactly Solvable Models - II

Lecture 6 - Exactly Solvable Models - II (Continued...)

Lecture 7 - Variational Principle - I

Lecture 8 - Variational Principle - II

Lecture 9 - Variational Method: Applications - I

Lecture 10 - Linear Variational Method

Lecture 11 - Applications of Linear Variational Method

Lecture 12 - Variational Method in Chemical Bonding - I

Lecture 13 - Variational Method in Chemical Bonding - II

Lecture 14 - Variational Method in Chemical Bonding - III

Lecture 15 - Molecular Orbital Treatment of Polyatomics

Lecture 16 - Molecular Orbital Treatment of Polyatomics

Lecture 17 - Perturbation Theory

Lecture 18 - Examples of Perturbation Theory - I

Lecture 19 - Examples of Perturbation Theory - II

Lecture 20 - Molecular Response to Electric Field - I

Lecture 21 - Molecular Response to Electric Field - II

Lecture 22 - Degenerate Perturbation Theory

Lecture 23 - Excited States of He Atom - I

Lecture 24 - Excited States of He Atom - II

Lecture 25 - Slater Determinants - I

Lecture 26 - Slater Determinants - II

Lecture 27 - Energy Expectation Value with Slater Determinants - I

Lecture 28 - Energy Expectation Value with Slater Determinants - II

Lecture 29 - Self-Consistent Field Method

Lecture 30 - Canonical HF Equations

Lecture 31 - Hartree-Fock Energy

[Lecture 32 - Hartree-Fock-Roothan Equations](#)

[Lecture 33 - The Density Matrix](#)

[Lecture 34 - Evaluation of Molecular Properties](#)

[Lecture 35 - Basis Sets - I](#)

[Lecture 36 - Basis Sets - II](#)

[Lecture 37 - Electron Correlation and Post HF Methods](#)

[Lecture 38 - Time-Dependent Perturbation Theory - I](#)

[Lecture 39 - Time-Dependent Perturbation Theory - II](#)

[Lecture 40 - Slowly Switched Constant Perturbation](#)

[Lecture 41 - Oscillating Perturbation](#)

[Lecture 42 - Einstein's Coefficients](#)

Lecture 1 - Metal Ions In Biological Systems

Lecture 2 - Metallobiosite structures

Lecture 3 - Biomolecular structure and molecular biology component

Lecture 4 - Structures of nucleic acids

Lecture 5 - Coordination Chemistry in action

Lecture 6 - Coordination of peptide building blocks

Lecture 7 - Occurrence and availability

Lecture 8 - Potential ligands of different types

Lecture 9 - Metal ion insertion

Lecture 10 - Organic cofactors and siderophores

Lecture 11 - Introduction

Lecture 12 - CD and Raman spectroscopy

Lecture 13 - EPR

Lecture 14 - NMR and X-ray

Lecture 15 - Electrochemical methods

Lecture 16 - Metal ion assimilation

Lecture 17 - Transport of metal ions in bacteria and plants

Lecture 18 - Transport of metal ions in fungi and mammals

Lecture 19 - Homeostasis in bacteria and plants

Lecture 20 - Homeostasis in fungi and mammals

Lecture 21 - Transport across membranes

Lecture 22 - Ion channels and ion pumps

Lecture 23 - (K<sup>+</sup>) channels

Lecture 24 - (Na<sup>+</sup>) channels

Lecture 25 - (Na<sup>+</sup>)-(K<sup>+</sup>) ATPase

Lecture 26 - (Mg<sup>2+</sup>) dependent enzymes and kinases

Lecture 27 - Phosphatases and enolases

Lecture 28 - Photoreception and enzymes

Lecture 29 - (Ca<sup>2+</sup>) transporting, binding and sensor proteins

Lecture 30 - Cell signaling by (Ca<sup>2+</sup>) binding and sensing

Lecture 31 - Functions of iron ions and iron ion proteins

- Lecture 32 - Heme proteins for (O<sub>2</sub>) transport and storage
- Lecture 33 - Activators of (O<sub>2</sub>) and electron transport proteins
- Lecture 34 - Iron-sulfur proteins
- Lecture 35 - Mononuclear and dinuclear non-heme enzymes
- Lecture 36 - Oxygen transport and SOD activity
- Lecture 37 - Type 1 blue copper proteins
- Lecture 38 - Type 2 non-blue copper proteins
- Lecture 39 - Type 3 dinuclear copper proteins
- Lecture 40 - Multicopper and mixed-copper enzymes
- Lecture 41 - Coordination chemistry and function of zinc ions
- Lecture 42 - Carbonic anhydrase and lyases
- Lecture 43 - Carboxypeptidase and metalloproteinases
- Lecture 44 - Alcohol dehydrogenase and Beta-lactamase
- Lecture 45 - Redox catalysis by manganese ions
- Lecture 46 - Redox catalysis by manganese ions
- Lecture 47 - Catalysis by manganese and cobalt ions
- Lecture 48 - Cobalt ion dependent proteins and enzymes
- Lecture 49 - Nickel proteins and enzymes
- Lecture 50 - More nickel ion bearing enzymes
- Lecture 51 - Carbon, hydrogen and oxygen
- Lecture 52 - Nitrogen and Silicon
- Lecture 53 - Phosphorus
- Lecture 54 - Sulfur and Selenium
- Lecture 55 - Chlorine and Iodine
- Lecture 56 - Brain and blood-brain barrier (BBB)
- Lecture 57 - Zinc and copper ions
- Lecture 58 - Iron ions
- Lecture 59 - Metal ion based drugs and metallotherapeutics
- Lecture 60 - Chemotherapy, radiotherapy and contrast agents

- Lecture 1 - Enolate generation, structure of enolates and related topic - I
- Lecture 2 - Enolate generation, structure of enolates and related topic - II
- Lecture 3 - Enolate generation, structure of enolates and related topic - III
- Lecture 4 - Different mode of asymmetric induction in enolate alkylation
- Lecture 5 - Revisit again, Different mode of asymmetric induction in enolate alkylation
- Lecture 6 - Substrate directed stereocontrol in acyclic and cyclic system
- Lecture 7 - Substrate directed enolate alkylation in bicyclic system
- Lecture 8 - Seebach's SRS principle and related systems - I
- Lecture 9 - Seebach's SRS principle and related systems - II
- Lecture 10 - Seebach's SRS principle and related systems - III
- Lecture 11 - Evans oxazolidinone and related systems - I
- Lecture 12 - Evans oxazolidinone and related systems - II
- Lecture 13 - Evans oxazolidinone and related systems - III
- Lecture 14 - Evans oxazolidinone and related systems - IV
- Lecture 15 - Evans oxazolidinone and related systems - V
- Lecture 16 - Helmchen's auxiliary, Oppolzer's sultam based auxiliary
- Lecture 17 - Camphor based N-acyloxazolidinones as chiral auxiliary
- Lecture 18 - Myer's ephedrine, Chiral Weinreb amide equivalents and related systems
- Lecture 19 - Myer's ephedrine and related systems
- Lecture 20 - Chiral Weinreb amide equivalents and related systems
- Lecture 21 - Meyer's oxazoline based alkylation - I
- Lecture 22 - Meyer's oxazoline based alkylation - II
- Lecture 23 - Meyer's bicyclic lactam based enolate alkylation
- Lecture 24 - Meyer's bicyclic lactam based alkylation
- Lecture 25 - Meyer's bicyclic lactams, Gleason's bicyclic thioglycolate lactam based systems
- Lecture 26 - Few problem solving from Meyer's oxazoline/bicyclic lactam based alkylation
- Lecture 27 - Schollkopf's bis-lactim ether and related systems; Auxiliary induced chiral relay
- Lecture 28 - Chiral relay systems in amino acid derived enolate alkylation
- Lecture 29 - Williams oxazinone, Yamada's chiral glycine enolate and related system
- Lecture 30 - Tricycloiminolactone as chiral glycine equivalents
- Lecture 31 - Najera's auxiliary, Davies diketopiperazine and related system

Lecture 32 - Ender's RAMP/SAMP, Coltart's cyclic carbamate hydrazone, Ellman's sulfinamide and related

Lecture 33 - Ender's RAMP/SAMP based systems

Lecture 34 - Ender's RAMP/SAMP based systems

Lecture 35 - Ender's RAMP/SAMP, Coltart's cyclic carbamate hydrazone, Ellman's sulfinamide

Lecture 36 - Coltart's cyclic carbamate hydrazone and its exploration

Lecture 37 - Memory of chirality in enolate alkylation

Lecture 38 - Organocatalytic methods for enolate alkylation (SOMO activation)

Lecture 39 - Enantioselective alkylation with chiral PTC

Lecture 40 - Overall analysis of the entire discussion

Lecture 1 - Bioenergetics: Understanding the significance in Biological Systems

Lecture 2 - Regulation of Enzyme Activity

Lecture 3 - Digestion and Absorption of Carbohydrates

Lecture 4 - Glycolysis, alcohol and lactic acid fermentation

Lecture 5 - Biochemistry of TCA Cycle (I)

Lecture 6 - TCA Cycle (II) - Regulation and special characteristics

Lecture 7 - Neoglucogenesis

Lecture 8 - Regulation of Glycolysis and Neoglucogenesis - I

Lecture 9 - Regulation of Glycolysis and Neoglucogenesis - II Cori Cycle, Rapoport Leubering

Lecture 10 - Hexose Monophosphate Shunt : Steps and Phases

Lecture 11 - Hexose Monophosphate Shunt : Regulation and Significance

Lecture 12 - Glycogen Metabolism - I

Lecture 13 - Glycogen Metabolism - II

Lecture 14 - Glycogen Metabolism - III

Lecture 15 - Glycogen Metabolism - IV

Lecture 16 - Galactose Metabolism and Associated Disorders

Lecture 17 - Fructose Metabolism and Associated Disorders

Lecture 18 - Regulation of Blood Glucose

Lecture 19 - Diabetes Mellitus and Metabolic Alterations

Lecture 20 - Digestion and absorption of Lipid

Lecture 21 - Lipoprotein Metabolism - I

Lecture 22 - Lipoprotein Metabolism - II

Lecture 23 - Lipoprotein metabolism - III

Lecture 24 - Fatty acid catabolism (Oxidation of Fatty acids) - I

Lecture 25 - Fatty acid catabolism (Oxidation of Fatty acids) - II

Lecture 26 - Fatty acid catabolism (Oxidation of Fatty acids) - III

Lecture 27 - Metabolism of Ketone Bodies

Lecture 28 - Biosynthesis of Fatty acid and its regulation

Lecture 29 - Biosynthesis of triacylglycerol, phosphoglycerides and sphingolipids

Lecture 30 - Cholesterol Metabolism

Lecture 31 - Digestion and absorption of Protein



Lecture 32 - Transformation of Amino acids

Lecture 33 - Metabolism of Ammonia and ammonia toxicity

Lecture 34 - Urea cycle - Steps, Significance and Energetics

Lecture 35 - Urea Cycle - Regulation and Enzyme Deficiency Disorders

Lecture 36 - Metabolism of Phenylalanine and Associated Disorders

Lecture 37 - Tyrosine Metabolism - I

Lecture 38 - Tyrosine Metabolism - II (Catecholamines)

Lecture 39 - Tyrosine Metabolism - III

Lecture 40 - Tryptophan Metabolism

Lecture 41 - Metabolism of Sulphur containing Amino acids (Methionine and Cysteine)

Lecture 42 - Metabolism of Glycine and its disorders

Lecture 43 - Metabolism of Serine, Threonine and Alanine

Lecture 44 - Branched chain amino acid metabolism and their disorders

Lecture 45 - Metabolism of Histidine, Proline, Arginine and Lysine

Lecture 46 - Heme Metabolism - I (Heme Synthesis and Regulation)

Lecture 47 - Heme Metabolism - II (Disorders of Heme Synthesis - Porphyrrias)

Lecture 48 - Heme Metabolism - III (Heme Degradation, Transport and Bilirubin Metabolism)

Lecture 49 - Disorders of Bilirubin Metabolism

Lecture 50 - Nucleotide Metabolism - I (Purine Metabolism)

Lecture 51 - Nucleotide Metabolism - II (Disorders of Purine Metabolism)

Lecture 52 - Nucleotide Metabolism - III (Pyrimidine Metabolism and Disorders)

Lecture 53 - Inborn errors of Metabolism

Lecture 54 - Integration of Metabolism - I (Cellular and Organ level integration)

Lecture 55 - Integration of Metabolism - II (Starve feed cycle)

Lecture 56 - Integration of Metabolism - III (Metabolic Control Analysis)

Lecture 57 - Obesity, Metabolic Syndrome and Role of Adipokines

Lecture 58 - Fatty Liver and alcohol metabolism

Lecture 59 - Energy metabolism and Nutritional disorders, Protein Energy Malnutrition and Dietary

Lecture 60 - Metabolism in Cancer Cells

Lecture 1 - Introduction

Lecture 2 - System, Equilibrium States

Lecture 3 - Mathematical foundation - Exact differentials

Lecture 4 - Mathematical foundation - Inexact differentials

Lecture 5 - First law - Introduction to Internal energy

Lecture 6 - First law - Heat and work

Lecture 7 - First law - Pressure-volume work

Lecture 8 - First law - Internal energy revisited

Lecture 9 - First Law - Enthalpy

Lecture 10 - First law - Estimation of change in internal energy and enthalpy

Lecture 11 - Second law - Introduction

Lecture 12 - Second law - Carnot engine and entropy

Lecture 13 - Entropy and Third law

Lecture 14 - Entropy and Spontaneity in isolated systems

Lecture 15 - Spontaneity and equilibrium - Thermodynamic potentials

Lecture 16 - Spontaneity and equilibrium - Non-isolated systems

Lecture 17 - Thermodynamic potentials and Maxwell's relations

Lecture 18 - Application of Maxwell's relations

Lecture 19 - Thermodynamic response functions

Lecture 20 - Using Maxwell's relations to solve numerical problems

Lecture 21 - Fundamental Equation of Chemical Thermodynamics

Lecture 22 - Open systems and chemical potential

Lecture 23 - Chemical potential in one and many component ideal gas

Lecture 24 - Gibbs-Duhem relation and thermodynamics of ideal gas mixture

Lecture 25 - Numerical applications of Gibbs-Duhem relation

Lecture 26 - Phase equilibrium - Part 1

Lecture 27 - Phase equilibrium - Part 2

Lecture 28 - Phase equilibrium - Part 3

Lecture 29 - Phase equilibrium - Part 4

Lecture 30 - Numerical problems in phase equilibrium

Lecture 31 - Simple non-reactive mixtures - Part 1

- Lecture 32 - Simple non-reactive mixtures - Part 2
- Lecture 33 - Numerical problems in simple mixtures
- Lecture 34 - Numerical problems on phase equilibrium in simple mixtures
- Lecture 35 - Chemical potential of real systems - Activity and concentration
- Lecture 36 - Numerical problems on chemical potential in real systems
- Lecture 37 - Chemical Equilibrium - Part I
- Lecture 38 - Chemical Equilibrium - Part II
- Lecture 39 - Chemical Equilibrium - Part III
- Lecture 40 - Chemical Equilibrium - Part IV
- Lecture 41 - Numerical problems on chemical equilibrium
- Lecture 42 - Numerical problems on chemical equilibrium (Continued...)
- Lecture 43 - Electrochemical equilibrium - Part I
- Lecture 44 - Electrochemical equilibrium - Part II
- Lecture 45 - Electrochemical equilibrium - Part III
- Lecture 46 - Electrochemical equilibrium - Part IV
- Lecture 47 - Electrochemical equilibrium - Part V
- Lecture 48 - Electrochemical equilibrium - Part VI
- Lecture 49 - Numerical problems on electrochemistry
- Lecture 50 - Numerical problems on electrochemistry (Continued...)
- Lecture 51 - Numerical problems on electrochemistry (Continued...)
- Lecture 52 - Numerical problems on electrochemistry (Continued...)
- Lecture 53 - Numerical problems on electrochemistry (Continued...)
- Lecture 54 - Thermodynamic stability
- Lecture 55 - Thermodynamics in action - Part I
- Lecture 56 - Thermodynamics in action - Part II
- Lecture 57 - Thermodynamics in action - Part III
- Lecture 58 - Thermodynamics in action - Part IV
- Lecture 59 - Demonstration
- Lecture 60 - Concluding Lecture

Lecture 1 - Remembering the Masters: From Zeeman to Zavoisky

Lecture 2 - Introduction to EPR spectroscopy

Lecture 3 - Electron-Nuclear Hyperfine Interaction - I

Lecture 4 - Electron-Nuclear Hyperfine Interaction - II

Lecture 5 - Magnetic Moment in Magnetic Field - I

Lecture 6 - Magnetic Moment in Magnetic Field - II

Lecture 7 - EPR Instrumentations - I

Lecture 8 - EPR Instrumentations - II

Lecture 9 - EPR Instrumentations - III

Lecture 10 - EPR Instrumentations - IV

Lecture 11 - Quantum Mechanical Description of EPR - I

Lecture 12 - Quantum Mechanical Description of EPR - II

Lecture 13 - Introduction to Spin Relaxation

Lecture 14 - Theory of First-order EPR Spectra - I

Lecture 15 - Theory of First-order EPR Spectra - II

Lecture 16 - How to Analyse First-order EPR Spectra

Lecture 17 - How to Record EPR Spectra

Lecture 18 - Second-order Effects on EPR Spectra

Lecture 19 - Photochemistry and EPR Spectroscopy

Lecture 20 - Electron Spin Polarisation - I

Lecture 21 - Electron Spin Polarisation - II

Lecture 22 - Anisotropic Interactions in EPR Spectroscopy

Lecture 23 - Theoretical Basis of isotropic Hyperfine Coupling

Lecture 24 - Spin Relaxation and Bloch Equations - I

Lecture 25 - Spin Relaxation and Bloch Equations - II

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3 - Part I](#)

[Lecture 3 - Part II](#)

[Lecture 4 - Part I](#)

[Lecture 4 - Part II](#)

[Lecture 4 - Part III](#)

[Lecture 5 - Part I](#)

[Lecture 5 - Part II](#)

[Lecture 5 - Part III](#)

[Lecture 5 - Part IV](#)

[Lecture 5 - Part V](#)

[Lecture 6 - Part I](#)

[Lecture 6 - Part II](#)

[Lecture 6 - Part III](#)

[Lecture 6 - Part IV](#)

[Lecture 7 - Part I](#)

[Lecture 7 - Part II](#)

[Lecture 8 - Part I](#)

[Lecture 8 - Part II](#)

[Lecture 8 - Part III](#)

[Lecture 9 - Part I](#)

[Lecture 9 - Part II](#)

[Lecture 9 - Part III](#)

[Lecture 10](#)

Lecture 1 - Electromagnetic radiation

Lecture 2 - Interaction of radiation with matter

Lecture 3 - Introduction to chemical applications

Lecture 4 - Analysis of spectra

Lecture 5 - Radiation densities and Einstein's semi classical model

Lecture 6 - Introduction to quantum mechanics - I

Lecture 7 - Introduction to quantum mechanics - II

Lecture 8 - Born-Oppenheimer approximation

Lecture 9 - Beer-Lambert law

Lecture 10 - Diatomic Vibration Spectra Hermonic Model

Lecture 11 - Diatomic Vibration Morse Oscillator Model

Lecture 12 - Normal Vibrational modes Triatomic molecules

Lecture 13 - Normal Vibrational modes Polyatomic molecules

Lecture 14 - Vibrational Polyatomic Infrared Spectroscopy Local Modes and Group Frequencies

Lecture 15 - Microwave spectra of di-atomic molecules

Lecture 16 - Diatomic Molecules Microwave Energies and Transitions

Lecture 17 - Methodology of solving problems

Lecture 18 - Rotational and Vibrational Line Intensities

Lecture 19 - Microwave Spectra of Polyatomic molecules (Symmetric tops)

Lecture 20 - Video Tutorial 2 : Part - I

Lecture 21 - Video Tutorial 2 : Part - II

Lecture 22 - Introduction to Tensors

Lecture 23 - Polarizability Tensor

Lecture 24 - Introduction to Rotational Raman Spectra.

Lecture 25 - Review of basic concepts in Molecular Spectroscopy

Lecture 26 - Review of Microwave Spectroscopy

Lecture 27 - Review of Elementary Vibrational Spectroscopy

[Module 1](#)

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- Lecture 1 - Activation of chemical reactions. Thermal and photochemical methods
- Lecture 2 - MOs of polyene and their symmetry properties and methods of analyzing pericyclic reactions
- Lecture 3 - Introduction to electrocyclic reactions and Woodward Hoffmann rules
- Lecture 4 - Electrocyclic reactions  $\hat{A}$ - examples of 3, 4 and 5 membered ring systems (2e and 4e systems)
- Lecture 5 - Electrocyclic reactions  $\hat{A}$ - examples of 6 and larger ring systems (6e and more)
- Lecture 6 - Tutorial session 1
- Lecture 7 - Cycloaddition reactions - Introduction and Woodward Hoffmann rules - [2+2] cycloadditions
- Lecture 8 - Cycloaddition reactions  $\hat{A}$ - ketene cycloadditions
- Lecture 9 - Cycloaddition reactions  $\hat{A}$ - Diels-Alder reaction - Woodward Hoffmann rule - Regiochemistry and Stereochemistry aspects
- Lecture 10 - Diels Alder reaction - synthetic applications
- Lecture 11 - Diels Alder reaction continued - Hetero diene and dienophile - Lewis acid mediated - asymmetric
- Lecture 12 - 1,3-Dipolar cycloaddition reactions
- Lecture 13 - 1,3-Dipolar cycloaddition reactions (Continued...)
- Lecture 14 - [4pi+4pi], [4pi+6pi] and higher order cycloaddition reactions
- Lecture 15 - Tutorial session 2 on cycloaddition reactions
- Lecture 16 - Pericyclic reactions  $\hat{A}$ - Sigmatropic rearrangements  $\hat{A}$ - Introduction and [1,3] migrations
- Lecture 17 - Pericyclic reactions  $\hat{A}$ - Sigmatropic rearrangements (Continued...) [1,5] H and C migrations and Cope rearrangement
- Lecture 18 - Pericyclic reactions  $\hat{A}$ - Sigmatropic rearrangements (Continued...) oxy Cope and Claisen Rearrangement
- Lecture 19 - Pericyclic reactions  $\hat{A}$ - Sigmatropic rearrangements (Continued...)
- Lecture 20 - Pericyclic reactions  $\hat{A}$ - Sigmatropic rearrangements (Continued...) [2,3] sigmatropic shifts and higher order rearrangements Completed
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- Lecture 22 - Pericyclic reactions  $\hat{A}$ - Chelotropic reactions - introduction, SO<sub>2</sub> extrusion reactions
- Lecture 23 - Pericyclic reactions  $\hat{A}$ - Tutorial session 3 - Problems on sigmatropic reactions
- Lecture 24 - Chelotropic reactions 2
- Lecture 25 - The Ene Reaction
- Lecture 26 - Tutorial session - 4
- Lecture 27 - Introduction to organic photochemistry
- Lecture 28 - Photochemistry of alkenes cis-trans isomerization
- Lecture 29 - Photochemistry of alkenes (Continued...)
- Lecture 30 - Photochemistry of carbonyl compounds, Norrish type 1 and 2 reactions

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Lecture 10 - Lecture 10 - Schrödinger Equation Particle in a One-dimensional Box : Part II

Lecture 11 - Lecture 11 - Schrödinger Equation Particle in Two-dimensional Box : Part I

Lecture 12 - Lecture 12 - Particle in Two-dimensional Box : Part II Uncertainty Principle

Lecture 13 - Lecture 13 - Particle in Two-dimensional Box : Part III Expectation Values

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Lecture 1 - Introduction to X-Ray Crystallography

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Lecture 4 - Equivalent Points and 1D Lattices

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Lecture 6 - 2D Space Lattices

Lecture 7 - Crystallographic Point Groups

Lecture 8 - Stereographic Projections of Point Groups

Lecture 9 - Understanding of Crystallographic Space Groups

Lecture 10 - 2D Projection of Space Groups

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Lecture 12 - 3D Space Groups and Equivalent Points

Lecture 13 - Obtaining Equivalent Points by Shifting of Origin

Lecture 14 - Representation of Orthorhombic and Tetragonal Space Groups

Lecture 15 - Miller Indices for Crystallographic Directions and Planes

Lecture 16 - Miller Indices and Planar Densities

Lecture 17 - Tutorial - 02

Lecture 18 - Cubic Structures and atomic packing factors

Lecture 19 - Ceramic Structures

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Lecture 21 - Tutorial - 03

Lecture 22 - Origin of Reciprocal Lattice

Lecture 23 - Bragg's Law in Reciprocal Lattice and Origin of Systematic Absences

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Lecture 25 - Special Method of Crystallisation

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Lecture 35 - Structure Refinement

Lecture 36 - Single Crystal X-Ray Diffractometer

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Lecture 39 - Structure Solution using Apex II (Bruker Diffractometer)

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Lecture 43 - Cambridge Structure Database and its Application

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Lecture 45 - Data Reduction - Lorentz and Polarization Correction

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Lecture 48 - Identification from Intensity Statistics the presence of 2 fold axis in Lattice

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Lecture 54 - Powder X-Ray Diffractometer - Theory

Lecture 55 - Powder X-Ray Diffractometer - Lab

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Lecture 57 - Polymorphs

Lecture 58 - Review of Reciprocal Lattice

Lecture 59 - Review of Reciprocal Lattice

Lecture 60 - Review of Reciprocal Lattice and Bragg's Law in Reciprocal Lattice

Lecture 61 - Ewald's Sphere and Limiting Sphere

Lecture 62 - Origin of/Introduction to Systematic absences



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Lecture 28 - Introduction to bimolecular reaction dynamics - 4

Lecture 29 - Unimolecular reaction - 1

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Lecture 37 - Non-ideal solutions, Activity of ions (Debye-Huckel theory) - 2

Lecture 38 - Electrochemistry: Insights into electrode processes, Ionic conductivity - 1

Lecture 39 - Electrochemistry: Insights into electrode processes, Ionic conductivity - 2

Lecture 40 - Reaction Dynamics: Femtosecond Pump Probe Spectroscopy

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Lecture 43 - Equilibrium constant using partition method

Lecture 44 - Photochemistry: Degradation of a dye

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Lecture 3 - Schrodinger Equation: Particle in a One Dimensional Box

Lecture 4 - Particle in a One dimensional Box: Probabilities and Expectation Values

Lecture 5 - Elementary Mathematics: Introduction to Matrix Algebra - Part 1

Lecture 6 - Elementary Mathematics: Introduction to Matrix Algebra - Part 2

Lecture 7 - Elementary Mathematics: Matrix Eigenvalues and Eigenfunctions - Part I

Lecture 8 - Elementary Mathematics: Matrix Eigenvalues and Eigenfunctions - Part II

Lecture 9 - Particle in a Two Dimensional Box (Infinite Barrier)

Lecture 10 - Heisenberg's Uncertainty Principle

Lecture 11 - Expectation Values and Postulates in Quantum Mechanics

Lecture 12 - Problems and Solutions for Particle in One and Two Dimensional Boxes

Lecture 13 - Linear Vector Spaces: Matrix Representations

Lecture 14 - Linear Vector Spaces and Operators: Dirac's Bracket Notation

Lecture 15 - Simple Harmonic Oscillator: Classical Hamiltonian

Lecture 16 - Simple Harmonic Oscillator: Quantum Mechanical Solutions

Lecture 17 - Simple Harmonic Oscillator: Wave Functions, Probabilities and Average Values

Lecture 18 - Simple Harmonic Oscillator: Average Values for Position and Momentum

Lecture 19 - Particle on a Ring: The Quantum Model

Lecture 20 - Particle on a Ring: Expectation Values for Angular Momentum

Lecture 21 - Coordinate Transformation

Lecture 22 - Problems and Solutions for Harmonic Oscillator

Lecture 23 - Hydrogen Atom: The Hamiltonian in Spherical Polar Coordinates

Lecture 24 - Hydrogen Atom: Separation of the Schrödinger Equation

Lecture 25 - Hydrogen Atom: Radial and Angular Solutions and Animations - Part I

Lecture 26 - Hydrogen Atom: Radial and Angular Solutions and Animations - Part II

Lecture 27 - Hydrogen Atom: Radial Solutions and Probabilities

Lecture 28 - Power Series Method for Differential Equation - I

Lecture 29 - Hermite's Differential Equation

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Lecture 31 - Born-Oppenheimer Approximation

Lecture 32 - Introduction to Angular Momentum

Lecture 33 - Spin  $\frac{1}{2}$  Angular Momentum

Lecture 34 - Spin Angular Momentum and Coupling of Two Spin-1/2 Angular Momenta

Lecture 35 - Coupling of Two Angular Momenta

Lecture 36 - Video Tutorial for Hermite polynomials and hydrogen atom - Part 1

Lecture 37 - Video Tutorials - Part 2

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Lecture 39 - Introduction to Variational Principle in Quantum Chemistry

Lecture 40 - Variational Method: Method of Lagrange Multipliers

Lecture 41 - Hydrogen Molecule Ion: The Molecular Orbital Method

Lecture 42 - Hydrogen Molecule Ion: Calculations and Results

Lecture 43 - Hydrogen Molecule: The Valence Bond Method

Lecture 44 - Hydrogen Molecule: Calculations and Molecular Orbital Method

Lecture 45 - Video Tutorials on Angular Momentum (Orbital and Spin) and Variational Method - Part 1

Lecture 46 - Video Tutorials on Angular Momentum (Orbital and Spin) and Variational Method - Part 2

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Lecture 48 - First Order Time Independent perturbation Theory for Non-Degenerate states

Lecture 49 - First and Second Order Time Independent Perturbation Theory for Non-Degenerate States

Lecture 50 - First and Second Order Time Independent Perturbation Theory: Simple Examples

Lecture 51 - Time Independent Perturbation Theory for Degenerate States: First Order

Lecture 52 - General MO method for Homonuclear Diatomic Molecules

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Lecture 2 - Rate constant, concept of impedance, Z of electrical elements, differential impedance

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Lecture 8 - FFT details, frequency range and resolution, cross correlation

Lecture 9 - Multi sine, odd harmonic, non-harmonics, crest factor, spectral leakage

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Lecture 13 - Linearity, causality, stability, impedance vs. admittance, measurement model

Lecture 14 - Linear KKT illustration

Lecture 15 - Tutorial 03

Lecture 16 - Introduction to EEC, Choice of circuits, confidence intervals, AIC

Lecture 17 - EEC fitting, initial values, distinguishability

Lecture 18 - Zero/pole representation,  $R_t$  and  $R_p$

Lecture 19 - Maxwell, Voigt, Ladder circuits, choice of initial values illustrated

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Lecture 26 - E-EAR reaction, negative resistance (2 of 2)

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Lecture 39 - PDM

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Lecture 8 - Enzyme Catalysis - Part II

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Lecture 10 - Introduction to Receptors

Lecture 11 - Receptor Types and Functions

Lecture 12 - Tutorial 4 - Receptors, Binding Interactions, Ion Channels

Lecture 13 - Nucleic Acids

Lecture 14 - RNA and Protein Synthesis

Lecture 15 - Tutorial 5 - Nucleic acids, and Basics of Molecular Biology

Lecture 16 - Enzymes as Drug Targets

Lecture 17 - Enzyme Kinetics and Inhibition

Lecture 18 - Tutorial 6 - Enzyme Kinetics, Various Modes of Inhibition etc.

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Lecture 20 - Receptors as Drug Targets - Part II

Lecture 21 - Tutorial 7 - Receptor-Drug Interactions, Stereochemistry, Chirality, Nomenclature

Lecture 22 - Receptor-Drug Interactions.

Lecture 23 - Stereochemistry and Conformation

Lecture 24 - Tutorial 8 - Determination of Drug-Receptor Interactions, Conformation of Cyclic and Acyclic Structures etc.

Lecture 25 - Nucleic Acids as Drug Targets - Part I

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- Lecture 15 - Heat is a path function
- Lecture 16 - Joule-Thomson Effect (For Ideal Gases)
- Lecture 17 - Joule-Thomson Effect (For Van der Waals gas)
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- Lecture 49 - Most Probable Distribution is the Boltzmann Distribution
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- Lecture 55 - Tutorial Problem - 9
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**Co-ordinators : Dr. P. Banerji**

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**Co-ordinators : Dr. T.I. Eldho**

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**NPTEL : Structural Analysis II (Civil Engineering)**

**Co-ordinators : Dr. P. Banerji**

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**Co-ordinators : Dr. Deepankar Choudhury**

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[Lecture 58 - LIDAR - Part 3](#)

[Lecture 59 - RS data, data portals and processing tools - Part 1](#)

[Lecture 60 - RS data, data portals and processing tools - Part 2](#)

[Lecture 61 - RS data, data portals and processing tools - Part 3](#)

[Lecture 62 - Land use, land cover monitoring and change detection - Part 1](#)

[Lecture 63 - Land use, land cover monitoring and change detection - Part 2](#)

[Lecture 64 - Application of RS in water resources management - Part 1](#)

[Lecture 65 - Application of RS in water resources management - Part 2](#)

[Lecture 66 - Application of RS in water resources management - Part 3](#)

[Lecture 67 - Application of RS in water resources management - Part 4](#)



- Lecture 1 - Introduction to Structural Dynamics
- Lecture 2 - Idealization of Structures
- Lecture 3 - Components of Dynamic System
- Lecture 4 - Equation of Motion
- Lecture 5 - Free Vibration
- Lecture 6 - Damped Free Vibration - Part 1
- Lecture 7 - Damped Free Vibration - Part 2
- Lecture 8 - Undamped Harmonic Excitations
- Lecture 9 - Damped Harmonic Excitations
- Lecture 10 - Frequency response curves
- Lecture 11 - Transmissibility
- Lecture 12 - Energy in Forced Vibrations
- Lecture 13 - Unit impulse Functions
- Lecture 14 - Step and Ramp Forces
- Lecture 15 - Pulse Excitations
- Lecture 16 - Numerical Response Methods
- Lecture 17 - Seismic Response Spectra
- Lecture 18 - Continuous systems
- Lecture 19 - Lumped mass systems
- Lecture 20 - Equation of motion
- Lecture 21 - Equation of motion - examples
- Lecture 22 - Mode shapes and frequencies
- Lecture 23 - Free vibration - Undamped and Damped
- Lecture 24 - Damping in MDOF Systems
- Lecture 25 - Forced response of MDOF systems
- Lecture 26 - Modal superposition Analysis
- Lecture 27 - Response Spectrum Analysis
- Lecture 28 - Concept of Seismic Isolation
- Lecture 29 - Dynamics of Base-isolation Systems

- Lecture 1 - Syllabus
- Lecture 2 - History Of Microwave Remote Sensing
- Lecture 3 - Overview Of Active and Passive Microwave Remote Sensing
- Lecture 4 - Fundamentals Laws Of Remote Sensing
- Lecture 5 - Tutorial 1: Python Programming From Beginner Perspective
- Lecture 6 - Scattering Of Microwaves
- Lecture 7 - Synthetic Aperture Radars - Basics
- Lecture 8 - Sar Image Processing - Fundamental Terminologies
- Lecture 9 - Working With Sar Imagery
- Lecture 10 - Understanding Radar Equation
- Lecture 11 - Tutorial 2 : Exploring Alos Palsar Data In Python
- Lecture 12 - Understanding Radar Imagery
- Lecture 13 - Tutorial 3: Introduction To SNAP
- Lecture 14 - Doppler Shift
- Lecture 15 - Speckle
- Lecture 16 - Speckle - How To Handle
- Lecture 17 - Tutorial 4 Part 1: Plotting In 1 D Using Python
- Lecture 18 - Tutorial 4 Part 2: Plotting In 2 D Using Python
- Lecture 19 - Tutorial 4 Part 3: Statistics Using Python
- Lecture 20 - Tutorial 4 Part 4: Hypothesis Tesing Using Python
- Lecture 21 - Sar Image Pre Processing
- Lecture 22 - Sar Image Texture
- Lecture 23 - Texture For Image Classification
- Lecture 24 - Polarization
- Lecture 25 - Tutorial 5 Part 1: Speckle Filtering Using Python
- Lecture 26 - Tutorial 5 Part 2: Speckle Filtering Using Python Using Gaussian Filter
- Lecture 27 - Numerical On Radar Remote Sensing
- Lecture 28 - Numerical On Radar Remote Sensing
- Lecture 29 - Image Classification - Basics
- Lecture 30 - Supervised Classification
- Lecture 31 - Maximum Likelihood Classification

- Lecture 32 - Tutorial 6 Part 1: Sar Image Pre-processing
- Lecture 33 - Tutorial 6 Part 2: Maximum Likelihood Classification In Snap
- Lecture 34 - Unsupervised Classification And Accuracy Assessment
- Lecture 35 - Fuzzy Classification
- Lecture 36 - Tutorial 7 Part 1: Working With Grace Data In Python
- Lecture 37 - Tutorial 7 Part 2: Altimetry Data In Python
- Lecture 38 - Tutorial 7 Part 3: Swot Mission For Altimetry
- Lecture 39 - Radars In Hydrology
- Lecture 40 - Applications Of Radar Remote Sensing In Hydrology
- Lecture 41 - Doppler Weather Radar
- Lecture 42 - Tutorial 8 Part 1: Doppler Weather Radar Data Visualization And Precipitation Estimation
- Lecture 43 - Tutorial 8 Part 2: Doppler Weather Radar Data Visualization And Precipitation Estimation
- Lecture 44 - Radar Altimetry
- Lecture 45 - Measuring Soil Moisture And Terrestrial Water Storage Using Radar Remote Sensing
- Lecture 46 - Tutorial 9: Handling Passive Microwave Observations
- Lecture 47 - Fundamentals Of Passive Microwave Remote Sensing - Part 1
- Lecture 48 - Fundamentals Of Passive Microwave Remote Sensing - Part 2
- Lecture 49 - Applications Of Passive Microwave Remote Sensing In Hydrology
- Lecture 50 - Passive Microwave Radiometers And Their Applications
- Lecture 51 - Tutorial 10: Processing Satellite Precipitation Data Using Python
- Lecture 52 - Introduction To The Basics Of Sar Interferometry
- Lecture 53 - Sar Interferometry (InSAR) And Applications
- Lecture 54 - Introduction To Other Modes Of Sar Interferometry And Applications - DInSAR, PSInSAR and DEM's
- Lecture 55 - Tutorial 11: Sar Interferometry Processing Using Snap
- Lecture 56 - Tutorial 12 Part 1: Hydrologic Modelling Using Microwave Remote Sensing
- Lecture 57 - Tutorial 12 Part 2: Introduction To Swat+ Hydrological Model
- Lecture 58 - Tutorial 12 Part 3: Introductory Tutorial On Vic Hydrological Model

- Lecture 1 - Introduction to Groundwater - Part 1
- Lecture 2 - Introduction to Groundwater - Part 2
- Lecture 3 - Introduction to Groundwater - Part 3
- Lecture 4 - Introduction to Groundwater - Part 4
- Lecture 5 - Introduction to Groundwater - Part 5
- Lecture 6 - International importance of groundwater and India - Part 1
- Lecture 7 - International importance of groundwater and India - Part 2
- Lecture 8 - International importance of groundwater and India - Part 3
- Lecture 9 - International importance of groundwater and India - Part 4
- Lecture 10 - International importance of groundwater and India - Part 5
- Lecture 11 - Physics and hydrology of Groundwater - Part 1
- Lecture 12 - Physics and hydrology of Groundwater - Part 2
- Lecture 13 - Physics and hydrology of Groundwater - Part 3
- Lecture 14 - Physics and hydrology of Groundwater - Part 4
- Lecture 15 - Physics and hydrology of Groundwater - Part 5
- Lecture 16 - Groundwater governing equations 1 - Part 1
- Lecture 17 - Groundwater governing equations 1 - Part 2
- Lecture 18 - Groundwater governing equations 1 - Part 3
- Lecture 19 - Groundwater governing equations 1 - Part 4
- Lecture 20 - Groundwater governing equations 1 - Part 5
- Lecture 21 - Groundwater governing equations 2 - Part 1
- Lecture 22 - Groundwater governing equations 2 - Part 2
- Lecture 23 - Groundwater governing equations 2 - Part 3
- Lecture 24 - Groundwater governing equations 2 - Part 4
- Lecture 25 - Groundwater governing equations 2 - Part 5
- Lecture 26 - Groundwater recharge and discharge - Part 1
- Lecture 27 - Groundwater recharge and discharge - Part 2
- Lecture 28 - Groundwater recharge and discharge - Part 3
- Lecture 29 - Groundwater recharge and discharge - Part 4
- Lecture 30 - Groundwater recharge and discharge - Part 5
- Lecture 31 - Constructing aquifers using groundwater data - Part 1

- [Lecture 32 - Constructing aquifers using groundwater data - Part 2](#)
- [Lecture 33 - Constructing aquifers using groundwater data - Part 3](#)
- [Lecture 34 - Constructing aquifers using groundwater data - Part 4](#)
- [Lecture 35 - Constructing aquifers using groundwater data - Part 5](#)
- [Lecture 36 - Conceptual model for groundwater - Part 1](#)
- [Lecture 37 - Conceptual model for groundwater - Part 2](#)
- [Lecture 38 - Conceptual model for groundwater - Part 3](#)
- [Lecture 39 - Conceptual model for groundwater - Part 4](#)
- [Lecture 40 - Conceptual model for groundwater - Part 5](#)
- [Lecture 41 - Groundwater data in India - Part 1](#)
- [Lecture 42 - Groundwater data in India - Part 2](#)
- [Lecture 43 - Groundwater data in India - Part 3](#)
- [Lecture 44 - Groundwater data in India - Part 4](#)
- [Lecture 45 - Groundwater data in India - Part 5](#)
- [Lecture 46 - Application of Groundwater data in India - Part 1](#)
- [Lecture 47 - Application of Groundwater data in India - Part 2](#)
- [Lecture 48 - Application of Groundwater data in India - Part 2](#)
- [Lecture 49 - Application of Groundwater data in India - Part 3](#)
- [Lecture 50 - Application of Groundwater data in India - Part 3](#)
- [Lecture 51 - Introduction to Groundwater modeling - Part 1](#)
- [Lecture 52 - Introduction to Groundwater modeling - Part 2](#)
- [Lecture 53 - Introduction to Groundwater modeling - Part 3](#)
- [Lecture 54 - Introduction to Groundwater modeling - Part 4](#)
- [Lecture 55 - Introduction to Groundwater modeling - Part 5](#)
- [Lecture 56 - Case studies of Groundwater in India - Part 1](#)
- [Lecture 57 - Case studies of Groundwater in India - Part 2](#)
- [Lecture 58 - Case studies of Groundwater in India - Part 3](#)
- [Lecture 59 - Case studies of Groundwater in India - Part 4](#)
- [Lecture 60 - Case studies of Groundwater in India - Part 5](#)

Lecture 1 - Importance of water resource management and Hydrological Cycle and representations - Part 1

Lecture 2 - Importance of water resource management and Hydrological Cycle and representations - Part 2

Lecture 3 - Importance of water resource management and Hydrological Cycle and representations - Part 3

Lecture 4 - Importance of water resource management and Hydrological Cycle and representations - Part 4

Lecture 5 - Importance of water resource management and Hydrological Cycle and representations - Part 5

Lecture 6 - Key Hydrological Parameters 1 - Part 1

Lecture 7 - Key Hydrological Parameters 1 - Part 2

Lecture 8 - Key Hydrological Parameters 1 - Part 3

Lecture 9 - Key Hydrological Parameters 1 - Part 4

Lecture 10 - Key Hydrological Parameters 1 - Part 5

Lecture 11 - Key Hydrological Parameters 2 - Part 1

Lecture 12 - Key Hydrological Parameters 2 - Part 2

Lecture 13 - Key Hydrological Parameters 2 - Part 3

Lecture 14 - Key Hydrological Parameters 2 - Part 4

Lecture 15 - Key Hydrological Parameters 2 - Part 5

Lecture 16 - Introduction to Groundwater hydrology - Part 1

Lecture 17 - Introduction to Groundwater hydrology - Part 2

Lecture 18 - Introduction to Groundwater hydrology - Part 3

Lecture 19 - Introduction to Groundwater hydrology - Part 4

Lecture 20 - Introduction to Groundwater hydrology - Part 5

Lecture 21 - Groundwater components - Part 1

Lecture 22 - Groundwater components - Part 2

Lecture 23 - Groundwater components - Part 3

Lecture 24 - Groundwater components - Part 4

Lecture 25 - Groundwater components - Part 5

Lecture 26 - Surface water hydrology - Part 1

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Lecture 29 - Surface water hydrology - Part 4

Lecture 30 - Surface water hydrology - Part 5

Lecture 31 - Water Mass Balance Equation - Part 1

- Lecture 32 - Water Mass Balance Equation - Part 2
- Lecture 33 - Water Mass Balance Equation - Part 3
- Lecture 34 - Water Mass Balance Equation - Part 4
- Lecture 35 - Water Mass Balance Equation - Part 5
- Lecture 36 - Rural water management issues, data challenges and observation records - Part 1
- Lecture 37 - Rural water management issues, data challenges and observation records - Part 2
- Lecture 38 - Rural water management issues, data challenges and observation records - Part 3
- Lecture 39 - Rural water management issues, data challenges and observation records - Part 4
- Lecture 40 - Rural water management issues, data challenges and observation records - Part 5
- Lecture 41 - Rural water resource management infrastructure (engineered) - Part 1
- Lecture 42 - Rural water resource management infrastructure (engineered) - Part 2
- Lecture 43 - Rural water resource management infrastructure (engineered) - Part 3
- Lecture 44 - Rural water resource management infrastructure (engineered) - Part 4
- Lecture 45 - Rural water resource management infrastructure (engineered) - Part 5
- Lecture 46 - Rural water resource management infrastructure (nature based) - Part 1
- Lecture 47 - Rural water resource management infrastructure (nature based) - Part 2
- Lecture 48 - Rural water resource management infrastructure (nature based) - Part 3
- Lecture 49 - Rural water resource management infrastructure (nature based) - Part 4
- Lecture 50 - Rural water resource management infrastructure (nature based) - Part 5
- Lecture 51 - Solving case studies in rural water resource management - Part 1
- Lecture 52 - Solving case studies in rural water resource management - Part 2
- Lecture 53 - Solving case studies in rural water resource management - Part 3
- Lecture 54 - Solving case studies in rural water resource management - Part 4
- Lecture 55 - Solving case studies in rural water resource management - Part 5
- Lecture 56 - Rural hydrological databases for India - Part 1
- Lecture 57 - Rural hydrological databases for India - Part 2
- Lecture 58 - Rural hydrological databases for India - Part 3
- Lecture 59 - Rural hydrological databases for India - Part 4
- Lecture 60 - Rural hydrological databases for India - Part 5

- Lecture 1 - Introduction
- Lecture 2 - Shear Strength of Soils - I
- Lecture 3 - Shear Strength of Soils - II
- Lecture 4 - Shear Strength of Soils - III
- Lecture 5 - Shear Strength of Soils - IV
- Lecture 6 - Testing for shear strength parameters: Introduction
- Lecture 7 - Direct shear box test
- Lecture 8 - Direct Shear Interpretation of Test Results - I
- Lecture 9 - Direct Shear Interpretation of Test Results - II
- Lecture 10 - Kf line
- Lecture 11 - Selection of Parameter (Shear Strength,SS) - I
- Lecture 12 - Selection of Parameter (Shear Strength,SS) - II
- Lecture 13 - Shear Strength of Cohesive Soils - I
- Lecture 14 - Shear Strength of Cohesive Soils - II
- Lecture 15 - Triaxial Test - I
- Lecture 16 - Triaxial Test - II
- Lecture 17 - Triaxial Test - III
- Lecture 18 - Interpretation of Triaxial test Results - I
- Lecture 19 - Interpretation of Triaxial test Results - II
- Lecture 20 - Interpretation of Triaxial test Results - III
- Lecture 21 - Pore Pressure Parameters - I
- Lecture 22 - Pore Pressure Parameters - II
- Lecture 23 - Stress Paths - I
- Lecture 24 - Stress Paths - II
- Lecture 25 - Plastic Equilibrium in Soils
- Lecture 26 - Mechanisms of Development of Plastic Equilibrium in Soils - I
- Lecture 27 - Mechanisms of Development of Plastic Equilibrium in Soils - II
- Lecture 28 - Earth Pressure Analysis (Trial Wedge) - I
- Lecture 29 - Earth Pressure Analysis (Trial Wedge) - II
- Lecture 30 - Earth Pressure Analysis (Trial Wedge) - III
- Lecture 31 - Analysis of Completely Submerged Retaining wall



[Lecture 32 - Gravity Walls Supporting Cohesive Soil Mass \(Backfill\)](#)

[Lecture 33 - Sloping Backfill](#)

[Lecture 34 - Earth Pressure Analysis - I](#)

[Lecture 35 - Earth Pressure Analysis - II](#)

[Lecture 36 - Sheet Pile Wall Introduction - I](#)

[Lecture 37 - Sheet Pile Wall Introduction - II](#)

[Lecture 38 - Sheet pile wall Introduction - III](#)

[Lecture 39 - Analysis of sheet piles - I](#)

[Lecture 40 - Analysis of sheet piles - II](#)

[Lecture 41 - Anchored Bulkheads](#)

[Lecture 42 - Cantilever Sheet Piles](#)

[Lecture 43 - Lateral Earth Pressure Braced Sheet Pile Walls](#)

[Lecture 44 - Slope Stability - I](#)

[Lecture 45 - Slope Stability - II](#)

[Lecture 46 - Slope Instability - I](#)

[Lecture 47 - Slope Instability - II](#)

[Lecture 48 - Slope Instability - III](#)

[Lecture 49 - Analysis of Finite Slopes - I Planar Failure Surface](#)

[Lecture 50 - Analysis of Finite Slopes - II Circular Failure Surface](#)

[Lecture 51 - Finite Slopes Friction Circle Method](#)

[Lecture 52 - Slip Circle Method](#)

- Lecture 1 - Introduction to course - Rural development (RD)
- Lecture 2 - Water security (SF) and Water security (GW) and issues
- Lecture 3 - Food security and issues
- Lecture 4 - Agriculture and rural infrastructure issues
- Lecture 5 - Rural Development
- Lecture 6 - Data and mapping issues for Rural regions
- Lecture 7 - Introduction to Remote Sensing and need
- Lecture 8 - Remote Sensing for Water and Food Security
- Lecture 9 - Remote Sensing for Rural infrastructures
- Lecture 10 - Remote Sensing for Rural Development
- Lecture 11 - Intro to Remote Sensing Data for Rural Development
- Lecture 12 - Intro to Remote Sensing Data for Rural Development : Water
- Lecture 13 - Intro to Remote Sensing Data for Rural Development : Soil and Climate
- Lecture 14 - Intro to Remote Sensing Data for Rural Development : NASA datasets for water
- Lecture 15 - Intro to Remote Sensing Data for Rural Development
- Lecture 16 - Intro to GIS and QGIS
- Lecture 17 - Intro to GIS data types and download
- Lecture 18 - Intro to GIS vector data type and QGIS panel
- Lecture 19 - Vector Tools in QGIS
- Lecture 20 - QGIS tutorials for vector analysis and data searching
- Lecture 21 - Intro to Raster Data type in GIS
- Lecture 22 - Raster data type formats and uses
- Lecture 23 - Raster data and Vector data quality issues
- Lecture 24 - Raster data tools: Raster calculator and Raster Align
- Lecture 25 - Raster data tools: Clip and Masking tools
- Lecture 26 - Intro to GIS Projections and Co-ordinate systems
- Lecture 27 - Intro to digitization of images for raster data
- Lecture 28 - Digitization of scanned maps into raster data
- Lecture 29 - Extracting point and line features from georeferenced data
- Lecture 30 - Extracting polygon features from georeferenced data
- Lecture 31 - Creating shapefiles from georeferenced maps

Lecture 32 - Google Earth Pro introduction for extracting data

Lecture 33 - Ground Control points from Google Earth Pro and Basemaps

Lecture 34 - Digital Elevation models and sources

Lecture 35 - Digital Elevation models (hands on example)

Lecture 36 - Introduction to Land Use Land Cover

Lecture 37 - Data for LULC and proxy data

Lecture 38 - Analyzing Bhuvan LULC data - Part 1

Lecture 39 - Analyzing Bhuvan LULC data - Part 2

Lecture 40 - Analyzing USGS LULC data

Lecture 41 - Different types of LULC classifications

Lecture 42 - Different types of LULC classifications

Lecture 43 - Remote Sensing for irrigation assessments

Lecture 44 - Remote Sensing for Groundwater irrigation assessments

Lecture 45 - Methods for Crop Statistics using Remote Sensing data

Lecture 46 - Remote Sensing based indicators for rural development

Lecture 47 - Remote Sensing methods for crop area and health assessments

Lecture 48 - NDVI data access

Lecture 49 - NDVI data from NASA platforms

Lecture 50 - NDVI data from Sentinel and NASA platforms

Lecture 51 - Remote Sensing based indicators database

Lecture 52 - Synergized mapping using Remote Sensing and Crowd Sourced data for rural infrastructures

Lecture 53 - RS and OSM for mapping rural infrastructures: Schools

Lecture 54 - RS and OSM for mapping rural infrastructures: Hospitals

Lecture 55 - RS and OSM for mapping rural infrastructures: Adding data, crops and water bodies

Lecture 56 - RS and GIS application for Rural Development: Monitoring and Evaluation

Lecture 57 - RS and GIS application for Rural Development: Monitoring and Evaluation using NDVI and NDWI

Lecture 58 - RS and GIS application for Rural Development: Water Quality Assessment

Lecture 59 - RS and GIS application for Rural Development: Indicators and Dashboards

Lecture 60 - RS and GIS for Rural Development - Summary, Wrap and Ways Forward

**NPTEL : Concrete Technology (Civil Engineering)**

**Co-ordinators : Dr. B. Bhattacharjee**

Lecture 1 - Production and Composition

Lecture 2 - Structure and Hydration

Lecture 3 - Structure and Hydration

Lecture 4 - Properties and Tests

Lecture 5 - Types and Use

Lecture 6 - Aggregates (Size, Shape)

Lecture 7 - Packing, FM, SM

Lecture 8 - Properties

Lecture 9 - Chemical Admixtures

Lecture 10 - Chemical Admixtures

Lecture 11 - Mineral Admixtures

Lecture 12 - Mineral Admixtures

Lecture 13 - Mineral Admixtures

Lecture 14 - Mix Proportioning of Concrete: General Principles

Lecture 15 - Mix design of Concrete: General and IS Method

Lecture 16 - Mix Design of Concrete: Is Example and British (DOE) Method

Lecture 17 - Mix Design of concrete: ACI 211 Method

Lecture 18 - Mix Design of concrete: Packing Density, Rheology

Lecture 19 - Batching and Mixing of concrete: General Principles

Lecture 20 - RMC and Transporting Concrete

Lecture 21 - Workability and Pumping of Concrete

Lecture 22 - Compaction and Curing Concrete

Lecture 23 - Strength of Concrete: Factors Affecting

Lecture 24 - Strength of Concrete: Aggregate Contribution

Lecture 25 - Strength of Concrete: Factors Affecting Test Results

Lecture 26 - Mechanical Properties of Concrete: Elastic Modulus, Poisson's Ratio, Fatigue, Impact

Lecture 27 - Creep of Concrete

Lecture 28 - Creep and Shrinkage of Concrete

Lecture 29 - Shrinkage of Concrete

Lecture 30 - Shrinkage of Concrete

Lecture 31 - Fundamental Concepts, Degradation Process, Attacks

[Lecture 32 - Frost Action and Rebar Corrosion](#)

[Lecture 33 - Carbonation and Chloride Affect](#)

[Lecture 34 - Rebar Corrosion](#)

[Lecture 35 - Rebar Corrosion and General Strategy](#)

[Lecture 36 - High Strength Concrete](#)

[Lecture 37 - High Strength Matrics and SCC](#)

[Lecture 38 - Self Compacting Concrete](#)

[Lecture 39 - Fiber Concrete](#)

[Lecture 40 - Fiber and Roller Compacted Concrete](#)

[Lecture 41 - Special Concrete and Sustainability](#)

- Lecture 1 - Seismology
- Lecture 2 - Seismology (Continued...)
- Lecture 3 - Seismology (Continued...)
- Lecture 4 - Seismology (Continued...)
- Lecture 5 - Seismic Inputs
- Lecture 6 - Seismic Inputs (Continued...)
- Lecture 7 - Seismic Inputs (Continued...)
- Lecture 8 - Seismic Inputs (Continued...)
- Lecture 9 - Response Analysis for Specified Ground Motion
- Lecture 10 - Response Analysis for Specified Ground Motion (Continued...)
- Lecture 11 - Response Analysis for Specified Ground Motion (Continued...)
- Lecture 12 - Response Analysis for Specified Ground Motion (Continued...)
- Lecture 13 - Response Analysis for Specified Ground Motion (Continued...)
- Lecture 14 - Response Analysis for Specified Ground Motion (Continued...)
- Lecture 15 - Frequency Domain Spectral Analysis
- Lecture 16 - Frequency Domain Spectral Analysis.
- Lecture 17 - Frequency Domain Spectral Analysis (Continued...)
- Lecture 18 - Frequency Domain Spectral Analysis (Continued...)
- Lecture 19 - Frequency Domain Spectral Analysis (Continued...)
- Lecture 20 - Response Spectrum Method of Analysis
- Lecture 21 - Response Spectrum Method of Analysis.
- Lecture 22 - Response Spectrum Method of Analysis (Continued...)
- Lecture 23 - Response Spectrum Method of Analysis (Continued...)
- Lecture 24 - Response Spectrum Method of Analysis (Continued...)
- Lecture 25 - Inelastic Seismic Response of Structures
- Lecture 26 - Inelastic Seismic Response of Structures (Continued...)
- Lecture 27 - Inelastic Seismic Response of Structures (Continued...)
- Lecture 28 - Inelastic Seismic Response of Structures (Continued...)
- Lecture 29 - Inelastic Seismic Response of Structures (Continued...)
- Lecture 30 - Inelastic Seismic Response of Structures (Continued...)

- Lecture 1 - Functions Of Buildings
- Lecture 2 - Role Of Material In Construction
- Lecture 3 - Concrete:Material
- Lecture 4 - Concrete Production (Continued...)
- Lecture 5 - Concrete Production (Continued...)
- Lecture 6 - Concrete:Production Pumping, Placing
- Lecture 7 - Concrete:Production Curing
- Lecture 8 - Cement: Hydration
- Lecture 9 - Cement and Cementitious Material
- Lecture 10 - Fresh Concrete
- Lecture 11 - Fresh Concrete : Role of Mix Parameters
- Lecture 12 - Fresh Concrete : Role of Admixtures
- Lecture 13 - Fresh Concrete : Segregation Bleeding
- Lecture 14 - Strength of Concrete - I
- Lecture 15 - Strength of Concrete - II
- Lecture 16 - Strength of Concrete - III
- Lecture 17 - Mechanical Properties of Concrete - I
- Lecture 18 - Mechanical Properties of Concrete - II
- Lecture 19 - Strength of Concrete : Non Destructive
- Lecture 20 - Durability of Concrete - I
- Lecture 21 - Durability of Concrete - II
- Lecture 22 - Durability of Concrete - III
- Lecture 23 - Cement Aggregate and Water Selection
- Lecture 24 - Mix Design of Concrete
- Lecture 25 - Mix Design Of concrete IS Method
- Lecture 26 - Mix Design Of Concrete: British
- Lecture 27 - Masonry : Materials
- Lecture 28 - Masonry : Walls
- Lecture 29 - Masonry : Walls; Resistance - I
- Lecture 30 - Masonry : Walls; Resistance - II
- Lecture 31 - Walls : Functional Performances

[Lecture 32 - Walls : Defects and Durability](#)

[Lecture 33 - Metals Fundamentals](#)

[Lecture 34 - Metals and Iron Systems](#)

[Lecture 35 - Steel : Uses in Construction](#)

[Lecture 36 - Steel : Uses in Rebar](#)

[Lecture 37 - Polymer in Construction](#)

[Lecture 38 - Polymer in Construction : Uses](#)

[Lecture 39 - Glass and Timber : Glass](#)

[Lecture 40 - Glass and Timber : Timber](#)

[Lecture 41 - Roof and Floor Construction](#)



**NPTEL : Water Management (Civil Engineering)**

**Co-ordinators : Dr. A.K. Gosain**

- Lecture 1 - Introduction to Irrigation Water Management
- Lecture 2 - Soil - Water - Plant Relationships
- Lecture 3 - Soil - Water - Plant Relationships (Continued...)
- Lecture 4 - Soil - Water - Plant Relationships (Continued...)
- Lecture 5 - Soil - Water - Plant Relationships (Continued...)
- Lecture 6 - Soil - Water - Plant Relationships (Continued...) and Infiltration
- Lecture 7 - Crop Water Requirements
- Lecture 8 - Crop Water Requirements (Continued...)
- Lecture 9 - Crop Water Requirements (Continued...)
- Lecture 10 - Crop Water Requirements (Continued...)
- Lecture 11 - Crop Water Requirements (Continued...)
- Lecture 12 - Crop Water Requirements (Continued...)
- Lecture 13 - Crop Water Requirements (continued...)
- Lecture 14 - Irrigation Efficiencies - Part I
- Lecture 15 - Irrigation Efficiencies - Part II and Irrigation Methods and their Suitability
- Lecture 16 - Irrigation Methods - III
- Lecture 17 - Irrigation Methods - IV
- Lecture 18 - Irrigation Methods - V
- Lecture 19 - Irrigation Methods - VI
- Lecture 20 - Irrigation Methods and their Suitability
- Lecture 21 - Border Irrigation System - I
- Lecture 22 - Border Irrigation System - II
- Lecture 23 - Border Irrigation System - III
- Lecture 24 - Border Irrigation System - IV
- Lecture 25 - Furrow Irrigation System - I
- Lecture 26 - Furrow Irrigation System - II
- Lecture 27 - Furrow Irrigation System - III
- Lecture 28 - Furrow Irrigation System - IV
- Lecture 29 - Sprinkler Irrigation System - I
- Lecture 30 - Sprinkler Irrigation System - II
- Lecture 31 - Sprinkler Irrigation System - III

[Lecture 32 - Sprinkler Irrigation System - IV](#)

[Lecture 33 - Sprinkler Irrigation System - V](#)

[Lecture 34 - Sprinkler Irrigation System - VI](#)

[Lecture 35 - Sprinkler Irrigation System - VII](#)

[Lecture 36 - Sprinkler Irrigation System - VIII](#)

[Lecture 37 - Drip Irrigation System - I](#)

[Lecture 38 - Drip Irrigation System - II](#)

[Lecture 39 - Drip Irrigation System - III](#)

[Lecture 40 - Drip Irrigation System - IV](#)

**NPTEL : NOC:Geoenvironmental Engineering (Environmental Geotechnology) Landfills, Slurry Ponds and Contaminated Sites  
(Civil Engineering)**

**Co-ordinators : Prof. Manoj Datta**

Lecture 1 - Introduction to Geoenvironmental Engineering

Lecture 2 - Sources and Impact of Contamination

Lecture 3 - Waste-Soil Interaction

Lecture 4 - Solid Waste Generation and Disposal

Lecture 5 - Waste Minimization by Integrated Solid Waste Management (ISWM)

Lecture 6 - Integrated Solid Waste Management (ISWM) - Case Studies

Lecture 7 - Principles of Landfilling

Lecture 8 - Planning of Landfills - Part 1

Lecture 9 - Planning of Landfills - Part 2

Lecture 10 - Liners for Landfills - Part 1

Lecture 11 - Liners for Landfills - Part 2

Lecture 12 - Liners for Landfills - Part 3

Lecture 13 - Liners for Landfills - Part 4

Lecture 14 - Covers for Landfills - Part 1

Lecture 15 - Covers for Landfills - Part 2

Lecture 16 - Generation and Control of Leachate

Lecture 17 - Generation and Control of Landfill Gas

Lecture 18 - Stability of Slopes - Part 1

Lecture 19 - Stability of Slopes - Part 2

Lecture 20 - Stability of Slopes - Part 3

Lecture 21 - (Lecture Missing)

Lecture 22 - Some Solved Examples

Lecture 23 - Subsurface Monitoring Around Landfills - Part 1

Lecture 24 - Subsurface Monitoring Around Landfills - Part 2

Lecture 25 - Cost of Geotechnical Components of Landfills

Lecture 26 - Construction and Operation of Landfills

Lecture 27 - Site Selection for Landfills

Lecture 28 - Closure, Rehabilitation and Expansion of MSW Landfills

Lecture 29 - Control and Remedial Measures at Contaminated Sites - Part 1

Lecture 30 - Control and Remedial Measures at Contaminated Sites - Part 2

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[Lecture 31 - Slurry Disposal on Land](#)

[Lecture 32 - Disposal of Slurry Waste in Ponds and Impoundments and Dry Waste in Mounds](#)

[Lecture 33 - Geotechnical Properties of Coal Ash and Mine Tailings - Part 1](#)

[Lecture 34 - Geotechnical Properties of Coal Ash and Mine Tailings - Part 2](#)

[Lecture 35 - Planning and Design of Slurry Ponds](#)

[Lecture 36 - Stability of Incrementally Raised Embankments - Part 1](#)

[Lecture 37 - Stability of Incrementally Raised Embankments - Part 2](#)

[Lecture 38 - Remedial Measures for Slope Failures in Embankments / Dykes of Slurry Ponds](#)

[Lecture 39 - Environmental Control at Slurry Ponds](#)

[Lecture 40 - Geotechnical Reuse of Waste Materials - Part 1](#)

[Lecture 41 - Geotechnical Reuse of Waste Materials - Part 2](#)

[Lecture 42 - End-of-the-Course Review](#)

- Lecture 1 - Introduction to Environmental Factors - 1
- Lecture 2 - Introduction to Environmental Factors - 2
- Lecture 3 - Introduction to Environmental Factors - 3
- Lecture 4 - Introduction to Environmental Factors - 4
- Lecture 5 - Introduction to Environmental Factors - 5
- Lecture 6 - Introduction to Environmental Factors - 6
- Lecture 7 - Introduction to Environmental Factors - 7
- Lecture 8 - Comfort and Heat Transfer Concepts
- Lecture 9 - Heat Flow in Buildings - 1
- Lecture 10 - Heat Flow in buildings - 2
- Lecture 11 - Heat Flow in buildings - 3
- Lecture 12 - Admittance Method - 1
- Lecture 13 - Admittance Method - 2
- Lecture 14 - Heat Flow in buildings - 1 (Frequency Domain)
- Lecture 15 - Heat Flow in buildings - 2 (Frequency Domain)
- Lecture 16 - Heat Flow in buildings - 2 (Frequency Domain)
- Lecture 17 - Heat flow in buildings
- Lecture 18 - Admittance Method
- Lecture 19 - Comfort - 1
- Lecture 20 - Comfort - 2
- Lecture 21 - Comfort and Thermal Design of Buildings - 1
- Lecture 22 - Comfort and Thermal Design of Buildings - 2
- Lecture 23 - Comfort and Thermal Design of Buildings - 3
- Lecture 24 - Thermal Design of Unconditioned Building
- Lecture 25 - External Shading Multipliers for external suns shading
- Lecture 26 - Passive Concepts
- Lecture 27 - Design for Thermal Efficiency
- Lecture 28 - Ventilation - 1
- Lecture 29 - Ventilation - 2
- Lecture 30 - Natural ventilation design
- Lecture 31 - Noise and Acoustic Fundamentals - 1

[Lecture 32 - Noise and Acoustic Fundamentals - 2](#)

[Lecture 33 - Noise and Acoustic Fundamentals - 3](#)

[Lecture 34 - Noise and Acoustic Fundamentals, Noise Outdoors](#)

[Lecture 35 - Noise outdoors](#)

[Lecture 36 - Sound within enclosure - 1](#)

[Lecture 37 - Sound within enclosure - 2](#)

[Lecture 38 - Sound within enclosure - 3](#)

[Lecture 39 - Sound within enclosure - 4](#)

[Lecture 40 - Sound within enclosure - 5](#)

[Lecture 41 - Sound within enclosure - 6](#)

[Lecture 42 - Sound within enclosure, isolation](#)

[Lecture 43 - Isolation - 1](#)

[Lecture 44 - Isolation - 2](#)

[Lecture 45 - Auditorium - 1](#)

[Lecture 46 - Auditorium - 2](#)

[Lecture 47 - Daylighting - 1](#)

[Lecture 48 - Daylighting - 2](#)

[Lecture 49 - Daylighting - 3](#)

[Lecture 50 - Daylighting - 4](#)

[Lecture 51 - Daylighting - 5](#)

[Lecture 52 - Daylighting - 6](#)

[Lecture 53 - Artificial Lighting](#)

[Lecture 54 - Design Sky models](#)

[Lecture 55 - Live Session](#)

Lecture 1 - Basic concepts of Fire Protection - I

Lecture 2 - Basic concepts of Fire Protection - II

Lecture 3 - Fire Resistance

Lecture 4 - Introduction Process of Combustion

Lecture 5 - ventilation and fuel Process of Combustion controlled fire

Lecture 6 - Process of Combustion: Flashover condition

Lecture 7 - Effect of Fire on Construction Materials

Lecture 8 - Design for Fire Resistance: Steel

Lecture 9 - Design for Fire Resistance: Steel

Lecture 10 - Design for Fire Resistance: Concrete

Lecture 11 - Fire Safety: Urban Planning

Lecture 12 - Fire Safety: Escape and Refuge

Lecture 13 - Fire safety: Internal planning, Detection and Suppression

Lecture 14 - Fire Safety: Detection and Suppression

Lecture 15 - Introduction to Lift Design

Lecture 16 - Design of Lift systems

Lecture 17 - Design of Lift systems: expected stops and floor of reversal

Lecture 18 - Design of Lift systems: Different cases

Lecture 19 - Design of Lift systems: Simulation and arrangement and Escalators

Lecture 20 - Introduction to System and Flow Systems

Lecture 21 - Water Supply System: Constant Demand

Lecture 22 - Water Supply System: Variable Demand and Diversity Factor

Lecture 23 - Diversity factor (Continued...)

Lecture 24 - Control Systems

Lecture 25 - Introduction to HVAC

Lecture 26 - Governing Equations for HVAC Process

Lecture 27 - Numerical Problem on HVAC System

Lecture 28 - Numerical Problem on HVAC System (Continued...)

Lecture 29 - Psychrometric Chart: Equation based Approach

Lecture 30 - Flow in Pipe Networks and Fixture Units

Lecture 31 - Flow in Pipe Networks (Continued...) and Design of Water Supply Distribution System

Lecture 32 - Design of Water Supply Distribution System (Continued...) and Flow in Waste Water pipes

Lecture 33 - Electrical Systems (introduction)

Lecture 34 - Design of Electrical Systems

Lecture 35 - Intelligent Building

Lecture 36 - Life cycle cost and basics of building maintenance

Lecture 37 - Stages of maintenance management

Lecture 38 - Planning for building maintenance

Lecture 39 - Periodicity of maintenance management

Lecture 40 - Estimation of repair cycle

Lecture 41 - Cost profile of maintenance

Lecture 42 - Lamp replacement

Lecture 43 - Building inspection, Planned and Ad-hoc maintenance

Lecture 44 - Condition survey and health evaluation of buildings

Lecture 45 - Diagnosis of building by visual survey

Lecture 46 - Case studies of visual survey

Lecture 47 - Effect of corrosion and Alkali Aggregate Reaction

Lecture 48 - Sampling and choice of test location

Lecture 49 - Non Destructive Testing - 1

Lecture 50 - Non Destructive Testing - 2

Lecture 51 - Core strength test

Lecture 52 - Carbonation and Chloride measurement

Lecture 53 - Electrical methods of progress measurement

Lecture 54 - Repair, Rehabilitation and Retrofit

Lecture 55 - Periodicity and economics of condition survey

Lecture 56 - Interpretation of test results



Lecture 1 - Introduction and Planet Equivalent

Lecture 2 - Basics of Carbon Cycle

Lecture 3 - Factors Affecting carbon Cycle

Lecture 4 - Fundamentals of Sustainability

Lecture 5 - Role of Materials and Embodied Energy

Lecture 6 - Case Study for Energy in Building

Lecture 7 - Calculation of Ecological Footprint

Lecture 8 - Role of Cement in Sustainability and Calculation of Chemical Exergy

Lecture 9 - Fuel for Cement

Lecture 10 - Cementitious/Supplementary Cementitious Materials and Their Characterization

Lecture 11 - Strength of Concrete With Supplementary Cementitious Materials and Composite Cements

Lecture 12 - Types of Composite Cements

Lecture 13 - Alternative Fuel for cement and Embodied Energy

Lecture 14 - Life Cycle Embodied Energy and Concrete Sustainability

Lecture 15 - Strength of Concrete and Use of Admixtures

Lecture 16 - Curing Methods and Use of Waste Water for Mixing and Curing

Lecture 17 - Modern Composite Concrete

Lecture 18 - Recycled Aggregate-ITZ and Processing

Lecture 19 - Classification of Recycled Aggregate: Crushing and Grinding of Aggregates

Lecture 20 - Crushing and Grinding: Bond's Law+Operational Energy: U-Value

Lecture 21 - Operational Energy: Thermal Conductivity Models

Lecture 22 - Operational Energy: Thermal Conductivity Models (Continued...)

Lecture 23 - Operational Energy: Estimation of Thermal Conductivity

Lecture 24 - Thermal Diffusivity and Clay Bricks

Lecture 25 - Types of Bricks Kilns and Carbon Balance

Lecture 26 - Carbon Balance, Comparison of Various Types of Brick Kilns and Sealants, Paints, Adhesive

Lecture 27 - Sealants, Health Hazards of Building Materials and Emission Models

Lecture 28 - Emission Models and Testing

Lecture 29 - Energy Efficient Design of Buildings

Lecture 30 - Design Optimization of Buildings

Lecture 31 - Building Design Optimization Using Genetic Algorithm

[Lecture 32 - Urban Heat Island: Radiation Concepts](#)

[Lecture 33 - Urban Heat Island: Urban Canopy Layer](#)

[Lecture 34 - Evapotranspiration: Theory and Models](#)

[Lecture 35 - Evapotranspiration: Case Study and Surface Water Balance](#)

[Lecture 36 - Energy Conservation Building Code \(ECBC2007\)](#)

[Lecture 37 - Energy Conservation Building Code \(ECBC2007\) \(Continued...\)](#)

[Lecture 38 - ECBC Compliant Methodology](#)

[Lecture 39 - OTTV Methodology](#)

[Lecture 40 - Solar Energy and Solar Cells](#)

[Lecture 41 - Solar Photo Volatic Cells](#)

[Lecture 42 - Solar Water Heating](#)

[Lecture 43 - Design Strategies and the Green Design Process](#)

[Lecture 44 - Green Building Rating Systems](#)

[Lecture 45 - Autoclaved Aerated Concrete, Insulated Precast System and Insulated Precast Forms](#)

[Lecture 46 - Insulated Concrete Form and Tunnel Form](#)

[Lecture 47 - Modular Construction](#)

Lecture 1 - Introduction to Projects

Lecture 2 - Inputs to Scheduling

Lecture 3 - Critical Path Method

Lecture 4 - Precedence Diagramming Method

Lecture 5 - Line of Balance Method

Lecture 6 - Resource-driven Scheduling

Lecture 7 - Information-driven Scheduling

Lecture 8 - Dependency Structure Matrix - I

Lecture 9 - Dependency Structure Matrix - II

Lecture 10 - Dependency Structure Matrix - III

Lecture 11 - Beeline Diagramming Method

Lecture 12 - Other Scheduling Techniques

Lecture 1 - Introduction to Safety in Construction

Lecture 2 - Introduction to Safety Standards; Signs, Signals in Construction

Lecture 3 - Role of Stakeholders in Construction safety

Lecture 4 - Cost of Injury Vs Investment in Safety

Lecture 5 - Safety Program Accident/Incident Investigation

Lecture 6 - PPE in Construction

Lecture 7 - A Case Study on Construction Safety

Lecture 8 - Introduction to Fatal Falls

Lecture 9 - Fall hazard in Concerting

Lecture 10 - Fall hazard in Demolition Works

Lecture 11 - Safety in Demolition Work Practical Examples

Lecture 12 - Trench Cav-ins

Lecture 13 - Tunneling Safety

Lecture 14 - Struck by and Caught-inbetween

Lecture 15 - Crane Safety

Lecture 16 - A case Study on Construction Safety - Jigar-Crane

Lecture 17 - A case Study on Construction Safety - Safety Talk

Lecture 18 - Fire Safety and Steel Construction

Lecture 19 - Electrical Safety

Lecture 20 - A case Study on Construction Safety - Contractual Provision on Construction Zone Safety

Lecture 21 - Health Issues in Construction

Lecture 22 - Ergonomics and Health Issues with Concerting

Lecture 23 - General Safety Precautions

Lecture 24 - Safety in MEP Services

Lecture 25 - Managing Hazards in Construction

Lecture 26 - BIM for Construction

Lecture 27 - BIM for Safety

- Lecture 1 - Introduction - advanced hydraulics & course structure
- Lecture 2 - Various classifications of open channel flows
- Lecture 3 - Flow classifications & velocity distribution
- Lecture 4 - Pressure distribution
- Lecture 5 - Equation of continuity & energy
- Lecture 6 - Specific energy & critical flow
- Lecture 7 - Energy, momentum & specific force
- Lecture 8 - Computation of critical flow - Part 1
- Lecture 9 - Critical flow computations
- Lecture 10 - Introduction to uniform flow
- Lecture 11 - Manning's equation and normal depth
- Lecture 12 - Uniform Flow Computations - Part 1
- Lecture 13 - Uniform flow in compound sections, concept of normal slope
- Lecture 14 - Uniform flow approximation for flood discharge
- Lecture 15 - Design of channels for uniform flow
- Lecture 16 - Design of channels using uniform flow
- Lecture 17 - Design of erodible channels
- Lecture 18 - Introduction to gradually varied flows
- Lecture 19 - Gradually varied flow equations
- Lecture 20 - Classification of gradually varied flow - Part 1
- Lecture 21 - Classification of gradually varied flow - Part 2
- Lecture 22 - Gradually varied flow profiles with change in bed slopes
- Lecture 23 - GVF profile properties and transitional depths
- Lecture 24 - Gradually varied flow computations - Part 1
- Lecture 25 - Gradually varied flow computations RK method - Part 2
- Lecture 26 - Standard step method for gradually varied flow computations
- Lecture 27 - Spatially varied flow
- Lecture 28 - Features on spatially varied flow
- Lecture 29 - Rapidly varied flow - introduction
- Lecture 30 - Theoretical aspects of hydraulic jump
- Lecture 31 - Characteristics of jumps in rectangular channel

[Lecture 32 - Features of hydraulic jumps](#)

[Lecture 33 - Jumps as energy dissipators](#)

[Lecture 34 - Jump controls](#)

[Lecture 35 - Surges - Part 1](#)

[Lecture 36 - Surges - Part 2](#)

[Lecture 37 - Channel transitions - Part 1](#)

[Lecture 38 - Channel transitions - Part 2](#)

[Lecture 39 - Channel transitions - Part 3](#)

[Lecture 40 - Application of momentum principles](#)

[Lecture 41 - Pumps - 1](#)

[Lecture 42 - Turbines - Part 3 \(pumps, turbines\)](#)

[Lecture 43 - Turbines, cavitation](#)

- Lecture 1 - Introduction to Design of Steel Structures
- Lecture 2 - Connections
- Lecture 3 - Riveted Connections
- Lecture 4 - Design of Rivet Joint
- Lecture 5 - Welding
- Lecture 6 - Design of Fillet and Butt Welds
- Lecture 7 - Bolted Connection
- Lecture 8 - Eccentric Connections: Rivet Joints
- Lecture 9 - Design of Eccentric Connection With Load Lying in Plane of Joint Rivet Bolt
- Lecture 10 - Eccentric Connection With Load Perpendicular to Plane of Riveted Joint
- Lecture 11 - Analysis and Design of Join with Seat Connection
- Lecture 12 - Eccentric Connection
- Lecture 13 - Load Lying Perpendicular to the Plane of Weld Joint
- Lecture 14 - Tension Member
- Lecture 15 - Design of Tension Member
- Lecture 16 - Design of Tension Member: Gusset Plates. Lug Angles and Tension Splices
- Lecture 17 - Design of Tension Member: Subjected to Axial and Bending
- Lecture 18 - Compression Member
- Lecture 19 - Design of Compression Member
- Lecture 20 - Design of Eccentrically Loaded tension Member
- Lecture 21 - Built up Compression Member
- Lecture 22 - Design of Built up Compression Member
- Lecture 23 - Lacing for Built Up Compression Member
- Lecture 24 - Design of Lacing System
- Lecture 25 - Design of Batten Plates
- Lecture 26 - Introduction to Flexural Members: Beams
- Lecture 27 - Design Procedure of Beam Members
- Lecture 28 - Design of Laterally Supported Beams
- Lecture 29 - Design of Laterally Unsupported Beams
- Lecture 30 - Built-Up Beams
- Lecture 31 - Built-Up Beams: Curtailment of the Flange Plates and Shear Connections

[Lecture 32 - Design of a Built-Up Beams](#)

[Lecture 33 - Design of Shear Connections and Purlins](#)

[Lecture 34 - Gantry Girders](#)

[Lecture 35 - Design of Gantry Girders](#)

[Lecture 36 - Introduction to Plate Girders - Part 1](#)

[Lecture 37 - Introduction to Plate Girders - Part 2](#)

[Lecture 38 - Design of a Plate Girder](#)

[Lecture 39 - Column Base - Part 1](#)

[Lecture 40 - Column Base - Part 2](#)



- Lecture 1 - Introduction to Hydraulics
- Lecture 2 - Open Channel Hydraulics - Part 1
- Lecture 3 - Open Channel Hydraulics - Part 2
- Lecture 4 - Velocity and Pressure Distribution
- Lecture 5 - Practical use of velocity co-efficient in channel flow
- Lecture 6 - Conservation Principles & Governing Equations
- Lecture 7 - Uniform Flow
- Lecture 8 - Uniform Flow Formula
- Lecture 9 - Computation of Uniform Flow - Part 1
- Lecture 10 - Computation of Uniform Flow - Part 2
- Lecture 11 - Uniform Flow in Mobile Boundary Channel
- Lecture 12 - Incipient Motion Condition and Regime of Flow
- Lecture 13 - Concept of Specific Energy
- Lecture 14 - Computation of Critical Depth
- Lecture 15 - Specific Force, Critical Depth & Sequent Depth
- Lecture 16 - Non-uniform Flow: Gradually Varied Flow
- Lecture 17 - Classification of Gradually Varied Flow
- Lecture 18 - Characteristic of Gradually Varied Flow
- Lecture 19 - Characteristic of Gradually Varied Flow & its Computation
- Lecture 20 - Gradually Varied Flow & its Computation
- Lecture 21 - Computation of Gradually Varied Flow
- Lecture 22 - Gradually Varied Flow: Numerical Methods and Problem Solving
- Lecture 23 - Rapidly Varied Flow: Hydraulic Jump
- Lecture 24 - Hydraulic Jump
- Lecture 25 - Flow Over Hump and Channel Contraction
- Lecture 26 - Canal Design - 1
- Lecture 27 - Canal Design - 2
- Lecture 28 - Design of Alluvial Channel - 1
- Lecture 29 - Design of Alluvial Channel - 2
- Lecture 30 - Design of Alluvial Channel - 3
- Lecture 31 - Unsteady Flow: Waves and its Classification

[Lecture 32 - Unsteady Flow Part - 2](#)

[Lecture 33 - Unsteady Flow Part - 3](#)

[Lecture 34 - Pipe Flow: Friction Loss](#)

[Lecture 35 - Pipe Flow: Losses in Pipes](#)

[Lecture 36 - Pipe in Series & Parallel](#)

[Lecture 37 - Pipe Network Analysis](#)

[Lecture 38 - Water Hammer & Surge Tank](#)

[Lecture 39 - Pipe Flow Friction Loss](#)

[Lecture 40 - Pipe Flow: Losses in Pipe](#)

Lecture 1 - Introduction to Higher Surveying

Lecture 2 - Understanding reference system, reference frame, and coordinate system for Earth

Lecture 3 - Coordinate and datum transformations

Lecture 4 - Projected coordinate system

Lecture 5 - Fundamentals of astronomy

Lecture 6 - Applications of concepts of astronomy

Lecture 7 - Time

Lecture 8 - Application of concepts of astronomy and time

Lecture 9 - Fundamental concepts of error, accuracy, and error propagation

Lecture 10 - Applications of error propagation

Lecture 11 - Observation Equation Method of adjustments

Lecture 12 - Condition Equation Method and Combined Method of adjustments

Lecture 13 - Analysis of adjustments and reporting of errors

Lecture 14 - Global Positioning System (GPS)

Lecture 15 - Introduction to Photogrammetry

Lecture 16 - Vertical photogrammetry

Lecture 17 - Stereo photogrammetry

Lecture 18 - Analytical photogrammetry - I

Lecture 19 - Analytical photogrammetry - II

Lecture 20 - Photogrammetric products

Lecture 21 - Image matching

Lecture 22 - Close range photogrammetry

Lecture 23 - Fundamentals of LiDAR

Lecture 24 - LiDAR data acquisition

Lecture 25 - Geolocation and errors of LiDAR data

Lecture 26 - Information extraction from LiDAR data

Lecture 27 - RADAR fundamenetals - I

Lecture 28 - RADAR fundamenetals - II

Lecture 29 - RADAR fundamenetals - III

Lecture 30 - Radargrammetry

Lecture 31 - Geoscience perspective for RADAR applications

[Lecture 32 - Fundamental concepts of hydrographic survey](#)

[Lecture 33 - Field procedures for hydrographic Surveying](#)

[Lecture 34 - Modern techniques for hydrographic Survey](#)

[Lecture 35 - Navigation](#)

[Lecture 36 - Conclusive lecture](#)

Lecture 1 - Fundamental Aspects of Unsaturated Soil Mechanics and its Basic Principles

Lecture 2 - Phases of Unsaturated Soils-I

Lecture 3 - Phases of Unsaturated Soils-II

Lecture 4 - Equilibrium between Air and Water Phases

Lecture 5 - Capillary Phenomenon in Unsaturated Soils - I

Lecture 6 - Capillary Phenomenon in Unsaturated Soils - II

Lecture 7 - Summary: Fundamental Principles and Constitutive Relationships

Lecture 8 - Concept of Water Retention and Soil Water Characteristics - I

Lecture 9 - Concept of Water Retention and Soil Water Characteristics - II

Lecture 10 - Hydraulic conductivity functions and determination of state variables

Lecture 11 - Suction Measurement/Control Techniques - I

Lecture 12 - Suction Measurement/Control Techniques - II

Lecture 13 - Summary: Suction Measurement and Control Techniques

Lecture 14 - HCF Determination

Lecture 15 - SWCC and HCF Models

Lecture 16 - HCF Modelling

Lecture 17 - Fitting of SWCC and HCF modelling

Lecture 18 - Pedo-transfer Functions (PTF)

Lecture 19 - Steady-State Flow Through Soils

Lecture 20 - Steady-State and Transient Flow

Lecture 21 - Analytical Methods for Transient Flow - I

Lecture 22 - Analytical Methods for Transient Flow - II

Lecture 23 - Shear Strength of Unsaturated Soils

Lecture 24 - Suction-Controlled Direct Shear Test

Lecture 25 - Suction-Controlled Triaxial Test

Lecture 26 - Extended M-C Criterion - I

Lecture 27 - Extended M-C Criterion - II

Lecture 28 - Extended M-C Criterion - III

Lecture 29 - Concept of Suction Stress - I

Lecture 30 - Concept of Suction Stress - II

Lecture 31 - Concept of Suction Stress - III

[Lecture 32 - Summary: Shear Strength of Unsaturated Soils and Introduction to Volume Change](#)

[Lecture 33 - Swelling Behaviour of Soils](#)

[Lecture 34 - Estimation of Swelling Pressure in the Laboratory and Behaviour of Collapsible soil](#)

[Lecture 35 - Volume Change Behaviour of Bentonite and Kaolin Clay](#)

[Lecture 36 - Demonstration of Various Experiments Related to Unsaturated Soil Mechanics](#)

Lecture 1 - Introduction

Lecture 2 - Phases and classification of subsurface Investigation

Lecture 3 - Test Pits+ Borings

Lecture 4 - Ground water table and rock drilling

Lecture 5 - Standard Penetration Test

Lecture 6 - Cone Penetration Test

Lecture 7 - Dilatometer Test

Lecture 8 - Pressuremeter Test

Lecture 9 - Seismic reflection method

Lecture 10 - Seismic refraction method

Lecture 11 - Electrical Resistivity Survey

Lecture 12 - Magnetic Survey

Lecture 13 - Surface wave method

Lecture 14 - Gravity Survey

Lecture 15 - Offshore Investigation

Lecture 16 - Geophysical Investigation in Offshore Environment

Lecture 17 - Sampling and Geotechnical Investigations in Offshore Environment

Lecture 18 - Important Terminologies in Offshore Environment

Lecture 19 - Dynamic Testing in Pile Driving

Lecture 20 - Dynamic Testing in Pile (Low Strain)

Lecture 21 - Conclusion

- Lecture 1 - Basic Concepts of Fluid
- Lecture 2 - Properties of Fluid
- Lecture 3 - Properties of Fluid
- Lecture 4 - Concepts of Hydrostatic
- Lecture 5 - Measurement of Pressure and Hydrostatic forces
- Lecture 6 - Buoyancy, Metacentre, Stability and Rigid body motion
- Lecture 7 - Reynolds Transport Theorem
- Lecture 8 - Conservation of Mass
- Lecture 9 - Conservation of Momentum
- Lecture 10 - Conservation of Momentum Applications
- Lecture 11 - Bernoulli's Equation
- Lecture 12 - Applications of Bernoulli's Equation
- Lecture 13 - Fluid Statics Applications: Example Problems
- Lecture 14 - Conservation of Momentum: Example problems
- Lecture 15 - Bernoulli's Equation: Problems Solving on Black Board
- Lecture 16 - Lagrangian and Eulerian Descriptions
- Lecture 17 - Motion and deformation of fluid elements
- Lecture 18 - Problems Solving on Black Board
- Lecture 19 - Dimensional Homogeneity
- Lecture 20 - Dimensional Analysis and Similarity
- Lecture 21 - Laminar and Turbulent Flows
- Lecture 22 - Losses in Pipe Fittings
- Lecture 23 - Flow in Noncircular Conduits and Multiple Path Pipeflow
- Lecture 24 - Mass Conservation Equation - I
- Lecture 25 - Mass Conservation Equation - II
- Lecture 26 - Stream Function
- Lecture 27 - Cauchy's Equation
- Lecture 28 - The Navier-Stokes Equation - Part I
- Lecture 29 - The Navier-Stokes Equation - Part II
- Lecture 30 - The Navier-Stokes Equation - Part III
- Lecture 31 - Approximate solutions of Navier Stokes Equation: Boundary Layer Approximation



[Lecture 32 - Boundary Layer Approximation - II](#)

[Lecture 33 - Boundary Layer Approximation - III](#)

[Lecture 34 - Open Channel Flow - I](#)

[Lecture 35 - Open Channel Flow - II](#)

[Lecture 36 - Open Channel Flow - III](#)

[Lecture 37 - Drag and Lift](#)

Lecture 1 - Overview and Introduction

Lecture 2 - Basics of Remote Sensing

Lecture 3 - Error corrections in satellite image

Lecture 4 - Error Identification and Correction - I

Lecture 5 - Error Identification and Correction - II

Lecture 6 - Error Identification and Correction - III

Lecture 7 - DIP - I

Lecture 8 - DIP - II

Lecture 9 - DIP - III

Lecture 10 - DIP - IV

Lecture 11 - Image Classification - I

Lecture 12 - Image Classification - II

Lecture 13 - Photogrammetry

Lecture 14 - Thermal Remote Sensing

Lecture 15 - Microwave Remote Sensing

Lecture 16 - HRS - I

Lecture 17 - HRS - II

Lecture 18 - HRS - III

Lecture 19 - HRS - IV

Lecture 20 - HRS - V

Lecture 21 - GIS - I

Lecture 22 - GIS - II

Lecture 23 - Applications of Remote Sensing and GIS - I

Lecture 24 - Applications of Remote Sensing and GIS - II

- Lecture 1 - Introduction to River Engineering
- Lecture 2 - Basic properties of sediment - I
- Lecture 3 - Basic properties of sediment - II
- Lecture 4 - Mass Conservation
- Lecture 5 - Linear Momentum Equation
- Lecture 6 - Navier-Stokes Equations
- Lecture 7 - St. Venant Equation and Solver
- Lecture 8 - Specific Energy and Critical Flow
- Lecture 9 - Hydraulic Jump and Celerity
- Lecture 10 - Floodwave Celerity and Loop Rating Curve
- Lecture 11 - Sediment Transport in River - I
- Lecture 12 - Sediment Transport in River - II
- Lecture 13 - Sediment Transport in River - III
- Lecture 14 - Physical River Models
- Lecture 15 - Bridge Scour: processes and estimation
- Lecture 16 - Bridge Scour-II
- Lecture 17 - Jet Scour and River Navigation
- Lecture 18 - River Training Work
- Lecture 19 - Riverbank Stabilization - I
- Lecture 20 - Riverbank Stabilization - II
- Lecture 21 - Riverbank Protection and Control Structures
- Lecture 22 - River Equilibrium - I
- Lecture 23 - River Equilibrium - II
- Lecture 24 - River Equilibrium - III

Lecture 1 - Introduction to solid waste

Lecture 2 - Functional elements

Lecture 3 - Types and sources of solid waste

Lecture 4 - Sampling and characteristics

Lecture 5 - Estimation of solid waste quantity

Lecture 6 - Factors affecting solid waste generation rate

Lecture 7 - Handling, separation and storage at source

Lecture 8 - Processing at source

Lecture 9 - Primary collection

Lecture 10 - Types of collection system

Lecture 11 - Analysis of collection system - Part I

Lecture 12 - Analysis of collection system - Part II

Lecture 13 - Analysis of collection system - Part III

Lecture 14 - Need and types of transfer station

Lecture 15 - Transport means and methods

Lecture 16 - Unit operation for component separation

Lecture 17 - Material recovery facilities (MRF)

Lecture 18 - Recycling of dry waste components

Lecture 19 - Waste as a fuel

Lecture 20 - Incineration/Combustion

Lecture 21 - Flue gas characteristics and treatment

Lecture 22 - Solid residue generation, characterization and treatment

Lecture 23 - Waste-to-energy (WtE) plants (case studies) pyrolysis and gasification

Lecture 24 - Definition and phases of composting

Lecture 25 - Factors affecting composting process

Lecture 26 - Types of composting - I

Lecture 27 - Types of composting - II

Lecture 28 - Compost quality

Lecture 29 - Vermicomposting

Lecture 30 - Definition, stages and factors affecting anaerobic digestion

Lecture 31 - Pretreatment and co-digestion for enhancement of biogas production

[Lecture 32 - Types of biogas digesters](#)

[Lecture 33 - Site selection and types of landfill](#)

[Lecture 34 - Leachate collection and treatment](#)

[Lecture 35 - Landfill gas collection and treatment](#)

[Lecture 36 - Design of landfill and Bio-minning of old dumpsite](#)

[Lecture 37 - Construction and demolition waste](#)

[Lecture 38 - Management of bio-medical, e-waste and inert waste](#)

[Lecture 39 - Integrated solid waste management \(ISWM\)](#)

[Lecture 40 - Municipal solid waste management rules](#)

[Lecture 41 - Financing in MSWM projects](#)

[Lecture 42 - Public-Private-Partnership \(PPP\)](#)

[Lecture 43 - Public-Private-Partnership \(PPP\) in MSWM projects](#)

Lecture 1 - Planning process of equipment

Lecture 2 - Estimation of Ownership cost (Average Annual Investment method)

Lecture 3 - Estimation of Ownership cost (Time value method)

Lecture 4 - Operating cost of Equipment

Lecture 5 - Equipment cost estimation

Lecture 6 - Equipment life and replacement analysis - Part 1

Lecture 7 - Equipment life and replacement analysis - Part 2

Lecture 8 - Equipment life and replacement analysis - Part 3

Lecture 9 - Engineering Fundamentals of Moving Earth

Lecture 10 - Bull Dozers

Lecture 11 - Scrapers - Part 1

Lecture 12 - Scrapers - Part 2

Lecture 13 - Front End loaders

Lecture 14 - Excavators

Lecture 15 - Trucks

Lecture 16 - Piles and Pile driving equipment - Part 1

Lecture 17 - Piles and Pile driving equipment - Part 2

Lecture 18 - Cranes - Part 1

Lecture 19 - Cranes - Part 2

Lecture 20 - Concreting Equipment - Part 1

Lecture 21 - Concreting Equipment - Part 2

Lecture 22 - Summary

- Lecture 1 - Introduction to course content
- Lecture 2 - Stress acting at a point - Cauchy stress
- Lecture 3 - Stress acting at a point - Stress tensor
- Lecture 4 - Stress acting on a plane
- Lecture 5 - Stress acting on a plane example
- Lecture 6 - Transformation of stress tensor
- Lecture 7 - Stress invariants
- Lecture 8 - Relationship between stress invariants
- Lecture 9 - Principle stresses and Eigen vectors
- Lecture 10 - Strain in soils
- Lecture 11 - Cause effect relationship
- Lecture 12 - Important constitutive relationship
- Lecture 13 - 3D to 2D idealization
- Lecture 14 - Mathematical formulation plane stress plane strain
- Lecture 15 - Mathematical formulation axisymmetric
- Lecture 16 - Summary of Module 1
- Lecture 17 - Basics of shear strength
- Lecture 18 - Stress representation
- Lecture 19 - Shear strength granular soil - I
- Lecture 20 - Shear strength granular soil - II
- Lecture 21 - Shear strength cohesive soil
- Lecture 22 - Shear strength cohesive soil - Stress strain
- Lecture 23 - Pore water pressure and Skemptions equation
- Lecture 24 - Overall pore water pressure parameter
- Lecture 25 - Pore water pressure - plane strain-effect of sampling
- Lecture 26 - Pore water pressure estimation
- Lecture 27 - Triaxial test
- Lecture 28 - Interpretation triaxial test - UU UCS
- Lecture 29 - Interpretation triaxial test - CU
- Lecture 30 - Interpretation triaxial test - CD
- Lecture 31 - Some additional aspects of shear strength

- Lecture 32 - Summary of Module 2
- Lecture 33 - Stress path and representation
- Lecture 34 - Failure line in stress path
- Lecture 35 - Stress path-some common cases - I
- Lecture 36 - Stress path-some common cases - II
- Lecture 37 - Stress path-triaxial test-drained
- Lecture 38 - Stress path-triaxial test-undrained
- Lecture 39 - Stress path-additional undrained case
- Lecture 40 - Stress path-field cases - I
- Lecture 41 - Stress path-field cases - II
- Lecture 42 - Stress path problems
- Lecture 43 - Summary of Module 3
- Lecture 44 - Introduction-critical state soil mechanics
- Lecture 45 - Introduction-critical state soil mechanics
- Lecture 46 - CSSM-2 D representation
- Lecture 47 - Peak state
- Lecture 48 - Soil yielding
- Lecture 49 - Cam clay
- Lecture 50 - Modified Cam clay
- Lecture 51 - Prediction of soil behavior from MCCM
- Lecture 52 - Prediction of soil behavior from MCCM
- Lecture 53 - Strain from MCCM
- Lecture 54 - State boundary surface
- Lecture 55 - CSSM problems
- Lecture 56 - Summary of Module 4
- Lecture 57 - Closure of Advanced Soil Mechanics Course



Lecture 1 - Introduction, classification of plates and some useful relations

Lecture 2 - Theory of thin plate bending

Lecture 3 - Plate equations and boundary conditions with examples

Lecture 4 - Exercises on the plate bending theory

Lecture 5 - Simply supported plate subjected to distributed loading

Lecture 6 - Simply supported plate subjected to concentrated load and couple

Lecture 7 - Simply supported plate resting on elastic foundation and other examples

Lecture 8 - General formulation for rectangular plate with two opposite edges simply supported

Lecture 9 - Levy's solution for different loading and boundary conditions

Lecture 10 - Rectangular plate with Levy's boundary condition subjected to edge moment

Lecture 11 - Transformation of plate equation from rectangular co-ordinates to polar co-ordinates

Lecture 12 - Axi-symmetrical bending of circular plate under pure moment and uniformly distributed load

Lecture 13 - Examples in axisymmetrical bending of solid and annular plate

Lecture 14 - Variational principle in plate problem

Lecture 15 - Applications of Rayleigh-Ritz and Gallerkin's method

Lecture 16 - Finite difference method in plate bending

Lecture 17 - Plate subjected to inplane forces and transverse load

Lecture 18 - Buckling load of rectangular plate with Navier's boundary condition

Lecture 19 - Buckling load of rectangular with Levy's boundary condition

Lecture 20 - Rayleigh-Ritz and Gallerkin method in buckling of plate

Lecture 21 - Finite difference method in buckling of plate

Lecture 22 - Introduction to shell structure and behavior of stretched membrane

Lecture 23 - Classification of shell structure

Lecture 24 - Stress resultants and couples in shells

Lecture 25 - Membrane analysis of shells of surface of revolution

Lecture 26 - Analysis of Spherical dome

Lecture 27 - Some examples of axi-symmetrical cases in surface of revolution

Lecture 28 - Membrane theory in pressure vessels

Lecture 29 - Membrane theory in pressure vessel in the form a Torus and in a tank of arbitrary meridian

Lecture 30 - Membrane theory of hyperboloid of revolution: Application to cooling tower

Lecture 31 - Differential Equations of Equilibrium in Cylindrical shell using membrane hypothesis

[Lecture 32 - Membrane Analysis of Cylindrical Shell roof subjected to self weight and snow load](#)

[Lecture 33 - Circular Cylindrical Shell for Fourier Loading in a membrane state of stress](#)

[Lecture 34 - Simplified Bending Theory of Cylindrical Shell-Beam and Arch theories](#)

[Lecture 35 - General bending theory of cylindrical shell](#)

[Lecture 36 - Some applications of symmetrical bending of circular cylindrical shell](#)

- Lecture 1 - Introduction to Optimization
- Lecture 2 - Classical Optimization
- Lecture 3 - Introduction to Linear Problem
- Lecture 4 - General system of equations
- Lecture 5 - Simplex Method
- Lecture 6 - Solution of Linear Problem using Excel Solver
- Lecture 7 - Bracketing Method
- Lecture 8 - Region Elimination Methods
- Lecture 9 - Gradient Based Method and Examples
- Lecture 10 - Convex Function
- Lecture 11 - Line Search Methods for Multi-Variable Problems
- Lecture 12 - Quadratic Approximation Method
- Lecture 13 - Constrained Optimization I: Equality constraints
- Lecture 14 - Constrained Optimization II: Inequality constraints
- Lecture 15 - Constrained Optimization III: Penalty function methods
- Lecture 16 - Introduction to Metaheuristic Optimization
- Lecture 17 - Genetic Algorithms - Part I
- Lecture 18 - Genetic Algorithms - Part II
- Lecture 19 - Genetic Algorithms - Part III
- Lecture 20 - Real Coded Genetic Algorithms
- Lecture 21 - Multi-modal optimization
- Lecture 22 - Introduction to R
- Lecture 23 - GA using R (Unconstrained problem)
- Lecture 24 - GA using R (Constrained problem)
- Lecture 25 - Constraint Handling in GAs
- Lecture 26 - Evolution Strategies (ESs)
- Lecture 27 - Particle swarm optimization
- Lecture 28 - Introduction to R - Part II
- Lecture 29 - Multi-objective Genetic Algorithms
- Lecture 30 - Introduction to Differential Evolution
- Lecture 31 - Introduction to Matlab

[Lecture 32 - Optimization using Matlab \(Classical methods\)](#)

[Lecture 33 - A tutorial on Differential Evolution](#)

[Lecture 34 - NSGA II Using R](#)

[Lecture 35 - Optimization using MATLAB](#)

[Lecture 36 - Optimization using Excel Solver](#)

[Lecture 37 - Multi-objective Genetic Algorithms using MATLAB](#)

[Lecture 38 - Solution of a Design Problem Using MATLAB](#)

Lecture 1 - Course Contents

Lecture 2 - Preliminary Concepts

Lecture 3 - Introduction to Reynolds Transport Theorem

Lecture 4 - Derivation of Reynolds Transport Theorem - Part I

Lecture 5 - Derivation of Reynolds Transport Theorem - Part II

Lecture 6 - Conservations Laws

Lecture 7 - Numerical Examples

Lecture 8 - Summary of Module - I

Lecture 9 - Atmospheric Water

Lecture 10 - Water Vapor Dynamics

Lecture 11 - Precipitable Water in the Static Atmospheric Column

Lecture 12 - Numerical Examples on Basic Atmospheric Parameters

Lecture 13 - Precipitation-Types and Formation

Lecture 14 - Terminal Velocity

Lecture 15 - Thunderstorm Cell Model

Lecture 16 - Numerical Examples on Terminal Velocity and Thunderstorm Cell

Lecture 17 - Forms of Precipitation

Lecture 18 - Measurement of rainfall

Lecture 19 - Raingauge Network

Lecture 20 - Presentation of Rainfall Data

Lecture 21 - Analysis of Rainfall Data

Lecture 22 - Average Areal Rainfall

Lecture 23 - Evaporation

Lecture 24 - Evaporation-Energy Balance Method

Lecture 25 - Evaporation-Aerodynamic Method

Lecture 26 - Evaporation-Combined Method

Lecture 27 - Numerical Examples on Evaporation

Lecture 28 - Evaporation-Empirical method

Lecture 29 - Evapotranspiration

Lecture 30 - Evapotranspiration-Numerical Example

Lecture 31 - Summary of Module - II

Lecture 32 - Subsurface Water

Lecture 33 - 1-D Unsteady Unsaturated Flow Equation

Lecture 34 - Infiltration

Lecture 35 - Measurement of Infiltration

Lecture 36 - Estimation of Infiltration-Empirical Equations

Lecture 37 - Numerical examples - Infiltration estimation using empirical equations

Lecture 38 - Estimation of Infiltration-Theoretical Equation

Lecture 39 - Infiltration-Green Ampt Equation

Lecture 40 - Ponding time

Lecture 41 - Numerical Examples on Green Ampt Infiltration Equation

Lecture 42 - Summary of Module - III

Lecture 43 - Surface Water

Lecture 44 - Excess Rainfall and Direct Runoff

Lecture 45 - Numerical Examples on Direct Runoff

Lecture 46 - Overland flow

Lecture 47 - Streamflow Measurement - I

Lecture 48 - Streamflow Measurement - II

Lecture 49 - Representation of Streamflow

Lecture 50 - Numerical Examples on Streamflow Measurement

Lecture 51 - Summary of Module - IV

Lecture 52 - Hydrologic Analysis - Introduction

Lecture 53 - Linear System Theory

Lecture 54 - Hydrograph Analysis-UH

Lecture 55 - Hydrograph Analysis-DRH

Lecture 56 - Numerical examples on UH and DRH

Lecture 57 - S-Hydrograph

Lecture 58 - Unit Hydrograph of Different Duration

Lecture 59 - Numerical examples UH of Different Duration

Lecture 60 - Instantaneous Unit Hydrograph

Lecture 61 - Instantaneous Unit Hydrograph-Nash's Model

Lecture 62 - Numerical Examples on IUH

Lecture 63 - Synthetic Unit Hydrograph

Lecture 64 - SCS-Synthetic Unit Hydrograph

[Lecture 65 - Numerical Examples on SUH](#)

[Lecture 66 - Hydrograph Routing](#)

[Lecture 67 - Reservoir Routing](#)

[Lecture 68 - Numerical Example on Reservoir Routing](#)

[Lecture 69 - Hydrologic Channel Routing](#)

[Lecture 70 - Numerical Examples on Channel Routing](#)

[Lecture 71 - Summary of Module - V](#)

[Lecture 72 - Hydrologic Statistics-Preliminary Concepts](#)

[Lecture 73 - Probability Distribution and Basic Descriptive Statistics](#)

[Lecture 74 - Probability Distributions](#)

[Lecture 75 - Frequency Analysis](#)

[Lecture 76 - Extreme Value Analysis](#)

[Lecture 77 - Summary of Module - VI](#)

[Lecture 78 - Hydrologic Design](#)

[Lecture 79 - Numerical examples on probability and risk](#)

[Lecture 80 - Design Storm](#)

[Lecture 81 - Design Flood](#)

[Lecture 82 - Summary of Module - VII](#)

[Lecture 83 - Closure of Engineering Hydrology](#)

**NPTEL : NOC:Expansive Soil (Civil Engineering)**

**Co-ordinators : Prof. Anil Kumar Mishra**

- Lecture 1 - Formation of soil
- Lecture 2 - Index properties and classification of soil
- Lecture 3 - Engineering properties of soil - I
- Lecture 4 - Engineering properties of soil - II
- Lecture 5 - Clay mineralogy
- Lecture 6 - Properties of clay particles
- Lecture 7 - Definition, type and behaviour
- Lecture 8 - Mechanism of soil-water interaction
- Lecture 9 - Swelling of expansive soil
- Lecture 10 - Factors controlling DDL thickness
- Lecture 11 - Determination of swelling properties
- Lecture 12 - Classification and prediction
- Lecture 13 - Factors controlling swelling of soil
- Lecture 14 - Shrinkage behaviour of soil
- Lecture 15 - Factors controlling shrinkage behavior of soils
- Lecture 16 - Measurement of various shrinkage characteristics of soil
- Lecture 17 - Cyclic Swelling-Shrinkage Behaviour of Soil
- Lecture 18 - Thermo-Mechanical-Hydraulic-Chemical Behaviour - I
- Lecture 19 - Thermo-Mechanical-Hydraulic-Chemical Behaviour - II
- Lecture 20 - Thermo-Mechanical-Hydraulic-Chemical Behaviour - III
- Lecture 21 - Mechanical Methods
- Lecture 22 - Hydraulic methods
- Lecture 23 - Chemical methods - 1
- Lecture 24 - Chemical methods - 2
- Lecture 25 - By inclusion or confinement
- Lecture 26 - Foundation on expansive soil
- Lecture 27 - Use of expansive soil for various geotechnical engineering applications
- Lecture 28 - Closure lecture



- Lecture 1 - General Introduction and Modelling of Dynamic Systems
- Lecture 2 - Time Domain Analysis of Linear System - Harmonic input
- Lecture 3 - Time Domain Analysis of Linear System - Arbitrary Input
- Lecture 4 - Transformed technique in vibration of linear system
- Lecture 5 - Formulation of problem: Equilibrium Approach
- Lecture 6 - Formulation of problem by Energy Principle
- Lecture 7 - Hamilton's principles for formulating vibration problems
- Lecture 8 - Lagrange's equation for formulating vibration problems
- Lecture 9 - One Dimensional Wave Equation
- Lecture 10 - D'Alembert's Solution of the Wave Equation
- Lecture 11 - Transverse Vibration of String
- Lecture 12 - Forced Transverse Vibration of String
- Lecture 13 - Axial Vibration of Bar
- Lecture 14 - Torsional Vibration of Bar
- Lecture 15 - Some typical problems in axial and torsional vibrations
- Lecture 16 - Transverse vibration of beams
- Lecture 17 - Natural frequencies and mode shapes of beams with various end conditions
- Lecture 18 - Free damped transverse vibration analysis of beam
- Lecture 19 - Forced damped vibration analysis of Euler Bernoulli beam
- Lecture 20 - Vibration of beams subjected to moving load
- Lecture 21 - Some special topics on the transverse vibration of beam
- Lecture 22 - Combination of continuous and lumped parameter system
- Lecture 23 - State space solutions in vibration problems
- Lecture 24 - Beam with moving oscillator, pulstating force and rolling mass
- Lecture 25 - Vibration of membrane
- Lecture 26 - Vibration of Circular membrane
- Lecture 27 - Vibration of Rectangular plate
- Lecture 28 - Free vibration of rectangular plates
- Lecture 29 - Forced vibration of rectangular plates
- Lecture 30 - Approximate method for vibration analysis
- Lecture 31 - Rayleigh-Ritz method for vibration analysis

[Lecture 32 - Gallerkin's method and Finite difference method](#)

[Lecture 33 - System subjected to support excitation](#)

[Lecture 34 - Response of continuous systems to transient excitations](#)

[Lecture 35 - Shock spectrum due to half sine pulse](#)

[Lecture 36 - Numerical Evaluation of Duhamel Integral](#)

[Lecture 37 - Direct Integration Methods](#)

[Lecture 38 - Spectral Analysis of structures for earthquake excitation](#)

Lecture 1 - Introduction

Lecture 2 - Random Variable

Lecture 3 - Functions of Random Variables

Lecture 4 - Joint Distributions

Lecture 5 - Mt. Gen. Func. and CLT

Lecture 6 - Theory of Estimation

Lecture 7 - Goodness of Fit

Lecture 8 - MVFOSM

Lecture 9 - MVFOSM (Continued...)

Lecture 10 - Hasofer-Lind Rel. Index

Lecture 11 - Rackwitz's Algorithm (Continued...)

Lecture 12 - HL-RF for Non-Normal Problems

Lecture 13 - HL-RF for Correlated Problems

Lecture 14 - FORM using MATLAB

Lecture 15 - FORM using MATLAB (Continued...)

Lecture 16 - FORM Using FEM

Lecture 17 - Morgenstern Model

Lecture 18 - Nataf Model

Lecture 19 - Rosenblatt Transformation

Lecture 20 - Brietung's Model

Lecture 21 - Tvedt's Model

Lecture 22 - Monte-Carlo Simulation

Lecture 23 - Importance Sampling

Lecture 24 - Least Square Curve Fitting

Lecture 25 - Orthogonal Polynomials

Lecture 26 - RSM

Lecture 27 - Stochastic Response Surface Method

Lecture 28 - Moving Least Square Method

Lecture 29 - Adaptive-SRSM

Lecture 30 - Partial Safety Factors

Lecture 31 - Optimal Partial Safety Factors

[Lecture 32 - FORM - Revisited](#)

[Lecture 33 - Subset Simulation](#)

[Lecture 34 - Applications](#)

[Lecture 35 - Applications \(Continued...\)](#)

[Lecture 36 - Introduction to Stochastic FEM](#)

- Lecture 1 - Plate tectonics and continental drift theory
- Lecture 2 - Fault Plane Solution - Part 1
- Lecture 3 - Fault Plane Solution - Part 2
- Lecture 4 - Fault Plane Solution (Stereonet)
- Lecture 5 - Seismic gaps
- Lecture 6 - Analogy of active and inactive fault
- Lecture 7 - Seismic waves and their use in locating EQ epicentre
- Lecture 8 - EQ Intensity, magnitude and wave attenuation
- Lecture 9 - Seismic source characterization and seismic activity
- Lecture 10 - Earthquake catalogue preparation and seismic activity parameters
- Lecture 11 - Ground motion simulation models and GMPEs
- Lecture 12 - Deterministic seismic hazard analysis (DSHA)
- Lecture 13 - Probabilistic seismic hazard analysis (PSHA)
- Lecture 14 - One Dimensional equation of motion: P wave
- Lecture 15 - One Dimensional equation of motion: S wave
- Lecture 16 - Solution to 1D equation of motion: S wave
- Lecture 17 - Local Site Effect (LSE) and Ground Response Analysis - Part I
- Lecture 18 - Local Site Effect (LSE) and Ground Response Analysis - Part II
- Lecture 19 - Ground Response Analysis - Part III
- Lecture 20 - Ground Response Analysis - Part IV
- Lecture 21 - State Criteria for Liquefaction - Part 1
- Lecture 22 - State Criteria for Liquefaction - Part 2
- Lecture 23 - Initiation of Liquefaction
- Lecture 24 - Assessment of Liquefaction Potential
- Lecture 25 - Paleoliquefaction
- Lecture 26 - Seismic Microzonation
- Lecture 27 - Landslides: Introduction and classification
- Lecture 28 - Seismic vulnerability and risk - Part 1
- Lecture 29 - Seismic vulnerability and risk - Part 2
- Lecture 30 - Seismic vulnerability and risk - Part 3

- Lecture 1 - D'Alembert Principle and Degrees of Freedom
- Lecture 2 - Simple Harmonic Motion
- Lecture 3 - Examples
- Lecture 4 - Undamped Free Vibration
- Lecture 5 - Damped free vibration
- Lecture 6 - Logarithmic Decrement and Coulomb Damped Free Vibration
- Lecture 7 - Structural Damping
- Lecture 8 - Damped Forced Vibration
- Lecture 9 - Response due to Harmonic Excitation
- Lecture 10 - Response due to Harmonic Excitation (Continued...)
- Lecture 11 - Examples Set 1
- Lecture 12 - Transmissibility and Support Motion Problem
- Lecture 13 - Examples Set 2
- Lecture 14 - Impulse Response function
- Lecture 15 - Duhamel's Integral
- Lecture 16 - Response in Frequency Domain
- Lecture 17 - Response due to Periodic and Non Periodic Excitations
- Lecture 18 - Nigam and Jennings and Central Difference method
- Lecture 19 - Wilson Theta and Newmark Method
- Lecture 20 - MATLAB Examples
- Lecture 21 - Response Spectrum
- Lecture 22 - MATLAB Code Generation
- Lecture 23 - Generalized SDOF system
- Lecture 24 - Rayleigh's Method and Calculus of Variation
- Lecture 25 - Hamilton's Principle to Lagrange Equation
- Lecture 26 - D'Alembert's Principle to Lagrange Equation
- Lecture 27 - Hamilton's Canonical Form
- Lecture 28 - Natural Frequencies and Mode shapes of MDOF system
- Lecture 29 - Modal Orthogonality and Modal Decomposition
- Lecture 30 - Rayleigh Damping Model and Free Vibration
- Lecture 31 - Response Analysis in Time Domain

[Lecture 32 - Response Analysis in Frequency Domain](#)

[Lecture 33 - Response History Analysis](#)

[Lecture 34 - Response Spectrum Analysis](#)

[Lecture 35 - Model Reduction Techniques](#)

[Lecture 36 - Free Vibration of Beams](#)

[Lecture 37 - Forced Vibration of Beams](#)

[Lecture 38 - FE Modelling and Modal Analysis of a Building](#)

[Lecture 39 - Modal Superposition Analysis of a Building](#)

[Lecture 40 - Response Spectrum Analysis of a Building](#)

[Lecture 41 - Modal Analysis of a Steel Bridge](#)

**NPTEL : Advanced Hydrology (Civil Engineering)**

**Co-ordinators : Dr. Ashu Jain**

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- Lecture 1 - Introduction and course overview
- Lecture 2 - Constituents of concrete - Part 1 of 2
- Lecture 3 - Constituents of concrete - Part 2 of 2
- Lecture 4 - Admixtures in concrete – mineral and chemical
- Lecture 5 - Hydration of cement
- Lecture 6 - Basic properties of concrete
- Lecture 7 - Proportioning of concrete mixes - Part 1 of 3
- Lecture 8 - Proportioning of concrete mixes - Part 2 of 3
- Lecture 9 - Proportioning of concrete mixes - Part 3 of 3
- Lecture 10 - Pores and porosity in concrete
- Lecture 11 - Porosimetry – measuring pores in concrete
- Lecture 12 - Principles of quality control in concrete construction
- Lecture 13 - Quality control and acceptance criteria for concrete based on compressive strength
- Lecture 14 - Fibre reinforced concrete
- Lecture 15 - High strength concrete
- Lecture 16 - Mass concrete - Part 1 of 2
- Lecture 17 - Mass concrete - Part 2 of 2
- Lecture 18 - Concreting in cold weather
- Lecture 19 - Concreting in hot weather
- Lecture 20 - Roller compacted concrete
- Lecture 21 - Self-compacting concrete
- Lecture 22 - Testing self-compacting concrete
- Lecture 23 - Shotcrete and underwater concrete
- Lecture 24 - Alkali – aggregate reaction - Part 1 of 2
- Lecture 25 - Alkali – aggregate reaction - Part 2 of 2
- Lecture 26 - Reinforcement corrosion in concrete
- Lecture 27 - Chloride penetration in concrete
- Lecture 28 - Using epoxy-coated bars in concrete structures
- Lecture 29 - Using FRP as reinforcement in concrete structures - Part 1 of 2
- Lecture 30 - Using FRP as reinforcement in concrete structures - Part 2 of 2
- Lecture 31 - Grouting and importance of formwork in concrete construction

[Lecture 32 - Carbonation and freezing & thawing in concrete structures](#)

[Lecture 33 - Using recycled aggregates in concrete construction](#)

[Lecture 34 - Basic non-destructive testing for concrete structures](#)

[Lecture 35 - Measuring permeability in concrete](#)

[Lecture 36 - Some additional topics](#)

[Lecture 37 - Considerations in repair of concrete structures - Part 1 of 2](#)

[Lecture 38 - Considerations in repair of concrete structures - Part 2 of 2](#)

[Lecture 39 - Laboratory demonstration](#)

[Lecture 40 - Review of the course](#)

**NPTEL : Environmental Air Pollution (Civil Engineering)**

**Co-ordinators : Prof. Mukesh Sharma**

- Lecture 1 - Introduction to Atmosphere
- Lecture 2 - Air Pollution Systems
- Lecture 3 - Air Quality Standards
- Lecture 4 - Types and Forms of Air Pollutants
- Lecture 5 - Measurement Units and Particulate classification
- Lecture 6 - Interpretation and Particle size Distribution
- Lecture 7 - Atmospheric formation of Air Pollutants - I
- Lecture 8 - Atmospheric formation of Air Pollutants - II
- Lecture 9 - Atmospheric formation of Air Pollutants - III
- Lecture 10 - Kinetics of Air pollution and combustion processes
- Lecture 11 - Internal Combustion Engine and Air Pollution - I
- Lecture 12 - Internal Combustion Engine and Air Pollution - II
- Lecture 13 - Air Pollution and Health - I
- Lecture 14 - Air Pollution and Health - II
- Lecture 15 - Emission Inventory
- Lecture 16 - Sources of Air Pollution
- Lecture 17 - Emission from Fugitive Sources and Sulfuric Acid Production
- Lecture 18 - Aluminium Production and Air Pollution - I
- Lecture 19 - Aluminium Production and Air Pollution - II
- Lecture 20 - Coke Production and Air Pollution
- Lecture 21 - Examples for Practice
- Lecture 22 - Meteorological Measurements and their interpretation
- Lecture 23 - Examples for Practice - Dispersion Modeling
- Lecture 24 - Vertical Temperature Profile of Atmosphere
- Lecture 25 - Stability, Mixing Height and Plume Behavior - I
- Lecture 26 - Stability, Mixing Height and Plume Behavior - II
- Lecture 27 - Examples - Solar Radiation Based Stability Calculation
- Lecture 28 - Air Quality Modeling - I
- Lecture 29 - Air Quality Modeling - II
- Lecture 30 - Derivation of Gaussian Model
- Lecture 31 - Gaussian Model - Useful Formulation

[Lecture 32 - Plume rise, Area and Line Source Model](#)

[Lecture 33 - Air Quality Modeling - Maximum Ground Level concentration](#)

[Lecture 34 - Examples of Air Quality Modeling](#)

[Lecture 35 - Air Pollution Control Devices - I](#)

[Lecture 36 - Air Pollution Control Devices - II](#)

[Lecture 37 - Source Emission Monitoring](#)

[Lecture 38 - Receptor Source Modeling](#)

[Lecture 39 - Environmental laws](#)

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**NPTEL : Geotechnical Measurements and Explorations (Civil Engineering)**

**Co-ordinators : Dr. Nihar Ranjan Patra**

Lecture 1 - Geotechnical Measurements & Explorations

Lecture 2 - Geotechnical Measurements & Explorations

Lecture 3 - Geotechnical Measurements & Explorations

Lecture 4 - Geotechnical Measurements & Explorations

Lecture 5 - Geotechnical Measurements & Explorations

Lecture 6 - Geotechnical Measurements & Explorations

Lecture 7 - Geotechnical Measurements & Explorations

Lecture 8 - Geotechnical Measurements & Explorations

Lecture 9 - Geotechnical Measurements & Explorations

Lecture 10 - Geotechnical Measurements & Explorations

Lecture 11 - Geotechnical Measurements & Explorations

Lecture 12 - Geotechnical Measurements & Explorations

Lecture 13 - Geotechnical Measurements & Explorations

Lecture 14 - Geotechnical Measurements & Explorations

Lecture 15 - Geotechnical Measurements & Explorations

Lecture 16 - Geotechnical Measurements & Explorations

Lecture 17 - Geotechnical Measurements & Explorations

Lecture 18 - Geotechnical Measurements & Explorations

Lecture 19 - Geotechnical Measurements & Explorations

Lecture 20 - Geotechnical Measurements & Explorations

Lecture 21 - Geotechnical Measurements & Explorations

Lecture 22 - Geotechnical Measurements & Explorations

Lecture 23 - Geotechnical Measurements & Explorations

Lecture 24 - Geotechnical Measurements & Explorations

Lecture 25 - Geotechnical Measurements & Explorations

Lecture 26 - Geotechnical Measurements & Explorations

Lecture 27 - Geotechnical Measurements & Explorations

Lecture 28 - Geotechnical Measurements & Explorations

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[Lecture 32 - Geotechnical Measurements & Explorations](#)

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**NPTEL : Application of Soil Mechanics (Civil Engineering)**

**Co-ordinators : Dr. Nihar Ranjan Patra**

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[Lecture 35 - Aeolian Processes and Landforms - Part I](#)

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Lecture 3 - Structural Elements and Measurements

Lecture 4 - How to measure strike-dip-pitch/rake-plunge

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Lecture 15 - Role of External Parameters

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Lecture 17 - Cataclastic Deformation

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Lecture 19 - Diffusive Mass Transfer

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Lecture 22 - Linear Fabrics (Lineation)

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Lecture 30 - Stereonet Problem I: True dip from two apparent dips

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[Lecture 38 - Stereonet Problem VI - Fold geometry from interlimb angle and fold axes](#)

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Lecture 4 - Introduction to Earthquake Geology - Part IV

Lecture 5 - Fundamentals Related to Paleoseismology - Part I

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Lecture 7 - Fundamentals Related to Paleoseismology - Part III

Lecture 8 - Plate Tectonics - Part I

Lecture 9 - Plate Tectonics - Part II

Lecture 10 - Plate Tectonics - Part III

Lecture 11 - Plate tectonics - Part IV

Lecture 12 - Plate Tectonics - Part V

Lecture 13 - Seismic Zonation of India

Lecture 14 - Interior of the Earth - Part I

Lecture 15 - Interior of the Earth - Part II

Lecture 16 - Earthquake Forecasting and Prediction Model - Part I

Lecture 17 - Earthquake Forecasting and Prediction Model - Part II

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Lecture 19 - Earthquake in Interplate and Intraplate Region

Lecture 20 - Earthquake Magnitude and Intensity Scale - Part I

Lecture 21 - Earthquake Magnitude and Intensity Scale - Part II

Lecture 22 - Fundamentals Related to Active Faults - Part I

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Lecture 25 - Fundamentals Related to Active Faults - Part IV

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- [Lecture 42 - Strike-Slip Tectonic Environments and Related Landforms - Part I](#)
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- [Lecture 49 - Tectonic Geomorphology - Part I](#)
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- Lecture 2 - Concrete - A composite material
- Lecture 3 - Basic properties (Fresh concrete)
- Lecture 4 - Basic properties (Hardened concrete)
- Lecture 5 - Fundamentals of proportioning concrete mixes
- Lecture 6 - Proportioning of normal concrete mixes
- Lecture 7 - Concrete mix proportions: Analysis and adjustments
- Lecture 8 - Pores and porosity in concrete
- Lecture 9 - Admixtures in concrete
- Lecture 10 - Curing of Concrete
- Lecture 11 - Cold weather Concreting
- Lecture 12 - Hot Weather Concreting
- Lecture 13 - Special Topics I - Importance of Right Methods and Specifications
- Lecture 14 - Heat of Hydration of Cement and Thermal Stresses
- Lecture 15 - Antiwashout Underwater Concrete
- Lecture 16 - Concreting Underwater
- Lecture 17 - Roller Compacted Concrete
- Lecture 18 - Self Compacting Concrete - I
- Lecture 19 - Self Compacting Concrete - II
- Lecture 20 - Self Compacting Concrete - III
- Lecture 21 - Special Topics - Rheology
- Lecture 22 - Fibre-Reinforced Concrete - I
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- Lecture 25 - Mixing of Concrete
- Lecture 26 - Shotcrete
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Lecture 32 - Closing the Course

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- Lecture 6 - Plate Tectonics and Continental Drift - III
- Lecture 7 - Plate Tectonics and Continental Drift - IV
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- Lecture 9 - Plate Tectonics and Continental Drift - VI
- Lecture 10 - Plate Tectonics and Continental Drift - VII
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- Lecture 12 - Rock-Forming Minerals and their Properties - I
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- Lecture 14 - Rock-Forming Minerals and their Properties - III
- Lecture 15 - Igneous Rocks and their Properties - I
- Lecture 16 - Igneous Rocks and their Properties - II
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- Lecture 18 - Sedimentary Rocks and their Properties - I
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- Lecture 20 - Sedimentary Rocks and their Properties - III
- Lecture 21 - Metamorphic Rocks and their Properties - I
- Lecture 22 - Metamorphic Rocks and their Properties - II
- Lecture 23 - Seismology and Internal Structure of the earth - Part 1
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Lecture 6 - Stereoscapy

Lecture 7 - Relief Displacement

Lecture 8 - Exploring the Remote Sensing Data and GIS Software - Part 1

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Lecture 10 - Exploring the Remote Sensing Data and GIS Software - Part 3

Lecture 11 - Georeferencing of Toposheets on QGIS

Lecture 12 - Georeferencing of Remote Sensing Data on QGIS

Lecture 13 - Mosaicking, Merging and Generation of Shape Files on QGIS

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Lecture 29 - Total Station (TS) and Real Time Kinematics (RTK) and its Applications

Lecture 30 - Field Demonstration of Real Time Kinematics (RTK) - Part 1

Lecture 31 - Field Demonstration of Real Time Kinematics (RTK) - Part 2



[Lecture 32 - Field Demonstration of Total Station \(TS\) - Part 1](#)

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[Lecture 34 - Ground Penetrating Radar \(GPR\) and its Applications - Part 1](#)

[Lecture 35 - Ground Penetrating Radar \(GPR\) and its Applications - Part 2](#)

[Lecture 36 - Field Demonstration of GPR - Part 1](#)

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[Lecture 38 - Optically Stimulated Luminescence \(OSL\) Dating technique and its Applications](#)

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Lecture 2 - Soil Exploration

Lecture 3 - Soil Exploration - Penetration Tests

Lecture 4 - Soil Exploration - Geophysical Exploration

Lecture 5 - Shallow Foundation - Introduction

Lecture 6 - Shallow Foundation : Bearing Capacity - I

Lecture 7 - Shallow Foundation : Bearing Capacity - II

Lecture 8 - Shallow Foundation : Bearing Capacity - III

Lecture 9 - Shallow Foundation : Bearing Capacity - IV

Lecture 10 - Shallow Foundation : Bearing Capacity - V

Lecture 11 - Shallow Foundation - Settlement Calculation - I

Lecture 12 - Shallow Foundation - Settlement Calculation - II

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Lecture 14 - Design of Shallow Foundation

Lecture 15 - Design of Raft Foundation

Lecture 16 - Deep Foundation - Introduction

Lecture 17 - Pile Foundation - Load Carrying Capacity - I

Lecture 18 - Pile Foundation - Load Carrying Capacity - II

Lecture 19 - Pile Foundation - Load Carrying Capacity - III and Settlement Calculation

Lecture 20 - Tension and Lateral Loaded Piles

Lecture 21 - Well Foundation

Lecture 22 - Well Foundation (Continued...)

Lecture 23 - Design of Retaining Wall

Lecture 24 - Design of Retaining Wall (Continued...)

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Lecture 26 - Design of Sheet Piles (Continued...)

Lecture 27 - Design of Sheet Piles (Continued...)

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Lecture 29 - Reinforced Earth

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[Lecture 32 - Seismic Design of Retaining Walls \(Continued...\)](#)

[Lecture 33 - Soil - Foundation Interaction](#)

[Lecture 34 - Soil - Foundation Interaction \(Continued...\)](#)

[Lecture 35 - Soil - Foundation Interaction \(Continued...\)](#)

[Lecture 36 - Soil - Foundation Interaction \(Continued...\)](#)

[Lecture 37 - Soil - Foundation Interaction \(Continued...\)](#)

[Lecture 38 - Soil - Foundation Interaction \(Continued...\)](#)

[Lecture 39 - Soil - Foundation Interaction \(Continued...\)](#)

[Lecture 40 - Soil - Foundation Interaction \(Continued...\)](#)

**NPTEL : Ground Water Hydrology (Civil Engineering)**

**Co-ordinators : Dr. Anirban Dhar, Dr. V.R. Desai**

Lecture 1 - Introduction : Ground Water (GW) Utilization and Historical Background, GW in hydrologic Cycle

Lecture 2 - Ground Water in & % Hydrologic Cycle (Continued...), Ground Water Budget, Ground Water Level Fluctuations and Environmental Influence

Lecture 3 - Ground water Level Fluctuations and Environmental Influence (Continued...) Literature/Data/Internet Resources

Lecture 4 - Ground water Level Fluctuations and Environmental Influence (Continued...) Literature/Data/Internet Resources

Lecture 5 - Occurrence and Movement of Ground Water : Origin and Age of Ground Water, Rock Properties Affecting Ground Water, Ground Water Column

Lecture 6 - Zones of Aeration and Saturation; Aquifers and their characteristics/classification

Lecture 7 - Aquifer Classification (Continued...), Ground water Basins and Springs; Darcy's Law; Permeability

Lecture 8 - Determination of Permeability : Heterogeneity and Anisotropy

Lecture 9 - Ground Water (GW) flowrates and flow directions; general flow equations through porous media

Lecture 10 - General Flow Equations Through Porous Media (Continued...), Dupuit's Assumptions

Lecture 11 - 1-D Unconfined Ground water Flows; Steady Flow into Wells

Lecture 12 - Steady Flow into Wells (Continued...); Unsteady Flow into Wells

Lecture 13 - Unsteady Flow into Wells (Continued...)

Lecture 14 - Unsteady Radial Flow in Confined and Unconfined Aquifers

Lecture 15 - Unsteady Radial Flow in Leaky Aquifers (Continued...); Well Flow Near Aquifer Boundaries

Lecture 16 - Well Flow for Special Conditions; Partially Penetrating Wells; Horizontal Wells and Collector Wells; Multiple Well Systems

Lecture 17 - Well Completion; Well Development; Well Protection; Well Rehabilitation; Well testing for Yields

Lecture 18 - Well Protection/Rehabilitation/Testing for yield (Continued...); Artificial Ground Water Recharge : Concept and Methods

Lecture 19 - Concept and methods of Artificial Ground Water Recharge (Continued...); Recharge Mounds and Induced Recharge

Lecture 20 - Induced Recharge (Continued...); Wastewater recharge for reuse; Water spreading

Lecture 21 - Pollution and Quality Analysis of Ground Water : Sources of Pollution of GW-Municipal, Industrial, Agricultural and Miscellaneous

Lecture 22 - Ground Water Pollution from Industrial, Agricultural and Miscellaneous Sources (Continued...)

Lecture 23 - Ground Water Pollution from Miscellaneous Sources (Continued...), Attenuation and Underground Distribution of Pollutants

Lecture 24 - Potential Evaluation of Ground water Pollution; Physical/Chemical/Biological analysis of Ground Water quality; Criteria and measures of Ground water quality

Lecture 25 - Ground water salinity and samples ; Graphical representations of ground water quality

Lecture 26 - Graphical representations of ground water quality (Continued...), Surface/Sub-Surface Investigation Of Ground Water: Geological/geophysical exploration; Remote sensing/electrical resistivity methods

Lecture 27 - Surface Investigation of ground water (Continued...): Electrical resistivity seismic refraction/gravity/magnetic methods

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Lecture 28 - Seismic refraction/gravity/magnetic methods (Continued...);Sub-surface investigation of ground water: Geographical/resistivity methods

Lecture 29 - Sub-surface investigation of ground water (Continued...): Geographical/resistivity/spontaneous potential/radiation of methods of logging

Lecture 30 - Radiation method of logging (Continued...); Temperature/caliper/fluid conductivity/fluid velocity/miscellaneous logging methods

Lecture 31 - Saline Water Intrusion in Aquifers:Occurence, Features affecting aquifers,Bodon - Ghyben - Hergberg Principle

Lecture 32 - Saline Water Intrusion in Aquifers : Bodon - Ghyben - Hergberg principle (Continued...), Analytical Solution of Saline Water Intrusion in Coastal Aquifer

Lecture 33 - Saline Water Intrusion in Aquifers : Analytical Solution of Saline Water Intrusion in Coastal Aquifer (Continued...), Density dependent salt water intrusion model

Lecture 34 - Saline Water Intrusion in Aquifers : Geochemical Investigations, Control of salt water intrusion, Practical Modeling of salt water intrusion

Lecture 35 - Modeling and Management of Ground Water : Ground Water Simulation Models, Ground Water Management Model : Confined Aquifer

Lecture 36 - Modeling and Management of Ground Water : Ground Water Management Model : Confined and Unconfined Aquifer, Linked Simulation - Optimization, Meta Model Based Approach

Lecture 37 - Modeling and Management of Ground Water : Contaminant Source Identification , Monitoring Network Design

Lecture 38 - Modeling and Management of Ground Water : Aquifer Yield and Ground Water Availability, Effects of Ground Water Development, Regional Scale Development of Ground Water

Lecture 39 - Modeling and Management of Ground Water : Conjunctive Surface - Subsurface Modeling of Overland Flow including flow through Vadose zone

Lecture 40 - Modeling and Management of Ground Water : Ground Water - Surface Water Interaction

Lecture 1 - Introduction to Numerical Methods

Lecture 2 - Error Analysis

Lecture 3 - Introduction to Linear Systems - I

Lecture 4 - Linear Systems - II

Lecture 5 - Linear Systems - III

Lecture 6 - Linear Systems - Error Bounds

Lecture 7 - Error Bounds and Iterative Methods for Solving Linear Systems

Lecture 8 - Iterative Methods for Solving Linear Systems - I

Lecture 9 - Iterative Methods - II

Lecture 10 - Iterative Methods - III

Lecture 11 - Iterative Methods for Eigen Value Extraction

Lecture 12 - Solving Nonlinear Equations - I

Lecture 13 - Solving Nonlinear Equations - II

Lecture 14 - Solving Multi Dimensional Nonlinear Equations - I

Lecture 15 - Solving Multi Dimensional Nonlinear Equations - II

Lecture 16 - ARC Length and Gradient Based Methods

Lecture 17 - Gradient Based Methods

Lecture 18 - Conjugate Gradient Method - I

Lecture 19 - Conjugate Gradient Method - II

Lecture 20 - Nonlinear Conjugate Gradient and Introduction to PDEs

Lecture 21 - Eigenfunction Solutions for the Wave Equation

Lecture 22 - Analytical Methods for Solving the Wave Equation

Lecture 23 - Analytical Methods for Hyperbolic and Parabolic PDEs

Lecture 24 - Analytical Methods for Parabolic and Elliptic PDEs

Lecture 25 - Analytical Methods for Elliptic PDE's

Lecture 26 - Series Solutions for Elliptic PDE's and Introduction to Differential Operators

Lecture 27 - Differential Operators - I

Lecture 28 - Differential Operators - II

Lecture 29 - Differential Operators - III

Lecture 30 - Interpolation

Lecture 31 - Polynomial Fitting

[Lecture 32 - Orthogonal Polynomials - I](#)

[Lecture 33 - Orthogonal Polynomials - II](#)

[Lecture 34 - Orthogonal Polynomials - III](#)

[Lecture 35 - Spline Functions](#)

[Lecture 36 - Orthogonal Basis Functions for Solving PDE's - I](#)

[Lecture 37 - Orthogonal Basis Functions for Solving PDE's - II](#)

[Lecture 38 - Integral Equations - I](#)

[Lecture 39 - Integral Equations - II](#)

[Lecture 40 - Integral Equations - III](#)

**NPTEL : Probability Methods in Civil Engineering (Civil Engineering)**

**Co-ordinators : Dr. Rajib Maity**

- Lecture 1 - Introduction - Role of Probability in Civil Engineering
- Lecture 2 - Random Events and Probability Concept
- Lecture 3 - Set Theory and Set Operations
- Lecture 4 - Axioms of Probability
- Lecture 5 - Probability of Events
- Lecture 6 - Concept and Definition of Random Variables
- Lecture 7 - Probability Distribution of Random Variables
- Lecture 8 - CDF and Descriptors of Random Variables
- Lecture 9 - Further Descriptors of Random Variables
- Lecture 10 - Discrete Probability Distribution
- Lecture 11 - Probability Distribution of Continuous RVs
- Lecture 12 - Probability Distribution of Continuous RVs (Continued...1)
- Lecture 13 - Probability Distribution of Continuous RVs (Continued...2)
- Lecture 14 - Functions of Single Random Variables
- Lecture 15 - Functions of Random Variables - Different Methods
- Lecture 16 - Functions of Random Variables - Different Methods (Continued...)
- Lecture 17 - Expectation and Moments of Functions of RV
- Lecture 18 - Expectation and Moments of Functions of RV (Continued...)
- Lecture 19 - Joint Probability Distribution
- Lecture 20 - Marginal Probability Distribution
- Lecture 21 - Conditional Probability Distribution
- Lecture 22 - Conditional Probability Distribution (Continued...)
- Lecture 23 - Properties of Multiple Random Variables
- Lecture 24 - Properties of Multiple Random Variables (Continued...)
- Lecture 25 - MGF of Multivariate RVs and Multivariate Probability Distributions
- Lecture 26 - Multivariate Distribution and Functions of Multiple Random Variables
- Lecture 27 - Functions of Multiple Random Variables (Continued...1)
- Lecture 28 - Functions of Multiple Random Variables (Continued...2)
- Lecture 29 - Introduction to Copulas
- Lecture 30 - Introduction to Copulas (Continued...)
- Lecture 31 - Probability Models using Normal Distribution



[Lecture 32 - Probability Models using Log Normal and Exponential Distribution](#)

[Lecture 33 - Probability Models using Gamma and Extreme Value Distribution](#)

[Lecture 34 - Probability Models using Discrete Probability Distributions](#)

[Lecture 35 - Sampling Distribution and Parameter Estimation](#)

[Lecture 36 - Sampling Distribution and Parameter Estimation \(Continued...\)](#)

[Lecture 37 - Hypothesis Testing](#)

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[Lecture 39 - Regression Analyses and Correlation](#)

[Lecture 40 - Regression Analyses and Correlation \(Continued...\)](#)

Lecture 1 - Introduction - I

Lecture 2 - Materials

Lecture 3 - Different Methods of Design of Reinforced Concrete Structures

Lecture 4 - Working Stress Method

Lecture 5 - Working Stress Method (Continued...)

Lecture 6 - Limit State of Collapse Flexure - I

Lecture 7 - Limit State of Collapse Flexure - II

Lecture 8 - Design of Doubly Reinforced Beam Flexure - I

Lecture 9 - Design of Doubly Reinforced Beam Flexure - II

Lecture 10 - Design of Doubly Reinforced Beam Flexure

Lecture 11 - Limit State of Collapse Shear

Lecture 12 - Design for Shear

Lecture 13 - Design for Shear (Continued...)

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Lecture 15 - Design of Slabs - Part II

Lecture 16 - Design of Slabs - Part III

Lecture 17 - Design of Slabs - Part IV

Lecture 18 - Design of Slabs - Part V

Lecture 19 - Design of Columns - Part I

Lecture 20 - Design of Columns - Part II

Lecture 21 - Design of Columns - Part III

Lecture 22 - Design of Columns - Part IV

Lecture 23 - Design of Columns - Part V

Lecture 24 - Design of Footings - Part I

Lecture 25 - Design of Footings - Part II

Lecture 26 - Design of Staircases

Lecture 27 - Design for Torsion - Part I

Lecture 28 - Design for Torsion - Part II

Lecture 29 - Design of RC Slender Columns

Lecture 30 - Deflection of RC Beams

**NPTEL : Engineering Geology (Civil Engineering)**

**Co-ordinators : Dr. Debasis Roy**

- Lecture 1 - Introduction to Engineering Geology
- Lecture 2 - Geologic Structures
- Lecture 3 - Geologic Maps and Stratigraphic Sections
- Lecture 4 - Remote Sensing in Engineering Geology
- Lecture 5 - Physical Properties of Minerals
- Lecture 6 - Crystallography and Optical Properties
- Lecture 7 - Chemical Characteristics of Minerals
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**Co-ordinators : Dr. K.S. Reddy, Dr. Bhargab Maitra**

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**NPTEL : Finite Element Analysis (Civil Engineering)**

**Co-ordinators : Dr. B.N. Rao**

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- Lecture 59 - Porosity and pore structure - Introduction, significance of pore distribution
- Lecture 60 - Porosity and pore structure - Working of mercury intrusion porosimeter - Part 1
- Lecture 61 - Porosity and pore structure - Working of mercury intrusion porosimeter - Part 2
- Lecture 62 - Electrical Impedance analysis - Principle and different methods - Part 1
- Lecture 63 - Electrical Impedance analysis - Principle and different methods - Part 2

[Lecture 64 - Electrical Impedance analysis - Deliverables and Interpretation - Part 1](#)

[Lecture 65 - Electrical Impedance analysis - Deliverables and Interpretation - Part 2](#)

[Lecture 66 - Electrochemical testing \(Corrosion\) using Electrochemical Impedance Spectroscopy \(EIS\) - Part 1](#)

[Lecture 67 - Electrochemical testing \(Corrosion\) using Electrochemical Impedance Spectroscopy \(EIS\) - Part 2](#)

Lecture 1 - What is Civil Engineering - Part 1

Lecture 2 - What is Civil Engineering - Part 2

Lecture 3 - Structural Conservation of Built Heritage

Lecture 4 - Introduction to Environmental Engineering

Lecture 5 - Interesting Environmental Projects

Lecture 6 - Hydraulic and Water Resources Engineering

Lecture 7 - Geotechnical Engineering

Lecture 8 - Construction Materials and Methods

Lecture 9 - Infrastructure Management

Lecture 10 - Structural Engineering - 1

Lecture 11 - Structural Engineering - 2

Lecture 12 - Structural Engineering - Analysis and Design

Lecture 13 - Structural Modeling

Lecture 14 - Scope for Highway Engineers in Civil Engineering Profession - 1

Lecture 15 - Scope for Highway Engineers in Civil Engineering Profession - 2

Lecture 16 - Introduction to Civil Engineering Profession

Lecture 17 - Hydrology and Water Security

Lecture 18 - An Overview of Computational Science and Engineering

Lecture 19 - Sustainability

Lecture 20 - The Big Picture

Lecture 1 - Prologue

Lecture 2 - Corrosion of embedded metal; Significance and fundamentals of corrosion

Lecture 3 - Corrosion of embedded metal; Carbonation-induced and chloride-induced corrosion

Lecture 4 - Corrosion of embedded metal; Types of reinforcement - Bare steels

Lecture 5 - TM - Ring Test For Assessing The Quality of TMT/QST Steel Rebars

Lecture 6 - Corrosion of embedded metal; Types of reinforcement - Metallic and non metallic coated rebars

Lecture 7 - Corrosion in prestressed concrete

Lecture 8 - Deterioration of cementitious systems - Introduction, sulphate attack, biofouling and acid attack

Lecture 9 - Deterioration of cementitious systems - frost attack, freeze-thaw and alkali-silica reaction

Lecture 10 - Deterioration of cementitious systems - Shrinkage and Creep

Lecture 11 - Deterioration of cementitious systems - Fire attack, abrasion and erosion

Lecture 12 - Condition assessment of concrete structures: Exposure conditions, visual inspection, on-site Concrete testing

Lecture 13 - Condition assessment of concrete structures: Testing of concrete in laboratory

Lecture 14 - Condition assessment of concrete structures; mechanical and corrosion testing of rebars

Lecture 15 - Strategies and materials for surface repair

Lecture 16 - Strategies and materials for surface repair

Lecture 17 - Strategies and materials for surface repair

Lecture 18 - Surface preparation and protective treatment

Lecture 19 - Surface preparation and Protective treatments

Lecture 20 - Surface preparation and Protective treatments

Lecture 21 - Surface preparation and Protective treatments

Lecture 22 - Surface preparation and Protective treatments

Lecture 23 - Coatings on concrete infrastructures

Lecture 24 - Waterproofing of concrete structures - 1

Lecture 25 - Waterproofing of concrete structures - 2

Lecture 26 - Structural Strengthening and Stabilization - Load effects and Introduction to S&S

Lecture 27 - Structural Strengthening and Stabilization - Beams and Slabs

Lecture 28 - Structural Strengthening and Stabilization - Columns and Walls

Lecture 29 - Structural strengthening - 4 (Joints and connections)

Lecture 30 - Injection Grouts for concrete repair

Lecture 31 - Structural repair of prestressed concrete systems



[Lecture 32 - Case studies on structural repair \(Right methodologies and systematic approach / case studies\)](#)

[Lecture 33 - Cathodic Protection in Concrete Structures - Laboratory and field studies](#)

[Lecture 34 - Service life estimation - 1](#)

[Lecture 35 - Service life estimation - 2](#)

Lecture 1 - Mechanical Characterization of Bituminous Materials-Introduction - Part 1

Lecture 2 - Mechanical Characterization of Bituminous Materials-Introduction - Part 2

Lecture 3 - Linear Viscoelastic Response - Part 1

Lecture 4 - Linear Viscoelastic Response - Part 2

Lecture 5 - Linear Viscoelastic Response - Part 3

Lecture 6 - Linear Viscoelastic Response - Part 4

Lecture 7 - Linear Viscoelastic Response - Part 5

Lecture 8 - Small Amplitude Oscillatory Shear - Part 1

Lecture 9 - Small Amplitude Oscillatory Shear - Part 2

Lecture 10 - Small Amplitude Oscillatory Shear - Part 3

Lecture 11 - Small Amplitude Oscillatory Shear - Part 4

Lecture 12 - Time temperature superposition principle - Part 1

Lecture 13 - Time temperature superposition principle - Part 2

Lecture 14 - Master curve models

Lecture 15 - Asphalt Usage and Processing - Part 1

Lecture 16 - Asphalt Usage and Processing - Part 2

Lecture 17 - Chemical composition of bitumen - Part 1

Lecture 18 - Chemical composition of bitumen - Part 2

Lecture 19 - Chemical composition of bitumen - Part 3

Lecture 20 - Chemical composition of bitumen - Part 4

Lecture 21 - Chemical composition of bitumen - Part 5

Lecture 22 - Aging of Bituminous Binders and Mixtures - Part I

Lecture 23 - Aging of Bituminous Binders and Mixtures - Part II

Lecture 24 - Aging of Bituminous Binders and Mixtures - Part III

Lecture 25 - Dynamic Shear Rheometer - Part I

Lecture 26 - Dynamic Shear Rheometer - Part II

Lecture 27 - Viscosity Grading - Part 1

Lecture 28 - Viscosity Grading - Part 2

Lecture 29 - Performance Grading - Part 1

Lecture 30 - Performance Grading - Part 2

Lecture 31 - PG-Theoretical Basis

- Lecture 32 - Low-temperature PG
- Lecture 33 - Modifiers for Bitumen - Part 1
- Lecture 34 - Modifiers for Bitumen - Part 2
- Lecture 35 - Modifiers for Bitumen - Part 3
- Lecture 36 - Modifiers for Bitumen - Part 4
- Lecture 37 - Mixing and Compaction Temperature - Part 1
- Lecture 38 - Mixing and Compaction Temperature - Part 2
- Lecture 39 - Mixing and Compaction Temperature - Part 3
- Lecture 40 - Dynamic Modulus of Bituminous Mixtures - Part 1
- Lecture 41 - Dynamic Modulus of Bituminous Mixtures - Part 2
- Lecture 42 - Resilient Modulus of Bituminous Mixtures - Part 1
- Lecture 43 - Resilient Modulus of Bituminous Mixtures - Part 2
- Lecture 44 - Rutting Characterisation - Different approaches
- Lecture 45 - Dry Rut Wheel Testing of Bituminous Mixtures
- Lecture 46 - Laboratory investigation for rutting of bituminous mixtures - Part 1
- Lecture 47 - Laboratory investigation for rutting of bituminous mixtures - Part 2
- Lecture 48 - Fatigue of Bituminous mixtures - Part 1
- Lecture 49 - Fatigue of Bituminous mixtures - Part 2
- Lecture 50 - Fatigue of Bituminous mixtures - Part 3
- Lecture 51 - Fatigue of Bituminous mixtures - Part 4
- Lecture 52 - Fatigue of Bituminous mixtures - Part 5
- Lecture 53 - Introduction to curve fitting using Matlab - Part 1
- Lecture 54 - Introduction to curve fitting using Matlab - Part 2
- Lecture 55 - MSCR Analysis using Matlab
- Lecture 56 - Summary

Lecture 1 - Introduction and motivation

Lecture 2 - Colloidal dispersions, terminology and classification

Lecture 3 - Stability in colloids

Lecture 4 - Source, synthesis and characterisation of colloids

Lecture 5 - Characterisation of colloidal particles - I

Lecture 6 - Characterisation of colloidal particles - II

Lecture 7 - Introduction to forces acting on an individual colloidal particle

Lecture 8 - Introduction to interaction between colloidal particles

Lecture 9 - Application of Brownian force: Measurement of diffusivity and size

Lecture 10 - Radiation used to study colloidal systems

Lecture 11 - Radiation used to study colloidal systems

Lecture 12 - Molecular origin of Van der waals forces

Lecture 13 - Vanderwaal interactions between particles

Lecture 14 - Problem on scaling of Vanderwaal interactions

Lecture 15 - Calculation of Vanderwaal's forces between semi-infinite blocks and Hamaker constant - I

Lecture 16 - Calculation of Vanderwaal's forces between semi-infinite blocks and Hamaker constant - II

Lecture 17 - Theories of Vanderwaal forces based on bulk properties and calculation of Hamaker constant using bulk properties

Lecture 18 - Effect of medium on Vanderwaal's interactions - I

Lecture 19 - Effect of medium on Vanderwaal's interactions - II

Lecture 20 - Colloid Polymer mixtures

Lecture 21 - Colloid polymer mixtures: colloid-solvent interactions and colloid-polymer interactions

Lecture 22 - Colloid polymer mixtures: Depletion flocculation

Lecture 23 - Colloid polymer mixtures: Depletion stabilisation

Lecture 24 - Depletion interactions

Lecture 25 - Steric interactions/osmotic repulsion

Lecture 26 - Tutorial problem on depletion interactions

Lecture 27 - Colloidal Interactions: Introduction to electrostatic interactions/electrical double layer interactions

Lecture 28 - Introduction to models of electrical double layer: Helmholtz model/capacitor model

Lecture 29 - Review and summary of Helmholtz model (or capacitor model) of electrical double layer

Lecture 30 - Models of electrical double layer: Diffuse double layer model/Gouy-Chapman model

Lecture 31 - Potential distribution near planar surfaces: Derivation of the Poisson-Boltzmann equation

Lecture 32 - Potential distribution near planar surfaces: Solution to the linearised Poisson-Boltzmann equation

Lecture 33 - Potential distribution near spherical surfaces: Solution to linearised Poisson-Boltzmann equation

Lecture 34 - Comparison of Capacitor model and Diffuse double layer model

Lecture 35 - Models of electrical double layer: Gouy Chapman Theory - I

Lecture 36 - Models of electrical double layer: Gouy Chapman Theory - II

Lecture 37 - Structure of Electrical double layer

Lecture 38 - Force of Repulsion between interacting surfaces

Lecture 39 - Potential Energy of repulsion between Planar double layers and DLVO Theory

Lecture 40 - Zeta Potential and Electrophoretic mobility of an ion

Lecture 41 - Electrokinetic Phenomena

Lecture 42 - Relation between Electrophoretic mobility and Zeta potential - I

Lecture 43 - Relation between Electrophoretic mobility and Zeta potential - II

Lecture 44 - Colloidal particles at interfaces:Introduction

Lecture 45 - Characterization of Particles at interface

Lecture 46 - Experimental Observations -Concept of Electrostatic interactions and Stability at interfaces

Lecture 47 - Implications from Surface energy balances and Estimation of energy required for detachment

Lecture 48 - Colloidal interactions at interface

Lecture 1 - Why are polymers so common?

Lecture 2 - Polymers: Molecular structure

Lecture 3 - Process, structure, property

Lecture 4 - Biopolymers

Lecture 5 - Molecular weight and distribution

Lecture 6 - Polymerization

Lecture 7 - Macromolecular nature

Lecture 8 - Renewable sources for polymers

Lecture 9 - Polymerization/depolymerization

Lecture 10 - States of interest

Lecture 11 - Application based terms

Lecture 12 - Reuse and repurpose

Lecture 13 - Molecular conformations

Lecture 14 - Size, mobility and flexibility

Lecture 15 - Polyelectrolytes

Lecture 16 - Structures in biopolymers

Lecture 17 - Amorphous/crystalline states - 1

Lecture 18 - Amorphous/crystalline states - 2

Lecture 19 - Orientation

Lecture 20 - Interactions

Lecture 21 - Kinetics of crystallization

Lecture 22 - Glass transition - 1

Lecture 23 - Glass transition - 2

Lecture 24 - States in environment

Lecture 25 - Liquid crystalline polymers

Lecture 26 - Copolymers - 1

Lecture 27 - Copolymers - 2

Lecture 28 - Blends - 1

Lecture 29 - Blends - 2

Lecture 30 - Microstructure in polymers

Lecture 31 - Composites

- Lecture 32 - Stress strain response
- Lecture 33 - Additives for polymeric systems
- Lecture 34 - Blends/composites in recycling
- Lecture 35 - Physical/chemical crosslinking
- Lecture 36 - Mechanical properties - I
- Lecture 37 - Mechanical properties - II
- Lecture 38 - Physical and chemical aging
- Lecture 39 - Solutions: properties
- Lecture 40 - Conducting polymers
- Lecture 41 - Dielectric response - I
- Lecture 42 - Dielectric response - II
- Lecture 43 - Plasticity
- Lecture 44 - Properties of composites
- Lecture 45 - Viscoelasticity: introduction
- Lecture 46 - Thermal response
- Lecture 47 - Viscoelasticity: characterization
- Lecture 48 - Viscoelasticity: simple models
- Lecture 49 - Dynamic Mechanical analysis
- Lecture 50 - Damping Applications
- Lecture 51 - Time Temperature superposition
- Lecture 52 - Impact and energy absorption
- Lecture 53 - Testing for applications
- Lecture 54 - Properties of blends
- Lecture 55 - Biomimetic polymers
- Lecture 56 - Advanced mechanics
- Lecture 57 - Viscoelastic response: examples
- Lecture 58 - Polymer packaging
- Lecture 59 - Porous polymers/membranes
- Lecture 60 - Polymer at interfaces
- Lecture 61 - Diffusion in polymers
- Lecture 62 - Compatibilizers
- Lecture 63 - Biopolymer applications
- Lecture 64 - Adhesives and Paints

[Lecture 65 - Dissolution and recovery](#)

[Lecture 66 - Polymerization kinetics](#)

[Lecture 67 - Polymerization reactors](#)

[Lecture 68 - Polymer processing - I](#)

[Lecture 69 - Polymer processing - II](#)

[Lecture 70 - Polymer processing - III](#)

[Lecture 71 - Flow simulations](#)

[Lecture 72 - Processing for recycling](#)

[Lecture 73 - Recycle, up-down cycling - I](#)

[Lecture 74 - Recycle, up-down cycling - II](#)

[Lecture 75 - Flow behaviour - rheology](#)

[Lecture 76 - Crosslinking](#)

[Lecture 77 - Conversion of polymers](#)

[Lecture 78 - Rheology and entanglement](#)

[Lecture 79 - Rheological models](#)

[Lecture 80 - Rheology and processing](#)

[Lecture 81 - Absorption and leaching](#)

[Lecture 82 - Swelling of polymers](#)

[Lecture 83 - Viscosity for polymer processing](#)

[Lecture 84 - Microplastics, aerosols, sediments](#)

[Lecture 85 - Biodegradation of polymers](#)

[Lecture 86 - Biodegradable polymers - 1](#)

[Lecture 87 - Biodegradable polymers - 2](#)



Lecture 1 - Introduction to Construction Materials - Part 1

Lecture 2 - Introduction to Construction Materials - Part 2

Lecture 3 - Introduction to Construction Materials - Part 3

Lecture 4 - Materials Engineering Concepts - Part 1

Lecture 5 - Materials Engineering Concepts - Part 2

Lecture 6 - Materials Engineering Concepts - Part 3

Lecture 7 - Materials Engineering Concepts - Part 4

Lecture 8 - Materials Engineering Concepts - Part 5

Lecture 9 - Materials Engineering Concepts - Part 6

Lecture 10 - Materials Engineering Concepts - Part 7

Lecture 11 - Nature of Materials - Part 1

Lecture 12 - Nature of Materials - Part 2

Lecture 13 - Nature of Materials - Part 3

Lecture 14 - Nature of Materials - Part 5

Lecture 15 - Nature of Materials - Part 6

Lecture 16 - Nature of Materials - Part 6

Lecture 17 - Nature of Materials - Part 7

Lecture 18 - Stone, Brick and Mortar 1 - Part 1

Lecture 19 - Stone, Brick and Mortar 1 - Part 2

Lecture 20 - Stone, Brick and Mortar 1 - Part 3

Lecture 21 - Stone, Brick and Mortar 1 - Part 4

Lecture 22 - Stone, Brick and Mortar 2 - Part 1

Lecture 23 - Stone, Brick and Mortar 2 - Part 2

Lecture 24 - Cement and Concrete 1 - Part 1

Lecture 25 - Cement and Concrete 1 - Part 2

Lecture 26 - Cement and Concrete 1 - Part 3

Lecture 27 - Cement and Concrete 2 - Part 1

Lecture 28 - Cement and Concrete 2 - Part 2

Lecture 29 - Cement and Concrete 3 - Part 1

Lecture 30 - Cement and Concrete 3 - Part 2

Lecture 31 - Cement and Concrete 4 - Part 1

[Lecture 32 - Cement and Concrete 4 - Part 2](#)

[Lecture 33 - Metals - 1 - Part 1](#)

[Lecture 34 - Metals - 1 - Part 2](#)

[Lecture 35 - Metals - 2 - Part 1](#)

[Lecture 36 - Metals - 2 - Part 2](#)

[Lecture 37 - Metals - 3 - Part 1](#)

[Lecture 38 - Metals - 3 - Part 2](#)

[Lecture 39 - Metals - 4](#)

[Lecture 40 - Metals - 5 - Part 1](#)

[Lecture 41 - Metals - 5 - Part 2](#)

[Lecture 42 - Polymers and Composites - Part 1](#)

[Lecture 43 - Polymers and Composites - Part 2](#)

[Lecture 44 - Polymers and Composites - Part 3](#)

[Lecture 45 - Pavement Materials 1 - Part 1](#)

[Lecture 46 - Pavement Materials 1 - Part 2](#)

[Lecture 47 - Pavement Materials 2 - Part 1](#)

[Lecture 48 - Pavement Materials 2 - Part 2](#)

[Lecture 49 - Wood and wood products - Part 1](#)

[Lecture 50 - Wood and wood products - Part 2](#)

[Lecture 51 - Glass](#)

**NPTEL : NOC:Introduction to Lean Construction (Civil Engineering)**

**Co-ordinators : Prof. Koshy Varghese, Prof. N Raghavan**

- Lecture 1 - Course Contents, Long-term Goals, Structure and Module 1 Topics
- Lecture 2 - Pedagogy, Approach, Institutions, Instructors, Audience and Pre-requisites
- Lecture 3 - ILCE, Conferences, Resources, Further Work Possible
- Lecture 4 - Lean Implementation in India from ILCE Directors and other Talks/Testimonials
- Lecture 5 - Status of Lean Implementation in India through Industry Panel Discussion with ILCE Directors
- Lecture 6 - History of Lean and other Management Philosophies; Toyota Production System (TPS); What is Lean?
- Lecture 7 - Lean Construction Timeline; Lean Project Delivery vs LC; Project Management vs LC
- Lecture 8 - Key Lean Concepts#1 (Wastes)
- Lecture 9 - Key Lean Concepts#1 (Value, Value Stream, Flow, Pull, Perfection)
- Lecture 10 - Key Lean Concepts#2 (Continuous Improvement, Collaborative working, Production System, Lean Culture)
- Lecture 11 - Key Lean Tools#1 (Productivity Measurement System, Work Sampling, Value Stream Mapping)
- Lecture 12 - Lean Overview - Key Lean Tools#2 (5S, CPS/ LPS, Big Room Approach)
- Lecture 13 - Lean Overview - Future module
- Lecture 14 - Productivity Measurement and Improvement, Construction Productivity, Productivity levels
- Lecture 15 - What is Productivity, Production?; Illustration
- Lecture 16 - Productivity and Production Impact; Visualizing Activity Productivity and Production Performance
- Lecture 17 - Profit, ROCE, Influences on Operational Productivity; Operational view vs. System view, Summary
- Lecture 18 - Outline, Planning and monitoring levels; Productivity Measurement System
- Lecture 19 - Measuring Output - Level of Effort (LOE)
- Lecture 20 - Productivity and Production Calculations: daily, weekly, cumulative
- Lecture 21 - Productivity and Production Calculations: Performance Evaluation
- Lecture 22 - Productivity and Production Calculations: Workhour Forecast and Analysis of Trends
- Lecture 23 - Factors Influencing Productivity, Productivity Improvement Approach, Summary
- Lecture 24 - Sampling/ Surveying Techniques - Data Sources in Construction
- Lecture 25 - Construction Activity with Workers doing VA/ NVAN/ NVA; WS vs PMS; Work Sampling
- Lecture 26 - Sampling basics, Sampling in construction
- Lecture 27 - Steps to Conduct a Work Sampling Study; WS Outcomes
- Lecture 28 - Illustration of Tour-based Work Sampling Approach
- Lecture 29 - Illustration of Crew-based Work Sampling Approach
- Lecture 30 - Explore relationship between WS Categories and Productivity; Summary
- Lecture 31 - Sampling/ Surveying Techniques - Foreman delay survey

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- Lecture 32 - Sampling/ Surveying Techniques - Foreman delay survey - Implementation
- Lecture 33 - Foreman delay survey - Illustrations; Comparison - PMS vs WS vs FDS - discussion
- Lecture 34 - Value Stream, Value Stream Mapping (VSM), System vs Process, References
- Lecture 35 - Illustration: Value and Value Stream in Food Delivery
- Lecture 36 - Value, Value Stream, VSM/PM, Language, Basic VSM - current state and future state
- Lecture 37 - Key steps for VSM, Work: Degrees of Granularity, Measurement Metrics
- Lecture 38 - VSM - Example 1 (Reinforcement)
- Lecture 39 - VSM - Example 2 (Blockwork); Summary
- Lecture 40 - Flow Process Chart, Symbols, Process mapping - steps and timing, Measurement metrics
- Lecture 41 - Process mapping - Illustration: Reinforcement shifting
- Lecture 42 - VSM vs PM; Process Flow chart - variations; Swim-lane diagrams; Summary
- Lecture 43 - Understand the Basics of 5S, Explanations and 5S Steps
- Lecture 44 - Understand Each -S- in Detail - Sort, Set in Order, Shine
- Lecture 45 - Understand Each -S- in Detail - Standardize, Sustain
- Lecture 46 - 5S: Key Points, Benefits, Signs of a 5S Site
- Lecture 47 - Experiment 5S with Yourself First, Project Implementation, Facilitations, Why 5S May Fail?, Recap
- Lecture 48 - Understand the Applications of 5S through Case Studies\_2 cases
- Lecture 49 - Understand the Applications of 5S through Case Studies\_3 cases
- Lecture 50 - Understand the Applications of 5S through Case Study - Ms Diamond Barretto (Godrej Construction)
- Lecture 51 - Current Project Performance, Workflow Variation, Traditional PM vs Lean Production Management
- Lecture 52 - Some Key Lean Concepts, Focusing on frontline Execution, CPS - Collaborative Planning System
- Lecture 53 - CPS Process, Overall Schedules (Master Schedule,Phase Schedule,LAP, Weekly Plan),Constraint Analysis
- Lecture 54 - Collaborative -Pull- Planning, Percentage Plan Completed (PPC), Daily Huddle, Variance Analysis, RCA
- Lecture 55 - Lean Work Structuring
- Lecture 56 - Impact of PPC on Productivity, Key aspects,Advantages,The Necessary Conditions,Blocks - CPS,Summary
- Lecture 57 - COLPLASSE: Look-Ahead Plan, Constraint Analysis, Weekly Plan, Summary
- Lecture 58 - Lean Project Delivery System, Conclusion
- Lecture 59 - Understand the Applications of CPS/LPS through Case Studies
- Lecture 60 - CPS/LPS implementation in Construction Projects through a Panel of Experts - Part 1
- Lecture 61 - CPS/LPS implementation in Construction Projects through a Panel of Experts - Part 2
- Lecture 62 - CPS/LPS implementation in Construction Projects through a Panel of Experts - Part 3
- Lecture 63 - Introduction of Big Room Approach, Some Requirements for Efficient Working, Virtual BR Meetings
- Lecture 64 - Big Room Approach through Case Studies

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[Lecture 65 - Big Room Approach - Implementation case from URC Construction](#)

[Lecture 66 - Future Construction Site, Lean Tools and Processes, Automation strategies and impact, Programming](#)

[Lecture 67 - Document Management, Workflow Process, Communication/Collab./Authen., Sensing](#)

[Lecture 68 - Mechanisation/ Robots, Visualization, AI/ Analytics, BIM, CPS/ IOT/ Industry 4.0, Digital Twin](#)

[Lecture 69 - Challenges and Causes, Problem?, Lean, BIM?, Traditional vs BIM, Tools/Technology providers](#)

[Lecture 70 - BIM uses; Metrics](#)

[Lecture 71 - BIM and Lean, Implementation Framework, BIM Execution Plan, Evidence Cases, Key takeaway](#)

[Lecture 72 - How to Start Practicing Lean Tools in Project Sites-1: Work Sampling](#)

[Lecture 73 - How to Start Practicing Lean Tools in Project Sites-1: VSM](#)

[Lecture 74 - How to Start Practicing Lean Tools in Project Sites-1: 5S](#)

[Lecture 75 - How to Start Practicing Lean Tools in Project Sites-1: CPS/ LPS](#)

[Lecture 76 - How to Start Practicing Lean Tools in Project Sites-1: Big Room Approach](#)

[Lecture 77 - Acknowledgement](#)

Lecture 1 - Bolts: dimensions and material

Lecture 2 - Bolts: installation techniques and clearances

Lecture 3 - Design of Bearing type bolts in shear: Basic design principle

Lecture 4 - Correction factors for bolts for long joints, long grip lengths, and thick packing plate

Lecture 5 - Design of friction grip bolts in shear and design of bolts in tension

Lecture 6 - Structural Welding Process

Lecture 7 - Groove/Butt Welds

Lecture 8 - Fillet Welds - 1

Lecture 9 - Fillet Welds - 2

Lecture 10 - Weld symbols, defects, and filler material

Lecture 11 - Design of groove welds

Lecture 12 - Design of fillet welds - 1

Lecture 13 - Design of fillet welds - 2

Lecture 14 - Design example of a bolt group

Lecture 15 - Design example of a weld group

Lecture 16 - Simple and rigid frame connections

Lecture 17 - Design of double angle connections

Lecture 18 - Design of seated angle connections

Lecture 19 - End-plate rigid connection: Introduction

Lecture 20 - End-plate connection: Design example

Lecture 21 - Welded-flange rigid connection

Lecture 22 - Ductile detailed beam-column connections - 1

Lecture 23 - Ductile detailed beam-column connections - 2

Lecture 1 - Pavement Cross-sections and Pavement Design Process

Lecture 2 - Pavement Design Factors - I

Lecture 3 - Pavement Design Factors - II

Lecture 4 - Stresses and Strains in Bituminous Pavements - I

Lecture 5 - Stresses and Strains in Bituminous Pavements - II

Lecture 6 - Numerical Problems in One-layer Theory

Lecture 7 - Numerical Problems in Two-layer Theory

Lecture 8 - Introduction to KENLAYER

Lecture 9 - KENLAYER - 1

Lecture 10 - KENLAYER - 2

Lecture 11 - KENLAYER - 3

Lecture 12 - KENLAYER - 4

Lecture 13 - Traffic Analysis - ESWL - Part 1

Lecture 14 - Traffic Analysis - ESWL - Part 2

Lecture 15 - Traffic Analysis - EALF

Lecture 16 - Traffic Analysis - ESAL using VDF

Lecture 17 - Traffic Analysis - ESAL using TF

Lecture 18 - Traffic Analysis - Examples

Lecture 19 - Traffic Analysis - Load Spectra Factor

Lecture 20 - Modulus for Design - CBR

Lecture 21 - Modulus for Design - Resilient modulus (Granular material)

Lecture 22 - Modulus for Design - Resilient modulus (Bituminous material)

Lecture 23 - Modulus for Design - Dynamic Modulus

Lecture 24 - Environmental Effect - Part 1

Lecture 25 - Environmental Effect - Part 2

Lecture 26 - Environmental Effect - Part 3

Lecture 27 - Environmental Effect - Part 4

Lecture 28 - Enhanced Integrated Climatic Model - Part 1

Lecture 29 - Enhanced Integrated Climatic Model - Part 2

Lecture 30 - Climate Consideration in Design Procedures

Lecture 31 - Reliability in Pavement Design - Part 1

- Lecture 32 - Reliability in Pavement Design - Part 2
- Lecture 33 - Reliability in Pavement Design - Part 3
- Lecture 34 - Reliability in Pavement Design - Part 4
- Lecture 35 - Reliability in Pavement Design - Part 5
- Lecture 36 - Reliability in Pavement Design - Part 6
- Lecture 37 - Distress Transfer Function - Fatigue Cracking
- Lecture 38 - Rutting and Low-Temperature Cracking
- Lecture 39 - KENLAYER - Nonlinear Analysis
- Lecture 40 - KENLAYER - Damage Analysis
- Lecture 41 - IRC design steps
- Lecture 42 - Design Input and IITPAVE software
- Lecture 43 - Pavement design with granular base
- Lecture 44 - Pavement design with CTB
- Lecture 45 - Pavement design with RAP Base
- Lecture 46 - Overview of Mechanistic-Empirical Pavement Design Methods - IRC
- Lecture 47 - Overview of Mechanistic-Empirical Pavement Design Methods - South Africa - Part I
- Lecture 48 - Overview of Mechanistic-Empirical Pavement Design Methods - South Africa - Part II
- Lecture 49 - Overview of Mechanistic-Empirical Pavement Design Methods - South Africa - Part III
- Lecture 50 - Overview of Mechanistic-Empirical Pavement Design Methods - Australia - Part I
- Lecture 51 - Overview of Mechanistic-Empirical Pavement Design Methods - Australia - Part II
- Lecture 52 - Overview of Mechanistic-Empirical Pavement Design Methods - AASHTO - Part I
- Lecture 53 - Overview of Mechanistic-Empirical Pavement Design Methods - AASHTO - Part II
- Lecture 54 - Summary of the course and design projects



- Lecture 1 - Introductory lecture and course outline
- Lecture 2 - Matrix algebra and Gauss elimination method
- Lecture 3 - Development of equilibrium equations for 1-d systems
- Lecture 4 - Development of equilibrium equations for 2-d bar elements and truss structures
- Lecture 5 - Development of equilibrium equations for beam elements
- Lecture 6 - Virtual work and principle of stationary potential energy
- Lecture 7 - Introduction to Rayleigh-Ritz Method
- Lecture 8 - Use of GEOFEM finite element program - Part I
- Lecture 9 - Use of GEOFEM finite element program - Part II
- Lecture 10 - Stresses and strains in continuum
- Lecture 11 - 2-dimensional approximations of continuum
- Lecture 12 - Analysis of continuum systems
- Lecture 13 - 3-node Constant Strain Triangle
- Lecture 14 - Classical methods for developing shape functions
- Lecture 15 - Numerical integration techniques
- Lecture 16 - Isoparametric Elements - Part I
- Lecture 17 - Isoparametric Elements - Part II
- Lecture 18 - Isoparametric calculations for stiffness and load vectors
- Lecture 19 - Force vector due to surface traction
- Lecture 20 - Patch test and Finite Element Modelling
- Lecture 21 - GEOFEM - Part III
- Lecture 22 - In situ earth pressures, construction and excavation sequences
- Lecture 23 - Joint and interface element modelling
- Lecture 24 - Modelling of interfaces - Joint Elements
- Lecture 25 - Mapped infinite elements for semi-infinite soil medium
- Lecture 26 - Some observations of soil behaviour and stress invariants
- Lecture 27 - Nonlinear analysis technique - 1
- Lecture 28 - Nonlinear analysis technique - 2
- Lecture 29 - Nonlinear analysis technique - 3
- Lecture 30 - Bilinear elastic models
- Lecture 31 - Nonlinear elastic and hyperbolic models

[Lecture 32 - Modified hyperbolic model and determination of material parameters](#)

[Lecture 33 - Stress correction procedures in finite element analysis](#)

[Lecture 34 - Numerical examples on working with modified hyperbolic models](#)

[Lecture 35 - Some Limit solutions in geotechnical engineering](#)

[Lecture 36 - Elastic - Plastic Constitutive Matrix](#)

[Lecture 37 - Nonassociated Elastic - Plastic Joint Element](#)

[Lecture 38 - Introduction to consolidation and dynamic analysis](#)

[Lecture 39 - Cam Clay models](#)

[Lecture 40 - Modified cam clay models](#)

[Lecture 41 - FEM in Geotechnical applications](#)

[Lecture 42 - Soil behaviour and An Introduction to the Existing Soil Models](#)

[Lecture 43 - Simulation of soil liquefaction using FLAC](#)

[Lecture 44 - Mitigation of soil liquefaction using granular columns](#)

Lecture 1 - Course Structure

Lecture 2 - Introduction to Google Earth

Lecture 3 - How Does Earth Science Work ?

Lecture 4 - What is a Mineral

Lecture 5 - Minerals and Rock Cycle

Lecture 6 - Continental Drift

Lecture 7 - Plate Tectonics

Lecture 8 - What are Igneous Rocks ?

Lecture 9 - Compositional Variation of Igneous Rocks

Lecture 10 - Why Does the Rock Melt ?

Lecture 11 - Igneous Activity and Plate Tectonics

Lecture 12 - Igneous Structures

Lecture 13 - Volcanoes

Lecture 14 - Discussion on Posted Questions

Lecture 15 - What are Metamorphic Rocks

Lecture 16 - Types of Metamorphism

Lecture 17 - Metamorphism and Plate Tectonics

Lecture 18 - Weathering and Erosion

Lecture 19 - Detrital Sedimentary Rocks

Lecture 20 - Chemical and Organic Sedimentary Rocks

Lecture 21 - Sedimentary Environment and Plate Tectonics

Lecture 22 - Discussion on Conceptual Questions

Lecture 23 - Discussion on Posted Questions

Lecture 24 - Diversity of Life

Lecture 25 - Why Do Groups Change ?

Lecture 26 - Nature of Paleontological Data

Lecture 27 - Introduction to PaleoDB

Lecture 28 - Relative Age

Lecture 29 - Correlation

Lecture 30 - Attempts to Estimate Absolute Age

Lecture 31 - Radiometric Dating

- Lecture 32 - Rocks Full of Life
- Lecture 33 - Discussion on Posted Questions\_3
- Lecture 34 - The Beginning
- Lecture 35 - The Formation of the Planets and Moon
- Lecture 36 - The Formation of the Continents
- Lecture 37 - The Formation of the Atmosphere and Ocean
- Lecture 38 - Origin of Life: Initial Ideas
- Lecture 39 - Origin of Life: Which Biomolecules Came First ?
- Lecture 40 - Origin of Life: Where did it all Start ?
- Lecture 41 - Evidence of Early Life
- Lecture 42 - Proterozoic Events and Life
- Lecture 43 - Discussion on Posted Questions\_4
- Lecture 44 - Cambrian Earth and Life
- Lecture 45 - Cambrian Explosion
- Lecture 46 - Journey to Land: Fishes and Tetrapods
- Lecture 47 - Journey to Land: Transitional Forms
- Lecture 48 - Appearance of Amniotes
- Lecture 49 - Dinosaurs
- Lecture 50 - Dinosaurs Footprints
- Lecture 51 - Appearance of Feathers
- Lecture 52 - Mass Extinctions and Their Impact
- Lecture 53 - K-Pg Extinction: Patterns
- Lecture 54 - K-Pg Extinction: Mechanisms
- Lecture 55 - Paleoclimatic Reconstruction
- Lecture 56 - Cenozoic Climate
- Lecture 57 - Recovery from K-Pg: Paleogene Event
- Lecture 58 - Who are Whales ?
- Lecture 59 - Discussion on Posted Questions\_5
- Lecture 60 - Development of Bipedality
- Lecture 61 - Early Hominids
- Lecture 62 - Megafaunal Extinction
- Lecture 63 - Recent Extinctions
- Lecture 64 - Anthropocene and Future



- Lecture 1 - Introduction-Overview of RCC - Part 1
- Lecture 2 - Introduction-Overview of RCC - Part 2
- Lecture 3 - Introduction to Design Concepts and Philosophies - Part 1
- Lecture 4 - Introduction to Design Concepts and Philosophies - Part 2
- Lecture 5 - Materials Short Term Properties - Part 1
- Lecture 6 - Materials Short Term Properties - Part 2
- Lecture 7 - Materials Short Term Properties - Part 3
- Lecture 8 - Materials Short Term Properties - Part 4
- Lecture 9 - Materials Long Term Properties - Part 1
- Lecture 10 - Materials Long Term Properties - Part 2
- Lecture 11 - Materials Rebar Properties
- Lecture 12 - Durability - Overview
- Lecture 13 - Durability - Effect of Chemical actions
- Lecture 14 - Durability - Effect of Physical,mechanical and corrosion
- Lecture 15 - Durability - Design approaches and code provisions
- Lecture 16 - Axial Behaviour - Introduction
- Lecture 17 - Axial Behaviour of Reinforced Concrete
- Lecture 18 - Axial Behaviour - Effect of Compressive Strength
- Lecture 19 - Flexure Behaviour - Background to flexural theory
- Lecture 20 - Flexure Behaviour - Moment curvature analysis-procedure
- Lecture 21 - Flexure Behaviour - Example-Moment curvature of singly reinforced section
- Lecture 22 - Flexure Behaviour - Effect of increasing reinforcement on Moment curvature behaviour
- Lecture 23 - Flexure Behaviour - Effect of compressive strength on Moment curvature  $\bar{M}$ , behaviour
- Lecture 24 - Flexure Behaviour - Effect of axial Compression on Moment curvature behaviour - Part 1
- Lecture 25 - Flexure Behaviour - Effect of axial Compression on Moment curvature behaviour - Part 2
- Lecture 26 - Flexure Behaviour - Effect of Compression steel on Moment curvature behaviour - Part 1
- Lecture 27 - Flexure Behaviour - Effect of Compression steel on Moment curvature behaviour - Part 2
- Lecture 28 - Flexure Behaviour - Analysis and Design of Singly Reinforced Sections using IS Code - Part 1
- Lecture 29 - Flexure Behaviour - Analysis and Design of Singly Reinforced Sections using IS Code - Part 2
- Lecture 30 - Flexure Behaviour - Examples in Flexure using IS Code Provisions
- Lecture 31 - Flexure Behaviour - Analysis and Design of Doubly Reinforced Sections using IS Code

- Lecture 32 - Flexure Behaviour - Analysis and Design of Flanged Sections using IS $\ddot{A}$ , Code $\ddot{A}$ , Provisions
- Lecture 33 - Shear Behaviour of RC elements - Part 1
- Lecture 34 - Shear Behaviour of RC elements - Part 2
- Lecture 35 - Shear Behaviour of RC elements - Part 3
- Lecture 36 - Shear Behaviour - Shear Design using IS 456 Provisions
- Lecture 37 - Shear Behaviour - Examples for Shear Design using IS 456 Provisions
- Lecture 38 - Shear Behaviour - Torsional Behaviour of RC elements - Part 1
- Lecture 39 - Shear Behaviour - Torsional Behaviour of RC elements - Part 2
- Lecture 40 - Shear Behaviour - Torsional Behaviour of RC elements - Part 3
- Lecture 41 - Shear Behaviour - Torsion Design of RC Beams using IS 456 Provisions
- Lecture 42 - Compression behaviour of RC Columns - Intro and Types - Part 1
- Lecture 43 - Compression behaviour of RC Columns - Short vs Slender and Effective length - Part 2
- Lecture 44 - Compression behaviour of RC Columns - Lateral Flexibility and Example - Part 3
- Lecture 45 - Compression behaviour of RC Columns IS Code Provisions - Part 1
- Lecture 46 - Compression behaviour of RC Columns Confinement and Tied Vs Spiral Confined Columns - Part 2
- Lecture 47 - Compression behaviour of RC Columns - P-M Interaction : Theory
- Lecture 48 - Compression behaviour of RC Columns - P-M Interaction : Example as per IS 456
- Lecture 49 - Compression behaviour of Design of RC Columns for Biaxial Bending - Part 1
- Lecture 50 - Compression behaviour of Design of RC Columns for Biaxial Bending - Part 2
- Lecture 51 - Compression behaviour of Slender Column Design: Theory - Part 1
- Lecture 52 - Compression behaviour of Slender Column Design: Example as per IS 456 - Part 2
- Lecture 53 - Serviceability - Introduction to Deflection of RC Beam Part - 1
- Lecture 54 - Serviceability - Introduction to Deflection of RC Beam Part - 2
- Lecture 55 - Serviceability - Long term deflection and IS code Provisions
- Lecture 56 - Serviceability - Numerical Example for the calculation of Deflection of RC beam
- Lecture 57 - Crack width calculation - Theory - Part 1
- Lecture 58 - Crack width Calculation - Example - Part 2
- Lecture 59 - Serviceability - Design for Bond - Theory - Part 1
- Lecture 60 - Serviceability - Design for Bond - Theory - Part 2
- Lecture 61 - Serviceability - Design example for Bond and Splicing - Part 3
- Lecture 62 - Two way slabs - Background
- Lecture 63 - Two way slabs - Design Methods
- Lecture 64 - Two way slabs - Direct Design Method - Part 1

[Lecture 65 - Two way slabs - Direct Design Method - Part 2](#)

[Lecture 66 - Two way slabs - Equivalent Frame Method - Part 1](#)

[Lecture 67 - Two way slabs - Equivalent Frame Method \(Example\) - Part 2](#)



Lecture 1 - Overview of Cement Chemistry and concrete performance: Cement history and production

Lecture 2 - Overview of Cement Chemistry and concrete performance: Quality control and composition

Lecture 3 - Overview of Cement Chemistry: Composition of Cement and Classification of Cement

Lecture 4 - Overview of Cement Chemistry: Hydration of Cement

Lecture 5 - Overview of Concrete Performance: Curing and Hardened Concrete

Lecture 6 - Overview of Concrete Performance: Basics of Hardened Concrete

Lecture 7 - Chemical Admixtures: Introduction

Lecture 8 - Chemical Admixtures: Water reducers - Part 1

Lecture 9 - Chemical Admixtures: Water reducers - Part 2

Lecture 10 - Chemical Admixtures: Water reducers - Part 3

Lecture 11 - Chemical Admixtures: Water reducers - Part 4

Lecture 12 - Chemical Admixtures: Water reducers - Part 5

Lecture 13 - Chemical Admixtures: Water reducers - Part 6

Lecture 14 - Chemical Admixtures: Set controllers

Lecture 15 - Chemical Admixtures: Set controllers - Accelerators

Lecture 16 - Chemical Admixtures: Set controllers - Retarders

Lecture 17 - Chemical Admixtures: Standards

Lecture 18 - Chemical Admixtures: Air entrainers - Part 1

Lecture 19 - Chemical Admixtures: Air entrainers - Part 2

Lecture 20 - Chemical Admixtures: Understanding Concrete Rheology - Part 1

Lecture 21 - Chemical Admixtures: Understanding Concrete Rheology - Part 2

Lecture 22 - Chemical Admixtures: Viscosity Modifying Agents (VMA)

Lecture 23 - Chemical Admixtures: Mechanism of corrosion

Lecture 24 - Chemical Admixtures: Corrosion inhibitors, Shrinkage reducing admixtures

Lecture 25 - Chemical Admixtures: Other specialty admixtures

Lecture 26 - Chemical Admixtures: Curing compounds

Lecture 27 - Mineral Admixtures: Introduction

Lecture 28 - Mineral Admixtures: Types, Composition and Particle size distribution

Lecture 29 - Mineral Admixtures: Microstructure of SCMs and Pozzolonic reactions

Lecture 30 - Mineral Admixtures: Pozzolonic activity

Lecture 31 - Mineral Admixtures: Electrical Conductivity method, Frattini test and Lime saturation method

- Lecture 32 - Mineral Admixtures: Strength Activity test, Lime reactivity test, Mixture Proportioning and R3 test
- Lecture 33 - Mineral Admixtures: Flyash - Part 1: Introduction
- Lecture 34 - Mineral Admixtures: Flyash - Part 2: Classification and structure
- Lecture 35 - Mineral Admixtures: Flyash - Part 3: Effects on fresh concrete
- Lecture 36 - Mineral Admixtures: Flyash - Part 4: Effects on hardened concrete
- Lecture 37 - Mineral Admixtures: Silica fume - Part 1: Introduction
- Lecture 38 - Mineral Admixtures: Silica fume - Part 2: Effects on fresh and hardened concrete
- Lecture 39 - Mineral Admixtures: Silica fume - Part 3: Effects on Microstructure + GGBS - Part 1 : Introduction
- Lecture 40 - Mineral Admixtures: GGBS - Part 2 : Properties
- Lecture 41 - Mineral Admixtures: GGBS - Part 3 : Hydration of slag and Durability of slag cements
- Lecture 42 - Mineral Admixtures: Metakaolin
- Lecture 43 - Mineral Admixtures: LC3 - Part 1 : Introduction
- Lecture 44 - Mineral Admixtures: LC3 - Part 2 : Comparision with other SCMs
- Lecture 45 - Mineral Admixtures: LC3 - Part 3 : Durability Performance
- Lecture 46 - Mineral Admixtures: Agricultural ashes - Part 1 : Sugarcane bagasse ash
- Lecture 47 - Mineral Admixtures: Agricultural ashes - Part 2 : Rice husk ash
- Lecture 48 - Mineral Admixtures: Calorimeter
- Lecture 49 - Mineral Admixtures: Pore solution analysis
- Lecture 50 - Mineral Admixtures: CASH analysis in blended system and Life cycle assessment of concrete - Part 1
- Lecture 51 - Life cycle assessment of concrete - Part 2
- Lecture 52 - Life cycle assessment of concrete - Part 3
- Lecture 53 - Special concretes - High strength concrete - Definition, design and concept of particle packing
- Lecture 54 - Special concretes - High strength concrete - Particle packing models
- Lecture 55 - Special concretes - High strength concrete - Mix designs, strength and durability
- Lecture 56 - Special concretes - High strength concrete - Design attributes, fresh and hardened properties
- Lecture 57 - Special concretes - High strength concrete - Stress:strain relationships, applications
- Lecture 58 - Special concretes - Ultra high performance concrete - Design principles, strength, durability
- Lecture 59 - Special concretes: Self compacting concrete -Introduction, design requirements and plastic shrinkage
- Lecture 60 - Special concretes: Self compacting concrete - Segregation and laboratory tests
- Lecture 61 - Special concretes - Self Compacting Concrete - Workability test methods, classifications and issues
- Lecture 62 - Special concretes - Self Compacting Concrete - Design principles, mix designs, concrete properties
- Lecture 63 - Special concretes - Mass concrete - Introduction, materials, thermal cracking
- Lecture 64 - Special concretes - Mass concrete - Design guidelines, temperature differential measurement

[Lecture 65 - Special concretes - Mass concrete - Temperature differential measurement, Design](#)

[Lecture 66 - Special concretes - Mass concrete - Temperature monitoring, nomogram, minimizing restraints](#)

[Lecture 67 - Special concretes - Mass concrete - Heat modelling](#)

[Lecture 68 - Special concretes - Lightweight concrete - Introduction, classifications](#)

[Lecture 69 - Special concretes - Lightweight concrete - Foamed concrete, lightweight aggregates](#)

[Lecture 70 - Special concretes - Lightweight concrete - Light weigh aggregates, aerated concrete](#)

[Lecture 71 - Special concretes - High density concrete - Heavy weight aggregates, design, case stud](#)

[Lecture 72 - Special concretes - Concrete for 3D printing - Introduction, classification, printing process](#)

[Lecture 73 - Special concretes - Concrete for 3D printing - Developments, advantages, case study](#)

[Lecture 74 - Special concretes - Concrete for 3D printing - Critical parameters, yield stress](#)

[Lecture 75 - Special concretes - Concrete for 3D printing - Mix design approach, admixtures](#)

[Lecture 76 - Special concretes - Concrete for 3D printing - Failure modes, buildability, early-age behaviour](#)

Lecture 1 - Aggregates and their effects on concrete properties - Part 1

Lecture 2 - Aggregates and their effects on concrete properties - Part 2

Lecture 3 - An overview of recycled concrete aggregates (RCA): sources and types - Part 1

Lecture 4 - An overview of recycled concrete aggregates (RCA): sources and types - Part 2

Lecture 5 - Recycled Concrete Aggregate (RCA): Availability, Collection, and Processing Methods - Part 1

Lecture 6 - Recycled Concrete Aggregate (RCA): Availability, Collection, and Processing Methods - Part 2

Lecture 7 - Recycled Concrete Aggregates: Properties and Performance - Part 1

Lecture 8 - Recycled Concrete Aggregates: Properties and Performance - Part 2

Lecture 9 - Recycled Concrete Aggregates: Properties and Performance - Part 3

Lecture 10 - Recycled Concrete Aggregates: Properties and Performance - Part 4

Lecture 11 - Recycled Concrete Aggregates: Properties and Performance - Part 5

Lecture 12 - Effect of moisture condition on the microstructure and design of RCA concrete - Part 1

Lecture 13 - Effect of moisture condition on the microstructure and design of RCA concrete - Part 2

Lecture 14 - Overview and generation of recycled concrete fines

Lecture 15 - Utilisation of recycled concrete fines

Lecture 16 - Recycled Concrete Aggregates: Properties, Design, and Standards

Lecture 17 - Environmental impact and life cycle assessment (LCA) - Part 1

Lecture 18 - Environmental impact and life cycle assessment (LCA) - Part 2

Lecture 19 - Construction supply chains - Part 1

Lecture 20 - Construction supply chains - Part 2

Lecture 21 - Recycled concrete aggregates market: problems and prospects - Part 1

Lecture 22 - Recycled concrete aggregates market: problems and prospects - Part 2

Lecture 1 - Shallow Foundation - 1

Lecture 2 - Shallow Foundation - 2

Lecture 3 - Shallow Foundation - 3

Lecture 4 - Shallow Foundation - 4

Lecture 5 - Shallow Foundation - 5

Lecture 6 - Shallow Foundation - 6

Lecture 7 - Shallow Foundation - 7

Lecture 8 - Lateral Earth pressure Theories Retaining Walls - 1

Lecture 9 - Lateral Earth pressure Theories Retaining Walls - 2

Lecture 10 - Lateral Earth pressure Theories Retaining Walls - 3

Lecture 11 - Lateral Earth Pressure Theories Retaining Walls - 4

Lecture 12 - Lateral Earth Pressure Theories Retaining Walls - 5

Lecture 13 - Pile Foundations - 1

Lecture 14 - Pile Foundations - 2

Lecture 15 - Pile Foundations - 3

Lecture 16 - Pile Foundations - 4

Lecture 17 - Pile Foundations - 5

Lecture 18 - Pile Foundations - 6

Lecture 19 - Pile Foundations - 7

Lecture 20 - Machine Foundations - 1

Lecture 21 - Machine Foundations - 2

Lecture 22 - Machine Foundations - 3

Lecture 23 - Machine Foundations - 4

Lecture 24 - Well Foundations - 1

Lecture 25 - Well Foundations - 2

Lecture 26 - Well Foundations - 3

Lecture 27 - Foundation Engineering - 1

Lecture 28 - Foundation Engineering - 2

Lecture 29 - Foundation Engineering - 3

Lecture 30 - Foundation Engineering - 4

Lecture 31 - Foundation Engineering - 5

[Lecture 32 - Foundation Engineering - 6](#)

[Lecture 33 - Foundation Engineering - 7](#)

[Lecture 34 - Foundation Engineering - 8](#)

[Lecture 35 - Foundation Engineering - 9](#)

[Lecture 36 - Foundation Engineering - 10](#)

[Lecture 37 - Foundation Engineering - 11](#)

[Lecture 38 - Foundation Engineering - 12](#)

[Lecture 39 - Foundation Engineering - 13](#)

[Lecture 40 - Foundation Engineering - 14](#)

- Lecture 1 - Geographic Information System An Introduction
- Lecture 2 - Introduction to Global Positioning System
- Lecture 3 - GPS Positioning Methods
- Lecture 4 - GPS Solutions and Errors
- Lecture 5 - GPS Application
- Lecture 6 - Remote Sensing Introduction
- Lecture 7 - Electromagnetic Spectrum
- Lecture 8 - Sensors and Platform
- Lecture 9 - Sensors and Platform
- Lecture 10 - Image Interpretation
- Lecture 11 - Statistical Evaluation of RS Data
- Lecture 12 - Rectification and Restoration
- Lecture 13 - Image Enhancement
- Lecture 14 - Image Transformation
- Lecture 15 - Orthogonal Transformation
- Lecture 16 - Image Classification (Supervised Classification)
- Lecture 17 - Image Classification (Unsupervised Classification)
- Lecture 18 - Spatial Filtering-Noise Removal
- Lecture 19 - Spatial Filtering-Edge Removal
- Lecture 20 - Photogramatic-Basic concepts of a single photography
- Lecture 21 - Stereoscopy-Basic concepts
- Lecture 22 - Stereoscopy-Geometry of overlapping photograph
- Lecture 23 - Terrestrial Photogrammetry
- Lecture 24 - Digital Elevation Model-Basic Concepts
- Lecture 25 - Digital Elevation Model-Data Input and Stamping
- Lecture 26 - Digital Elevation Model-Surface representation and analysis
- Lecture 27 - GIS-Introductory Concepts
- Lecture 28 - GIS-Data Input
- Lecture 29 - Data Verification and Editing
- Lecture 30 - GIS Data Model
- Lecture 31 - GIS Data Base

[Lecture 32 - Spatial Analysis](#)

[Lecture 33 - Map Overlay and Spatial Correlation](#)

[Lecture 34 - Application to Drought Management](#)

[Lecture 35 - GIS base planning model for educational facilities in rural areas](#)

[Lecture 36 - Application extraction of building attributes](#)

[Lecture 37 - Zonal based tourism planning](#)

[Lecture 38 - Zonal Planning using remote sensing](#)

[Lecture 39 - Municipal GIS for assessment of property tax](#)

[Lecture 40 - Application of remote sensing](#)



**NPTEL : Transportation Engineering II (Civil Engineering)**

**Co-ordinators : Prof. Rajat Rastogi**

- Lecture 1 - Introduction to Railway Engineering
- Lecture 2 - Gauges and Permanent Way
- Lecture 3 - Wheel and Axles, Coning of Wheels
- Lecture 4 - Track Resistances, Hauling Capacity
- Lecture 5 - Track Modulus, Stresses in Track
- Lecture 6 - Stresses in Components of Track
- Lecture 7 - Rails
- Lecture 8 - Creep in Rails
- Lecture 9 - Wears & Failures in Rails
- Lecture 10 - Jointed or Welded rails
- Lecture 11 - Sleepers
- Lecture 12 - Ballast
- Lecture 13 - Fastenings
- Lecture 14 - Geometric Design - Alignment of Track
- Lecture 15 - Horizontal Curve and Super elevation
- Lecture 16 - Speeds on Track
- Lecture 17 - Transition Curve & Widening of Track
- Lecture 18 - Vertical Curve & Gradients
- Lecture 19 - Turnouts - Components
- Lecture 20 - Crossing and Design of Turnout
- Lecture 21 - Track Junctions and Designs
- Lecture 22 - Signals - Part 1
- Lecture 23 - Signals - Part 2
- Lecture 24 - Train Control Systems
- Lecture 25 - Interlocking of Track
- Lecture 26 - High Speed Tracks
- Lecture 27 - Introduction of Air Transport
- Lecture 28 - Aircraft Characteristics
- Lecture 29 - Aircraft Controls, Airport Site&Size Selection
- Lecture 30 - Airport Obstructions
- Lecture 31 - Runway Orientation

[Lecture 32 - Runway Length](#)

[Lecture 33 - Runway Geometric](#)

[Lecture 34 - Taxiway](#)

[Lecture 35 - Exit Taxiway](#)

[Lecture 36 - Aprons and Aircraft Parking](#)

[Lecture 37 - Terminal Area and Building](#)

[Lecture 38 - Terminal Planning and Hangers](#)

[Lecture 39 - Visual Aids-Markings](#)

[Lecture 40 - Visual Aids-Lighting and Signage](#)

Lecture 1 - What is Geographic Information Systems ?

Lecture 2 - Different components of GIS

Lecture 3 - Different types of vector data and concept of topology

Lecture 4 - Raster data models and comparisons with vector

Lecture 5 - TIN data model and comparisons with raster

Lecture 6 - Non-spatial data (attributes) and their type

Lecture 7 - Raster data compression techniques

Lecture 8 - Spatial database systems and their types

Lecture 9 - Pre-processing of spatial datasets

Lecture 10 - Geo-referencing

Lecture 11 - Different map projections

Lecture 12 - Spatial interpolation techniques

Lecture 13 - Digital Elevation Models and different types of resolutions

Lecture 14 - Quality assessment of freely available DEMS

Lecture 15 - GIS analysis - Part 1

Lecture 16 - GIS analysis - Part 2 (Overlaying Operations)

Lecture 17 - GIS analysis - Part 3 (Buffer Analysis)

Lecture 18 - Classification Methods

Lecture 19 - Errors in GIS and Key elements of maps

Lecture 20 - Limitations of GIS

Lecture 1 - Solar Geometry

Lecture 2 - Climate Classification

Lecture 3 - Thermal Comfort in Built Environment - 1

Lecture 4 - Thermal Comfort in Built Environment - 2

Lecture 5 - Thermal Adaptation

Lecture 6 - Bioclimatic Assessment

Lecture 7 - Thermal Performance of Building Envelop

Lecture 8 - Thermal Performance of Building Envelop - Indices and Measures (1/2)

Lecture 9 - Thermal Performance of Building Envelop - Indices and Measures (2/2)

Lecture 10 - Glazing and Shading Systems

Lecture 11 - Shading Analysis

Lecture 12 - Energy Efficiency and Simulation

Lecture 13 - Building Acoustics - Basics

Lecture 14 - Sound Propagation

Lecture 15 - Acoustic Quality Indicators (1/2)

Lecture 16 - Acoustic Quality Indicators (2/2)

Lecture 17 - Acoustic Design Considerations

Lecture 18 - Acoustic Materials

Lecture 19 - Lighting - Basics

Lecture 20 - Lighting – Design Concepts

Lecture 1 - Introduction (GPS Surveying and Applications)

Lecture 2 - GPS System

Lecture 3 - GPS Signal (Civilian Perspective)

Lecture 4 - GPS Receiver

Lecture 5 - GPS Software

Lecture 6 - GPS Position

Lecture 7 - GPS Positioning (Principle and Methods)

Lecture 8 - Field demonstration of GPS Positioning Method

Lecture 9 - GPS Observables (Types, Errors and Quality)

Lecture 10 - Errors in GPS Observables (Systematics Errors)

Lecture 11 - GPS Data Pre-Processing - I

Lecture 12 - GPS Data Pre-Processing - II

Lecture 13 - GPS Data Processing - I

Lecture 14 - GPS Data Processing - II

Lecture 15 - Quality Assessment of GPS Surveying

Lecture 16 - Procedure of GPS Surveying - I

Lecture 17 - Procedure of GPS Surveying - II

Lecture 18 - Procedure of GPS Surveying - III

Lecture 19 - GPS Field Surveying

Lecture 20 - GPS Data Processing

Lecture 1 - Introduction and Applications

Lecture 2 - Fundamentals and Operations

Lecture 3 - Overview of Digital Land Surveying

Lecture 4 - Introduction of GPS

Lecture 5 - GPS Signal (Civilian Perspective)

Lecture 6 - GPS User Segment

Lecture 7 - GPS Positioning of Control Point

Lecture 8 - Demonstration of GPS Receivers, Software and Positioning of Control Point

Lecture 9 - GPS Position

Lecture 10 - Principle of GPS Positioning and GPS Observables

Lecture 11 - Errors in GPS Observables

Lecture 12 - GPS Data Pre-processing: Differencing

Lecture 13 - GPS Data Pre-processing: Point Positioning

Lecture 14 - GPS Data Processing: Baseline Processing

Lecture 15 - GPS Data Processing: Network Adjustment

Lecture 16 - Quality Assessment of GPS Surveying

Lecture 17 - Introduction to Total Station

Lecture 18 - Parts of Total Station

Lecture 19 - Accessories of Total Station

Lecture 20 - Handling and Setting of Total Station

Lecture 21 - Measurement of Distance

Lecture 22 - Measurement of Distance Using TS

Lecture 23 - Measurement of Horizontal Angle Using TS

Lecture 24 - Measurement of Vertical Angle and Height Using TS

Lecture 25 - Errors in Total Station

Lecture 26 - Other Errors in Total Station

Lecture 27 - Errors and Quality of Surveying Measurements

Lecture 28 - Error Propagation and Survey Specifications

Lecture 29 - Basics of Vertical Representation

Lecture 30 - Contouring

Lecture 31 - Mapping Fundamentals

[Lecture 32 - Mapping Basics](#)

[Lecture 33 - Mapping Software](#)

[Lecture 34 - Automated Mapping](#)

[Lecture 35 - Working Steps](#)

[Lecture 36 - Establishment of Control Point](#)

[Lecture 37 - Detailing of Digital Land Surveying](#)

[Lecture 38 - Demonstration of Digital Land Survey Detailing](#)

[Lecture 39 - Data Preparation and Map Making](#)

[Lecture 40 - Overview of the Course](#)

Lecture 1 - Remote-sensing Image and How it is represented

Lecture 2 - Different Techniques of Image Acquisition

Lecture 3 - Why is Digital Image processing Important ?

Lecture 4 - Image characteristics and Different Resolutions in Remote Sensing

Lecture 5 - Electromagnetic spectrum, solar reflection, and thermal emission

Lecture 6 - Color Representation and Transformations

Lecture 7 - Image histograms and statistics

Lecture 8 - Geo-referencing Techniques

Lecture 9 - Image Enhancement Techniques part 1

Lecture 10 - Image Enhancement Techniques part 2

Lecture 11 - Multispectral Transform, Scatter Plot, Principal Component Analysis and Decorrelation Stretch

Lecture 12 - Spatial Filtering Techniques

Lecture 13 - Frequency Domain Fourier Transformation

Lecture 14 - Basic Image Compression Techniques and Different Image File Formats

Lecture 15 - Image Classification Techniques

Lecture 16 - Principles of Image Interpretation

Lecture 17 - SAR Interferometry (InSAR) Techniques

Lecture 18 - Image Merging and Image Mosaicing Techniques

Lecture 19 - Application of Image Analysis

Lecture 20 - Limitations and Future of Digital Image Processing



Lecture 1 - Introduction - I

Lecture 2 - Introduction - II

Lecture 3 - Cell Structure - I

Lecture 4 - Cell Structure - II

Lecture 5 - Central Dogma - I

Lecture 6 - Central Dogma - II

Lecture 7 - Microbial Energetics - I

Lecture 8 - Microbial Energetics - II

Lecture 9 - Microbial Energetics - III

Lecture 10 - Microbial Energetics - IV

Lecture 11 - Microbial Metabolism - I

Lecture 12 - Microbial Metabolism - II

Lecture 13 - Functional Diversity of Bacteria - I

Lecture 14 - Functional Diversity of Bacteria - II

Lecture 15 - Functional Diversity of Bacteria - III

Lecture 16 - Microbial Ecosystem - I

Lecture 17 - Microbial Ecosystem - II

Lecture 18 - Microbial Ecosystem - III

Lecture 19 - Microbial Ecosystem - IV

Lecture 20 - Microbial Ecosystem - V

Lecture 21 - Environmental Genomics - I

Lecture 22 - Environmental Genomics - II

Lecture 23 - Environmental Genomics - III

Lecture 24 - Environmental Genomics - IV

Lecture 25 - Environmental Genomics - V

Lecture 26 - Microbial Symbiosis - I

Lecture 27 - Microbial Symbiosis - II

Lecture 28 - Virus - I

Lecture 29 - Virus - II

Lecture 30 - Applied Environmental Microbiology

Lecture 31 - Techniques in Environmental Microbiology - I

[Lecture 32 - Techniques in Environmental Microbiology - II](#)

[Lecture 33 - Bioremediation - I](#)

[Lecture 34 - Bioremediation - II](#)

[Lecture 35 - Bioremediation - III](#)

[Lecture 36 - Wastewater Microbiology - I](#)

[Lecture 37 - Wastewater Microbiology - II](#)

[Lecture 38 - Built Microbiology](#)

[Lecture 39 - Exposomes - I](#)

[Lecture 40 - Exposomes - II](#)

[Lecture 41 - Drinking Water Microbiology - I](#)

[Lecture 42 - Drinking Water Microbiology - II](#)

[Lecture 43 - Drinking Water Microbiology - III](#)

[Lecture 44 - Drinking Water Microbiology - IV](#)

[Lecture 45 - Drinking Water Microbiology - V](#)

[Lecture 46 - Solid Waste Microbiology - I](#)

[Lecture 47 - Solid Waste Microbiology - II](#)

[Lecture 48 - Solid Waste Microbiology - III](#)

[Lecture 49 - Antimicrobial Resistance - I](#)

[Lecture 50 - Antimicrobial Resistance - II](#)

[Lecture 51 - Epidemiology - I](#)

[Lecture 52 - Epidemiology - II](#)

[Lecture 53 - Biosensors - I](#)

[Lecture 54 - Biosensors - II](#)

[Lecture 55 - Biosensors - III](#)

[Lecture 56 - Bioinformatics - I](#)

[Lecture 57 - Bioinformatics - II](#)

[Lecture 58 - Bioinformatics - III](#)

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- Lecture 1 - Concept of Digital Elevation Model and How It Is Represented
- Lecture 2 - Various Techniques to Generate Digital Elevation Model - 1
- Lecture 3 - Various Techniques to Generate Digital Elevation Model - 2
- Lecture 4 - Various Techniques to Generate Digital Elevation Model - 3
- Lecture 5 - Importance of Spatial Resolution With DEMs
- Lecture 6 - How To Assess Quality of DEM?
- Lecture 7 - Integration of DEMs With Satellite Data
- Lecture 8 - Common Derivatives of DEMs- Slope and Aspect
- Lecture 9 - Triangulated Irregular Network (TIN) and Its Derivatives
- Lecture 10 - Shaded Relief Models and Thier Applications
- Lecture 11 - DEMs Derivatives - 1
- Lecture 12 - DEMs Derivatives - 2
- Lecture 13 - DEMs Derivatives - 3
- Lecture 14 - DEMs Derivatives - 4
- Lecture 15 - DEM Based Surface Hydrologic Modelling - 1
- Lecture 16 - DEM Based Surface Hydrologic Modelling - 2
- Lecture 17 - DEM and DAM Simulation and Its Application In Ground Water Hydrology
- Lecture 18 - Applications of DEMs In Solar and Wind Energy Potential Estimations
- Lecture 19 - Applications of DEMs in Viewshed and Flood Hazard Mapping
- Lecture 20 - DEMs Sources, Limitations and Future of Digital Elevation Models

Lecture 1 - Introduction, Fundamentals of Equilibrium and Kinetics

Lecture 2 - Equilibrium-Process Feasibility, Gibbs Energy-Standard Condition

Lecture 3 - Gibbs Free Energy-Non Standard Conditions - I

Lecture 4 - Gibbs Free Energy-Non Standard Conditions - II

Lecture 5 - Phase Equilibrium

Lecture 6 - Component Balance

Lecture 7 - Reaction Kinetics

Lecture 8 - Rate of Reaction - I

Lecture 9 - Rate of Reaction - II, Types of Reactors

Lecture 10 - Mass Balance on different types of Reactors

Lecture 11 - Material Balance for Complex Reactions

Lecture 12 - Material Balance for Reversible Reactions

Lecture 13 - Determination of Kinetic Equations

Lecture 14 - Acid-Base Reactions

Lecture 15 - Acid Dissociation Constant, Strength of Acid

Lecture 16 - Ionization Fractions

Lecture 17 - Introduction to VMINTEQ

Lecture 18 - Estimation of pH using VMINTEQ

Lecture 19 - Mixing Problems

Lecture 20 - Inverse Dose Problems

Lecture 21 - logC-pH Diagram

Lecture 22 - Carbonate System: Closed System

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Lecture 24 - VMINTEQ: Application of Gases, Acid-Base Titration

Lecture 25 - VMINTEQ: Titration and Multisweep, Buffer: Introduction

Lecture 26 - VMINTEQ: Buffer System, Buffer Intensity: Introduction

Lecture 27 - Buffer Intensity: Monoprotic and Diprotic Acids

Lecture 28 - Alkalinity: Introduction

Lecture 29 - Alkalinity: Theoretical and Practical Definition

Lecture 30 - Acidity and its Applications

Lecture 31 - Alkalinity and Acidity: Applications

- Lecture 32 - Mixing of Two Solutions and Conservative Quantities - I
- Lecture 33 - Mixing of Two Solutions and Conservative Quantities - II
- Lecture 34 - Carbonate and Non-Carbonate Alkalinity
- Lecture 35 - Anaerobic Digester: Acid Formation and Neutralization
- Lecture 36 - Aqueous Complexes: Applications in Toxicity Reduction
- Lecture 37 - Aqueous Complexes: Solubility, Rate Constants and Strength of Ligands
- Lecture 38 - Aqueous Complexes of Aluminium (Al)
- Lecture 39 - Aqueous Complexes of Mercury (Hg)
- Lecture 40 - Precipitation and Dissolution: Introduction and Applications
- Lecture 41 - Applications of Precipitation and Dissolution
- Lecture 42 - Different Stages in Precipitation, Equilibrium of Precipitation - I
- Lecture 43 - Equilibrium of Precipitation - II
- Lecture 44 - Examples Related to Equilibrium of Precipitation
- Lecture 45 - Other Examples of Equilibrium of Precipitation
- Lecture 46 - Solubility and Competitive Precipitation
- Lecture 47 - Predominance Area Diagram and Introduction to Redox Processes
- Lecture 48 - Redox Reactions and its Applications
- Lecture 49 - Balancing of Redox and Development of Half Reaction
- Lecture 50 - Kinetics of Redox Processes
- Lecture 51 - Equilibrium of Redox - I
- Lecture 52 - Equilibrium of Redox - II and Reaction Feasibility
- Lecture 53 - Reaction Feasibility Based on  $P_e$  - I
- Lecture 54 - Reaction Feasibility Based on  $P_e$  - II
- Lecture 55 - Effect of Complexation on Redox
- Lecture 56 - Effect of Complexation and Solid Phase on Redox
- Lecture 57 - Reaction Feasibility based on  $E_h$
- Lecture 58 - Introduction to Electrochemical cell (Ecell)
- Lecture 59 - Applications of Ecell
- Lecture 60 -  $\log C$ - $P_e$  and  $pH$ - $P_e$  Diagram

Lecture 1 - Introduction - I

Lecture 2 - Introduction - II

Lecture 3 - Course Outline

Lecture 4 - Introduction to hazardous waste laws and risk assessment

Lecture 5 - The major aspects of Risk Assessment

Lecture 6 - Risk Characterization

Lecture 7 - Risk Assessment - Deterministic approach

Lecture 8 - Risk Assessment - Stochastic Approach

Lecture 9 - Hazardous Waste laws - The TCLP Test

Lecture 10 - Hazardous rules and regulations

Lecture 11 - Remediation of contaminated GW-Plume Containment

Lecture 12 - Remediation of contaminated GW-Javandel et al's approach

Lecture 13 - Remediation of contaminated GW by Pump and Treat - I

Lecture 14 - Remediation of contaminated GW by Pump and Treat - II

Lecture 15 - Remediation of contaminated GW- Calculation of remediation time and introduction to source control

Lecture 16 - Permeable Reactive Barriers - I

Lecture 17 - Permeable Reactive Barriers - II

Lecture 18 - Permeable Reactive Barriers - III

Lecture 19 - Design of Permeable Reactive Barriers

Lecture 20 - Case Study on Permeable Reactive Barriers - I

Lecture 21 - Case Study on Permeable Reactive Barriers - II

Lecture 22 - Case Study- PRB (Utah)

Lecture 23 - Case Study (Utah) (Continued...)

Lecture 24 - Mechanism of natural attenuation and the affecting factors

Lecture 25 - Introduction to natural attenuation and its types

Lecture 26 - Pathways of Contaminant Transport and Rate of Degradation of Contaminant

Lecture 27 - Rate of Degradation of Contaminant when advection is considered

Lecture 28 - Rate of Degradation of Contaminant when both diffusion and advection are considered

Lecture 29 - Example of Rate of Degradation in natural attenuation

Lecture 30 - Case study: Natural Attenuation

Lecture 31 - Results of Case Study: Natural Attenuation

- Lecture 32 - Introduction of Soil/Sediments contamination with some examples
- Lecture 33 - Case Study: Soil/Sediments Contamination and remediation by Excavation and Disposal
- Lecture 34 - Hazardous waste disposal site/TSDf
- Lecture 35 - Different type of fluxes through containment barrier
- Lecture 36 - Introduction to Solidification and Stabilisation and Case Study
- Lecture 37 - Different contaminant reactions during solidification and stabilisation
- Lecture 38 - Diffusion of contaminant through solidified form
- Lecture 39 - Calculations for fractions of binders, admixtures, waste and water used in solidification
- Lecture 40 - Discussion of TCLP approach in solidification and its examples
- Lecture 41 - Discussion of TCLP approach (contd.) and Cost estimation of Solidification
- Lecture 42 - Case Study: Solidification and Stabilization
- Lecture 43 - Chemical Treatment
- Lecture 44 - Case Study: In-Situ Chemical Oxidation - Part I
- Lecture 45 - Case Study: In-Situ Chemical Oxidation - Part II
- Lecture 46 - Case Study: In-Situ Chemical Oxidation - Part III
- Lecture 47 - Surfactant Extraction - Part I
- Lecture 48 - Surfactant Extraction - Part II
- Lecture 49 - Case Study: Surfactant Extraction - Part I
- Lecture 50 - Case Study: Surfactant Extraction - Part II
- Lecture 51 - Soil Vapor Extraction - Part I
- Lecture 52 - Soil Vapor Extraction - Part II
- Lecture 53 - Bioremediation - Part I
- Lecture 54 - Bioremediation - Part II
- Lecture 55 - Case Study: Bioremediation
- Lecture 56 - Case Study: Soil Vapor Extraction - Part I
- Lecture 57 - Case Study: Soil Vapor Extraction - Part II
- Lecture 58 - Phyto-remediation
- Lecture 59 - Conceptual Site Model
- Lecture 60 - Adaptive Design in Remediation Engineering
- Lecture 61 - Solubilization Theory - Part I
- Lecture 62 - Solubilization Theory - Part II
- Lecture 63 - Enhanced Aquifer Flushing Technologies

Lecture 1 - Introduction to Global Navigation Satellite System (GNSS)

Lecture 2 - How position is determined by the GNSS? - Part I

Lecture 3 - How position is determined by the GNSS? - Part II

Lecture 4 - How position is determined by the GNSS? - Part III

Lecture 5 - NAVSTAR - Global Positioning System

Lecture 6 - Global Navigation Satellite System (GLONASS)

Lecture 7 - BeiDou Navigation Satellite System (BDS)

Lecture 8 - Indian Regional Navigation Satellite System (IRNSS)

Lecture 9 - GALILEO

Lecture 10 - Quasi-Zenith Satellite System (QZSS)

Lecture 11 - Differential Global Navigation Satellite System (DGNSS)

Lecture 12 - Real-Time Kinematic (RTK)

Lecture 13 - Satellite Based Augmentation System (SBAS)

Lecture 14 - GNSS Errors

Lecture 15 - GNSS Correction Methods

Lecture 16 - Why altitude estimated by GNSS receivers is not very accurate

Lecture 17 - Global Navigation Satellite Systems (GNSS) Applications - I

Lecture 18 - Global Navigation Satellite Systems (GNSS) Applications - II

Lecture 19 - GNSS: Current Trends and Future

Lecture 20 - GNSS: Opportunities in India



Lecture 1 - Introduction to Geomorphology and Concept of Time Scale in a Geomorphic System

Lecture 2 - Process of Landform Development

Lecture 3 - Energy Flow in Geomorphic System and Role of Uniformitarianism Vs Catastrophism

Lecture 4 - Landform Development - Equilibrium and Evolution

Lecture 5 - Process Geomorphology - I

Lecture 6 - Process Geomorphology - II

Lecture 7 - Weathering and soil Formation Introduction - I

Lecture 8 - Weathering and soil Formation Introduction - II

Lecture 9 - Weathering and Soil Formation (Types of Weathering)

Lecture 10 - Weathering and Soil Formation (Mechanical Weathering)

Lecture 11 - Weathering and Soil Formation (Mechanical and Chemical Weathering)

Lecture 12 - Weathering and Soil Formation (Chemical and Biological Weathering)

Lecture 13 - Weathering of Silicate rocks and Weathering Products

Lecture 14 - Factors of Weathering

Lecture 15 - Soil Formation

Lecture 16 - Soil Formation Processes

Lecture 17 - Soil Classification

Lecture 18 - Mass Wasting

Lecture 19 - Classification of Mass Wasting - I

Lecture 20 - Classification of Mass Wasting - II

Lecture 21 - Hill Slope Evolution - I

Lecture 22 - Hill Slope Evolution - II

Lecture 23 - Arid Zone Geomorphology

Lecture 24 - Landforms in Dry Region

Lecture 25 - Pediment Evolution

Lecture 26 - Aeolian Processes and Landforms - I

Lecture 27 - Aeolian Processes and Landforms - II

Lecture 28 - Wind Erosional Landforms - I

Lecture 29 - Wind Erosional Landforms - II

Lecture 30 - Dune Classification - I

Lecture 31 - Dune Classification - II

- Lecture 32 - Coastal Geomorphology - I
- Lecture 33 - Coastal Geomorphology and Landforms
- Lecture 34 - Coastal Geomorphology - II
- Lecture 35 - Coastal Geomorphology - III
- Lecture 36 - Shoreline Platform
- Lecture 37 - Coastal Geomorphology - IV
- Lecture 38 - Coastal Geomorphology - V
- Lecture 39 - Coastal Geomorphology - VI
- Lecture 40 - Coastal Geomorphology - VII
- Lecture 41 - Coastal Geomorphology - VIII
- Lecture 42 - Coastal Geomorphology - IX
- Lecture 43 - Tectonic Geomorphology
- Lecture 44 - Fluvial Process
- Lecture 45 - Fluvial Process - I
- Lecture 46 - Fluvial Process - II
- Lecture 47 - Fluvial Process - III
- Lecture 48 - Fluvial Process - IV
- Lecture 49 - Fluvial Process - V and Drainage Analysis
- Lecture 50 - Fluvial Process - VI and Drainage Analysis
- Lecture 51 - Fluvial Geomorphology River System - I
- Lecture 52 - Fluvial Geomorphology River System - II
- Lecture 53 - Glacial Geomorphology - I
- Lecture 54 - Glacial Geomorphology - II (Valley Glacier)
- Lecture 55 - Glacial Geomorphology - III
- Lecture 56 - Glacial Geomorphology - IV (Geomorphologic Changes by Glacier)
- Lecture 57 - Exploration Geomorphology in Oil field Sandbody Geometry - I
- Lecture 58 - Exploration Geomorphology in Oil Field Sandbody Geometry - II
- Lecture 59 - Seismic Geomorphology - I
- Lecture 60 - Seismic Geomorphology - II

Lecture 1 - Rudiments of Remote Sensing and Advantages

Lecture 2 - Historical Perspective of development of remote sensing technology

Lecture 3 - EM spectrum, solar reflection and thermal emission

Lecture 4 - Interaction of EM radiation with atmosphere including atmospheric scattering, absorption and emission

Lecture 5 - Interaction mechanisms of EM radiation with ground, spectral response curves

Lecture 6 - Laws of Radiation and their relevance in Remote Sensing

Lecture 7 - Basis of remote sensing image representation

Lecture 8 - Various Remote Sensing Platforms

Lecture 9 - Multi-spectral scanners and imaging devices

Lecture 10 - Significant characteristics of LANDSAT, SPOT, Sentinel sensors

Lecture 11 - Prominent characteristics of IRS, Cartosat, ResourceSat sensors

Lecture 12 - Unmanned Aerial Vehicle/Drone

Lecture 13 - Passive Microwave Remote Sensing

Lecture 14 - Image characteristics and different resolutions in Remote Sensing

Lecture 15 - Different techniques of Image acquisition

Lecture 16 - Importance of digital image processing

Lecture 17 - Digital Image Processing Software

Lecture 18 - Basic image enhancement techniques

Lecture 19 - Colour representations and transformations

Lecture 20 - Image Histograms and statistics

Lecture 21 - Atmospheric errors and corrections

Lecture 22 - Geometric transformations/Geo-referencing Technique

Lecture 23 - Digital Image Processing Software Demonstration - 1

Lecture 24 - Image enhancement techniques - 1

Lecture 25 - Image enhancement techniques - 2

Lecture 26 - Digital Image Processing Software Demonstration - 2

Lecture 27 - Spatial Filtering Techniques, Band rationing and PCA

Lecture 28 - Frequency Domain Fourier Transformation

Lecture 29 - Digital Image Processing Software Demonstration - 3

Lecture 30 - Unsupervised image classification and density slicing techniques

Lecture 31 - Supervised image classification techniques and limitations

- Lecture 32 - Digital Image Processing Software Demonstration - 4
- Lecture 33 - LiDAR Technique and applications
- Lecture 34 - Mosaicking, subsets, sub-sampling techniques and applications
- Lecture 35 - False Topographic Phenomena and correction techniques - 1
- Lecture 36 - False Topographic Phenomena and correction techniques - 2
- Lecture 37 - High Spatial Resolution Satellite Images and limitations
- Lecture 38 - Basic Image Compression techniques and different image file formats
- Lecture 39 - Hyperspectral Remote Sensing
- Lecture 40 - Digital Image vs Digital Photograph
- Lecture 41 - NDVI and other indices
- Lecture 42 - Active Microwave Remote Sensing - 1
- Lecture 43 - Active Microwave Remote Sensing - 2
- Lecture 44 - Radar Images interpretation and applications
- Lecture 45 - SAR Interferometry (InSAR) Technique - 1
- Lecture 46 - SAR Interferometry (InSAR) Technique - 2
- Lecture 47 - Principles of image interpretation
- Lecture 48 - Image interpretation of different geological landforms, rock types and structures
- Lecture 49 - Remote Sensing of Moon and Mars
- Lecture 50 - Google Earth and its Applications
- Lecture 51 - Integrated applications of RS and GIS in groundwater studies - 1
- Lecture 52 - Integrated applications of RS and GIS in groundwater studies - 2
- Lecture 53 - Applications of Remote Sensing in Earthquake Studies - 1
- Lecture 54 - Applications of Remote Sensing in Earthquake Studies - 2
- Lecture 55 - Different sources of free satellite images
- Lecture 56 - Limitations of Remote Sensing Techniques

Lecture 1 - Introduction

Lecture 2 - Shallow Foundations: General Requirements

Lecture 3 - Shallow Foundations: Bearing Capacity

Lecture 4 - Shallow Foundations: Settlement

Lecture 5 - Shallow Foundations: Numerical Examples

Lecture 6 - Combined Footings

Lecture 7 - Raft Foundations: General Requirements

Lecture 8 - Raft Foundations: Methods of Analysis

Lecture 9 - Footings under Dynamic Loads: Eccentric and Inclined Loads, A New Method

Lecture 10 - Footings under Dynamic Loads: Design Procedure and Example on a New Method

Lecture 11 - Footings under Dynamic Loads: Analytical Approaches

Lecture 12 - Footings under Dynamic Loads: Numerical on Analytical Approaches

Lecture 13 - Pile Foundations subjected to Static Vertical Load

Lecture 14 - Pile Foundations: Group Action of Piles and Numerical

Lecture 15 - Pile Foundations under Lateral Loads: Conventional and Elastic Methods

Lecture 16 - Pile Foundations under Lateral Loads: Elastic Method for Cohesionless Soils

Lecture 17 - Pile Foundations under Lateral Loads: Elastic Method for Cohesive Soils including degradation of modulus of subgrade reaction ( $k$ )

Lecture 18 - Pile Foundations under Lateral Loads: Numerical Examples

Lecture 19 - Dynamic Analysis of Piles under Vertical and Horizontal Vibrations

Lecture 20 - Dynamic Analysis of Piles under Horizontal Vibration: Continue with Numerical Example

Lecture 21 - Seismic Response of Pile Foundations - 1

Lecture 22 - Seismic Response of Pile Foundations - 2

Lecture 23 - Combined Pile-Raft Foundations (CPRF) - General

Lecture 24 - Geotechnical and Seismic Analyses of CPRF

Lecture 25 - Design of Piles in Liquefiable Soils - 1

Lecture 26 - Design of Piles in Liquefiable Soils - 2

Lecture 27 - Introduction to Well Foundations

Lecture 28 - Lateral Stability of Well Foundations

Lecture 29 - Lateral Stability, Construction and Sinking of Well Foundation

Lecture 30 - Tilt and Shifting of Wells, Numerical Problems

[Lecture 31 - Introduction to Soil-Structure Interaction](#)

[Lecture 32 - Effects of Soil-Structure Interaction](#)

[Lecture 33 - SGM and Wave Propagation](#)

[Lecture 34 - Dispersion, Attenuation of Waves and Damping](#)

[Lecture 35 - Ground Response Analysis \(GRA\)](#)

[Lecture 36 - Soil-Pile Interaction \(SPI\)](#)

[Lecture 37 - Raft Foundations – Numerical Examples](#)

[Lecture 38 - Foundations on Slopes - 1](#)

[Lecture 39 - Foundations on Slopes - 2](#)

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Lecture 1 - What is Geographic Information Systems ?

Lecture 2 - Essential Components of GIS

Lecture 3 - Different types of vector data

Lecture 4 - Concept of topology

Lecture 5 - Demonstration through GIS software

Lecture 6 - Raster data model and comparisons with vector

Lecture 7 - TIN data model and comparisons with raster

Lecture 8 - Non-spatial data (attributes) and their types

Lecture 9 - Vector data compression techniques

Lecture 10 - Demonstration through GIS software

Lecture 11 - Raster data compression techniques - 1

Lecture 12 - Raster data compression techniques - 2

Lecture 13 - Georeferencing

Lecture 14 - Pre-processing of spatial datasets - 1

Lecture 15 - Demonstration through GIS software

Lecture 16 - Pre-processing of spatial datasets - 2

Lecture 17 - Pre-processing of spatial datasets - 3

Lecture 18 - Spatial Interpolation Techniques - 1

Lecture 19 - Spatial Interpolation Techniques - 2

Lecture 20 - GIS ANALYSIS - 1

Lecture 21 - GIS Analysis - 2

Lecture 22 - GIS Analysis - 3

Lecture 23 - GIS Analysis - 4

Lecture 24 - GIS Analysis - 5

Lecture 25 - Demonstration through GIS software

Lecture 26 - GIS Analysis - 6

Lecture 27 - GIS Analysis - 7

Lecture 28 - Attributes Classification Methods

Lecture 29 - Special database systems and their types - 1

Lecture 30 - Demonstration through GIS software

Lecture 31 - Spatial database systems and their types - 2

Lecture 32 - Concept of NoData in Raster

Lecture 33 - Different map projections

Lecture 34 - Concept of digital elevation model (DEM) and how it is represented

Lecture 35 - Demonstration through GIS software

Lecture 36 - Various techniques to generate digital elevation model - 1

Lecture 37 - Various techniques to generate digital elevation model - 2

Lecture 38 - Various techniques to generate digital elevation model - 3

Lecture 39 - Digital Elevation Models and different types of resolutions

Lecture 40 - Demonstration through GIS software

Lecture 41 - How to assess quality of a DEM?

Lecture 42 - Integration of DEMs with satellite data

Lecture 43 - Demonstration through GIS software...

Lecture 44 - Common derivatives of DEMs - Slope and aspect - 1

Lecture 45 - Common derivatives of DEMs - Slope and aspect - 2

Lecture 46 - Common derivatives of DEMs - Slope and aspect - 3

Lecture 47 - Demonstration through GIS software

Lecture 48 - DEMs derivatives - 1

Lecture 49 - DEMs derivatives - 2

Lecture 50 - DEMs derivatives - 3

Lecture 51 - DEMs derivatives - 4

Lecture 52 - Shaded relief models and their applications

Lecture 53 - DEM based Surface Hydrologic Modelling - 1

Lecture 54 - DEM based Surface Hydrologic Modelling - 2

Lecture 55 - DEMs and Dam Simulation and its application in groundwater hydrology

Lecture 56 - Applications of DEMs in Viewshed and Flood Hazard Mapping

Lecture 57 - Applications of DEMs in solar and wind energy potential estimations

Lecture 58 - DEMs Sources, limitations and future of Digital Elevation Models

Lecture 59 - Errors in GIS and key elements of maps

Lecture 60 - Limitations of GIS



- Lecture 1 - Importance of water and wastewater treatment
- Lecture 2 - Life expectancy and real-world scenario
- Lecture 3 - Course outline
- Lecture 4 - Review of fundamentals
- Lecture 5 - Mass balance
- Lecture 6 - Mass Balance: Batch reactor, CSTR, and Plug flow reactors
- Lecture 7 - Mass balance: Comparison of CSTR and Plug flow reactor
- Lecture 8 - Mass Balance: Non ideal system and Water quality parameters
- Lecture 9 - Water quality: DO and ways to measure it
- Lecture 10 - Water quality: Nutrients in water
- Lecture 11 - Water quality: Total suspended solids and Pathogens
- Lecture 12 - Wastewater treatment plant: basic principals
- Lecture 13 - Wastewater treatment plant: Preliminary treatment
- Lecture 14 - Wastewater treatment plant: Sedimentation and basics
- Lecture 15 - Sedimentation: Discrete and Flocculant settling
- Lecture 16 - Design of primary settling tank
- Lecture 17 - Biological treatment: BOD and Nutrient removal
- Lecture 18 - Analysis of biological removal process(ASP)
- Lecture 19 - Activated sludge process: Material balance for aeration basin
- Lecture 20 - Oxygen transfer: types and basic principals
- Lecture 21 - Relevance of F/M ratio and Design Parameters of Activated Sludge Process
- Lecture 22 - Sludge Bulking and Activated Sludge Variations
- Lecture 23 - Sequencing Batch Reactor
- Lecture 24 - Nitrogen Removal - I
- Lecture 25 - Nitrogen Removal - II and Phosphorus Removal - I
- Lecture 26 - Phosphorus Removal - II
- Lecture 27 - Secondary Clarifiers and Attached Growth System
- Lecture 28 - Disinfection
- Lecture 29 - Chlorination Disinfection
- Lecture 30 - Disinfection By-products (DBPs) and Disinfectant Removal
- Lecture 31 - Water demand

- Lecture 32 - Water Quality Parameters
- Lecture 33 - Overview of Water Treatment
- Lecture 34 - Physico-Chemical treatment
- Lecture 35 - Coagulation - I
- Lecture 36 - Coagulation - II
- Lecture 37 - Rapid Mixing
- Lecture 38 - Flocculation - I
- Lecture 39 - Flocculation - II
- Lecture 40 - Flocculent settling
- Lecture 41 - Filtration
- Lecture 42 - Depth filtration
- Lecture 43 - Design of Sand filter and Surface filtration
- Lecture 44 - Disinfection
- Lecture 45 - Hardness - I
- Lecture 46 - Hardness - II
- Lecture 47 - Lime-Soda softening - I
- Lecture 48 - Lime-Soda softening - II
- Lecture 49 - Recarbonation
- Lecture 50 - Types of Softening Basin and Adsorption
- Lecture 51 - Adsorption
- Lecture 52 - Adsorption Isotherms
- Lecture 53 - Ion Exchange
- Lecture 54 - Nanofiltration and RO
- Lecture 55 - Aeration: Removal of Fe and Mn
- Lecture 56 - Residual Management
- Lecture 57 - Sludge Thickening
- Lecture 58 - Stabilization of Sludge
- Lecture 59 - Anaerobic and Aerobic digestion of sludge
- Lecture 60 - Conditioning, Dewatering and Disposal of Sludge

Lecture 1 - Introduction

Lecture 2 - Minerals and Rock Classes

Lecture 3 - Mineral Identification Procedure

Lecture 4 - Rock Identification Procedure

Lecture 5 - Geological Structures and Discontinuities

Lecture 6 - Spherical Representation of Geological Data - 1

Lecture 7 - Spherical Representation of Geological Data - 2

Lecture 8 - Spherical Representation of Geological Data - 3

Lecture 9 - Application of Graphical Representation of Geological Data

Lecture 10 - Laboratory Testing of Rocks - Sampling

Lecture 11 - Laboratory testing of Rocks - Preparations and UCS

Lecture 12 - Factors Influencing UCS and Modes of Failure in Compression

Lecture 13 - Failure Mechanism and Post-Failure Behaviour in Compression, Indirect Method for UCS

Lecture 14 - Indirect Method for UCS, Brazilian Test, Schmidt Rebound Hardness Test

Lecture 15 - Sound Velocity Test, Slake Durability Test, Swelling Pressure and Free Swell Test and Void Index Test

Lecture 16 - Shear Tests - 1

Lecture 17 - Shear Tests - 2

Lecture 18 - Engineering Classification of Intact Rocks, Concept of Rock Mass, RQD

Lecture 19 - Concept of Rock Mass, Factors Affecting Discontinuities

Lecture 20 - Factors Affecting Discontinuities

Lecture 21 - Classification of Rock Mass: Rock Mass Rating (RMR) - 1

Lecture 22 - Classification of Rock Mass: Rock Mass Rating (RMR) - 2

Lecture 23 - Classification of Rock Mass: Rock Mass Quality (Q-system) - 1

Lecture 24 - Classification of Rock Mass: Rock Mass Quality (Q-system) - 2

Lecture 25 - Classification of Rock Mass: Geological Strength Index (GSI)

Lecture 26 - Strength Criteria for Isotropic and Anisotropic Rock - 1

Lecture 27 - Strength Criteria for Isotropic and Anisotropic Rocks -2, Mohr's Failure Theory

Lecture 28 - Mohr-Coulomb Failure Criterion

Lecture 29 - Mohr-Coulomb Failure Criterion, Coulomb Navier Failure Criterion

Lecture 30 - Concept of Instantaneous  $c$  and  $\phi$ : Balmer Approach

Lecture 31 - Empirical Failure Criteria: Basics of Regression Analysis

Lecture 32 - Hoek and Brown Criterion (1980)

Lecture 33 - Parameters of Failure Criteria

Lecture 34 - Failure Criteria for Rock Mass

Lecture 35 - Tunneling: Underground Excavations

Lecture 36 - Tunneling: Ground Conditions

Lecture 37 - Elastic Stress Distribution Around Circular Tunnels - 1

Lecture 38 - Elastic Stress Distribution Around Circular Tunnels - 2

Lecture 39 - Elastic Analysis of Circular Tunnels - Displacements

Lecture 40 - Thick Wall Cylinder in Biaxial Stress Field

Lecture 41 - Elasto-Plastic Stress Distribution Around Circular Tunnel

Lecture 42 - Underground Excavation Failure Mechanisms

Lecture 43 - Structurally Controlled Failure: Roof Failure

Lecture 44 - Structurally Controlled Failure: Sidewall Failures - 1

Lecture 45 - Structurally Controlled Failure: Sidewall Failures - 2

Lecture 46 - Rock Mass Support Interaction Analysis - 1

Lecture 47 - Rock Mass Support Interaction Analysis - 2

Lecture 48 - Rock Slope Stability

Lecture 49 - Rock Slope Stability - Plane Failure

Lecture 50 - Rock Slope Stability - Wedge Failure

Lecture 51 - Rock Slope Stability - Circular Failure

Lecture 52 - Rock Slope Stability - Toppling Failure - 1

Lecture 53 - Rock Slope Stability - Toppling Failure - 2

Lecture 54 - Rock Slope Stability - Toppling Failure - 3

Lecture 55 - Rock Slope Stabilization

Lecture 56 - Foundations on Weak Rocks

Lecture 57 - Ultimate Bearing Capacity Using Bell's Approach

Lecture 58 - Bearing Capacity from Classification Approaches and Based on UCS

Lecture 59 - Bearing Capacity Based on Plate Load test; Treatment of Foundations

Lecture 60 - Dam Foundation Problems

- Lecture 1 - Introduction to Scientific Computations - I
- Lecture 2 - Introduction to Scientific Computations - II
- Lecture 3 - Basic Concepts of Linear Algebra
- Lecture 4 - Polynomial Interpolation and Numerical Quadrature - I
- Lecture 5 - Polynomial Interpolation and Numerical Quadrature - II
- Lecture 6 - Polynomial Interpolation and Numerical Quadrature - III
- Lecture 7 - Polynomial Interpolation and Numerical Quadrature - IV
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# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

**NPTEL : NOC:Design and Pedagogy of the Introductory Programming Course (Computer Science and Engineering)**

**Co-ordinators : Prof. Abhiram G Ranade**

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**NPTEL : NOC:Introduction to Computer and Network Performance Analysis using Queuing Systems (Computer Science and Engineering)**

**Co-ordinators : Prof. Varsha Apte**

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Lecture 2 - Performance metrics and parameters

Lecture 3 - Introducing Queuing Systems

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Lecture 5 - Operational Laws

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Lecture 3 - Finite automata continued, deterministic finite automata (DFAs), language accepted by a DFA

Lecture 4 - Regular languages, their closure properties

Lecture 5 - DFAs solve set membership problems in linear time, pumping lemma

Lecture 6 - More examples of nonregular languages, proof of pumping lemma, pumping lemma as a game, converse of pumping lemma does not hold

Lecture 7 - A generalization of pumping lemma, nondeterministic finite automata (NFAs), computation trees for NFAs

Lecture 8 - Formal description of NFA, language accepted by NFA, such languages are also regular

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Lecture 10 - NFA's with epsilon transitions

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Lecture 13 - Closure properties (Continued...)

Lecture 14 - Closure under reversal, use of closure properties

Lecture 15 - Decision problems for regular languages

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Lecture 18 - Application of Myhill-Nerode theorem. DFA minimization

Lecture 19 - DFA minimization (Continued...)

Lecture 20 - Introduction to context free languages (cfls) and context free grammars (cfgs). Derivation of strings by cfgs

Lecture 21 - Languages generated by a cfg, leftmost derivation, more examples of cfgs and cfls

Lecture 22 - Parse trees, inductive proof that  $L$  is  $L(G)$ . All regular languages are context free

Lecture 23 - Towards Chomsky normal forms: elimination of useless symbols, analysis of reachable symbols, generating nonterminals, order of substeps matter

Lecture 24 - Simplification of cfgs continued, Removal of epsilon productions: algorithm and its correctness

Lecture 25 - Elimination of unit productions. Converting a cfg into Chomsky normal form. Towards pumping lemma for cfls

Lecture 26 - Pumping lemma for cfls. Adversarial paradigm

Lecture 27 - Completion of pumping lemma proof. Examples of use of pumping lemma. Converse of lemma does not hold. Closure properties of cfls

Lecture 28 - Closure properties continued. cfls not closed under complementation

Lecture 29 - Another example of a cfl whose complement is not a cfl. Decision problems for cfls

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Lecture 30 - More decision problems. CYK algorithm for membership decision

Lecture 31 - Introduction to pushdown automata (pda)

Lecture 32 - pda configurations, acceptance notions for pdas. Transition diagrams for pdas

Lecture 33 - Equivalence of acceptance by empty stack and acceptance by final state

Lecture 34 - Turing machines (TM): motivation, informal definition, example, transition diagram

Lecture 35 - Execution trace, another example (unary to binary conversion)

Lecture 36 - Example continued. Finiteness of TM description, TM configuration, language acceptance, definition of recursively enumerable (r.e.) languages

Lecture 37 - Notion of non-acceptance or rejection of a string by a TM. Multitrack TM, its equivalence to standard TM. Multitape TMs

Lecture 38 - Simulation of multitape TMs by basic model. Nondeterministic TM (NDTM). Equivalence of NDTMs with deterministic TMs

Lecture 39 - Counter machines and their equivalence to basic TM model

Lecture 40 - TMs can simulate computers, diagonalization proof

Lecture 41 - Existence of non-r.e. languages, recursive languages, notion of decidability

Lecture 42 - Separation of recursive and r.e. classes, halting problem and its undecidability

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# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

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**Co-ordinators : Prof. Soumya Kanti Ghosh**

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**HTML Links for 1,14,300+ NPTEL Video Lectures, Created by LinuXpert Systems, Chennai**

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# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

**NPTEL : NOC:Programming, Data Structures and Algorithms (Computer Science and Engineering)**

**Co-ordinators : Prof. Hema A Murthy, Prof. Shankar Balachandran, Dr. N.S. Narayanaswamy**

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Lecture 31 - Analysis of minimum and maximum in an array

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Lecture 54 - Hierarchical Reinforcement Learning  
Lecture 55 - Types of Optimality  
Lecture 56 - Semi Markov Decision Processes  
Lecture 57 - Options  
Lecture 58 - Learning with Options  
Lecture 59 - Hierarchical Abstract Machines  
Lecture 60 - MAXQ  
Lecture 61 - MAXQ Value Function Decomposition  
Lecture 62 - Option Discovery  
Lecture 63 - POMDP Introduction  
Lecture 64 - Solving POMDP





Lecture 1 - Intro to the Course

Lecture 2 - Introduction to OS

Lecture 3 - PC Hardware

Lecture 4 - From Programs to Processes

Lecture 5 - Sharing the CPU

Lecture 6 - Introduction

Lecture 7 - Virtual Memory

Lecture 8 - MMU Mapping

Lecture 9 - Segmentation

Lecture 10 - Memory Management in xv6

Lecture 11 - PC Booting

Lecture 12 - Week 3 Introduction

Lecture 13 - Create Execute and Exit from Processes

Lecture 14 - System Calls for Process Management

Lecture 15 - Interrupts

Lecture 16 - Interrupt Handling

Lecture 17 - Software Interrupts and System calls

Lecture 18 - CPU Context switching

Lecture 19 - CPU Scheduling

Lecture 20 - Priority Based Scheduling Algorithms

Lecture 21 - Multi-Processor Scheduling

Lecture 22 - Scheduling in Linux

Lecture 23 - Completely Fair Scheduling

Lecture 24 - Inter Process Communication

Lecture 25 - Synchronization

Lecture 26 - Software solutions for critical sections

Lecture 27 - Bakery Algorithm

Lecture 28 - Hardware Locks

Lecture 29 - Mutexes

Lecture 30 - Semaphores

Lecture 31 - Dining Philosophers Problem

[Lecture 32 - Deadlocks](#)

[Lecture 33 - Dealing with Deadlocks](#)

[Lecture 34 - Threads - Part 1](#)

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[Lecture 37 - Information Flow policies](#)

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- Lecture 1 - Lecture 1 - Algorithms and programming: simple gcd
- Lecture 2 - Lecture 2 - Improving naive gcd
- Lecture 3 - Lecture 3 - Euclid's algorithm for gcd
- Lecture 4 - Lecture 4 - Downloading and installing Python
- Lecture 5 - Lecture 1 - Assignment statement, basic types - int, float, bool
- Lecture 6 - Lecture 2 - Strings
- Lecture 7 - Lecture 3 - Lists
- Lecture 8 - Lecture 4 - Control Flow
- Lecture 9 - Lecture 5 - Functions
- Lecture 10 - Lecture 6 - Examples
- Lecture 11 - Lecture 1 - More about range()
- Lecture 12 - Lecture 2 - Manipulating lists
- Lecture 13 - Lecture 3 - Breaking out of a loop
- Lecture 14 - Lecture 4 - Arrays vs lists, binary search
- Lecture 15 - Lecture 5 - Efficiency
- Lecture 16 - Lecture 6 - Selection Sort
- Lecture 17 - Lecture 7 - Insertion Sort
- Lecture 18 - Lecture 8 - Recursion
- Lecture 19 - Lecture 1 - Mergesort
- Lecture 20 - Lecture 2 - Mergesort, analysis
- Lecture 21 - Lecture 3 - Quicksort
- Lecture 22 - Lecture 4 - Quicksort analysis
- Lecture 23 - Lecture 5 - Tuples and dictionaries
- Lecture 24 - Lecture 6 - Function definitions
- Lecture 25 - Lecture 7 - List Comprehension
- Lecture 26 - Lecture 1 - Exception Handling
- Lecture 27 - Lecture 2 - Standard input and output
- Lecture 28 - Lecture 3 - Handling files
- Lecture 29 - Lecture 4 - String functions
- Lecture 30 - Lecture 5 - Formatting printed output
- Lecture 31 - Lecture 6 - pass, del() and None

[Lecture 32 - Lecture 1 - Backtracking, N queens](#)

[Lecture 33 - Lecture 2 - Global scope, nested functions](#)

[Lecture 34 - Lecture 3 - Generating permutations](#)

[Lecture 35 - Lecture 4 - Sets, stacks, queues](#)

[Lecture 36 - Lecture 5 - Priority queues and heaps](#)

[Lecture 37 - Lecture 1 - Abstract datatypes, classes and objects](#)

[Lecture 38 - Lecture 2 - Classes and objects in Python](#)

[Lecture 39 - Lecture 3 - User defined lists](#)

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[Lecture 41 - Lecture 1 - Memoization and dynamic programming](#)

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Lecture 2 - Intro to Course

Lecture 3 - Incidents

Lecture 4 - Tutorial 1 - Part 1 Ubuntu

Lecture 5 - Tutorial 1 - Part 2 Python

Lecture 6 - OSM APIs and tools for data collection

Lecture 7 - Tutorial 2 - Part 1 Facebook API

Lecture 8 - Tutorial 2 - Part 2 Facebook API

Lecture 9 - Trust and Credibility on OSM

Lecture 10 - Misinformation on Social Media

Lecture 11 - Privacy and Social Media

Lecture 12 - Tutorial 3 - Part 1 Twitter API

Lecture 13 - Tutorial 3 - Part 2 MySQL

Lecture 14 - Tutorial 3 - Part 3 MongoDB

Lecture 15 - Privacy and Pictures on Online Social Media

Lecture 16 - Policing and Online Social Media

Lecture 17 - Policing and Online Social Media

Lecture 18 - Policing and Online Social Media

Lecture 19 - eCrime on Online Social Media

Lecture 20 - eCrime on Online Social Media

Lecture 21 - Tutorial 4 - Social Network Analysis

Lecture 22 - Link Farming in Online Social Media

Lecture 23 - Nudges

Lecture 24 - Semantic attacks: Spear phishing

Lecture 25 - Tutorial 5 - Analyzing text using Python NLTK

Lecture 26 - Profile Linking on Online Social Media

Lecture 27 - Anonymous Networks

Lecture 28 - Tutorial 6 - Gephi Network Visualization

Lecture 29 - Privacy in Location Based Social Networks - Part 1

Lecture 30 - Privacy in Location Based Social Networks - Part 2

Lecture 31 - Tutorial 7 - Visualization - Highcharts

[Lecture 32 - Beware of What You Share Inferring Home Location in Social Networks](#)

[Lecture 33 - On the dynamics of username change behavior on Twitter](#)

[Lecture 34 - Boston Marathon Analyzing Fake Content on Twitter](#)

Lecture 1 - Java Basics

Lecture 2 - Java : Primitive Data Types, Strings, Loops, Conditional Statements

Lecture 3 - Java : Strings, OOP principles

Lecture 4 - Java : Interfaces

Lecture 5 - Java : Classes, Exceptions, Threads

Lecture 6 - Introduction to Android Studio

Lecture 7 - Your First App

Lecture 8 - Deploying your App to a Phone

Lecture 9 - Extending app - Buttons, Toast

Lecture 10 - Android Development Environment

Lecture 11 - User Interface

Lecture 12 - Application Fundamentals

Lecture 13 - Extending the application

Lecture 14 - Activity Lifecycle - I

Lecture 15 - Activity Lifecycle - II

Lecture 16 - Activity LifeCycle - III

Lecture 17 - Adding Icon, Layouts, Handling Rotation - I

Lecture 18 - Adding Icon, Layouts, Handling Rotation - II

Lecture 19 - Debugging

Lecture 20 - Intents - I

Lecture 21 - Intents - II

Lecture 22 - Observer Pattern

Lecture 23 - Fragments - I

Lecture 24 - Fragments - II

Lecture 25 - Fragment Basic Programming Example

Lecture 26 - Fragments - Advanced Example

Lecture 27 - Implicit Intents

Lecture 28 - Saving Data - I

Lecture 29 - Saving Data - II

Lecture 30 - Security and System Permissions

Lecture 31 - Services

[Lecture 32 - Processes and threads](#)

[Lecture 33 - Working with Fragments - I](#)

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[Lecture 35 - Working with Fragments - III](#)

[Lecture 36 - RecyclerView, Adapter](#)

[Lecture 37 - RecyclerView, Adapter, ViewHolder](#)

[Lecture 38 - ViewPager](#)

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Lecture 1 - Introduction to the course

Lecture 2 - Introduction to a web-app

Lecture 3 - Building a web-app

Lecture 4 - Networks

Lecture 5 - Practical - Running your own web-server

Lecture 6 - Protocols

Lecture 7 - Practical - SSH + Network experiments

Lecture 8 - Practical - Building a webapp with nodejs and using git. Introduction to reverse proxies.

Lecture 9 - Practical - Introduction to server-side javascript and HTML/CSS

Lecture 10 - Introduction to client-side Javascript

Lecture 11 - Practical - APIs and mobile apps use web-servers

Lecture 12 - Introduction to databases

Lecture 13 - Data modelling and constraints

Lecture 14 - Interacting with a DBMS

Lecture 15 - Practical - Deeper exploration of a DBMS (column types and more)

Lecture 16 - Introduction to SQL

Lecture 17 - Understanding database performance

Lecture 18 - Transactions and ACID properties

Lecture 19 - Database security, backup and recovery

Lecture 20 - Analytics and Views

Lecture 21 - Scaling a database

Lecture 22 - Connecting your webapp to your database and SQL Injection

Lecture 23 - SQL and NoSQL systems

Lecture 24 - Authentication with HTTP

Lecture 25 - Understanding security, and some best practices for webapps

Lecture 26 - Introduction to authentication, hashing, curl and sessions

Lecture 27 - Introduction to mobile apps

Lecture 28 - Introduction to Mobile Application Development Part 2

Lecture 29 - Introduction to Android

Lecture 30 - Getting started with Android Application Development

Lecture 31 - Building Custom UI using XML and Logs

[Lecture 32 - Building a Blog App](#)

[Lecture 33 - Deploying an app to the Google Play Store](#)

[Lecture 34 - Introduction to iOS](#)

[Lecture 35 - The API Economy](#)

[Lecture 36 - Version Control using Git](#)

[Lecture 37 - Backend Architectures](#)

Lecture 1 - Operating System Introduction

Lecture 2 - Storage Hierarchy, Exceptions, Interrupts and traps

Lecture 3 - OS Management Services

Lecture 4 - OS Security Issues

Lecture 5 - Process and Threads

Lecture 6 - Process Scheduling

Lecture 7 - Scheduling Algorithm

Lecture 8 - Process Synchronization

Lecture 9 - Memory Management - 1

Lecture 10 - Memory Management - 2

Lecture 11 - File Systems - 1

Lecture 12 - File Systems - 2

Lecture 13 - Unix Filesystem

Lecture 14 - Unix Filesystem (Continued...)

Lecture 15 - Linux: Basic Commands

Lecture 16 - Linux: Basic Commands (Continued...)

Lecture 17 - Linux: Users and Permissions

Lecture 18 - Linux: I/O Redirection and Pipes

Lecture 19 - Linux: Task Control

Lecture 20 - Linux: Shell Environment

Lecture 21 - Linux: Text Editors

Lecture 22 - Linux: Compression / Archiving

Lecture 23 - Linux: Print and Sync Commands

Lecture 24 - Linux: File Comparison

Lecture 25 - Basic Networking Administration

Lecture 26 - Filesystems and Devices

Lecture 27 - Shell Introduction

Lecture 28 - Shell Comments and Variables

Lecture 29 - Shell Variables

Lecture 30 - Shell Arrays and Arithmetic

Lecture 31 - Shell Condition and Relation

[Lecture 32 - Shell Examples](#)

[Lecture 33 - Shell Functions](#)

[Lecture 34 - Shell File Test](#)

[Lecture 35 - Shell Loop Control](#)

[Lecture 36 - Shell Script Variations](#)

[Lecture 37 - Shell Pattern Matching](#)

[Lecture 38 - Shell Case Statements](#)

[Lecture 39 - Shell Co-routines](#)

[Lecture 40 - Shell Signals and Traps](#)

[Lecture 41 - Shell Subshell](#)

[Lecture 42 - Shell Declarations](#)

[Lecture 43 - Shell Examples 2](#)

[Lecture 44 - Shell Review](#)

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[Lecture 46 - Structure of a Network](#)

[Lecture 47 - Network Core - Definition](#)

[Lecture 48 - Network Access and Physical Media](#)

[Lecture 49 - Structure of ISP and Packet Delays](#)

[Lecture 50 - Network Protocol Layers](#)

[Lecture 51 - Network Devices](#)

[Lecture 52 - Network Security - An Introduction](#)

[Lecture 53 - Public Key Cryptography](#)

[Lecture 54 - Digital Signatures](#)

[Lecture 55 - Security in Practise](#)

[Lecture 56 - Security in Practise \(Continued...\)](#)

[Lecture 57 - Wireshark](#)

[Lecture 58 - Snort](#)

[Lecture 59 - Review I](#)

[Lecture 60 - Review II](#)

Lecture 1 - Constraint Satisfaction Problems

Lecture 2 - CSP Examples: Map colouring, N-Queens, Classroom scheduling

Lecture 3 - CSP Examples: Huffman-Clowes Labelling, Waltz Algorithm, Crosswords

Lecture 4 - Model Based Diagnosis - An application of CSP

Lecture 5 - Constraint Networks - An Introduction

Lecture 6 - Binary Constraint Networks (BCN), Equivalent Networks

Lecture 7 - Projection Networks

Lecture 8 - Constraint Propagation

Lecture 9 - Algorithms AC1 and AC3

Lecture 10 - Can we do better than AC3?

Lecture 11 - Algorithm AC4

Lecture 12 - Generalized AC, Path-Consistency

Lecture 13 - i-Consistency, Algorithm PC1

Lecture 14 - Algorithm PC2, Strong i-Consistency

Lecture 15 - Directional Consistency and Graph Ordering

Lecture 16 - Min-Width and Min-Induced-Width Ordering

Lecture 17 - Directional Arc-Consistency and Tree CSPs

Lecture 18 - Directional Path-Consistency and Directional i-Consistency

Lecture 19 - Backtrack-Free search and Adaptive Consistency

Lecture 20 - Adaptive Consistency: Bucket Elimination

Lecture 21 - Search Methods for Solving CSPs

Lecture 22 - Algorithm Backtracking

Lecture 23 - Look-Ahead Methods in Search

Lecture 24 - Look-Ahead Search: Examples

Lecture 25 - Combining Search with Reasoning: Algorithm DPLL

Lecture 26 - Algorithm Backmarking

Lecture 27 - Dynamic Value Ordering, Dynamic Variable Ordering

Lecture 28 - Look-Back Methods - Definitions

Lecture 29 - Gaschnig's Backjumping: The Culprit Variable

Lecture 30 - Gaschnig's Backjumping, Graph-Based Backjumping

Lecture 31 - Graph-Based Backjumping: Internal and Relevant Dead-Ends

[Lecture 32 - Conflict-Directed Backjumping: Definitions](#)

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[Lecture 39 - Planning as Constraint Satisfaction](#)

[Lecture 40 - Planning as Constraint Satisfaction \(Continued...\)](#)

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Lecture 1 - Introduction High Speed Circuit - Design Recursive Doubling

Lecture 2 - High Speed Circuit Design - Fast Adder Circuits

Lecture 3 - Lab 1 : Introduction

Lecture 4 - Fast Adder Circuits (Continued...)

Lecture 5 - Fast Multiplier Circuit

Lecture 6 - Fast Multiplier Circuit (Continued...)

Lecture 7 - Programming using X86 ISA - Addressing Modes

Lecture 8 - Programming using X86 ISA - Addressing Modes

Lecture 9 - Floating point - Precision and Accuracy

Lecture 10 - Floating Point - Addition, Subtraction and Multiplication

Lecture 11 - Instruction Set Architecture

Lecture 12 - Instruction Set Architecture (Continued...)

Lecture 13 - Lab 2 : Segmentation - Part I

Lecture 14 - Lab 2 : Segmentation - Part II

Lecture 15 - Lab 2 : Segmentation - Part III

Lecture 16 - Orthogonal ISA, C Constructs Mapping, Addressing Modes

Lecture 17 - Atomic and Predicated Instructions

Lecture 18 - Atomic and Predicated Instructions (Continued...)

Lecture 19 - General Purpose Registers

Lecture 20 - Expanding opcodes

Lecture 21 - Introduction to Pipelining

Lecture 22 - Pipelining

Lecture 23 - Data Hazards

Lecture 24 - Lab 2 : Instruction Scheduling - Static and Dynamic

Lecture 25 - Dynamic Instruction Scheduling

Lecture 26 - Dynamic Instruction Scheduling (Continued...)

Lecture 27 - Control Hazard, Branch Prediction

Lecture 28 - Process Management

Lecture 29 - Branch prediction

Lecture 30 - Global Branch Prediction

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[Lecture 32 - Lab 3 : Virtual Memory](#)

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[Lecture 34 - Page Replacement Algorithm](#)

[Lecture 35 - Multilevel Paging, Translational Lookaside Buffer](#)

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[Lecture 37 - Multilevel Paging - Part 1](#)

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[Lecture 42 - Cache - Cache Coherency, Dual Ported Cache](#)

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[Lecture 44 - Cache, Degree of Multiprogramming](#)

[Lecture 45 - Shared Memory Architecture](#)

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[Lecture 47 - Virtually Indexed - Virtually Tagged and Physically Tagged Caches](#)

[Lecture 48 - Lab 4 : Task Switching \(Continued...\)](#)

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[Lecture 50 - Concurrent Programming in Hardware - Part I](#)

[Lecture 51 - Concurrent Programming in Hardware - Part II](#)

[Lecture 52 - Conclusion : Recent Trends in Computer Organization and Architecture](#)



Lecture 1 - Overview of Cellular Systems - Part 1

Lecture 2 - Overview of Cellular Systems - Part 2

Lecture 3 - Overview of Cellular Systems - Part 3

Lecture 4 - 5G and other Wireless Technologies

Lecture 5 - Basic Cellular Terminology

Lecture 6 - Introduction to Antennas and Propagation Models

Lecture 7 - Link budget, Fading margin, Outage

Lecture 8 - Cellular Concept

Lecture 9 - Cellular system design and analysis

Lecture 10 - Cellular Geometry and System Design

Lecture 11 - Cellular System Capacity, Trunking

Lecture 12 - Handoff and Mobility

Lecture 13 - Handoff Part 2, Classification of Signal Variation

Lecture 14 - Shadowing, Outage, Multipath

Lecture 15 - Rayleigh Fading and Statistical Characterization

Lecture 16 - Properties of Rayleigh Distribution

Lecture 17 - BER in Fading, Narrowband vs Wideband Channels

Lecture 18 - Characterization of Multipath Fading Channels

Lecture 19 - Choice of Modulation

Lecture 20 - Coherent versus Differential Detection

Lecture 21 - Review of Lecture 1-19

Lecture 22 - Coherent vs Differential Detection - Part II and BER in Fading

Lecture 23 - BER in Fading - Part II, Ricean Fading

Lecture 24 - Ricean and Nakagami Fading, Moment Generating Function (MGF)

Lecture 25 - MGF Part II, WSSUS Model

Lecture 26 - WSSUS Part II, Coherence Time, Doppler Spectrum

Lecture 27 - Doppler, Temporal Characteristics of Fading Channels

Lecture 28 - WSSUS-Characterization of Time Dispersive Fading Channels

Lecture 29 - WSSUS-Classification of Fading Channels

Lecture 30 - Practical Channel Models (ITU, COST), Computer generation of Rayleigh fading

Lecture 31 - Rayleigh Fading simulation - Clark and Gans Method, Jakes's™ Method

[Lecture 32 - Jakes's™ Method properties](#)

[Lecture 33 - Introduction to Diversity, Antenna selection diversity](#)

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[Lecture 36 - Array Gain, Diversity Gain, Alamouti Scheme](#)

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Lecture 2 - Basic Algorithms in Message Passing System

Lecture 3 - Leader Election in Rings

Lecture 4 - Distributed Models of Computation, Causality and Logical Time

Lecture 5 - Size of Vector Clock, Matrix Clocks, Virtual Time and Physical Clock Synchronization

Lecture 6 - Global State and Snapshot Recording Algorithms

Lecture 7 - Distributed Mutual Exclusion and Non-Token based Approaches

Lecture 8 - Quorum Based Distributed Mutual Exclusion Approaches

Lecture 9 - Token Based Distributed Mutual Exclusion Approaches

Lecture 10 - Consensus and Agreement Algorithms

Lecture 11 - Checkpointing and Rollback Recovery

Lecture 12 - Deadlock Detection in Distributed Systems

Lecture 13 - Distributed Shared Memory

Lecture 14 - Distributed Minimum Spanning Tree

Lecture 15 - Termination Detection in Distributed System

Lecture 16 - Message Ordering and Group Communication

Lecture 17 - Self-Stabilization

Lecture 18 - Case Study 1 - Distributed Randomized Algorithms

Lecture 19 - Case Study 2 - Peer-to-Peer Computing and Structured Overlay Network

Lecture 20 - Case Study 3 - The Google File System (GFS)

Lecture 21 - Case Study 4 - MapReduce

Lecture 22 - Case Study 5 - HDFS

Lecture 23 - Case Study 6 - Spark

Lecture 24 - Case Study 7 - Distributed Algorithms for Sensor Networks

Lecture 25 - Case Study 8 - Authentication in Distributed Systems

Lecture 26 - Case Study 9 - Bitcoin: A Peer-to-Peer Electronic Cash System

Lecture 27 - Case Study 10 - BlockChain Technology

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Lecture 2 - Answer to the puzzle

Lecture 3 - Introduction to Python - 1

Lecture 4 - Introduction to Python - 2

Lecture 5 - Introduction to Networkx - 1

Lecture 6 - Introduction to Networkx - 2

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Lecture 8 - Google Page Rank

Lecture 9 - Searching in a Network

Lecture 10 - Link Prediction

Lecture 11 - The Contagions

Lecture 12 - Importance of Acquaintances

Lecture 13 - Marketing on Social Networks

Lecture 14 - Introduction to Datasets

Lecture 15 - Ingredients Network

Lecture 16 - Synonymy Network

Lecture 17 - Web Graph

Lecture 18 - Social Network Datasets

Lecture 19 - Datasets : Different Formats

Lecture 20 - Datasets : How to Download?

Lecture 21 - Datasets : Analysing Using Networkx

Lecture 22 - Datasets : Analysing Using Gephi

Lecture 23 - Introduction : Emergence of Connectedness

Lecture 24 - Advanced Material : Emergence of Connectedness

Lecture 25 - Programming Illustration : Emergence of Connectedness

Lecture 26 - Summary to Datasets

Lecture 27 - Introduction

Lecture 28 - Granovetter's Strength of weak ties

Lecture 29 - Triads, clustering coefficient and neighborhood overlap

Lecture 30 - Structure of weak ties, bridges, and local bridges

Lecture 31 - Validation of Granovetter's experiment using cell phone data

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[Lecture 34 - Social Capital](#)

[Lecture 35 - Finding Communities in a graph \(Brute Force Method\)](#)

[Lecture 36 - Community Detection Using Girvan Newman Algorithm](#)

[Lecture 37 - Visualising Communities using Gephi](#)

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[Lecture 46 - Introduction to Fatman Evolutionary model](#)

[Lecture 47 - Fatman Evolutionary Model - The Base Code \(Adding people\)](#)

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[Lecture 57 - Schelling Model Implementation - 1 \(Introduction\)](#)

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[Lecture 59 - Schelling Model Implementation - 3 \(Visualization and Getting a list of boundary and internal nodes\)](#)

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[Lecture 62 - Chapter - 5 Positive and Negative Relationships \(Introduction\)](#)

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- Lecture 65 - Characterizing the Structure of Balanced Networks
- Lecture 66 - Balance Theorem
- Lecture 67 - Proof of Balance Theorem
- Lecture 68 - Introduction to positive and negative edges
- Lecture 69 - Outline of implementation
- Lecture 70 - Creating graph, displaying it and counting unstable triangles
- Lecture 71 - Moving a network from an unstable to stable state
- Lecture 72 - Forming two coalitions
- Lecture 73 - Forming two coalitions (Continued...)
- Lecture 74 - Visualizing coalitions and the evolution
- Lecture 75 - The Web Graph
- Lecture 76 - Collecting the Web Graph
- Lecture 77 - Equal Coin Distribution
- Lecture 78 - Random Coin Dropping
- Lecture 79 - Google Page Ranking Using Web Graph
- Lecture 80 - Implementing PageRank Using Points Distribution Method - 1
- Lecture 81 - Implementing PageRank Using Points Distribution Method - 2
- Lecture 82 - Implementing PageRank Using Points Distribution Method - 3
- Lecture 83 - Implementing PageRank Using Points Distribution Method - 4
- Lecture 84 - Implementing PageRank Using Random Walk Method - 1
- Lecture 85 - Implementing PageRank Using Random Walk Method - 2
- Lecture 86 - DegreeRank versus PageRank
- Lecture 87 - We Follow
- Lecture 88 - Why do we Follow?
- Lecture 89 - Diffusion in Networks
- Lecture 90 - Modeling Diffusion
- Lecture 91 - Modeling Diffusion (Continued...)
- Lecture 92 - Impact of Communities on Diffusion
- Lecture 93 - Cascade and Clusters
- Lecture 94 - Knowledge, Thresholds and the Collective Action
- Lecture 95 - An Introduction to the Programming Screencast (Coding 4 major ideas)
- Lecture 96 - The Base Code
- Lecture 97 - Coding the First Big Idea - Increasing the Payoff

- Lecture 98 - Coding the Second Big Idea - Key People
- Lecture 99 - Coding the Third Big Idea - Impact of Communities on Cascades
- Lecture 100 - Coding the Fourth Big Idea - Cascades and Clusters
- Lecture 101 - Introduction to Hubs and Authorities (A Story)
- Lecture 102 - Principle of Repeated Improvement (A story)
- Lecture 103 - Principle of Repeated Improvement (An example)
- Lecture 104 - Hubs and Authorities
- Lecture 105 - PageRank Revisited - An example
- Lecture 106 - PageRank Revisited - Convergence in the Example
- Lecture 107 - PageRank Revisited - Conservation and Convergence
- Lecture 108 - PageRank, conservation and convergence - Another example
- Lecture 109 - Matrix Multiplication (Pre-requisite 1)
- Lecture 110 - Convergence in Repeated Matrix Multiplication (Pre-requisite 1)
- Lecture 111 - Addition of Two Vectors (Pre-requisite 2)
- Lecture 112 - Convergence in Repeated Matrix Multiplication- The Details
- Lecture 113 - PageRank as a Matrix Operation
- Lecture 114 - PageRank Explained
- Lecture 115 - Introduction to Powerlaw
- Lecture 116 - Why do Normal Distributions Appear?
- Lecture 117 - Power Law emerges in WWW graphs
- Lecture 118 - Detecting the Presence of Powerlaw
- Lecture 119 - Rich Get Richer Phenomenon
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# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

**NPTEL : NOC:Applied Accelerated Artificial Intelligence (Computer Science and Engineering)**

**Co-ordinators : Prof. Satyadhyan Chickerur, Prof. Bharatkumar Sharma, Prof. Adesuyi Tosin, Prof. Satyajit Das**

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**Co-ordinators : Prof. Sabuj Kumar Mandal**

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**Co-ordinators : Prof. Kishore Chatterjee, Prof. B.G. Fernandes**

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Lecture 4 - Fundamentals of Digital Communication: Signal Processing methods, vectors, and relevant GNU Radio Examples - Part 1

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Lecture 6 - Complex Baseband Signal Representation

Lecture 7 - Real Passband Signal Representation, Up and Down Conversion of Complex Baseband Signals

Lecture 8 - Random Variables and Random Processes

Lecture 9 - Fundamentals of Digital Modulation

Lecture 10 - Linear Modulation Methods: Amplitude Shift Keying (ASK)

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- Lecture 49 - Orthogonal Frequency Division Multiplexing (OFDM)
- Lecture 50 - OFDM in the presence of dispersive channels
- Lecture 51 - Equalisation using OFDM in GNU Radio
- Lecture 52 - Error Control Coding: Parity Check Codes
- Lecture 53 - Error Control Coding: Repetition Codes
- Lecture 54 - Error Control Coding: Linear Block Codes
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- Lecture 58 - (7,4) Hamming Code in GNU Radio
- Lecture 59 - Rate and error-free Communication
- Lecture 60 - Quantisation
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**NPTEL : Circuit Theory (Electrical Engineering)**

**Co-ordinators : Prof. S.C. Dutta Roy**

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Lecture 2 - Review of Signals and Systems

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Lecture 4 - Problem Session 1

Lecture 5 - Step, Impulse and Complete Responses

Lecture 6 - 2nd Order Circuits:Magnetically Coupled Circuits

Lecture 7 - Transformer Transform Domain Analysis

Lecture 8 - Problem Session 2 : Step,Impulse

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Lecture 10 - Network Functions (Continued.)

Lecture 11 - Amplitude and Phase of Network Functions

Lecture 12 - Problem Session 3 : Network Theorems Transform

Lecture 13 - Poles, Zeros and Network Response

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Lecture 15 - Single Tuned Circuits (Continued.)

Lecture 16 - Double Tuned Circuits

Lecture 17 - Double Tuned Circuits (Continued.)

Lecture 18 - Problem Session 4 : Network Functions, Analysis

Lecture 19 - Double Tuned Circuits (Continued.)

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Lecture 21 - Two-port Networks (Continued.)

Lecture 22 - Problem Session 5

Lecture 23 - Minor - 1

Lecture 24 - The Hybrid & Transmission Parameters of 2 ports

Lecture 25 - Problem Session 6 : Two - port networks

Lecture 26 - Two - port Network parameters

Lecture 27 - Two-port Interconnections

Lecture 28 - Interconnection of Two-port Networks (Continued.)

Lecture 29 - Problem Session 7 : Two-port Networks (Continued.)

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Lecture 31 - Scattering Parameters of a Two-port



Lecture 32 - Problem Session 8 : Two- port Parameters

Lecture 33 - Solutions of Minor - 2 Problems

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Lecture 35 - Example of Insertion Loss and Elements

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Lecture 37 - Positive Real Functions

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Lecture 42 - LC Driving Point Synthesis (Continued.)

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Lecture 45 - RC & RL One-port Synthesis (Continued.)

Lecture 46 - Elementary RLC One-port Synthesis

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Lecture 49 - Resistance Terminated LC Ladder (Continued.)

Lecture 50 - Problem session 11: Two-port Synthesis

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Lecture 2 - Basic Feedback Structure

Lecture 3 - Introduction to Control Problem (Continued.)

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Lecture 5 - Dynamic Systems and Dynamic Response (Continued.)

Lecture 6 - Dynamic Systems and Dynamic Response (Continued.)

Lecture 7 - Dynamic Systems and Dynamic Response (Continued.)

Lecture 8 - Dynamic Systems and Dynamic Response (Continued.)

Lecture 9 - Dynamic Systems and Dynamic Response (Continued.)

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Lecture 11 - Models of Industrial Control Devices and Systems (Continued.)

Lecture 12 - Models of Industrial Control Devices and Systems( Continued.)

Lecture 13 - Models of Industrial Control Devices and Systems( Continued.)

Lecture 14 - Models of Industrial Control Devices and Systems( Continued.)

Lecture 15 - Models of Industrial Control Devices and Systems( Continued.)

Lecture 16 - Models of Industrial Control Devices and Systems (Continued.)

Lecture 17 - Models of Industrial Control Devices and Systems (Continued.)

Lecture 18 - Models of Industrial Control Devices and Systems (Continued.)

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Lecture 6 - More ARM Instructions

Lecture 7 - ARM: Interrupt Processing

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Lecture 9 - More on DSP Processors

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Lecture 17 - Serial Interfaces

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Lecture 19 - Software for Embedded Systems

Lecture 20 - Fundamentals of Embedded Operating Systems

Lecture 21 - Scheduling Policies

Lecture 22 - Resource Management

Lecture 23 - Embedded - OS

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Lecture 25 - Networked Embedded Systems - II

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- Lecture 10 - Transmission Line Parameters
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- Lecture 12 - Characteristics and Performance of Transmission Lines
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- Lecture 23 - Distribution Systems
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- Lecture 27 - Load Flow Problem
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Lecture 2 - Review of DC Models of BJT (Continued...) and FET

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Lecture 4 - Problem Session-1 on DC Analysis of BJT Circuits

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Lecture 6 - BJT Bias Stability (Continued...)

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Lecture 11 - Mid Frequency Analysis of the CE and CB Amplifier

Lecture 12 - Problem Session-3 on Mid- Frequency Analysis of CE Amplifiers

Lecture 13 - Midband Analysis of CB and CC Amplifiers

Lecture 14 - Midband Analysis of FET Amplifiers

Lecture 15 - Problem Session-4 on Midband Analysis of Amplifiers

Lecture 16 - High Frequency Response of Small Signal Amplifiers

Lecture 17 - High Frequency Response of Small Signal Amplifiers (Continued...)

Lecture 18 - Low Frequency Response of Small Signal Amplifiers

Lecture 19 - Problem Session-5 on Frequency Response of Small Signal Amplifiers

Lecture 20 - Differential Amplifiers

Lecture 21 - Differential Amplifiers (Continued...)

Lecture 22 - Discussion on Minor-1 Problems and Differential Amplifiers (Continued...)

Lecture 23 - Problem Session-6 on Frequency Response of Small Signal Amplifiers (Continued...) and Differential Amplifiers

Lecture 24 - Use of Current Mirrors in Differential Amplifiers

Lecture 25 - FET Differential Amplifiers and Introduction to Power Amplifiers

Lecture 26 - Class B, Class AB and Class A Power Amplifiers

Lecture 27 - Class A Power Amplifiers; Efficiency Considerations

Lecture 28 - Problem Session-7 on Deferential and Power Amplifiers

Lecture 29 - Introduction to Feedback Amplifiers

Lecture 30 - Advantages of Negative Feedback Amplifiers

Lecture 31 - Analysis of Feedback Amplifiers

- Lecture 32 - Analysis of the Series - Series and Other Feedback Configurations
- Lecture 33 - Problem Session-8 on Feedback Amplifiers
- Lecture 34 - Sinusoidal Oscillators : An Example of Positive Feedback
- Lecture 35 - More on Oscillators
- Lecture 36 - Solutions to Minor-2 Exam and Concluding Discussions on Oscillators
- Lecture 37 - Problem Session-9 on Oscillators
- Lecture 38 - Tuned (or Narrowband) Amplifiers
- Lecture 39 - Widebanding Techniques : Introduction & Use of Inductors
- Lecture 40 - Widebanding By Using an Inductance
- Lecture 41 - Problem Session-10 on Tuned Amplifiers
- Lecture 42 - Widebanding by Using Compound Devices
- Lecture 43 - Cascode Configuration as Wideband Amplifier
- Lecture 44 - Widebanding by Local Feedback
- Lecture 45 - Problem Session-11 on Minor-3 Problems & Widebanding by Compound Devices
- Lecture 46 - Widebanding by Local Feedback and Feedback Cascades
- Lecture 47 - Widebanding by Overall Feedback and Dual Loop Feedback
- Lecture 48 - The Differential Pair and the Gilbert Cell as Wideband Amplifiers
- Lecture 49 - Correction to Gilbert Cell Analysis and Operational Amplifier Imperfections
- Lecture 50 - Op-Amp offsets, Compensation and Slew Rate
- Lecture 51 - Op-Amp Compensation, Slew Rate and Some Problems

Lecture 1 - Introduction to the Course

Lecture 2 - Digital Representation of Analog Signals, Delta Modulation

Lecture 3 - Digital Representation of Analog Signals, Pulse Code Modulation

Lecture 4 - Digital Representation of Analog Signals

Lecture 5 - Quantization Noise in Delta Modulation (Continued...) and Time Division Multiplexing

Lecture 6 - Introduction to Line Coding

Lecture 7 - Spectral Properties of Line Codes: General Relations

Lecture 8 - Spectral Properties of Line Codes: On-off / Polar / Bipolar Signalling

Lecture 9 - Spectral Properties of Line Codes: Duobinary Manchester and HDB Codes

Lecture 10 - Baseband Pulse Shaping: Nyquist's First Criterion

Lecture 11 - Baseband Pulse Shaping; Raised Cosine Family of Pulses

Lecture 12 - Partial Response Signalling: Duobinary and Modified Duobinary Pulse Shaping

Lecture 13 - Precoding for Duobinary and Modified Duobinary Systems

Lecture 14 - Precoding for Modified Duobinary Systems (Continued...) and General Partial Response Signalling

Lecture 15 - Binary Baseband Digital Modulation Techniques

Lecture 16 - M-ary Baseband Digital Modulation Techniques

Lecture 17 - Passband Digital Modulations - I : PSK and QPSK

Lecture 18 - Passband Digital Modulations - II : Offset QPSK

Lecture 19 - Passband Digital Modulations - III : Minimum Shift Keying (MSK)

Lecture 20 - Passband Digital Modulations - IV : MSK (Continued...) : Passband Waveforms for M-ary Signalling

Lecture 21 - Passband Modulations for Band Limited Channels

Lecture 22 - Baseband and Passband Digital Demodulations : General Issues and Concepts

Lecture 23 - Digital Modulation Part - II Matched Filters

Lecture 24 - Matched Filters and Coherent Demodulation-I

Lecture 25 - Coherent Demodulation for Binary Wave Form

Lecture 26 - Demodulators for Binary Waveforms (Continued...) : Coherent and Noncoherent Receivers for Orthogonal Signalling (OOK and FSK)

Lecture 27 - Performance Analysis of Binary Digital Modulations: Signal and Noise Statistics in Coherent and Noncoherent Receivers

Lecture 28 - Error Rates for Binary Signalling : Coherent Receivers

Lecture 29 - Performance of Non Coherent FSK and Differential Phase Shift Keying

Lecture 30 - Demodulation of DPSK and M-ary Signals

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[Lecture 31 - Performance of M'ary Digital Modulations](#)

[Lecture 32 - Performance of M'ary Digital Modulations \(Continued...\)](#)

[Lecture 33 - Introduction to Information Theory, Part-1](#)

[Lecture 34 - Source Coding](#)

[Lecture 35 - Error Free Communication Over a Noisy Channel](#)

[Lecture 36 - The Concept of Channel Capacity](#)

[Lecture 37 - Error Correcting Codes](#)

[Lecture 38 - Error Correcting Codes \(Continued...\)](#)

**NPTEL : Introduction To Electronic Circuits (Electrical Engineering)**

**Co-ordinators : Prof. S.C. Dutta Roy**

- Lecture 1 - Introduction to the Course and Basic Electrical Quantity
- Lecture 2 - R.L.C. Components, Energy Considerations, Sources and Circuit Laws
- Lecture 3 - KCL, KVL and Network Analysis
- Lecture 4 - Networks Theorems ( Thevenin's Norton's )
- Lecture 5 - Source Transformation; Super Position Theorem and Non-Linear One-Ports
- Lecture 6 - Signal Wave Forms
- Lecture 7 - Periodic Wave Forms and Elements of Amplifiers
- Lecture 8 - Operational Amplifiers and Diodes
- Lecture 9 - Rectifiers and Power Supplies
- Lecture 10 - Wave Shaping Circuits
- Lecture 11 - More on Wave Shaping Circuits and Introduction to Natural Response of Circuits
- Lecture 12 - Natural Response (Continued...)
- Lecture 13 - Natural Response of 2nd Order Circuit
- Lecture 14 - Natural Response of 2nd Order Circuit (Continued...)
- Lecture 15 - Impedance Functions, Poles, Zeros and their Applications
- Lecture 16 - Natural Response and Poles and Zeros and Introduction to Forced Response
- Lecture 17 - Phasors and their Applications in AC Ckts, analysis
- Lecture 18 - More About Phasors and Introduction to Complete Response
- Lecture 19 - Complete Response of Electrical Circuits
- Lecture 20 - AC Circuit Analysis
- Lecture 21 - Filter Circuits and Resonance
- Lecture 22 - Resonance (Continued...)
- Lecture 23 - General Network Analysis
- Lecture 24 - Two-Port Networks
- Lecture 25 - Semiconductor Physics
- Lecture 26 - Semiconductor Physics (Continued...)
- Lecture 27 - More About Diodes Including Zener Diodes
- Lecture 28 - Bipolar Junction Transistors
- Lecture 29 - Transistors Characteristics and Biasing
- Lecture 30 - BJT Biasing and Introduction to Power Amplifiers
- Lecture 31 - BJT Power Amplifiers

[Lecture 32 - Power Amplifier](#)

[Lecture 33 - Power Amplifiers \(Continued...\) and an Introduction to Small Signal Modelling of BJT](#)

[Lecture 34 - Small Signal Model and Small Signal Amplifiers](#)

[Lecture 35 - Small Signal Amplifiers \(Continued...\)](#)

[Lecture 36 - Small Signal Amplifier \(Continued...\)](#)

[Lecture 37 - Small Signal Amplifiers \(Continued...\)](#)

[Lecture 38 - Negative Feedback](#)

[Lecture 39 - Digital Circuits](#)

[Lecture 40 - Digital Circuits \(Continued...\)](#)

Lecture 1 - Introduction to Analog Circuits Introduction to the Diode

Lecture 2 - Diodes, Introduction to The Transistor

Lecture 3 - MOS Device, Characteristics

Lecture 4 - DC operating point

Lecture 5 - DC operating point, amplifier design

Lecture 6 - Common source amplifier, small signal analysis

Lecture 7 - Common gate, common drain

Lecture 8 - Common gate circuit

Lecture 9 - Source degenerated amplifier

Lecture 10 - Swing limits

Lecture 11 - Swing limits (Continued...), multi transistor amplifiers

Lecture 12 - Multi-transistor amplifiers

Lecture 13 - Introduction to current sources

Lecture 14 - Current sources/mirrors (Continued...)

Lecture 15 - Current sources, biasing

Lecture 16 - Differential circuits

Lecture 17 - Differential amplifiers-I

Lecture 18 - Differential amplifiers-II

Lecture 19 - Differential amplifiers-III

Lecture 20 - Self biased active load diff. amp

Lecture 21 - Diff. Cascode amplifier, two stage amplifiers

Lecture 22 - Two stage diff. amps, op-amps

Lecture 23 - Op-amps, OTAs

Lecture 24 - Circuits with op-amps

Lecture 25 - Capacitance in MOS devices

Lecture 26 - Common source, drain, gate-revisited

Lecture 27 - Common gate, common drain with capacitances

Lecture 28 - Cascode, cascade-revisit with capacitance

Lecture 29 - Cascade amplifier (with capacitance)

Lecture 30 - Diversion: 2-pole systems phase margin

Lecture 31 - Diversion Continued: Two Pole Systems



[Lecture 32 - Compensation](#)

[Lecture 33 - Op-amp Design with Compensation](#)

[Lecture 34 - Unity Gain Bandwidth](#)

[Lecture 35 - Power Amplification](#)

[Lecture 36 - Power Amplifiers-2](#)

[Lecture 37 - Power Amplifiers- Class A,B,AB,C ClassD](#)

[Lecture 38 - Class D Amplifiers, Push-pull Amplifiers](#)

[Lecture 39 - Introduction to Voltage Regulators](#)

[Lecture 40 - Voltage Regulators- line, load; Conclusion Regulation](#)

[Lecture 1 - Introduction](#)

[Lecture 2 - Preliminaries](#)

[Lecture 3 - Model Reference Adaptive Control - Part 1](#)

[Lecture 4 - Model Reference Adaptive Control - Part 2](#)

[Lecture 5 - Model Reference Adaptive Control - Part 3](#)

[Lecture 6 - Adaptive Command Tracking](#)

[Lecture 7 - Robust Model Reference Adaptive Control - Part 1](#)

[Lecture 8 - Robust Model Reference Adaptive Control - Part 2](#)

[Lecture 9 - Robust Model Reference Adaptive Control - Part 3](#)

[Lecture 10 - Robust Model Reference Adaptive Control - Part 4](#)

Lecture 1 - Introduction to Information Theory

Lecture 2 - Entropy, Mutual Information, Conditional and Joint Entropy

Lecture 3 - Measures for Continuous, Random Variable, Relative Entropy

Lecture 4 - Variable Length Codes, Prefix Codes

Lecture 5 - Source Coding Theorem

Lecture 6 - various source coding Techniques: Huffman, Arithmetic, Lempel Ziv, Run Length

Lecture 7 - Optimum Quantizer, Practical Application of Source Coding: JPEG Compression

Lecture 8 - Introduction to Super Information

Lecture 9 - Channel Models and Channel Capacity

Lecture 10 - Noisy Channel Coding Theorem

Lecture 11 - Gaussian Channel and Information Capacity Theorem

Lecture 12 - Capacity of MIMO Channels

Lecture 13 - Introduction to Error Control Coding

Lecture 14 - Introduction to Galois Field

Lecture 15 - Equivalent Codes, Generator Matrix and Parity Check Matrix

Lecture 16 - Systematic Codes, Error Detections and Correction

Lecture 17 - Erasure and Errors, Standard Array and Syndrome Decoding

Lecture 18 - Probability of Error, Coding Gain and Hamming Bound

Lecture 19 - Hamming Codes, LDPC Codes and MDS Codes

Lecture 20 - Introduction to Cyclic Codes

Lecture 21 - Generator Polynomial, Syndrome Polynomial and Matrix Representation

Lecture 22 - Fire Code, Golay Code, CRC Codes and Circuit Implementation of Cyclic Codes

Lecture 23 - Introduction to BCH Codes: Generator Polynomials

Lecture 24 - Multiple Error Correcting BCH Codes, Decoding of BCH Codes

Lecture 25 - Introduction to Reed Solomon (RS) Codes

Lecture 26 - Introduction to Convolutional Codes

Lecture 27 - Trellis Codes: Generator Polynomial Matrix and Encoding using Trellis

Lecture 28 - Vitrebi Decoding and Known good Convolutional Codes

Lecture 29 - Introduction to Turbo Codes

Lecture 30 - Introduction to Trellis Coded Modulation (TCM)

Lecture 31 - Ungerboeck's Design Rules and Performance Evaluation of TCM Schemes

[Lecture 32 - TCM for Fading Channel and Space Time Trellis Codes \(STTC\)](#)

[Lecture 33 - Introduction to Space Time Block Codes \(STBC\)](#)

[Lecture 34 - Space Time Codes](#)

[Lecture 35 - Space Time Codes \(Continued...\)](#)

[Lecture 36 - Introduction to Cryptography: Symmetric key and Asymmetric Key Cryptography](#)

[Lecture 37 - Some Well-Known Algorithms: DES, IDEA, PGP, DH Protocol](#)

[Lecture 38 - Introduction to Physical Layer Security: Notion of Secrecy Capacity](#)

[Lecture 39 - Secrecy Outage Capacity, Secrecy Outage Probability, Cooperative Jamming](#)

Lecture 1 - Introduction

Lecture 2 - Transmission Lines : Wave Propagation

Lecture 3 - Transmission Lines : Reflection,Transmission; Travelling Waves

Lecture 4 - Transmission Lines : Travelling Waves (Continued...); Sinusoidal Signals; Impedance Transformation

Lecture 5 - Transmission Lines : Standing Wave Ratio:Measurement of Impedance

Lecture 6 - Transmission Lines : General Transmission Lines Equations,Low loss,Transmission Lines,Transmission Lines as Circuit Elements

Lecture 7 - Transmission Lines : Section as Circuit Elements

Lecture 8 - Transmission Lines : Velocities of Propagation, Transmission Lines Charts

Lecture 9 - Transmission Lines : Smith Chart

Lecture 10 - Transmission Lines : Impedance Matching using Stub-Lines

Lecture 11 - Transmission Lines : Transmission Lines Parameters; (primary Constants)

Lecture 12 - Wave Propagation

Lecture 13 - Wave Propagation (Continued...)

Lecture 14 - Wave Propagation : Polarisation,Poynting Vector

Lecture 15 - Wave Propagation : Power Flow,Complex Poynting vector,wave equation for a conducting Medium

Lecture 16 - Wave Propagation : Conducting Medium;Conductors and Dielectrics Depth of Penetration;Surface Impedance

Lecture 17 - Wave Propagation : Surface Impedance; Power Loss in a Conductor Reflection at a Perfect conductor (Normal Inc.)

Lecture 18 - Reflection and Refraction of waves : Reflection at the Surface of a Conducting Medium,Reflection at a Perfect Conductor (Oblique Inc.)

Lecture 19 - Reflection and Refraction of waves (Continued...)

Lecture 20 - Reflection and Refraction of waves (Continued...) - 1

Lecture 21 - Reflection and Refraction of waves (Continued...); The Plane slab

Lecture 22 - Reflection and Refraction of waves (Continued...); Transmission Line Analogy for Planes Waves

Lecture 23 - Wave Guides

Lecture 24 - Wave Guides (Continued...) Parallel plane Guide,Transverse Electric Waves,Field Distribution,Superposition of Plane Waves

Lecture 25 - Wave Guides (Continued...)

Lecture 26 - Wave Guides (Continued...) Parallel plane Guide,Characteristics of TE and Tm Waves,TEM Waves,Wave Impedances

Lecture 27 - Wave Guides (Continued...) - 1

Lecture 28 - Wave Guides (Continued...) - 2

Lecture 29 - Wave Guides (Continued...) Rectangular Wave Guides

[Lecture 30 - Wave Guides \(Continued...\)](#)

[Lecture 31 - Wave Guides \(Continued...\) Rectangular Wave Guides - 1](#)

[Lecture 32 - Resonators General Properties](#)

[Lecture 33 - Resonators \(Continued...\) Transmission Line Resonators](#)

[Lecture 34 - Resonators \(Continued...\) Wave Guide Resonators](#)

[Lecture 35 - Radiation](#)

[Lecture 36 - Radiation \(Continued...\)](#)

[Lecture 37 - Radiation \(Continued...\) - 1](#)

[Lecture 38 - Radiation \(Continued...\) - 2](#)

[Lecture 39 - Radiation \(Continued...\) Monopole Antennas half Wave Dipole Antenna](#)

[Lecture 40 - Radiation \(Continued...\)](#)

[Lecture 41 - Radiation \(Continued...\) 2 - Element Arrays, Yagi-Uda Array](#)

Lecture 1 - Introduction

Lecture 2 - Signal Spaces : Waveforms and Vector Spaces

Lecture 3 - Inner Product and Orthogonal Expansion

Lecture 4 - Signal Spaces : Gram Schmidt Orthogonalization and Receiver Structures

Lecture 5 - Signal Spaces : Fourier Series and Related expansions

Lecture 6 - Signal Spaces : Bandwidth and Degree of Freedom

Lecture 7 - Random Variables and Random Processes : Discrete Random Variable

Lecture 8 - Random Variables and Random Processes : Continuous Random Variable

Lecture 9 - Random Variables and Random Processes : Multiple Random Variable

Lecture 10 - Random Variables and Random Processes : Random Vectors

Lecture 11 - Random Variables and Random Processes : Introduction to Random Process

Lecture 12 - Random Variables and Random Processes : Properties of Random Process

Lecture 13 - Random Variables and Random Processes : Gaussian Random Process - Part 1

Lecture 14 - Random Variables and Random Processes : Gaussian Random Process - Part 2

Lecture 15 - Random Variables and Random Processes : Types of Random Process

Lecture 16 - Random Variables and Random Processes : Random Process through an LTI system

Lecture 17 - Random Variables and Random Processes : Spectral description of Random Process

Lecture 18 - Waveform Coding

Lecture 19 - Modulation : Complex Baseband Representation of Passband Signals - Part 1

Lecture 20 - Modulation : Complex Baseband Representation of Passband Signals - Part 2

Lecture 21 - Modulation : Complex Baseband Representation of Passband Signals - Part 3

Lecture 22 - Modulation : Spectral Description of Sources - Part 1

Lecture 23 - Modulation : Spectral Description of Sources - Part 2

Lecture 24 - Modulation : Spectral Description of Sources using Markov Chains and Cyclostationary Random Processes

Lecture 25 - Modulation : Nyquist Pulses

Lecture 26 - Modulation : Pulse Amplitude Modulation and Quadrature Amplitude Modulation - Part 1

Lecture 27 - Modulation : Pulse Amplitude Modulation and Quadrature Amplitude Modulation - Part 2

Lecture 28 - Modulation : Orthogonal Modulation Schemes

Lecture 29 - Modulation : Differential Modulation Schemes

Lecture 30 - Detection : Maximum A posteriori Probability (MAP) Detector and Maximum Likelihood (ML) Detector

Lecture 31 - Detection : Vector Detection

[Lecture 32 - Detection : Theorem of Irrelevance and Waveform Detection](#)

[Lecture 33 - Detection : Sequence Detection](#)

[Lecture 34 - Detection : Performance of Binary Signalling Schemes](#)

[Lecture 35 - Detection : Performance of M-ary Signaling Schemes](#)

[Lecture 36 - Detection : Performance of Orthogonal Modulation Schemes and Bit-Level Demodulation](#)

[Lecture 37 - Detection : Performance of Non-Coherent Systems Systems](#)

[Lecture 38 - Detection : Fading Channel](#)



- Lecture 1 - Introduction - EV Historical Background
- Lecture 2 - Introduction - EV Benefits of Using EVs
- Lecture 3 - Introduction - EV Overview of types of EVs and its Challenges
- Lecture 4 - Introduction - EV Motor Drive Technologies
- Lecture 5 - Introduction - EV Energy Source Technologies
- Lecture 6 - Introduction - EV Battery Charging Technologies
- Lecture 7 - Introduction - EV Vehicle to Grid
- Lecture 8 - Introduction - EV Subsystems and Configurations
- Lecture 9 - Introduction - HEV Subsystems and Configurations
- Lecture 10 - Introduction - HEV Subsystems and Modes of Operation
- Lecture 11 - Vehicle Dynamics Introduction and tractive effort
- Lecture 12 - Vehicle Dynamics and dynamic equation
- Lecture 13 - Vehicle Dynamics simulation dynamic equation constant  $F_t$
- Lecture 14 - Vehicle Dynamics dynamic equation variable  $F_t$
- Lecture 15 - Vehicle Dynamics simulation dynamic equation variable  $F_t$
- Lecture 16 - Vehicle Dynamics Modelling and simulation in Simulink
- Lecture 17 - Summary Electric Vehicles Part 1 Course
- Lecture 18 - Basics of DC Motor Drive
- Lecture 19 - Realization of DC Chopper
- Lecture 20 - Open Loop Operation of Chopper Fed DC Motor Drive
- Lecture 21 - Review of Control Theory
- Lecture 22 - Modeling and Current Controller Design for Separately Excited DC Motor Drive
- Lecture 23 - Speed Controller Design and Performance Evaluation of DC Motor Drive
- Lecture 24 - Fundamentals of Three Phase Induction Motor
- Lecture 25 - Equivalent Circuit and Torque-Speed Characteristics of Induction Motor
- Lecture 26 - Starting and Speed Control of Induction Motor
- Lecture 27 - Realisation of DC to AC Power Converter
- Lecture 28 - Impact of Non-Sinusoidal Voltage on Induction Motor
- Lecture 29 - Selective Harmonic Elimination and Optimal Pulse Width Modulation Techniques
- Lecture 30 - Switching Energy Losses and Sine-Triangle PWM
- Lecture 31 - Analysis of Sine-Triangle PWM

Lecture 32 - Simulation Studies on Open Loop Induction Motor Drive

- Lecture 1 - Introduction to Power Electronics
- Lecture 2 - Power Devices: Diodes and SCR
- Lecture 3 - Power Devices: SCR, Triac, GTO and BJT
- Lecture 4 - Power Devices: BJT, MOSFET and IGBT
- Lecture 5 - Single-phase Uncontrolled Rectifiers
- Lecture 6 - Single-phase Controlled Rectifiers - I
- Lecture 7 - Single-phase Controlled Rectifiers - II
- Lecture 8 - Three Phase Rectifiers - I
- Lecture 9 - Numericals on devices and Single-phase Rectifiers
- Lecture 10 - Three Phase Rectifiers - II
- Lecture 11 - Dual Converter and Communication Overlap
- Lecture 12 - Communication Overlap - II and AC-AC Converter-Introduction
- Lecture 13 - Single-Phase and Three-Phase AC Voltage Controllers
- Lecture 14 - Three-Phase AC Voltage Controllers and Cycloconverters
- Lecture 15 - Non-Isolated DC-DC Converters - I
- Lecture 16 - Non-Isolated DC-DC Converters - II
- Lecture 17 - Isolated DC-DC Converters - I
- Lecture 18 - Isolated DC-DC Converters - II and Cuk Converters
- Lecture 19 - Voltage Source Inverters
- Lecture 20 - VSI PWM Techniques - I
- Lecture 21 - VSI PWM Techniques - II
- Lecture 22 - SPWM and SVM Technique
- Lecture 23 - Current Source Inverter
- Lecture 24 - Power Electronics Applications

Lecture 1 - Introduction to Electrical Machines - I

Lecture 2 - Single-phase and Three-phase AC Circuits, Magnetic circuits

Lecture 3 - Magnetic Circuit - II

Lecture 4 - Magnetic Circuit - III

Lecture 5 - Transformers - Introduction

Lecture 6 - Transformers - Amp-Turn Balance, Ideal and practical transformers

Lecture 7 - Transformer Equivalent circuit and Reducing leakage

Lecture 8 - Transformer equivalent circuit parameter determination

Lecture 9 - Transformers - Voltage regulation and efficiency

Lecture 10 - Auto-transformers

Lecture 11 - PU notation and Introduction to Instrument transformers

Lecture 12 - Instrument Transformers and All Day Efficiency

Lecture 13 - Three Phase Transformers - I

Lecture 14 - Three Phase Transformers - II

Lecture 15 - Electromechanical Energy Conversion - I

Lecture 16 - Electromechanical Energy Conversion - II

Lecture 17 - Electromechanical Energy Conversion - III

Lecture 18 - DC Machines-Introduction, Constructional Features

Lecture 19 - DC Machines - EMF and Torque Equations and Generator Operation

Lecture 20 - DC Machines - OCC and Load Characteristics Classification

Lecture 21 - DC Machines - Armature Reaction

Lecture 22 - DC Machines - Voltage Build-up and Load Characteristics

Lecture 23 - DC Generator Characteristics and Introduction to DC Motors

Lecture 24 - DC Motors: Basics and Speed-Torque Relationship

Lecture 25 - DC Motor: Speed Control (Shunt and Separately Excited Motor)

Lecture 26 - DC Motor: Speed Control (Series and Compound Motor)

Lecture 27 - DC Machine: Starting and Braking

Lecture 28 - DC Machine: Commutation

Lecture 29 - 3 Phase Induction Machine: Constructional Features and Principle of Operation

Lecture 30 - 3 Phase Induction Machine: Equivalent Circuit

Lecture 31 - 3 Phase Induction Machine: Speed Torque Characteristics

[Lecture 32 - Testing of Induction Motor: OC and SC Test](#)

[Lecture 33 - 3 Phase Induction Machine: Starting Methods](#)

[Lecture 34 - Synchronous Machines: Introduction](#)

[Lecture 35 - Synchronous Machines: Constructional Features](#)

[Lecture 36 - Numerical Session](#)

[Lecture 37 - Synchronization of Alternators](#)

[Lecture 38 - Synchronous Machines: Equivalent Circuit and Phasor Diagram](#)

[Lecture 39 - Synchronous Machines: OC and SC Test](#)

[Lecture 40 - Synchronous Machines: Power Angle Relationship, V and Inverted V Curves](#)

[Lecture 41 - Single Phase Induction Motors](#)

Lecture 1 - Special Electromechanical Systems (Introduction)

Lecture 2 - Classification of Machines

Lecture 3 - Single and Two-Phase Motors

Lecture 4 - Single-Phase Induction Motors-Analysis

Lecture 5 - Starting of Single-Phase Induction Motors

Lecture 6 - Single-Phase Induction Motors Analysis

Lecture 7 - Induction Motors Analysis by Symmetrical Components

Lecture 8 - Modelling of 1-Phase Induction Motor (One and Two Windings)

Lecture 9 - Asymmetrical Induction Motor Generalized Rotating Field Theory

Lecture 10 - Generalized Rotating Field Theory (Continued...)

Lecture 11 - Generalized Rotating Field Theory (Continued...)

Lecture 12 - Generalized Rotating Field Theory (Continued...)

Lecture 13 - Analysis of Asymmetrical Machine by Generalized Rotating Field Theory

Lecture 14 - Analysis of Asymmetrical Machine

Lecture 15 - Analysis of Asymmetrical Induction Machine

Lecture 16 - Generalised Rotating-Field Theory of Wound Rotor Ind. Machine Having Asymmetry in Stator and Rotor Windings

Lecture 17 - Generalised Rotating-Field Theory of Wound Rotor Ind. Machine Having Asymmetry in Stator and Rotor Windings (Continued...)

Lecture 18 - Testing of Small Electrical Machines

Lecture 19 - Testing of 1-Phase Induction Motors

Lecture 20 - Variable Reluctance (VR) Motors

Lecture 21 - Switched Reluctance Motor (Continued...)

Lecture 22 - Switched Reluctance Motor (Continued...)

Lecture 23 - Switched Reluctance Motor (Continued...)

Lecture 24 - Stepper Motors

Lecture 25 - Stepper Motors (Continued...)

Lecture 26 - Induction Generators

Lecture 27 - Induction Generators (Continued...)

Lecture 28 - Doubly Fed Induction Generators

Lecture 29 - Self Excited Induction Generators

Lecture 30 - Self Excited Induction Generators (Continued...)

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[Lecture 31 - Permanent Magnet Machines](#)

[Lecture 32 - Squarewave Permanent Magnet Brushless Motor Drive](#)

[Lecture 33 - Sine Wave Permanent Magnet Brushless Motor Drives](#)

[Lecture 34 - Permanent Magnet Synchronous Motors](#)

- Lecture 1 - Basic Understanding of Converter (Introduction to Power Converters)
- Lecture 2 - Basic Understanding of Converter (Half Bridge and Full Bridge Circuit Operation)
- Lecture 3 - Basic Understanding of Converter (Sinusoidal Pulse width Modulation and Three Phase Circuit)
- Lecture 4 - Basic Understanding of Converter (Harmonics in Sinusoidal PWM)
- Lecture 5 - Third harmonic addition in Sine PWM
- Lecture 6 - Introduction to Space Vectors
- Lecture 7 - Space Vector PWM - Timing Calculation
- Lecture 8 - Space Vector PWM - Switching Sequence
- Lecture 9 - Space Vector PWM - Using Carriers
- Lecture 10 - Basic Introduction to Power Devices
- Lecture 11 - Introduction to Multilevel Converters
- Lecture 12 - Cascaded H-bridge Multilevel Converters
- Lecture 13 - Output Voltage Waveform Synthesis in CHB Converter and Basic of Asymmetrical CHB Converters
- Lecture 14 - Cascaded H-Bridge Converters: Phase-Shifted PWM
- Lecture 15 - Cascaded H-Bridge Converters: Level-Shifted PWM
- Lecture 16 - Fault Tolerant Operation of Cascaded H-Bridge Converter - Part I
- Lecture 17 - Fault Tolerant Operation of Cascaded H-Bridge Converter - Part II
- Lecture 18 - Modular Multilevel Converter - Topology and Operation
- Lecture 19 - Modular Multilevel Converter - Arm and Cell Voltage Ratings
- Lecture 20 - Modular Multilevel Converter - Arm Currents
- Lecture 21 - Modular Multilevel Converter - Arm Energy Balancing
- Lecture 22 - Modular Multilevel Converter - Different Circuit Topologies
- Lecture 23 - Modular Multilevel Converter - PWM Technique and Capacitor Voltage Balancing
- Lecture 24 - Modular Multilevel Converter - Fault Tolerant Operation and Commercial Production
- Lecture 25 - Design of Components in MMC
- Lecture 26 - Neutral Point Clamped Converter - Circuit Topology - Part I
- Lecture 27 - Neutral Point Clamped Converter - Circuit Topology - Part II
- Lecture 28 - Neutral Point Clamped Converter - Space Vector Diagram
- Lecture 29 - Neutral Point Clamped Converter - Space Vector PWM
- Lecture 30 - NPC - Sinusoidal PWM and Space Vector PWM using Single Carrier Strategy
- Lecture 31 - Neutral Point Clamped Converter - Mid-point Voltage Fluctuations



[Lecture 32 - Neutral Point Clamped Converter - Capacitor Voltage Balancing](#)

[Lecture 33 - Neutral Point Clamped Converter - Another Strategy of Capacitor Voltage Balancing](#)

[Lecture 34 - Other Topologies of NPC Converters - Higher Level NPC, TNPC and Active NPC](#)

[Lecture 35 - Multipulse Transformer - Part I](#)

[Lecture 36 - Multipulse Transformer - Part II](#)

[Lecture 37 - A Case Study on MMC and CHB](#)

[Lecture 38 - Basics of Gate Driver Circuits](#)

[Lecture 39 - Gate Driver Circuits - Turn-on and Turn-off Process](#)

[Lecture 40 - Gate Driver Circuits - Features of Gate Drivers and Basics of Bootstrap Functionality](#)

[Lecture 41 - Condition Monitoring of Converters](#)

[Lecture 42 - Other Converter Topologies](#)

[Lecture 43 - Summary of the Course](#)

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**Co-ordinators : Dr. S.P. Das**

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**NPTEL : High Voltage DC Transmission (Electrical Engineering)**

**Co-ordinators : Dr. S.N. Singh**

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Lecture 7 - Transmission of Signal through Linear Time Invariant (LTI) Systems and Cross- Correlation of Signals

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Lecture 20 - Generation of Single Sideband (SSB) Modulation Signals through Frequency Discrimination

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Lecture 25 - Complex Pre- Envelope and Complex Envelope of QCM (Quadrature Carrier Modulated) Signals

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Lecture 27 - Properties of Vestigial Side Band Filter for Reconstruction of Message Signal without Distortion

Lecture 28 - Introduction to Angle Modulation, Description of Phase Modulation (PM) and Frequency Modulation (FM)

Lecture 29 - Frequency Modulation (FM) with Sinusoidal Modulation Signal and Pictorial Examples, Insights of PM and FM signals

Lecture 30 - Indirect Method for Generation of FM Signals - Generation of Narrowband FM Signal



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- Lecture 32 - Spectrum of Frequency Modulated (FM) Signals
- Lecture 33 - Bandwidth of Frequency Modulated (FM) Signals - Carson's Rule
- Lecture 34 - Demodulation of Frequency Modulated (FM) Signals, Condition of Envelope Detection
- Lecture 35 - Analog to Digital Conversion of Signals and Introduction to Sampling
- Lecture 36 - Spectrum of Sampled Signal, Aliasing and Nyquist Sampling Theorem
- Lecture 37 - Ideal Impulse Train Sampling, Reconstruction of Original Signal from Samples, Sinc Interpolation
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- Lecture 40 - Introduction to Quantization, Uniform Quantizer, Mid-Tread Quantizer
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- Lecture 42 - Introduction to Lloyd-Max Quantization Algorithm, Optimal Quantizer Design
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- Lecture 44 - Companding for Non-Uniform Quantization,  $\mu$ -law Compressor, A-law Compressor
- Lecture 45 - Introduction to Delta Modulation, One-bit Quantizer
- Lecture 46 - Signal Reconstruction in Delta Modulation, Schematic Diagrams, Slope Overload Distortion and Granular Noise
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- Lecture 48 - Frequency Mixing and Translation in Communication Systems, Heterodyne and Super Heterodyne Receivers
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- Lecture 50 - Frequency Division Multiplexing (FDM), Carrier Spacing in FDM
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Lecture 7 - Digital Communication Receiver, Noise Properties and Output Noise Power

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Lecture 35 - Channel Capacity, Implications of Channel Capacity, Claude E. Shannon- Father of Information Theory and Example of Capacity of Binary Symmetric Channel

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Lecture 44 - Lower Bound on Average Code Length and Kullback-Leibler Divergence

Lecture 45 - Optimal Code length, Constrained Optimization and Morse Code Example

Lecture 46 - Approaching Lower Bound on Average code length and Block Coding

Lecture 47 - Huffman Code, Algorithm, Example and Average Code Length

Lecture 48 - Introduction to channel coding, Rate of Code, Repetition Code and Hamming Distance

Lecture 49 - Introduction to Convolutional Codes, Binary Field Arithmetic and Linear Codes

Lecture 50 - Example of Convolutional Code Output and Convolution Operation for Code generation

Lecture 51 - Matrix Representation of Convolutional Codes, Generator Matrix, Transform Domain Representation and Shift Register Architecture

Lecture 52 - State Diagram Representation of Convolutional Code, State transitions and Example of Code Generation using State transitions

Lecture 53 - Trellis Representation of Convolutional Code and Valid Code Words

Lecture 54 - Decoding of the Convolutional Code, Minimum Hamming distance and Maximum Likelihood Codeword Estimate

Lecture 55 - Principle of Decoding of Convolutional code

Lecture 56 - Viterbi Decoder for Maximum Likelihood Decoding of Convolutional Code Using Trellis Representation, Branch Metric Calculation, State Metric Calculation and Example

- Lecture 1 - Introduction to Applied Electromagnetics
- Lecture 2 - Introduction to Transmission lines
- Lecture 3 - Sinusoidal waves on Transmission lines
- Lecture 4 - Terminating T-lines: Reflection and Transmission coefficient
- Lecture 5 - Circuit parameters of a T-line
- Lecture 6 - Lossy Transmission lines and primary constants
- Lecture 7 - When to apply T-line Theory?
- Lecture 8 - Standing Waves on T-lines
- Lecture 9 - Lumped equivalent circuits of T-lines
- Lecture 10 - Impedance transformation and power flow on T-lines
- Lecture 11 - Graphical aid: Smith Chart Derivation
- Lecture 12 - Smith chart applications
- Lecture 13 - Further applications of Smith chart - Part 1
- Lecture 14 - Further applications of Smith chart - Part 2
- Lecture 15 - Impedance matching techniques - Part 1
- Lecture 16 - Impedance matching techniques - Part 2
- Lecture 17 - Impedance matching techniques - Part 3
- Lecture 18 - T-lines in time domain: Lattice diagrams
- Lecture 19 - Further examples of use of lattice diagrams
- Lecture 20 - High-speed digital signal propagation on T-lines
- Lecture 21 - Transient analysis with reactive termination and Time-domain reflectometry
- Lecture 22 - Fault detection using TDR
- Lecture 23 - Why Electromagnetics?
- Lecture 24 - Rectangular coordinate systems
- Lecture 25 - Cylindrical coordinate systems
- Lecture 26 - Review of vector fields and Gradient
- Lecture 27 - Divergence, Curl, and Laplacian operations
- Lecture 28 - Towards Maxwells equations - Part 1
- Lecture 29 - Towards Maxwells equations - Part 2
- Lecture 30 - Faradays law
- Lecture 31 - Completing Maxwells equations and Boundary conditions

- Lecture 32 - Boundary conditions for Electromagnetic fields
- Lecture 33 - Electrostatics-I: Laplace and Poissons equations
- Lecture 34 - Electrostatics-II: Solving Laplaces equation in 1D
- Lecture 35 - Electrostatics-III: Solving Laplaces equation in 2D
- Lecture 36 - Electrostatics-IV: Finite Difference method for solving Laplaces equation
- Lecture 37 - Magnetostatic fields-I: Biot-Savart Law
- Lecture 38 - Magnetostatic fields-II: Calculation of magnetic fields
- Lecture 39 - Inductance calculations
- Lecture 40 - From Maxwells equations to uniform plane waves
- Lecture 41 - Plane wave propagation in lossless dielectric media
- Lecture 42 - Polarization of plane waves
- Lecture 43 - Can an Ideal capacitor exist?
- Lecture 44 - Skin effect in conductors
- Lecture 45 - Skin effect in round wires
- Lecture 46 - Finite difference method
- Lecture 47 - Reflection of uniform plane waves
- Lecture 48 - Application: Reflection from multiple media and anti-reflection coating.
- Lecture 49 - Oblique incidence of plane waves
- Lecture 50 - Total internal reflection
- Lecture 51 - Application: Matrix analysis of reflection from multiple boundaries
- Lecture 52 - Application: Fabry-Perot cavity and Multi-layer films
- Lecture 53 - Introduction to waveguides
- Lecture 54 - Rectangular waveguides
- Lecture 55 - Attenuation and Dispersion in rectangular waveguides
- Lecture 56 - Planar optical waveguides
- Lecture 57 - Application: Optical Fibers
- Lecture 58 - Application: WDM Optical Components
- Lecture 59 - Mach-Zehnder Modulator
- Lecture 60 - Wave Propagation in Anisotropic Medium
- Lecture 61 - Wave Propagation in Ferrites
- Lecture 62 - Magnetic Vector Potential - Part 1
- Lecture 63 - Magnetic Vector Potential - Part 2
- Lecture 64 - Fields of a Dipole Antenna

[Lecture 65 - Antenna Parameters and Long wire Antenna](#)

[Lecture 66 - Friis Transmission Formula](#)



Lecture 1 - Principles of Signals and Systems- Introduction to Signals and Systems, Signal Classification - Continuous and Discrete Time Signals

Lecture 2 - Analog and Digital Signals

Lecture 3 - Energy and Power Signals

Lecture 4 - Real Exponential Signals

Lecture 5 - Memory/Memory-less and Causal/Non-Causal Systems

Lecture 6 - Properties of Linear Systems

Lecture 7 - Example Problems - 1

Lecture 8 - Example Problems - 2

Lecture 9 - Example Problems - 3

Lecture 10 - Properties and Analysis of LTI Systems - I

Lecture 11 - Properties and Analysis of LTI Systems - II

Lecture 12 - Properties and Analysis of LTI Systems - III

Lecture 13 - Properties of Discrete Time LTI Systems

Lecture 14 - Example Problems LTI Systems - I

Lecture 15 - Example Problems LTI Systems - II

Lecture 16 - Example Problems DT-LTI Systems

Lecture 17 - Laplace Transform

Lecture 18 - Laplace Transform Properties - I

Lecture 19 - Laplace Transform Properties - II

Lecture 20 - Laplace Transform of LTI Systems

Lecture 21 - Laplace Transform Example Problems - I

Lecture 22 - Laplace Transform Example Problems - II

Lecture 23 - Laplace Transform of RL, RC Circuit

Lecture 24 - Z-Transform

Lecture 25 - Z-Transform Properties - I

Lecture 26 - Z-Transform Properties - II

Lecture 27 - Z-Transform of LTI Systems

Lecture 28 - Z-Transform Examples - I

Lecture 29 - Z-Transform Examples - II

Lecture 30 - Z-Transform Examples - III

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Lecture 31 - Z-Transform Examples - IV

Lecture 32 - Inverse Z-Transform

Lecture 33 - Fourier Analysis Introduction

Lecture 34 - Complex Exponential and Trigonometric FS

Lecture 35 - Conditions for Existence of FS

Lecture 36 - Fourier Transform (FT) Introduction

Lecture 37 - Properties of Fourier Transform - I

Lecture 38 - Properties of Fourier Transform - II

Lecture 39 - Fourier Transform - Parseval's Relation

Lecture 40 - Fourier Transform of LTI Systems

Lecture 41 - FT- Ideal and Non-Ideal Filters

Lecture 42 - Fourier Analysis Examples - I

Lecture 43 - Fourier Analysis Examples - II

Lecture 44 - Fourier Analysis Examples - III

Lecture 45 - Fourier Analysis Examples - IV

Lecture 46 - Fourier Analysis Examples - V

Lecture 47 - Fourier Analysis Examples - VI

Lecture 48 - Fourier Analysis Bode Plot - I

Lecture 49 - Fourier Analysis Bode Plot - II

Lecture 50 - Fourier Transform Examples: Filtering - Ideal Low Pass Filter

Lecture 51 - Fourier Transform Problems: Unit Step Response of RC Circuit, Sampling of Continuous Signal

Lecture 52 - Sampling: Spectrum of Sampled Signal, Nyquist Criterion

Lecture 53 - Sampling: Reconstruction from Sampled Signal

Lecture 54 - Fourier Analysis of Discrete Time Signals and Systems - Introduction

Lecture 55 - Fourier Analysis of Discrete Time Signals - Duality, Parseval's Theorem

Lecture 56 - Discrete Time Fourier Transform: Definition, Inverse DTFT, Convergence, Relation between DTFT and z-Transform, DTFT of Common Signals

Lecture 57 - Discrete Time Fourier Transform: Properties of DTFT - Linearity, Time Shifting, Frequency Shifting, Conjugation, Time-Reversal, Duality

Lecture 58 - Discrete Time Fourier Transform: Properties of DTFT - Differentiation in Frequency, Difference in Time, Convolution, Multiplication, Parseval's Relation

Lecture 59 - DTFT: Discrete Time LTI Systems - LTI Systems Characterized by Difference Equations

Lecture 60 - Discrete Fourier Transform - Definition, Inverse DFT, Relation between DFT and DFS, Relation between DFT and DTFT, Properties - Linearity, Time Shifting

Lecture 61 - Discrete Fourier Transform: Properties - Conjugation, Frequency Shift, Duality, Circular Convolution, Multiplication, Parseval's Relation, Example Problems for Fourier Analysis of Discrete Time Signals

HTML Links for 1,14,300+ NPTEL Video Lectures, Created by LinuXpert Systems, Chennai

[Lecture 62 - Example Problems: DFS Analysis of Discrete Time Signals, Problems on DTFT](#)

[Lecture 63 - Example Problems: DTFT of Cosine, Unit Step Signals](#)

[Lecture 64 - DTFT Example Problems - III](#)

[Lecture 65 - DTFT Example Problems - IV](#)

[Lecture 66 - DTFT Example Problems - V](#)

[Lecture 67 - DFT Example Problems - I](#)

[Lecture 68 - Example Problems: DFT, IDFT in Matrix form](#)

[Lecture 69 - Group/Phase Delay - Part I](#)

[Lecture 70 - Group/Phase Delay - Part II](#)

[Lecture 71 - IIR Filter Structures: DF-I, DF-II](#)

[Lecture 72 - IIR Filter Structures: Transpose Form](#)

[Lecture 73 - IIR Filter Structures: Example](#)

[Lecture 74 - IIR Filter Structures: Cascade Form](#)

[Lecture 75 - IIR Filter: Parallel Form-I and II](#)

- Lecture 1 - Vectors and Matrices - Linear Independence and Rank
- Lecture 2 - Eigenvectors and Eigenvalues of Matrices and their Properties
- Lecture 3 - Positive Semidefinite (PSD) and Positive Definite (PD) Matrices and their Properties
- Lecture 4 - Inner Product Space and its Properties: Linearity, Symmetry and Positive Semi-definite
- Lecture 5 - Inner Product Space and its Properties: Cauchy Schwarz Inequality
- Lecture 6 - Properties of Norm, Gaussian Elimination and Echelon form of matrix
- Lecture 7 - Gram Schmidt Orthogonalization Procedure
- Lecture 8 - Null Space and Trace of Matrices
- Lecture 9 - Eigenvalue Decomposition of Hermitian Matrices and Properties
- Lecture 10 - Matrix Inversion Lemma (Woodbury identity)
- Lecture 11 - Introduction to Convex Sets and Properties
- Lecture 12 - Affine Set Examples and Application
- Lecture 13 - Norm Ball and its Practical Applications
- Lecture 14 - Ellipsoid and its Practical Applications
- Lecture 15 - Norm Cone, Polyhedron and its Applications
- Lecture 16 - Applications: Cooperative Cellular Transmission
- Lecture 17 - Positive Semi Definite Cone And Positive Semi Definite (PSD) Matrices
- Lecture 18 - Introduction to Affine functions and examples
- Lecture 19 - norm balls and Matrix properties: Trace, Determinant
- Lecture 20 - Inverse of a Positive Definite Matrix
- Lecture 21 - Example Problems: Property of Norms, Problems on Convex Sets
- Lecture 22 - Problems on Convex Sets (Continued...)
- Lecture 23 - Introduction to Convex and Concave Functions
- Lecture 24 - Properties of Convex Functions with examples
- Lecture 25 - Test for Convexity: Positive Semidefinite Hessian Matrix
- Lecture 26 - Application: MIMO Receiver Design as a Least Squares Problem
- Lecture 27 - Jensen's Inequality and Practical Application
- Lecture 28 - Jensen's Inequality application
- Lecture 29 - Properties of Convex Functions
- Lecture 30 - Conjugate Function and Examples to prove Convexity of various Functions
- Lecture 31 - Examples on Operations Preserving Convexity

Lecture 32 - Examples on Test for Convexity, Quasi-Convexity

Lecture 33 - Examples on Convex Functions

Lecture 34 - Practical Application: Beamforming in Multi-antenna Wireless Communication

Lecture 35 - Practical Application: Maximal Ratio Combiner for Wireless Systems

Lecture 36 - Practical Application: Multi-antenna Beamforming with Interfering User

Lecture 37 - Practical Application: Zero-Forcing (ZF) Beamforming with Interfering User

Lecture 38 - Practical Application: Robust Beamforming With Channel Uncertainty for Wireless Systems

Lecture 39 - Practical Application: Robust Beamformer Design for Wireless Systems

Lecture 40 - Practical Application: Detailed Solution for Robust Beamformer Computation in Wireless Systems Text

Lecture 41 - Linear modeling and Approximation Problems: Least Squares

Lecture 42 - Geometric Intuition for Least Squares

Lecture 43 - Practical Application: Multi antenna channel estimation

Lecture 44 - Practical Application: Image deblurring

Lecture 45 - Least Norm Signal Estimation

Lecture 46 - Regularization: Least Squares + Least Norm

Lecture 47 - Convex Optimization Problem representation: Canonical form, Epigraph form

Lecture 48 - Linear Program Practical Application: Base Station Co-operation

Lecture 49 - Stochastic Linear Program, Gaussian Uncertainty

Lecture 50 - Practical Application: Multiple Input Multiple Output (MIMO) Beamforming

Lecture 51 - Practical Application: Multiple Input Multiple Output (MIMO) Beamformer Design

Lecture 52 - Practical Application: Co-operative Communication, Overview and various Protocols used

Lecture 53 - Practical Application: Probability of Error Computation for Co-operative Communication

Lecture 54 - Practical Application: Optimal power allocation factor determination for Co-operative Communication

Lecture 55 - Practical Application: Compressive Sensing

Lecture 56 - Practical Application

Lecture 57 - Practical Application- Orthogonal Matching Pursuit (OMP) algorithm for Compressive Sensing

Lecture 58 - Example Problem: Orthogonal Matching Pursuit (OMP) algorithm

Lecture 59 - Practical Application : L1 norm minimization and regularization approach for Compressive Sensing Optimization problem

Lecture 60 - Practical Application of Machine Learning and Artificial Intelligence: Linear Classification, Overview and Motivation

Lecture 61 - Practical Application: Linear Classifier (Support Vector Machine) Design

Lecture 62 - Practical Application: Approximate Classifier Design

Lecture 63 - Concept of Duality

Lecture 64 - Relation between optimal value of Primal and Dual Problems, concepts of Duality gap and Strong Duality

Lecture 65 - Example problem on Strong Duality

Lecture 66 - Karush-Kuhn-Tucker (KKT) conditions

Lecture 67 - Application of KKT condition:Optimal MIMO power allocation (Waterfilling)

Lecture 68 - Optimal MIMO Power allocation (Waterfilling)-II

Lecture 69 - Example problem on Optimal MIMO Power allocation (Waterfilling)

Lecture 70 - Linear objective with box constraints, Linear Programming

Lecture 71 - Example Problems II

Lecture 72 - Examples on Quadratic Optimization

Lecture 73 - Examples on Duality: Dual Norm, Dual of Linear Program (LP)

Lecture 74 - Examples on Duality: Min-Max problem, Analytic Centering

Lecture 75 - Semi Definite Program (SDP) and its application:MIMO symbol vector decoding

Lecture 76 - Application:SDP for MIMO Maximum Likelihood (ML) Detection

Lecture 77 - Introduction to big Data: Online Recommender System (Netflix)

Lecture 78 - Matrix Completion Problem in Big Data: Netflix-I

Lecture 79 - Matrix Completion Problem in Big Data: Netflix-II

Lecture 1 - Overview of fiber-optic communication systems

Lecture 2 - Review of Maxwell's equations

Lecture 3 - Uniform plane waves (UWPs) in free-space

Lecture 4 - Properties of UWPs (propagation constant, polarization, and Poynting vector)

Lecture 5 - Boundary conditions and reflection from a PEC

Lecture 6 - Obliquely incident waves-I (TE and TM waves, Snell's laws)

Lecture 7 - Obliquely incident waves-II (Reflection and transmission coefficients, Brewster angle)

Lecture 8 - Total internal reflection

Lecture 9 - Ray theory of dielectric slab waveguides

Lecture 10 - Transverse resonance condition for slab waveguides

Lecture 11 - Introduction to optical fibers

Lecture 12 - Ray theory of light propagation in optical fibers

Lecture 13 - Concept of waveguide modes

Lecture 14 - Systematic procedure to obtain modes of a waveguide

Lecture 15 - Systematic analysis of parallel plate metallic waveguide

Lecture 16 - Systematic analysis of dielectric slab waveguides

Lecture 17 - Further discussion on slab waveguides

Lecture 18 - Modal analysis of step index optical fiber

Lecture 19 - Properties of modes of step-index optical fiber - I

Lecture 20 - Properties of modes of step-index optical fiber - II

Lecture 21 - Linearly polarized modes

Lecture 22 - Attenuation and power loss in fibers

Lecture 23 - Introduction to dispersion in fibers

Lecture 24 - Mathematical modelling of dispersion: Transfer function approach

Lecture 25 - Pulse propagation equation and its solution

Lecture 26 - Pre-chirped pulses and Inter and Intra-modal dispersion in optical fibers

Lecture 27 - Beam Propagation Method

Lecture 28 - Polarization Effects on Pulse Propagation

Lecture 29 - Modes in Optical Fibres and Pulse Propagation in Optical Fibres

Lecture 30 - Graded Index Fibers

Lecture 31 - Light Sources, Detectors and Amplifiers

- Lecture 32 - Basics of Lasers-I (Structure of Lasers, Process of Photon Emission)
- Lecture 33 - Basics of Lasers-II (Einstein's Theory of Radiation)
- Lecture 34 - Basics of Lasers-III (Population Inversion and Rate Equation for Lasers)
- Lecture 35 - Basic Properties of Semiconductor Laser-I (Energy Gap, Intrinsic and Extrinsic Semiconductors)
- Lecture 36 - Basic Properties of Semiconductor Laser-II (Fermi Level)
- Lecture 37 - Optical Properties of Semiconductors-I (Direct Bandgap and Indirect Bandgap, Density of States)
- Lecture 38 - Optical Properties of Semiconductors-II (Gain, Absorption, Recombination rate) Homojunction Lasers
- Lecture 39 - Double Heterostructure Lasers, Introduction to Quantum Well Lasers
- Lecture 40 - Semiconductor Optical Amplifier
- Lecture 41 - Erbium-doped fiber amplifier
- Lecture 42 - Photodetectors
- Lecture 43 - Noise in Photodetectors
- Lecture 44 - Introduction to WDM components
- Lecture 45 - Couplers, Circulators, FRM and Filters
- Lecture 46 - Filter, MUX/DEMUX, Diffraction grating (FBG and Long period grating)
- Lecture 47 - Optical Modulators-I (Current modulation)
- Lecture 48 - Optical Modulators-II (Electro-optic modulators)
- Lecture 49 - Review of Communication Concepts-I (Deterministic and Random Signals, Baseband and Passband Signals)
- Lecture 50 - Review of Communication Concepts-II (Signal and vectors, Signal energy, Orthonormal basis functions)
- Lecture 51 - Intensity modulation/ Direct Detection
- Lecture 52 - BER discussion for OOK systems
- Lecture 53 - Higher order modulation and Coherent Receiver
- Lecture 54 - Coherent receiver for BPSK systems and BER calculation
- Lecture 55 - Recovering Polarization
- Lecture 56 - DSP algorithms for Chromatic dispersion mitigation
- Lecture 57 - DSP algorithms for Carrier phase estimation - I
- Lecture 58 - DSP algorithms for Carrier phase estimation - II
- Lecture 59 - Nonlinear effects in fiber
- Lecture 60 - Four wave mixing, Loss measurement, Dispersion measurement
- Lecture 61 - Lab Demonstration (Laser diode characteristics, Loss measurement, Optical Intensity Modulation)



Lecture 1 - Introduction and Types of Transmission Lines

Lecture 2 - Distributed Circuit Model of Uniform Transmission Line

Lecture 3 - Voltage and Current Equation of the Transmission line

Lecture 4 - Sinusoidal Excitation of Transmission Line (Propagation constant, Characteristic Impedance)

Lecture 5 - Properties of Transmission Line (Reflection Coefficient, Input Impedance, Standing Wave Ratio)

Lecture 6 - Power Calculations and Introduction to Smith Chart

Lecture 7 - Smith Chart

Lecture 8 - Additional Applications of Smith Chart

Lecture 9 - Time domain Analysis of Transmission Line - I

Lecture 10 - Time domain Analysis of Transmission Line - II

Lecture 11 - Usage of Lattice Diagrams

Lecture 12 - TDR analysis of Transmission Lines

Lecture 13 - Introduction to Propagation of Electromagnetic Waves

Lecture 14 - Uniform Plane Waves - I

Lecture 15 - Uniform Plane Waves - II

Lecture 16 - Poynting Vector, Average Power, Polarization

Lecture 17 - Uniform Plane Waves in Lossy Medium

Lecture 18 - Normal Incidence of Plane Waves

Lecture 19 - Oblique Incidence of Plane Waves - I

Lecture 20 - Oblique Incidence of Plane Waves - II

Lecture 21 - Total Internal Reflection

Lecture 22 - Slab Waveguides

Lecture 23 - Optical Fibers

Lecture 24 - Parallel Plate Waveguides

Lecture 25 - Rectangular Waveguides

Lecture 26 - Modes of Rectangular Waveguides

Lecture 27 - Waveguides summary and Introduction to Radiation

Lecture 28 - Solution to Electric Scalar Potential and Magnetic Vector Potential Equations

Lecture 29 - Further discussion on Magnetic Vector Potential and Elementary Hertzian Dipole

Lecture 30 - Near field and Far-field Antenna and Properties of Antennas

Lecture 31 - Linear antenna - I

[Lecture 32 - Linear antenna - II and Properties of Transmitting and Receiving Antenna](#)

[Lecture 33 - Friis Transmission Formula](#)

[Lecture 34 - Antenna Array](#)

[Lecture 35 - Wireless Channel](#)

[Lecture 36 - Further discussion on Wireless Channel Modelling](#)

[Lecture 37 - Diffraction - I](#)

[Lecture 38 - Diffraction - II](#)

[Lecture 39 - Distribution of Laser Beam](#)

[Lecture 40 - Interference \(Double slit experiment, Fabry Perot Interferometer\)](#)

[Lecture 41 - Summary](#)

Lecture 1 - Basic Concepts

Lecture 2 - Sinusoids and Phasors

Lecture 3 - Circuit Elements - Part 1

Lecture 4 - Circuit Elements - Part 2

Lecture 5 - AC Power Analysis

Lecture 6 - RMS Voltage and Current

Lecture 7 - Topology

Lecture 8 - Star-Delta Transformation and Mesh Analysis

Lecture 9 - Mesh Analysis.

Lecture 10 - Nodal Analysis

Lecture 11 - Linearity Property and Superposition Theorem

Lecture 12 - Source Transformation

Lecture 13 - Duality

Lecture 14 - Thevenin's Theorem - 1

Lecture 15 - Thevenin's Theorem - 2

Lecture 16 - Norton's Theorem - 1

Lecture 17 - Norton's Theorem - 2

Lecture 18 - Maximum Power Transfer Theorem - 1

Lecture 19 - Maximum Power Transfer Theorem - 2

Lecture 20 - Reciprocity and Compensation Theorem

Lecture 21 - First Order RC Circuits

Lecture 22 - First Order RL Circuits

Lecture 23 - Singularity Functions

Lecture 24 - Step Response of RC and RL Circuits

Lecture 25 - Second Order Response

Lecture 26 - Step Response of Second Order Circuits-First Order and Second Order Circuits (Continued...)

Lecture 27 - Step Response of Parallel RLC Circuit-First Order and Second Order Circuits (Continued...)

Lecture 28 - Definition of the Laplace Transform

Lecture 29 - Properties of the Laplace Transform

Lecture 30 - Inverse Laplace Transform

Lecture 31 - Laplace Transform of Circuit Elements

[Lecture 32 - Transfer Function](#)

[Lecture 33 - Convolution Integral](#)

[Lecture 34 - Graphical Approach of Convolution Integral](#)

[Lecture 35 - Network Stability and Network Synthesis](#)

[Lecture 36 - Impedance Parameters](#)

[Lecture 37 - Admittance Parameters](#)

[Lecture 38 - Hybrid Parameters](#)

[Lecture 39 - Transmission Parameters](#)

[Lecture 40 - Interconnection of Networks](#)

[Lecture 41 - Nodal and Mesh Analysis](#)

[Lecture 42 - Superposition Theorem and Source Transformation](#)

[Lecture 43 - Thevenin's, Norton's and, Maximum Power Transfer Theorem](#)

[Lecture 44 - Magnetically Coupled Circuits](#)

[Lecture 45 - Energy in Coupled Circuits and Ideal Transformer](#)

[Lecture 46 - Ideal Transformer and Introduction to Three-Phase Circuits](#)

[Lecture 47 - Balanced Three-Phase Connections](#)

[Lecture 48 - Balanced Wye-Delta and Delta-Delta Connections](#)

[Lecture 49 - Balanced Delta-Wye Connection and Power in Balanced Three-Phase System](#)

[Lecture 50 - Unbalanced Three-Phase System and Three-Phase Power Measurement](#)

[Lecture 51 - Introduction to Graphical Models](#)

[Lecture 52 - State Equations](#)

[Lecture 53 - State Diagram](#)

[Lecture 54 - State Transition Matrix](#)

[Lecture 55 - State Variable Method to Circuit Analysis](#)

[Lecture 56 - Characteristic Equation, Eigenvalues, and Eigenvectors-State Variable Analysis \(Continued...\)](#)

[Lecture 57 - Modeling of Mechanical Systems](#)

[Lecture 58 - Modeling of The Rotational Motion of Mechanical Systems](#)

[Lecture 59 - Modeling of Electrical Systems](#)

[Lecture 60 - Solving Analogous Systems](#)

Lecture 1 - Introduction to Electric Drives

Lecture 2 - Dynamics of Electric Drives, Four Quadrant Operation, Equivalent Drive Parameters

Lecture 3 - Equivalent Drive Parameters, Friction Components, Nature of Load Torque

Lecture 4 - Steady State Stability, Load Equalization

Lecture 5 - Load Equalization, Characteristics of DC Motor

Lecture 6 - Speed Torque Characteristics of Separately Excited DC Motor and Series DC Motor

Lecture 7 - Field Control of Series Motor, Motoring and Braking of Separately Excited and Series DC motors

Lecture 8 - Speed Control of Separately Excited DC Motor Using Controlled Rectifiers

Lecture 9 - Analysis of Single Phase Full Controlled Converter-fed Separately Excited DC Motor

Lecture 10 - Speed Torque Characteristics of Full Controlled Converter-fed Separately Excited DC Motor, Analysis of Single Phase Half Controlled Converter-fed Separately Excited DC Motor

Lecture 11 - Analysis of Single Phase Half Controlled Converter-fed Separately Excited DC Motor.

Lecture 12 - Three Phase Full Controlled Converter-fed Separately Excited DC Motor, Multi-quadrant Operation of DC Motor

Lecture 13 - Dual Converter-fed DC Motor, Multi-quadrant Operation Using Field Current Reversal

Lecture 14 - DC Chopper-fed Separately Excited DC Motor for Motoring and Braking

Lecture 15 - Two-quadrant DC Chopper, Four-quadrant DC Chopper

Lecture 16 - Dynamic Braking of DC Motor by Chopper Controlled Resistor, Closed-loop Operation of DC Drives, Induction Motor Drives

Lecture 17 - Speed Torque Characteristics of Induction Motor, Operation of Induction Motor from Non-sinusoidal Supply

Lecture 18 - Operation of Induction Motor from Non-sinusoidal Supply

Lecture 19 - Stator Current of Induction Motor with Non-sinusoidal Supply, Operation of Induction Motor with Unbalanced Voltage Supply

Lecture 20 - Single Phasing of Induction Motor, Braking of Induction Motor

Lecture 21 - Dynamic braking of induction motor, AC dynamic braking, DC dynamic braking

Lecture 22 - Analysis of DC dynamic braking of induction motor

Lecture 23 - Self-excited dynamic braking of induction motor, Speed control of induction motor using stator voltage regulator, Variable voltage variable frequency control

Lecture 24 - Variable voltage variable frequency control of induction motor, Open loop V/F control

Lecture 25 - Slip speed control of induction motor, Constant Volt/Hz control with slip speed regulation

Lecture 26 - Closed-loop Volt/Hz control of induction motor with slip speed regulation, Multi-quadrant operation of induction motor drive

Lecture 27 - Current Source Inverter (CSI) fed induction motor drive

Lecture 28 - Closed-loop operation of current source inverter (CSI) fed induction motor drive, Control of slip ring induction motor - Static rotor resistance control

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Lecture 29 - Closed-loop operation of slip ring induction motor with static rotor resistance control, Slip power recovery in slip ring induction motor - Static Kramer drive

Lecture 30 - Static Kramer drive and its closed-loop control, Introduction to synchronous motor

Lecture 31 - Various types of synchronous motors, Equivalent circuit and phasor diagram of cylindrical synchronous motor, Speed-torque characteristics of cylindrical synchronous motor

Lecture 32 - Phasor diagram of salient pole synchronous motor, Expression of power and torque for a salient pole synchronous motor, Synchronous reluctance motor, Open-loop V/f control of synchronous motor

Lecture 33 - Open-loop V/f control, Torque-speed characteristics, Self controlled synchronous motor drive employing load commutated thyristor inverter

Lecture 34 - Detailed analysis of commutation of load commutated thyristor inverter, Derivation of overlap angle and margin angle, Closed-loop speed control scheme for load commutated inverter-fed synchronous motor drive

Lecture 35 - Low cost brushless DC motor (BLDCM), Trapezoidal permanent magnet AC motor

Lecture 36 - Trapezoidal permanent magnet AC motor, Derivation of power and torque, Closed-loop control of trapezoidal BLDC motor, Introduction to switched reluctance motor

Lecture 37 - Construction and operating principle of switched reluctance motor

Lecture 38 - Current/ voltage control for switched reluctance motor, operating modes of switched reluctance motor, Introduction to traction drives

Lecture 39 - Current collector for mainline trains, Nature of traction load, Duty cycle of traction drives

Lecture 40 - Duty cycle of traction drives, Distance between two stops, Calculation of total tractive effort and drive rating

Lecture 1 - Introduction: Fuzzy Sets, Logic and Systems and Applications

Lecture 2 - Introduction: Real Life Applications of Fuzzy Systems

Lecture 3 - Fuzzy Sets and Fuzzy Logic Toolbox in MATLAB - I

Lecture 4 - Fuzzy Sets and Fuzzy Logic Toolbox in MATLAB - II

Lecture 5 - Membership Functions - I

Lecture 6 - Membership Functions - II

Lecture 7 - Nomenclatures used in Fuzzy Set Theory - I

Lecture 8 - Nomenclatures used in Fuzzy Set Theory - II

Lecture 9 - Nomenclatures used in Fuzzy Set Theory - III

Lecture 10 - Set Theoretic Operations on Fuzzy Sets - I

Lecture 11 - Set Theoretic Operations on Fuzzy Sets - II

Lecture 12 - Properties of Fuzzy Sets - I

Lecture 13 - Properties of Fuzzy Sets - II

Lecture 14 - Properties of Fuzzy Sets - III

Lecture 15 - Properties of Fuzzy Sets - IV

Lecture 16 - Properties of Fuzzy Sets - V

Lecture 17 - Distance between Fuzzy Sets - I

Lecture 18 - Distance between Fuzzy Sets - II

Lecture 19 - Distance between Fuzzy Sets - III

Lecture 20 - Arithmetic Operations on Fuzzy Numbers - I

Lecture 21 - Arithmetic Operations on Fuzzy Numbers - II

Lecture 22 - Arithmetic Operations on Fuzzy Numbers - III

Lecture 23 - Complement of Fuzzy Sets

Lecture 24 - T-norm Operators

Lecture 25 - S-norm Operators

Lecture 26 - Parameterized T-Norm Operators

Lecture 27 - Parameterized S-Norm Operators

Lecture 28 - Fuzzy Relation - I

Lecture 29 - Fuzzy Relation - II

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# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

**NPTEL : NOC:Applied Linear Algebra for Signal Processing, Data Analytics and Machine Learning (Electrical Engineering)**

**Co-ordinators : Prof. Aditya K. Jagannatham**

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- Lecture 6 - Matrix: Determinant, Inverse Computation, Adjoint, Cofactor Concepts
- Lecture 7 - Applications of Matrices: Solution of System of Linear equations, MIMO Wireless Technology
- Lecture 8 - Applications of Matrices: Electric Circuits, Traffic flows
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**HTML Links for 1,14,300+ NPTEL Video Lectures, Created by LinuXpert Systems, Chennai**

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**NPTEL : Illumination Engineering (Electrical Engineering)**

**Co-ordinators : Prof. N.K. Kishore**

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# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

**NPTEL : NOC:Fundamentals of Electric Vehicles: Technology and Economics (Electrical Engineering)**

**Co-ordinators : Prof. Ashok Jhunjunwala, Prof. Prabhjot Kaur, Prof. Kaushal Kumar Jha, Prof. L Kannan**

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**NPTEL : Phase-locked loops (Electrical Engineering)**

**Co-ordinators : Dr. Saurabh Saxena**

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- Lecture 44 - Frequency response of Differential Amplifier
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- Lecture 46 - Basic Feedback Topologies
- Lecture 47 - Design of feedback amplifier for all configuration
- Lecture 48 - Stability and amplifier poles
- Lecture 49 - Bode plots and Frequency Plot
- Lecture 50 - Ideal Operational Amplifier and its terminal
- Lecture 51 - Op-amp as a Integrator and Differentiator
- Lecture 52 - Large Signal Operation of Op-amp and second order effects
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**NPTEL : NOC:DC Microgrid (Electrical Engineering)**

**Co-ordinators : Prof. Avik Bhattacharya**

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- Lecture 2 - Concept of Microgrids
- Lecture 3 - Microgrid and distributed generation
- Lecture 4 - Microgrid vs Conventional Power System
- Lecture 5 - AC and DC Microgrid with Distributed Energy Resources (AC Microgrid Part)
- Lecture 6 - AC and DC Microgrid with Distributed Energy Resources (AC Microgrid Part) (Continued...)
- Lecture 7 - Power Electronics for Microgrid
- Lecture 8 - Power Electronic Converters in Microgrid Applications
- Lecture 9 - Power Electronic Converters in Microgrid Applications (Power Electronic for Interfacing )
- Lecture 10 - Power Electronic Converters in Microgrid Applications (Converter Modulation Techniques)
- Lecture 11 - Modeling of converters in microgrid power system (AC/DC and DC/AC Converters Modeling)
- Lecture 12 - Modeling of Power Converters in Microgrid Power System (DC/DC Converter Modeling and Control)
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- Lecture 15 - Modeling of Energy Storage System
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- Lecture 18 - Microgrid Operation Modes and Standards - Part I
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- Lecture 27 - DC Microgrid System Architecture and AC Interface (Continued...)
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- Lecture 29 - DC Microgrid Dynamics and Modeling
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- Lecture 11 - Passive Filter Design - I
- Lecture 12 - Passive Filter Design - II
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- Lecture 14 - PWM Rectifier - II
- Lecture 15 - PWM Rectifier - III
- Lecture 16 - Three phase converters - I
- Lecture 17 - Three Phase Converters - II and multi pulse Converters
- Lecture 18 - Three Phase Converters - III and multi-pulse Converters
- Lecture 19 - VSI and CSI
- Lecture 20 - Multilevel Inverter - I
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- Lecture 2 - Introduction to VLSI Physical Design
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- Lecture 4 - Graphs for Physical Design
- Lecture 5 - Graph searching Algorithms
- Lecture 6 - Spanning Tree and Shortest Path Algorithms
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- Lecture 9 - Delay Parameters of a Combinational Circuit
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- Lecture 11 - Timing Analysis in a Sequential Circuit
- Lecture 12 - STA in Sequential Circuit with Clock Skew - I
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- Lecture 17 - STA for Combinational Circuits - I
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- Lecture 24 - Introduction to Floorplanning
- Lecture 25 - Floorplanning Representations
- Lecture 26 - Floorplanning Algorithms - 1
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- Lecture 28 - Pin Assignment and Power - Ground Routing
- Lecture 29 - Introduction to Placement
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- Lecture 31 - Min-cut placement



- Lecture 32 - Placement Algorithms
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- Lecture 34 - Introduction to Clock Tree Synthesis
- Lecture 35 - Clock Routing Algorithms - I
- Lecture 36 - Clock Routing Algorithms - II
- Lecture 37 - Clock Routing Algorithms - III
- Lecture 38 - Introduction and Optimization Goals - Global Routing
- Lecture 39 - Single net routing (Rectilinear routing)
- Lecture 40 - Global Routing in the connectivity graph
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- Lecture 57 - Open-Source tool - YOSYS
- Lecture 58 - OpenSTA Static Timing Analyzer
- Lecture 59 - OpenROAD Physical Synthesis Flow - I
- Lecture 60 - OpenROAD Physical Synthesis Flow - II

Lecture 1 - Introduction and Objectives of the course

Lecture 2 - Definition of a system and history of semiconductors

Lecture 3 - Products and levels of packaging

Lecture 4 - Packaging aspects of handheld products; Case studies in applications

Lecture 5 - Case Study (continued); Definition of PWB, summary and Questions for review

Lecture 6 - Basics of Semiconductor and Process flowchart; Video on "Sand-to-Silicon"

Lecture 7 - Wafer fabrication, inspection and testing

Lecture 8 - Wafer packaging; Packaging evolution; Chip connection choices

Lecture 9 - Wire bonding, TAB and flipchip-1

Lecture 10 - Wire bonding, TAB and flipchip-2; Tutorials

Lecture 11 - Why packaging? & Single chip packages or modules (SCM)

Lecture 12 - Commonly used packages and advanced packages; Materials in packages

Lecture 13 - Advances packages (continued); Thermal mismatch in packages; Current trends in packaging

Lecture 14 - Multichip modules (MCM)-types; System-in-package (SIP); Packaging roadmaps; Hybrid circuits; Quiz on packages

Lecture 15 - Electrical Issues " I; Resistive Parasitic

Lecture 16 - Electrical Issues " II; Capacitive and Inductive Parasitic

Lecture 17 - Electrical Issues " III; Layout guidelines and the Reflection problem

Lecture 18 - Electrical Issues " IV; Interconnection

Lecture 19 - Quick Tutorial on packages; Benefits from CAD; Introduction to DFM, DFR & DFT

Lecture 20 - Components of a CAD package and its highlights

Lecture 21 - Design Flow considerations; Beginning a circuit design with schematic work and component layout

Lecture 22 - Demo and examples of layout and routing; Technology file generation from CAD; DFM check list and design rules; Design for Reliability

Lecture 23 - Review of CAD output files for PCB fabrication; Photo plotting and mask generation

Lecture 24 - Process flow-chart; Vias; PWB substrates

Lecture 25 - Substrates continued; Video highlights; Surface preparation

Lecture 26 - Photoresist and application methods; UV exposure and developing; Printing technologies for PWBs

Lecture 27 - PWB etching; Resist stripping; Screen-printing technology

Lecture 28 - Through-hole manufacture process steps; Panel and pattern plating methods

Lecture 29 - Video highlights on manufacturing; Solder mask for PWBs; Multilayer PWBs; Introduction to microvias

Lecture 30 - Microvia technology and Sequential build-up technology process flow for high-density interconnects

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Lecture 31 - Conventional Vs HDI technologies; Flexible circuits; Tutorial session

Lecture 32 - SMD benefits; Design issues; Introduction to soldering

Lecture 33 - Reflow and Wave Soldering methods to attach SMDs

Lecture 34 - Solders; Wetting of solders; Flux and its properties; Defects in wave soldering

Lecture 35 - Vapour phase soldering, BGA soldering and Desoldering/Repair; SMT failures

Lecture 36 - SMT failure library and Tin Whiskers

Lecture 37 - Tin-lead and lead-free solders; Phase diagrams; Thermal profiles for reflow soldering; Lead-free alloys

Lecture 38 - Lead-free solder considerations; Green electronics; RoHS compliance and e-waste recycling issues

Lecture 39 - Thermal Design considerations in systems packaging

Lecture 40 - Introduction to embedded passives; Need for embedded passives; Design Library; Embedded resistor processes

Lecture 41 - Embedded capacitors; Processes for embedding capacitors; Case study examples; Summary of materials in packaging

Lecture 42 - Chapter-wise summary

- Lecture 1 - Course introduction and overview
- Lecture 2 - Distributed generation technologies
- Lecture 3 - Distributed storage technologies
- Lecture 4 - Distribution system protection
- Lecture 5 - Circuit breaker coordination
- Lecture 6 - Symmetrical component analysis and sequence excitation
- Lecture 7 - Modeling of distribution system components
- Lecture 8 - Protection components
- Lecture 9 - Impact of distributed generation of distribution protection
- Lecture 10 - Consumption and distribution grounding
- Lecture 11 - Islanding of distribution systems
- Lecture 12 - Modeling of islanded distribution systems
- Lecture 13 - Distribution system problems and examples
- Lecture 14 - Distribution system problems and examples continued
- Lecture 15 - Anti-islanding methods
- Lecture 16 - Solid state circuit switching
- Lecture 17 - Relaying for distributed generation
- Lecture 18 - Feeder voltage regulation
- Lecture 19 - Grounding, distribution protection coordination problems and examples
- Lecture 20 - Ring and network distribution
- Lecture 21 - Economic evaluation of DG systems
- Lecture 22 - Design for effective initial cost
- Lecture 23 - Single phase inverters
- Lecture 24 - DC bus design in voltage source inverter
- Lecture 25 - Electrolytic capacitor reliability and lifetime
- Lecture 26 - Inverter switching and average model
- Lecture 27 - Common mode and differential mode model of inverters
- Lecture 28 - Two leg single phase inverter
- Lecture 29 - Distribution system problems, and examples
- Lecture 30 - DG evaluation problems and examples
- Lecture 31 - Switch selection in two level voltage source inverters and loss evaluation

[Lecture 32 - Thermal model, management and cycling failure of IGBT modules](#)

[Lecture 33 - Semiconductor switch design reliability considerations](#)

[Lecture 34 - AC filters for grid connected inverters](#)

[Lecture 35 - AC inductor design and need for LCL filter](#)

[Lecture 36 - LCL filter design](#)

[Lecture 37 - Examples in power electronic design for DG systems](#)

[Lecture 38 - Examples in power electronic design for DG systems continued](#)

[Lecture 39 - Higher order passive damping design for LCL filters](#)

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Lecture 1 - Electronic switches

Lecture 2 - DC - DC converters

Lecture 3 - DC - AC converters

Lecture 4 - Multilevel converters - I

Lecture 5 - Multilevel converters - II

Lecture 6 - Applications of voltage source converter - I

Lecture 7 - Applications of voltage source converter - II

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Lecture 9 - Purpose of PWM - I

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Lecture 12 - Low switching frequency PWM - II

Lecture 13 - Selective harmonic elimination

Lecture 14 - Off-line optimized pulsewidth modulation

Lecture 15 - Sine-triangle pulsewidth modulation

Lecture 16 - Harmonic injection pulsewidth modulation

Lecture 17 - Bus-clamping pulsewidth modulation

Lecture 18 - Triangle-comparison based PWM for three-phase inverter

Lecture 19 - Concept of space vector

Lecture 20 - Conventional space vector PWM

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Lecture 22 - Space vector based advanced bus-clamping PWM

Lecture 23 - Harmonic analysis of PWM techniques

Lecture 24 - Analysis of RMS line current ripple using the notion of stator flux ripple

Lecture 25 - Evaluation of RMS line current ripple using the notion of stator flux ripple

Lecture 26 - Analysis and design of PWM techniques from line current ripple perspective

Lecture 27 - Instantaneous and average dc link current in a voltage source inverter

Lecture 28 - DC link current and DC capacitor current in a voltage source inverter

Lecture 29 - Analysis of torque ripple in induction motor drives - I

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Lecture 31 - Evaluation of conduction loss in three-phase inverter

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[Lecture 36 - Analysis of overmodulation in sine-triangle PWM from space vector perspective](#)

[Lecture 37 - Overmodulation in space vector modulated inverter](#)

[Lecture 38 - PWM for three-level neutral-point-clamped inverter - I](#)

[Lecture 39 - PWM for three-level neutral-point-clamped inverter - II](#)

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Lecture 1 - Introduction to DC-DC converter

Lecture 2 - Diode

Lecture 3 - Controlled Switches

Lecture 4 - Prior Art

Lecture 5 - Inductor

Lecture 6 - Transformer

Lecture 7 - Capacitor

Lecture 8 - Issues related to switches

Lecture 9 - Energy storage - Capacitor

Lecture 10 - Energy storage - Inductor

Lecture 11 - Primitive Converter

Lecture 12 - Non-Isolated converter - I

Lecture 13 - Non-Isolated converter - II

Lecture 14 - Isolated Converters - I

Lecture 15 - Isolated Converters - II

Lecture 16 - Conduction Mode

Lecture 17 - Problem set - I

Lecture 18 - Problem set - II

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Lecture 21 - State Space representation - II

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Lecture 23 - Circuit Averaging - II

Lecture 24 - State Space Model of Boost Converter

Lecture 25 - DC-DC converter controller

Lecture 26 - Controller Structure

Lecture 27 - PID Controller - I

Lecture 28 - PID Controller - II

Lecture 29 - PID Controller - III

Lecture 30 - Implementation of PID controller

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[Lecture 34 - Controllers and Sensing Circuit](#)

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[Lecture 37 - Current Control](#)

[Lecture 38 - Unity Power Factor Converter](#)

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Lecture 2 - Passive Components

Lecture 3 - Sources

Lecture 4 - Kirchoff's Law

Lecture 5 - Modelling of Circuit - Part 1

Lecture 6 - Modelling of Circuit - Part 2

Lecture 7 - Analysis Using MatLab

Lecture 8 - Sinusoidal steady state

Lecture 9 - Transfer Function and Pole Zero domain

Lecture 10 - Transfer function & pole zero

Lecture 11 - The Sinusoid

Lecture 12 - Phasor Analysis - Part 1

Lecture 13 - Phasor Analysis - Part 2

Lecture 14 - Power Factor

Lecture 15 - Power ports

Lecture 16 - Transformer Basics - Part 1

Lecture 17 - Transformer Basics - Part 2

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Lecture 19 - The Practical Transformer - Part 1

Lecture 20 - The Practical Transformer - Part 2

Lecture 21 - The Practical Transformer - Part 3

Lecture 22 - DC Machines - Part 1

Lecture 23 - DC Machines - Part 2

Lecture 24 - DC Generators - Part 1

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Lecture 1 - Electric Drive

Lecture 2 - Controlled Rectifier - Part-1

Lecture 3 - Controlled Rectifier - Part-2 (Three phase)

Lecture 4 - Controlled Rectifier - Part-3 (Three phase)

Lecture 5 - Controlled Rectifier - Part-4 (Three Phase)

Lecture 6 - Controlled Rectifier - Part-5 (Three Phase)

Lecture 7 - Power Electronics Improvements

Lecture 8 - Four Quadrant Dc to Dc Converter

Lecture 9 - Sine Triangle PWM Control of Converter

Lecture 10 - Front-end Ac-Dc Converter with harmonic control

Lecture 11 - Ac to Dc Converter Close Loop Control Schematic

Lecture 12 - Ac-Dc Converter Close loop Control Block Diagram

Lecture 13 - Design of the Converter Controller & AC to DC

Lecture 14 - Front-End Ac to Dc Converter-Design

Lecture 15 - Front-End Ac to Dc Converter - Simulation study

Lecture 16 - Dc Motor Speed Control - Introduction

Lecture 17 - Dc Motor Speed Control - Block Diagram

Lecture 18 - Dc Motor Speed Control Current Control & S C L

Lecture 19 - Dc-Motor Speed Control Controller Design - Part-1

Lecture 20 - Dc Motor Speed Control Controller Design - Part-2

Lecture 21 - Dc Motor Speed Control Controller Design - Part-3

Lecture 22 - Basics of DC to AC Converter - Part-1

Lecture 23 - Basics of DC to AC Converter - Part-2

Lecture 24 - Inverter Sine Triangle PWM

Lecture 25 - Inverter - Current Hysteresis Controlled PWM

Lecture 26 - C H controlled & Basics of space vector PWM

Lecture 27 - Space Vector PWM - Part-2

Lecture 28 - Space Vector PWM - Part-3

Lecture 29 - Space Vector PWM Signal Generation

Lecture 30 - Speed Control of Induction Motor - Part-1

Lecture 31 - Speed Control of Induction Motor - Part-2

[Lecture 32 - High dynamic performance of I M Drive](#)

[Lecture 33 - Dynamic Model of Induction Motor - Part-1](#)

[Lecture 34 - Dynamic Model of Induction Motor - Part-2](#)

[Lecture 35 - Vector Control of Induction Motor](#)

[Lecture 36 - Effect of Switching Time lag in Inverter](#)

[Lecture 37 - Power Switch Protection - Snubbers](#)

Lecture 1 - Introduction to IOTs - Part I

Lecture 2 - Introduction to IOTs - Part II

Lecture 3 - Introduction to IOTs - Examples

Lecture 4 - IOT applications - I

Lecture 5 - IOT applications - II

Lecture 6 - Power management in IOT device

Lecture 7 - Introduction to LDO

Lecture 8 - Design with an LDO

Lecture 9 - Introduction to switching regulators

Lecture 10 - Designing with LDO's, switching regulators and case studies - Part I

Lecture 11 - Designing with LDO's, switching regulators and case studies - Part II

Lecture 12 - Designing with LDO's, switching regulators and case studies - Part II

Lecture 13 - Designing with LDO's, switching regulators and case studies - Part IV

Lecture 14 - Power Conditioning with Energy Harvesters - I

Lecture 15 - Power Conditioning with Energy Harvesters - II

Lecture 16 - Power Conditioning with Energy Harvesters - III

Lecture 17 - Battery less power supply and battery life calculation for embedded devices - I

Lecture 18 - Battery less power supply and battery life calculation for embedded devices - II

Lecture 19 - Battery less power supply and battery life calculation for embedded devices - III

Lecture 20 - Introduction to MQTT

Lecture 21 - Quality of Service in MQTT

Lecture 22 - Standards and Security in MQTT

Lecture 23 - Introduction and Implementation of AMQP

Lecture 24 - Implementation of CoAP and MDNS

Lecture 25 - Basics of RFID

Lecture 26 - RFID protocol and applications

Lecture 27 - BLE Security

Lecture 28 - LPWAN technologies

Lecture 29 - Choice of Microcontrollers

Lecture 30 - Case Study 1 - Joule Jotter

Lecture 31 - Case Study 2 - Cloud Based Systems



Lecture 1 - Advantages of HVAC/DC Transmission, Introduction to Grid Management

Lecture 2 - Transmission system development, Important components of transmission system

Lecture 3 - Insulation coordination, over voltage in power systems

Lecture 4 - Design/selection of insulators, Importance of grading/cc rings

Lecture 5 - Non ceramic insulators performance-service experience

Lecture 6 - Failure of apparatus in the field, importance of reliability and testing

Lecture 7 - Pollution flashover phenomena, modeling etc

Lecture 8 - Planning of High Voltage laboratories

Lecture 9 - Importance of High Voltage testing and techniques employed

Lecture 10 - Basic philosophy of HV testing, tests for various HV apparatus

Lecture 11 - HV testing techniques for various apparatus

Lecture 12 - HV testing on Composite Insulators

Lecture 13 - Surface degradation studies on composite insulators

Lecture 14 - Surface morphological techniques for composite insulators

Lecture 15 - Conductors used for EHV/UHV transmission

Lecture 16 - Corona and interference on transmission lines

Lecture 17 - Introduction of HTLS conductors and their advantages

Lecture 18 - Mechanical considerations for HV conductors

Lecture 19 - Introduction to Towers and importance of foundations

Lecture 20 - Selection/Design of clearances for HV towers

Lecture 21 - Design Optimization for UHV towers

Lecture 22 - Introduction to 1100kV HVDC

Lecture 23 - Introduction to HV Substations

Lecture 24 - Types of Substations, comparison

Lecture 25 - Insulation coordination, Components in a typical substation

Lecture 26 - Preventive maintenance of Substation

Lecture 27 - Electric and magnetic fields, mitigations techniques

Lecture 28 - Importance of Grounding, reducing Earthing resistance

Lecture 29 - Introduction to the use of Fiber optic cables, OPGW

Lecture 30 - Introduction to communication and SCADA

Lecture 31 - Precautions and safety measures in substation



[Lecture 32 - Electrical hazards, minimum clearances in substation](#)

[Lecture 33 - Importance of Generation of HVDC in the laboratory](#)

[Lecture 34 - Importance of Generation of HVAC, Impulse Voltage and Currents in the laboratory](#)

[Lecture 35 - Measurements of High Voltages](#)

[Lecture 36 - Measurements of High Voltages \(Continued...\)](#)

[Lecture 37 - Introduction to digital recorders, measurement](#)

[Lecture 38 - Upgradation/uprating of transmission lines- advantages](#)

[Lecture 39 - Upgradation/uprating of transmission lines- advantages \(Continued...\)](#)

[Lecture 40 - Summary of the course](#)

- Lecture 1 - Introduction to signal processing
- Lecture 2 - Basics of signals and systems
- Lecture 3 - Linear time-invariant systems
- Lecture 4 - Modes in a linear system
- Lecture 5 - Introduction to state space representation
- Lecture 6 - State space representation
- Lecture 7 - Non-uniqueness of state space representation
- Lecture 8 - Introduction to vector space
- Lecture 9 - Linear independence and spanning set
- Lecture 10 - Unique representation theorem
- Lecture 11 - Basis and cardinality of basis
- Lecture 12 - Norms and inner product spaces
- Lecture 13 - Inner products and induced norm
- Lecture 14 - Cauchy Schwartz inequality
- Lecture 15 - Orthonormality
- Lecture 16 - Problem on sum of subspaces
- Lecture 17 - Linear independence of orthogonal vectors
- Lecture 18 - Hilbert space and linear transformation
- Lecture 19 - Gram Schmidt orthonormalization
- Lecture 20 - Linear approximation of signal space
- Lecture 21 - Gram Schmidt orthogonalization of signals
- Lecture 22 - Problem on orthogonal complement
- Lecture 23 - Problem on signal geometry (4-QAM)
- Lecture 24 - Basics of probability and random variables
- Lecture 25 - Mean and variance of a random variable
- Lecture 26 - Introduction to random process
- Lecture 27 - Statistical specification of random processes
- Lecture 28 - Stationarity of random processes
- Lecture 29 - Problem on mean and variance
- Lecture 30 - Problem on MAP Detection
- Lecture 31 - Fourier transform of dirac comb sequence

[Lecture 32 - Sampling theorem](#)

[Lecture 33 - Basics of multirate systems](#)

[Lecture 34 - Frequency representation of expanders and decimators](#)

[Lecture 35 - Decimation and interpolation filters](#)

[Lecture 36 - Fractional sampling rate alterations](#)

[Lecture 37 - Digital filter banks](#)

[Lecture 38 - DFT as filter bank](#)

[Lecture 39 - Noble Identities](#)

[Lecture 40 - Polyphase representation](#)

[Lecture 41 - Efficient architectures for interpolation and decimation filters](#)

[Lecture 42 - Problems on simplifying multirate systems using noble identities](#)

[Lecture 43 - Problem on designing synthesis bank filters](#)

[Lecture 44 - Efficient architecture for fractional decimator](#)

[Lecture 45 - Multistage filter design](#)

[Lecture 46 - Two-channel filter banks](#)

[Lecture 47 - Amplitude and phase distortion in signals](#)

[Lecture 48 - Polyphase representation of 2-channel filter banks, signal flow graphs and perfect reconstruction](#)

[Lecture 49 - M-channel filter banks](#)

[Lecture 50 - Polyphase representation of M-channel filter bank](#)

[Lecture 51 - Perfect reconstruction of signals](#)

[Lecture 52 - Nyquist and half band filters](#)

[Lecture 53 - Special filter banks for perfect reconstruction](#)

[Lecture 54 - Introduction to wavelets](#)

[Lecture 55 - Multiresolution analysis and properties](#)

[Lecture 56 - The Haar wavelet](#)

[Lecture 57 - Structure of subspaces in MRA](#)

[Lecture 58 - Haar decomposition - 1](#)

[Lecture 59 - Haar decomposition - 2](#)

[Lecture 60 - Wavelet Reconstruction](#)

[Lecture 61 - Haar wavelet and link to filter banks](#)

[Lecture 62 - Demo on wavelet decomposition](#)

[Lecture 63 - Problem on circular convolution](#)

[Lecture 64 - Time frequency localization](#)

[Lecture 65 - Basic analysis: Pointwise and uniform continuity of functions](#)

[Lecture 66 - Basic Analysis : Convergence of sequence of functions](#)

[Lecture 67 - Fourier series and notions of convergence](#)

[Lecture 68 - Convergence of Fourier series at a point of continuity](#)

[Lecture 69 - Convergence of Fourier series for piecewise differentiable periodic functions](#)

[Lecture 70 - Uniform convergence of Fourier series of piecewise smooth periodic function](#)

[Lecture 71 - Convergence in norm of Fourier series](#)

[Lecture 72 - Convergence of Fourier series for all square integrable periodic functions](#)

[Lecture 73 - Problem on limits of integration of periodic functions](#)

[Lecture 74 - Matrix Calculus](#)

[Lecture 75 - KL transform](#)

[Lecture 76 - Applications of KL transform](#)

[Lecture 77 - Demo on KL Transform](#)

[Lecture 78 - Live Session](#)

[Lecture 79 - Live Session 2](#)

Lecture 1 - Electronic Equipment Thermal issues

Lecture 2 - Practical Examples - 1

Lecture 3 - Practical Examples - 2

Lecture 4 - CEDT worked examples - 1

Lecture 5 - CEDT worked examples - 2

Lecture 6 - Text book theory

Lecture 7 - Sample heat sinks

Lecture 8 - Published correlations - 1

Lecture 9 - Published correlations - 2

Lecture 10 - Parallel combined effects

Lecture 11 - Mounting of packages

Lecture 12 - Combined Rth of devices

Lecture 13 - Schonholzer moduls

Lecture 14 - 1972 model paper

Lecture 15 - Jensen model

Lecture 16 - Thermal management - 1

Lecture 17 - Thermal management - 2

Lecture 18 - Round up of full model

Lecture 19 - Fan cooling

Lecture 20 - Thermo-electric cooling

Lecture 21 - On-the-net DIY work

Lecture 22 - Practical video

Lecture 23

Lecture 24

Lecture 25

Lecture 26

Lecture 27 - Real packages

Lecture 28 - Prior art

Lecture 29 - OTS standard profiles

Lecture 30 - CAD detailed design of profiles

Lecture 31 - Round up

[Lecture 32 - 4X Peltier Cooler](#)

[Lecture 33 - Manufacturing Video](#)

[Lecture 34 - Peltier heat sink](#)

- Lecture 1 - Introduction to Integrated Circuits (IC) Technology
- Lecture 2 - Introduction to fabrication of IC: Substrates
- Lecture 3 - Introduction to IC fabrication
- Lecture 4 - Introduction to IC fabrication (Continued...)
- Lecture 5 - Introduction to the fabrication of sensors
- Lecture 6 - Introduction to fabrication technology
- Lecture 7 - Introduction to fabrication technology (Continued...)
- Lecture 8 - Introduction to fabrication technology (Continued...)
- Lecture 9 - Introduction to fabrication technology (Continued...)
- Lecture 10 - Introduction to fabrication technology (Continued...)
- Lecture 11 - Process flow for Fabrication of MOSFETs
- Lecture 12 - Operation of Enhancement type MOSFET
- Lecture 13 - Operation of Depletion type MOSFET
- Lecture 14 - MOSFETs Characteristics and Applications (Current Mirrors)
- Lecture 15 - Introduction to Operational Amplifiers
- Lecture 16 - Operational Amplifier Characteristics
- Lecture 17 - Operational Amplifier Characteristics (Continued...)
- Lecture 18 - Characteristics of an op-amp (Continued...)
- Lecture 19 - Operational Amplifier Configurations
- Lecture 20 - Operational Amplifier Configurations (Continued...)
- Lecture 21 - Applications of Operational Amplifier: Differential Amplifier
- Lecture 22 - Applications of Operational Amplifier: Integrator
- Lecture 23 - Applications of Operational Amplifier: Differentiator
- Lecture 24 - Introduction to Passive and Active Filters and op-amp as Low Pass Filter
- Lecture 25 - Operational Amplifier as a High Pass Filter
- Lecture 26 - Operational Amplifier as a Band Pass and Band Reject Filter
- Lecture 27 - Introduction to Oscillator
- Lecture 28 - RC Phase Shift Oscillator using Op-amp
- Lecture 29 - Wein Bridge Oscillator using Op-amp
- Lecture 30 - Hartley and Colpitts Oscillator using Op-amp
- Lecture 31 - Working of Crystal Oscillators

- Lecture 32 - Construction and Operation of UJT Relaxation Oscillators
- Lecture 33 - Introduction to Noise and its Types
- Lecture 34 - Analysis of Data Sheets of an Op-Amp
- Lecture 35 - Analysis of Data Sheets of an Op-Amp (Continued...)
- Lecture 36 - Analysis of Data Sheets of an Op-Amp (Continued...)
- Lecture 37 - Experiment - Introduction to Laboratory Equipment
- Lecture 38 - Experiment - Measurement of Active and Passive elements using Multimeter
- Lecture 39 - Experiment - Working with Laboratory Equipment: Power Supply
- Lecture 40 - Experiment - Working with Laboratory Equipment: Function Generator, Oscilloscope
- Lecture 41 - Experiment - Op-Amp Characteristics: Input Bias Current
- Lecture 42 - Experiment - Op-Amp Characteristics: Input Offset Current
- Lecture 43 - Experiment - Op-Amp Characteristics: Input Offset Voltage
- Lecture 44 - Experiment - Op-Amp as Inverting Amplifier
- Lecture 45 - Experiment - Op-Amp as Non-Inverting Amplifier
- Lecture 46 - Experiment - To study input and output voltage range of an Op-Amp
- Lecture 47 - Experiment - Differential amplifier using op-amp
- Lecture 48 - Experiment - To study the gain of instrumentation amplifier
- Lecture 49 - Experiment - Summing amplifier using op-amp
- Lecture 50 - Experiment - To study op-amp based comparator
- Lecture 51 - Experiment - To study op-amp based integrator and differentiator
- Lecture 52 - Experiment - Study of passive low pass filter
- Lecture 53 - Experiment - Op-amp based active low pass filter
- Lecture 54 - Experiment - Passive and active high pass filter
- Lecture 55 - Experiment - Introduction to experimental set-up of band pass filter
- Lecture 56 - Experiment - Passive and active band pass filter
- Lecture 57 - Experiment - Introduction to experimental set-up for band reject filter
- Lecture 58 - Experiment - Active band reject filter
- Lecture 59 - Experiment - Peak detector circuit using Op-Amp



Lecture 1 - Quantum Mechanics: Concept of Wave Particle, Schrodingers Equation

Lecture 2 - Quantum Mechanics: Particle in a Box

Lecture 3 - Quantum Mechanics: Particle in a Box (Continued...), Harmonic Oscillator

Lecture 4 - Solids: Formation of Bands, Kronig-Penny Model

Lecture 5 - Solids: Kronig-Penny Model (Continued...)

Lecture 6 - Solids: Electrons and Holes

Lecture 7 - Solids: Electrons and Holes (Continued...)

Lecture 8 - Solids: Crystals

Lecture 9 - Density of States

Lecture 10 - Density of States (Continued...), Fermi Function

Lecture 11 - Fermi Function - Carrier Concentration

Lecture 12 - Doping

Lecture 13 - Doping (Continued...)

Lecture 14 - Recombination and Generation

Lecture 15 - Recombination and Generation (Continued...)

Lecture 16 - Recombination and Generation (Continued...), Charge Transport

Lecture 17 - Charge Transport (Continued...)

Lecture 18 - Continuity Equation

Lecture 19 - Junctions

Lecture 20 - Metal Semiconductor Junctions

Lecture 21 - Schottky Contact: Electrostatics

Lecture 22 - Schottky Contact: Current-Voltage (IV) Characteristics

Lecture 23 - Schottky Contact: IV Characteristics (Continued...)

Lecture 24 - Schottky Contact: Small Signal Impedance

Lecture 25 - PN Junctions: Electrostatics

Lecture 26 - PN Junctions: IV Characteristics

Lecture 27 - PN Junctions: Small Signal Impedance

Lecture 28 - PN Junctions: Non-Idealities

Lecture 29 - Bipolar Junction Transistors (BJT)

Lecture 30 - BJT: IV Characteristics

Lecture 31 - BJT: Non-Idealities and Equivalent Circuit Modeling

[Lecture 32 - Metal Oxide Semiconductor Capacitor \(MOSCAP\)](#)

[Lecture 33 - MOSCAP \(Continued...\)](#)

[Lecture 34 - MOSCAP: CV Characteristics](#)

[Lecture 35 - MOSCAP: CV Characteristics \(Continued...\)](#)

[Lecture 36 - MOSFET: Introduction](#)

[Lecture 37 - MOSFET: I-V characteristics](#)

[Lecture 38 - MOSFET: I-V characteristics \(Continued...\)](#)

[Lecture 39 - MOSFET: I-V characteristics \(Continued...\)](#)

[Lecture 40 - Subthreshold swing, Additional concepts](#)

[Lecture 41 - Trapped charge, Body-bias](#)

[Lecture 42 - Scaling of MOSFETs](#)

[Lecture 43 - Scaling of MOSFETs \(Continued...\), Leakage currents in MOSFETs](#)

[Lecture 44 - MOSFET characterization: Parameter extraction](#)

[Lecture 45 - MOSFET characterization: Trapped charges, contact resistance](#)

[Lecture 46 - MOSFET as a switch](#)

[Lecture 47 - MOSFET as a switch \(Continued...\)](#)

[Lecture 48 - Amplifiers using MOSFET](#)

[Lecture 49 - Amplifiers using MOSFET \(Continued...\)](#)

[Lecture 50 - Circuits: Frequency Response, Noise](#)

[Lecture 51 - Introduction: Amorphous Semiconductors](#)

[Lecture 52 - Thin Film Transistors](#)

[Lecture 53 - Tutorials Session - 1](#)

[Lecture 54 - Tutorials Session - 2](#)

[Lecture 55 - Tutorials Session - 3](#)

- Lecture 1 - Introduction to Microengineering Devices
- Lecture 2 - Introduction to Microengineering Devices (Continued...)
- Lecture 3 - Introduction to Microengineering Devices (Continued...)
- Lecture 4 - Silicon, silicon di-oxide and photolithography
- Lecture 5 - Silicon, silicon di-oxide and photolithography (Continued...)
- Lecture 6 - Physical Vapour Deposition
- Lecture 7 - Physical Vapour Deposition (Continued...)
- Lecture 8 - Photolithography
- Lecture 9 - Mask Aligner
- Lecture 10 - Mask Aligner (Continued...)
- Lecture 11 - Micromachining
- Lecture 12 - Micromachining: Fabrication of VOC Sensor
- Lecture 13 - Micromachining: Fabrication of VOC Sensor (Continued...)
- Lecture 14 - Micromachining: Fabrication of VOC Sensor and Cantilever
- Lecture 15 - Chemical Vapour Deposition
- Lecture 16 - Typical Microfabricated Devices for Biomedical Applications
- Lecture 17 - Cancer Diagnostic Tool
- Lecture 18 - Process flow for Fabrication of Micro Heater
- Lecture 19 - Process flow for Fabrication of Interdigitated Electrodes
- Lecture 20 - Process flow for Fabrication of Interdigitated Electrodes (Continued...)
- Lecture 21 - Process flow for Fabrication of ETM phenotyping
- Lecture 22 - Process flow for Fabrication of Piezo canteliver
- Lecture 23
- Lecture 24
- Lecture 25
- Lecture 26
- Lecture 27 - Microchip for Rapid Drug Screening
- Lecture 28 - Microchip for Rapid Drug Screening (Continued...)
- Lecture 29 - A Microfluidic chip for rapid bacterial antibiotic Susceptibility testing
- Lecture 30 - Smart Catheter
- Lecture 31 - Smart Catheter: Flexible Force Sensor

[Lecture 32 - Smart Catheter: Flexible Force Sensor \(Continued...\)](#)

[Lecture 33 - Tissue and Cell Culture Techniques](#)

[Lecture 34 - Clean Room: Equipments Required](#)

[Lecture 35 - GLP: Gowning Procedure for using Lab](#)

[Lecture 36 - Introduction to Equipments: Refridgerator](#)

[Lecture 37 - Gowning Procedure for using Biological Lab Setup](#)

[Lecture 38 - Introduction to Equipments: Desiccator](#)

[Lecture 39 - Introduction to Equipments: Impedance Analyzer](#)

[Lecture 40 - Introduction to Equipments: DAQ](#)

[Lecture 41 - Function generator, Multimeter, Sampling, LabVIEW, NI-CDAQ](#)

[Lecture 42 - Introduction to Equipments: Stereo Microscope](#)

[Lecture 43 - Introduction to Equipments: Metallurgical Microscope](#)

[Lecture 44 - Introduction to Equipments: Inverted Microscope](#)

[Lecture 45 - Introduction to Equipments: Fire Alarm](#)

[Lecture 46 - Introduction to Equipments: Bio-safety Hood](#)

[Lecture 47 - Introduction to Equipments: Peristaltic Pump](#)

[Lecture 48 - Introduction to Equipments: Incubator](#)

[Lecture 49 - Introduction to Equipments: Oven](#)

[Lecture 50 - Introduction to Equipments: Micromanipulator](#)

[Lecture 51 - PDMS Moulding](#)

[Lecture 52 - 3D Printing](#)

[Lecture 53 - Introduction to Fabricated Sensors](#)

[Lecture 54 - Simulation: Electro- Thermo- Mechanical Properties of Micro-heater using COMSOL Multiphysics](#)

[Lecture 55 - Simulation: Electro- Thermo- Mechanical Properties of Micro-heater using COMSOL Multiphysics \(Continued...\)](#)

Lecture 1 - Introduction/Summary on Op-amps

Lecture 2 - Introduction/Summary on Op-amps (Continued...)

Lecture 3 - Introduction/Summary on Op-amps (Continued...)

Lecture 4 - Effect of Loading and Input Impedance - Part 1

Lecture 5 - Effect of Loading and Input Impedance - Part 2

Lecture 6 - Effect of Loading and Input Impedance - Part 3

Lecture 7 - Effect of Loading and Input Impedance - Part 4

Lecture 8 - Introduction to an Analog Circuit Development Board (TI ASLK Pro)

Lecture 9 - Op-amp Applications: Half Wave Rectifier

Lecture 10 - Op-amp Applications: Full Wave Rectifier

Lecture 11 - Op-amp Applications: Clipper

Lecture 12 - Op-amp Circuits using Diodes: Clamper

Lecture 13 - Understanding the Range of Feedback Amplifiers

Lecture 14 - Op-amps as Phase Shift Oscillator

Lecture 15 - Op-amp as Wein Bridge Oscillator

Lecture 16 - Op-amp as Hartley Oscillator

Lecture 17 - Op-amp as Colpitts Oscillator

Lecture 18 - Op-amps as Comparator: Window Comparator

Lecture 19 - Op-amp with Positive Feedback: Inverting Schmitt Trigger

Lecture 20 - Op-amp with Positive Feedback: Non-Inverting Schmitt Trigger

Lecture 21 - Op-amp with Positive Feedback: Astable Multivibrator

Lecture 22 - Op-amp with Positive Feedback: Monostable Multivibrator

Lecture 23 - Op-amp based Voltage Controlled Current Source

Lecture 24 - Measure of Unknown Resistance by Constant Current Drive Circuit Implemented using Op-amp

Lecture 25 - Design and Development of Temperature Controlled Circuit using Op-amp as ON-OFF, Proportional and Proportional Integral Controllers: Introduction

Lecture 26 - Implementation of Error Detector Circuit and Signal Conditioning Circuit for Temperature Control

Lecture 27 - Implementation of Plant/Heating Circuit and ON-OFF Controller

Lecture 28 - Implementation of P and PI Controllers

Lecture 29 - Experiment on Controlling the Temperature on the Plant using different Controllers

Lecture 30 - Experiment: Design and Implementation of Signal Conditioning unit for Thermocouple Cold Junction Compensation

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Lecture 31 - Introduction to ECG Experiment

Lecture 32 - Design and Implementation of ECG Preprocessing Stage - Part 1

Lecture 33 - Design and Implementation of ECG Preprocessing Stage - Part 2

Lecture 34 - Design and Implementation of ECG Preprocessing Stage - Part 3

Lecture 35 - Design and Implementation of ECG Preprocessing Stage - Part 4

Lecture 36 - Design and Implementation of Peak Detector and Thresholding Circuit for ECG Signal Conditioning

Lecture 37 - Live Demonstration on ECG Signal Acquisition, Conditioning and Measurement of BPM

Lecture 38 - Understanding Analog Multipliers using Development Board

Lecture 39 - Application: Automatic Gain Controller using Development Board

Lecture 40 - Introduction to Data-Acquisition

Lecture 41 - Analog to Digital Conversion Circuits and Experiment on 2-bit Flash Type ADC

Lecture 42 - Digital to Analog Conversion Circuits and Experiment on 4-bit R-2R DAC

Lecture 43 - DAC Basics using Development Board - Introduction

Lecture 44 - Understanding DAC 7821 Datasheet

Lecture 45 - Basic DAC Experiment on Variable Gain Amplifier

Lecture 46 - Understanding DAC: Experiment on Variable Square and Triangular Wave Generator

Lecture 47 - Introduction to CDAQ (Compact DAQ)

Lecture 48 - Software-in-Loop based Temperature Controller using CDAQ and LabVIEW

Lecture 1 - Products prototyping

Lecture 2 - Prototype concepts

Lecture 3 - Physical simulation

Lecture 4 - Rapid Prototyping

Lecture 5 - Products detailing

Lecture 6 - Advantages of Design Modelling

Lecture 7 - Sample product concept

Lecture 8 - Product sample exercise 1

Lecture 9 - Exercise in product sample 2

Lecture 10 - Integration of components 1

Lecture 11 - Components integration in models

Lecture 12 - 3D printing detail 1

Lecture 13 - 3D printing detail 2

Lecture 14 - 3D print assembly design

Lecture 15 - Heat spreader to 3D print

Lecture 16 - Metallic, 3D, build up 1

Lecture 17 - 3D build up 2

Lecture 18 - 3D design 1 from Photo snap

Lecture 19 - 3D design 2 from Photo snap

Lecture 20 - 3D Laser cuts 1, prints

Lecture 21 - 3D Laser cuts 2, open source public prints

Lecture 22 - Demo of 3D Part print

Lecture 23 - Building a model 1

Lecture 24 - Building a model 2

Lecture 25 - Common place objects

Lecture 26 - Materials

Lecture 27 - Future 3D In biology

Lecture 28 - Product clamp variants

Lecture 29 - Product clamp build up

Lecture 30 - Multi direction features

Lecture 31 - Multi direction features (Continued...)

[Lecture 32 - Fastening detail](#)

[Lecture 33 - Flat objects](#)

[Lecture 34 - Modularity](#)

[Lecture 35 - Creative design work](#)

[Lecture 36 - Creative designs](#)

[Lecture 37 - Using flat features](#)

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- Lecture 15 - Waveguide modes - 1
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- Lecture 19 - Waveguide design - Boundary value formulation
- Lecture 20 - Waveguide design - BVP solution
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- Lecture 23 - Coupled mode theory - 1
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- Lecture 4 - Lab 2 - Cleanroom and Gowning Protocol
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- Lecture 18 - Lab 6 - Liftoff Demonstration
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- Lecture 7 - Analysis of Magnetic Circuits With and Without Air Gaps
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- Lecture 23 - Stator Winding Design-Fractional Slot Double Layer Winding
- Lecture 24 - Variable Pole Machine Stator Winding Design (Pole-Phase Modulation) - 1
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- Lecture 26 - Importance of Motor Design and Standards of Electric Motors
- Lecture 27 - Electric Machine Sizing Equations-Output Power and Volume (D2L) Product Equation
- Lecture 28 - Lab Session on Re-winding of Induction Motor (Example: Double Layer Winding)
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- Lecture 30 - Electric Machine Sizing Equations-Output Power Equation in terms of D3L Product - 1
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- Lecture 32 - Analysis of Copper Function and Output Function w r t the Electric Machine D3L Product Eqn
- Lecture 33 - Example Problems on Output Power Equation in terms of D3L Product
- Lecture 34 - Electric Machine Sizing Equations-Output Power Equation in terms of D the power 2.5 L Product
- Lecture 35 - Design Procedure of an Electric Machine
- Lecture 36 - Name Plate Details and Datasheets of Induction Motor
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- Lecture 38 - Design of Induction Machine- Stator Design - 2 (Stator Winding Design)
- Lecture 39 - Design of Induction Machine- Stator Design - 3 (Stator Slot Geometry)
- Lecture 40 - Design of Induction Machine- Rotor Design - 1 (Rotor Slots Selection)
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- Lecture 42 - Design of Induction Machine- Rotor Design - 3 (Rotor Slot Geometry)
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- Lecture 45 - Carter's Coefficient of Electrical Machines
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- Lecture 47 - Stator MMF and Magnetizing Current Equations of Induction Machine
- Lecture 48 - Magnetizing Inductance of Induction Machine
- Lecture 49 - Stator and Rotor Leakage Inductances of Induction Machine
- Lecture 50 - Equivalent Circuit Parameters of Induction Machine
- Lecture 51 - Loss Calculation of Induction Machine - 1
- Lecture 52 - Loss Calculation of Induction Machine - 2 and Performance Parameters of Induction Motor
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- Lecture 54 - The Figure of Merits for SRM and Example Problem on Output Power Equation i t f D2L Product
- Lecture 55 - Design of Switched Reluctance Machine: Stator Design - 1
- Lecture 56 - Design of Switched Reluctance Machine: Stator Design - 2 and Rotor Design
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- Lecture 59 - Efficiency and Loss Calculation of SRM
- Lecture 60 - Importance of Thermal Design and Thermal Limits for Electrical Machines
- Lecture 61 - Electric and Thermal Circuits Interface
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- Lecture 6 - Heterojunction device physics (Continued...) and III-nitrides
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- Lecture 24 - Small-signal model and noise in HEMTs
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- Lecture 27 - pHEMTs for low noise and introduction to InP HEMT
- Lecture 28 - InP HEMTs for power and the concept of metamorphic HEMTs
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- Lecture 31 - AlGaIn/GaN HEMT: gate process, field-plate and trade-offs in design



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- Lecture 38 - Noise in MOSFETs and Introduction to LDMOS
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- Lecture 41 - LDMOS: HCI, snapback, finger layout and some aspects of commercial devices
- Lecture 42 - BJT: common base and common emitter from the device point of view
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- Lecture 51 - Waveguides, T-lines and introduction to 2-port networks
- Lecture 52 - S-parameters and the basics of Smith Chart
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- Lecture 9 - Iterating the filter bank from  $\Psi$ ,  $\Phi$
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# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

**NPTEL : Advanced VLSI Design (Electronics and Communication Engineering)**

**Co-ordinators : Prof. A.N. Chandorkar, Prof. D.K. Sharma, Prof. Sachin Patkar, Prof. Virendra Singh**

Lecture 1 - Historical Perspective and Future Trends in CMOS VLSI Circuit and System Design - Part I

Lecture 2 - Historical Perspective and Future Trends in CMOS VLSI Circuit and System Design - Part II

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Lecture 10 - D.T.S (L.T.I System)

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Lecture 16 - Pole and Zero in Z-Transform

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Lecture 21 - Discrete Fourier Transform Linear Transform View (Continued...)

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- Lecture 32 - STFT Synthesis
- Lecture 33 - Fast Fourier Transform (FFT) Algorithms
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- Lecture 35 - Radix-2 FFT Algorithms
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- Lecture 40 - Linear Symmetric and Anti-symmetric filter
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- Lecture 48 - Linear Prediction and Optimum Linear Filters
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- Lecture 52 - Lattice Formulations of Linear Prediction (Continued....)
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- Lecture 54 - Analysis of Decimation and Interpolation
- Lecture 55 - Fractional Rate Conversion
- Lecture 56 - Implementations of Decimator and Interpolator
- Lecture 57 - Sample Rate Conversion by Stages
- Lecture 58 - Power Spectrum Estimation
- Lecture 59 - Power Spectrum Estimation (Continued...)
- Lecture 60 - Tutorial 6: Tutorial for Final Examination

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- Lecture 2 - Negative feedback amplifier
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- Lecture 4 - Loop gain and unity loop gain frequency; Opamp
- Lecture 5 - Opamp realization using controlled sources; Delay in the loop
- Lecture 6 - Negative feedback amplifier with ideal delay-small delays
- Lecture 7 - Negative feedback amplifier with ideal delay-large delays
- Lecture 8 - Negative feedback amplifier with parasitic poles and zeros
- Lecture 9 - Negative feedback amplifier with parasitic poles and zeros; Nyquist criterion
- Lecture 10 - Nyquist criterion; Phase margin
- Lecture 11 - Phase margin
- Lecture 12 - Single stage opamp realization
- Lecture 13 - Two stage miller compensated opamp
- Lecture 14 - Two stage miller compensated opamp
- Lecture 15 - Two and three stage miller compensated opamps; Feedforward compensated opamp
- Lecture 16 - Feedforward compensated opamp
- Lecture 17 - Feedforward compensated opamp
- Lecture 18 - Feedforward compensated opamp; typical opamp data sheet
- Lecture 19 - Opamp offset and CMRR; Transimpedance amplifier using an opamp
- Lecture 20 - Components available in a CMOS process
- Lecture 21 - MOS transistors-basics
- Lecture 22 - MOS transistors-parasitics, mismatch
- Lecture 23 - MOS transistors-mismatch, speed
- Lecture 24 - Noise in resistors
- Lecture 25 - Noise in MOS transistors; Input and output referred noise
- Lecture 26 - Noise scaling; Basic amplifier stages-Common source, common gate
- Lecture 27 - Basic amplifier stages-Common drain; Frequency response of amplifiers
- Lecture 28 - Common source amplifier frequency response; Differential amplifier
- Lecture 29 - Differential and common mode half circuits; Differential pair with active load
- Lecture 30 - Differential pair with current mirror load
- Lecture 31 - Single stage opamp characteristics

- Lecture 32 - Opamp with single and dual supplies; Single stage opamp tradeoffs
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- Lecture 34 - Telescopic cascode opamp; Folded cascode opamp
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- Lecture 38 - Common mode rejection ratio; Example
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- Lecture 47 - Type I PLL transfer function and reference feedthrough
- Lecture 48 - Type II PLL
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- Lecture 50 - Type II PLL-extra poles; Random noise in a PLL
- Lecture 51 - Oscillator phase noise
- Lecture 52 - PLL phase noise; LC and ring Oscillators
- Lecture 53 - Generating PTAT and constant MOS gm bias currents
- Lecture 54 - Reducing supply sensitivity; Bandgap voltage reference
- Lecture 55 - Fractional bandgap reference; Low dropout regulator
- Lecture 56 - Low dropout regulators; Continuous-time active filters
- Lecture 57 - Continuous-time active filters
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- Lecture 59 - Discrete-time active filters
- Lecture 60 - Transistor sizing in practice; Course summary



Lecture 1 - Introduction to Linear Block Codes

Lecture 2 - Properties of Linear Block Codes

Lecture 3 - Dual of Linear Block Codes

Lecture 4 - Minimum Distance of Codes

Lecture 5 - Operations on Codes

Lecture 6 - Bounds on Code Parameters

Lecture 7 - Optimal Decoders

Lecture 8 - Syndrome Decoder, Basics of Finite Fields

Lecture 9 - Constructions of Finite Fields

Lecture 10 - Computations in Finite Fields

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Lecture 13 - BCH and RS Codes I

Lecture 14 - BCH and RS Codes II

Lecture 15 - Decoding BCH Codes

Lecture 16 - Decoding RS Codes

Lecture 17 - Coded Modulation and Soft Decision Decoding

Lecture 18 - Optimal Decoders for BPSK and AWGN

Lecture 19 - Bitwise Map Decoder for BPSK over AWGN

Lecture 20 - Bitwise Map Decoder from the Dual Code

Lecture 21 - Simulating Coded Modulation

Lecture 22 - Union Bound, Introduction to LDPC Codes

Lecture 23 - LDPC Codes

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Lecture 25 - Thresholds of LDPC Codes

Lecture 26 - Irregular LDPC Codes

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- Lecture 5 - Logic Simplification
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- Lecture 17 - S-R, J-K and D Flip Flops
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- Lecture 20 - Up/Down Counters
- Lecture 21 - Shift Registers
- Lecture 22 - Application of shift Registers
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- Lecture 26 - Mealy and Moore Circuits
- Lecture 27 - Pattern Detector
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Lecture 3 - Classification and properties of semiconductor devices

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Lecture 15 - Ohmic contacts on semiconductors

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- Lecture 2 - Evolution and Uniqueness of Semiconductor
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- Lecture 5 - Crystal Structure (Continued.)
- Lecture 6 - Defects in Crystal + Crystal growth
- Lecture 7 - Crystal growth Contd + Epitaxy I
- Lecture 8 - Epitaxy II - Vapour phase Epitaxy
- Lecture 9 - Epitaxy III - Doping during Epitaxy
- Lecture 10 - Molecular beam Epitaxy
- Lecture 11 - Oxidation I - Kinetics of Oxidation
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- Lecture 13 - Oxidation III - Dopant Redistribution
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- Lecture 28 - Etching of Si, SiO<sub>2</sub>, SiN and other materials
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Lecture 2 - Electrical circuit elements: Voltage and current sources; R, C, L; Voltage sources in series; Example of superposition

Lecture 3 - Elements in series and parallel; Superposition in linear circuits

Lecture 4 - Controlled sources; Determining the characteristics of a two terminal element; Realizing a resistor using a VCCS or a CCVS

Lecture 5 - Nodal analysis of a network with conductances and current sources; Setting up the equations; Conductance matrix; Superposition

Lecture 6 - Circuit analysis; Number of KCL and KVL equations in a circuit; Nodal analysis of a network with conductances and current sources; Setting up the equations; Conductance matrix;

Lecture 7 - Nodal analysis with voltage sources and controlled sources; Brief introduction to modified nodal analysis; Use of supernode to solve circuits with voltage sources; Superposition theorem

Lecture 8 - Mesh analysis of a circuit with resistors and voltage sources; Comparison with nodal analysis; Mesh analysis of circuits with current sources-supermesh

Lecture 9 - Choice of nodal versus mesh analysis; Circuit theorems: Pushing a voltage source through a node, splitting a current source, substitution theorem, superposition

Lecture 10 - Thevenin and Norton (theorem and) equivalent circuits; Power conservation in a circuit

Lecture 11 - Tellegen's theorem; Reciprocity theorem

Lecture 12 - Compensation Theorem; Two ports

Lecture 13 - Two port parameters-y parameters

Lecture 14 - Two port parameters(z, h, and g); Reciprocal two ports

Lecture 15 - Opamp, ideal opamp circuits, non-inverting and inverting amplifiers; Ensuring that the opamp has negative feedback

Lecture 16 - RC circuit natural response; First order differential equation

Lecture 17 - RC (first-order) circuit, complete response with step inputs; Transient(natural) and steady state(forced) responses; Zero-state and zero-input responses

Lecture 18 - Step response of RC circuit with loops of voltage sources and capacitors; RL circuits; RLC circuits

Lecture 19 - Second order(RLC circuit) natural response; Series and parallel RLC circuits; Differential equation-characteristic equation and solutions; Forced response of a second order circuit

Lecture 20 - General formulation of second order(RLC circuit) natural response; Natural frequency and damping/quality factor; Series/parallel RLC circuits; R, L, C in sinusoidal steady state

Lecture 21 - Sinusoidal steady state response of RC and RLC circuits

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Lecture 6 - Kirchoff's Voltage law (KVL)

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Lecture 16 - Series connection of R, L, C, current source

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Lecture 23 - Power - Methodology and Analysis

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Lecture 2 - Embedded System Software and Hardware, stack implementation in ARM, Endianness, condition codes

Lecture 3 - Processor core VS CPU core, ARM7TDMI Interface signals, Memory Interface, Bus Cycle types, Register set, Operational Modes

Lecture 4 - Instruction Format, ARM Core Data Flow Model, ARM 3 stage Pipeline, ARM family attribute comparison

Lecture 5 - ARM 5 stage Pipeline, Pipeline Hazards, Data forwarding - a hardware solution

Lecture 6 - ARM ISA and Processor Variants, Different Types of Instructions, ARM Instruction set, data processing instructions

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Lecture 25 - Cache Memory, Mapping Functions

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Lecture 27 - Processes, Memory Map, Protected Systems, ARM systems with MPU, memory Protection Unit (MPU)

Lecture 28 - Physical Vs Virtual Memory, Paging, Segmentation

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Lecture 36 - Protocols (I2c, SPI), UART, GPIO

Lecture 37 - ARM ISAs, ARMv5, ARMv6, ARM v7, big.little technology, ARMv8

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Lecture 2 - Embedded Systems Basics Session 1 (Continued...)

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Lecture 7 - Depicting Levels of Testing (Continued...)

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Lecture 10 - Embedded V-Model Life Cycle (Continued...)

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Lecture 23 - Static Testing

Lecture 24 - Static Analysis

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Lecture 26 - Static Analysis (Continued...)

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- Lecture 30 - Decision making in System Design (Continued...)

**NPTEL : Vehicle Dynamics (Engineering Design)**

**Co-ordinators : Dr. R. Krishnakumar**

- Lecture 1 - Introduction to Vehicle Dynamics
- Lecture 2 - Longitudinal Dynamics
- Lecture 3 - Vehicle Load Distribution - Acceleration and Braking
- Lecture 4 - Brake Force Distribution, Braking Efficiency and Braking Distance
- Lecture 5 - Tractor - Semi Trailer
- Lecture 6 - Tire Mechanics - An Introduction
- Lecture 7 - Mechanical Properties of Rubber
- Lecture 8 - Slip, Grip and Rolling Resistance
- Lecture 9 - Tire Construction and Force Development
- Lecture 10 - Contact Patch and Contact Pressure Distribution
- Lecture 11 - Tire Brush Model
- Lecture 12 - Lateral Force Generation
- Lecture 13 - Ply Steer and Conicity - Part 1
- Lecture 14 - Ply Steer and Conicity - Part 2
- Lecture 15 - Tire Models - Magic Formula
- Lecture 16 - Classification of Tyre Models and Combined Slip
- Lecture 17 - Lateral Dynamics - An Introduction
- Lecture 18 - Lateral Dynamics - Bicycle Model
- Lecture 19 - Lateral Dynamics - Stability and Steering Conditions
- Lecture 20 - Understeer Gradient and State Space Approach
- Lecture 21 - Handling Response of a Vehicle
- Lecture 22 - Mimuro Plot for Lateral Transient Response - Part 1
- Lecture 23 - Mimuro Plot for Lateral Transient Response - Part 2
- Lecture 24 - Parameters affecting vehicle handling characteristics
- Lecture 25 - Subjective and Objective Evaluation of Vehicle Handling - Part 1
- Lecture 26 - Subjective and Objective Evaluation of Vehicle Handling - Part 2
- Lecture 27 - Subjective and Objective Evaluation of Vehicle Handling and Rollover P
- Lecture 28 - Rollover Prevention (Continued...) and Vertical Dynamics
- Lecture 29 - Vertical Dynamics - An Introduction
- Lecture 30 - Vertical Dynamics - Quarter Car Model
- Lecture 31 - Noise, Vibration and Harshness - Random Processes

[Lecture 32 - Random Process and Conclusion \(Continued...\)](#)

Lecture 1 - Introduction to Control Systems - Part 1

Lecture 2 - Introduction to Control Systems - Part 2

Lecture 3 - Overview of Feedback Control Systems - Part 1

Lecture 4 - Overview of Feedback Control Systems - Part 2

Lecture 5 - Mathematical Preliminaries - Part 1

Lecture 6 - Mathematical Preliminaries - Part 2

Lecture 7 - Transfer Function - Part 1

Lecture 8 - Transfer Function - Part 2

Lecture 9 - System Response - Part 1

Lecture 10 - System Response - Part 2

Lecture 11 - BIBO Stability - Part 1

Lecture 12 - BIBO Stability - Part 2

Lecture 13 - Effect of Zeros - Part 1

Lecture 14 - Effect of Zeros - Part 2

Lecture 15 - Closed Loop System - Part 1

Lecture 16 - Closed Loop System - Part 2

Lecture 17 - First Order Systems - Part 1

Lecture 18 - First Order Systems - Part 2

Lecture 19 - Second Order Systems - Part 1

Lecture 20 - Second Order Systems - Part 2

Lecture 21 - Controllers - Part 1

Lecture 22 - Controllers - Part 2

Lecture 23 - Closed Loop Control - Part 1

Lecture 24 - Closed Loop Control - Part 2

Lecture 25 - Routh's Stability Criterion - Part 1

Lecture 26 - Routh's Stability Criterion - Part 2

Lecture 27 - Special Cases of Routh's Stability Criterion - Part 1

Lecture 28 - Special Cases of Routh's Stability Criterion - Part 2

Lecture 29 - Performance Specifications - Part 1

Lecture 30 - Performance Specifications - Part 2

Lecture 31 - Steady State Error Analysis - Part 1



[Lecture 32 - Steady State Error Analysis - Part 2](#)

[Lecture 33 - Root Locus 1 - Part 1](#)

[Lecture 34 - Root Locus 1 - Part 2](#)

[Lecture 35 - Root Locus 2 - Part 1](#)

[Lecture 36 - Root Locus 2 - Part 2](#)

[Lecture 37 - Root Locus 3 - Part 1](#)

[Lecture 38 - Root Locus 3 - Part 2](#)

[Lecture 39 - Root Locus 4 - Part 1](#)

[Lecture 40 - Root Locus 4 - Part 2](#)

[Lecture 41 - Case Study - Modelling - Part 1](#)

[Lecture 42 - Case Study - Modelling - Part 2](#)

[Lecture 43 - Case Study - Control Design - Part 1](#)

[Lecture 44 - Case Study - Control Design - Part 2](#)

[Lecture 45 - State Space Representation - Part 1](#)

[Lecture 46 - State Space Representation - Part 2](#)

[Lecture 47 - Frequency Response - Part 1](#)

[Lecture 48 - Frequency Response - Part 2](#)

[Lecture 49 - Bode Plot 1 - Part 1](#)

[Lecture 50 - Bode Plot 1 - Part 2](#)

[Lecture 51 - Bode Plot 2 - Part 1](#)

[Lecture 52 - Bode Plot 2 - Part 2](#)

[Lecture 53 - Bode Plot 3 - Part 1](#)

[Lecture 54 - Bode Plot 3 - Part 2](#)

[Lecture 55 - Bode Plot 4 - Part 1](#)

[Lecture 56 - Bode Plot 4 - Part 2](#)

[Lecture 57 - Nyquist Plot 1 - Part 1](#)

[Lecture 58 - Nyquist Plot 1 - Part 2](#)

[Lecture 59 - Nyquist Plot 2 - Part 1](#)

[Lecture 60 - Nyquist Plot 2 - Part 2](#)

[Lecture 61 - Nyquist Stability Criterion - Part 1](#)

[Lecture 62 - Nyquist Stability Criterion - Part 2](#)

[Lecture 63 - Relative Stability 1 - Part 1](#)

[Lecture 64 - Relative Stability 1 - Part 2](#)

[Lecture 65 - Relative Stability 2 - Part 1](#)

[Lecture 66 - Relative Stability 2 - Part 2](#)

[Lecture 67 - Lead Compensation - Part 1](#)

[Lecture 68 - Lead Compensation - Part 2](#)

[Lecture 69 - Lead Compensator Design - Part 1](#)

[Lecture 70 - Lead Compensator Design - Part 2](#)

[Lecture 71 - Lag and Lag-Lead Compensation - Part 1](#)

[Lecture 72 - Lag and Lag-Lead Compensation - Part 2](#)

[Lecture 1 - Course Overview and Classification of Internal Combustion Engines - Part 1](#)

[Lecture 2 - Course Overview and Classification of Internal Combustion Engines - Part 2](#)

[Lecture 3 - Engine Components - Part 1](#)

[Lecture 4 - Engine Components - Part 2](#)

[Lecture 5 - Operation of Four Stroke Engines - Part 1](#)

[Lecture 6 - Operation of Four Stroke Engines - Part 2](#)

[Lecture 7 - Two Stroke Engine and Engine Cycles - Part 1](#)

[Lecture 8 - Two Stroke Engine and Engine Cycles - Part 2](#)

[Lecture 9 - Otto Cycle and Diesel Cycle - Part 1](#)

[Lecture 10 - Otto Cycle and Diesel Cycle - Part 2](#)

[Lecture 11 - Dual Cycle and Engine Performance - Part 1](#)

[Lecture 12 - Dual Cycle and Engine Performance - Part 2](#)

[Lecture 13 - Engine Performance - Part 1](#)

[Lecture 14 - Engine Performance - Part 2](#)

[Lecture 15 - Supercharging and Combustion in SI Engines - Part 1](#)

[Lecture 16 - Supercharging and Combustion in SI Engines - Part 2](#)

[Lecture 17 - Knocking in SI Engines - Part 1](#)

[Lecture 18 - Knocking in SI Engines - Part 2](#)

[Lecture 19 - Combustion in CI Engines and Carburetion - Part 1](#)

[Lecture 20 - Combustion in CI Engines and Carburetion - Part 2](#)

[Lecture 21 - Fuel Introduction Systems - Part 1](#)

[Lecture 22 - Fuel Introduction Systems - Part 2](#)

[Lecture 23 - Analysis of Carburetor - Part 1](#)

[Lecture 24 - Analysis of Carburetor - Part 2](#)

[Lecture 25 - Engine Emissions - Part 1](#)

[Lecture 26 - Engine Emissions - Part 2](#)

[Lecture 27 - Emission Control Systems - Part 1](#)

[Lecture 28 - Emission Control Systems - Part 2](#)

[Lecture 29 - Automotive Powertrain - Part 1](#)

[Lecture 30 - Automotive Powertrain - Part 2](#)

[Lecture 31 - Automotive Clutch - Part 1](#)

- Lecture 32 - Automotive Clutch - Part 2
- Lecture 33 - Transmission - Part 1
- Lecture 34 - Transmission - Part 2
- Lecture 35 - Powertrain Analysis - Part 1
- Lecture 36 - Powertrain Analysis - Part 2
- Lecture 37 - Powertrain Analysis 2 - Part 1
- Lecture 38 - Powertrain Analysis 2 - Part 2
- Lecture 39 - Transmission Matching - Part 1
- Lecture 40 - Transmission Matching - Part 2
- Lecture 41 - Brake System - Part 1
- Lecture 42 - Brake System - Part 2
- Lecture 43 - Components of a Brake System and Drum Brake - Part 1
- Lecture 44 - Components of a Brake System and Drum Brake - Part 2
- Lecture 45 - Disc Brake and Introduction to Hydraulic Brake - Part 1
- Lecture 46 - Disc Brake and Introduction to Hydraulic Brake - Part 2
- Lecture 47 - Hydraulic Brake System - Part 1
- Lecture 48 - Hydraulic Brake System - Part 2
- Lecture 49 - Air Brake System - Part 1
- Lecture 50 - Air Brake System - Part 2
- Lecture 51 - Antilock Brake System 1 - Part 1
- Lecture 52 - Antilock Brake System 1 - Part 2
- Lecture 53 - Antilock Brake System 2 - Part 1
- Lecture 54 - Antilock Brake System 2 - Part 2
- Lecture 55 - Braking Analysis - Part 1
- Lecture 56 - Braking Analysis - Part 2
- Lecture 57 - Steering System - Part 1
- Lecture 58 - Steering System - Part 2
- Lecture 59 - Manual Steering Systems - Part 1
- Lecture 60 - Manual Steering Systems - Part 2
- Lecture 61 - Power Steering and Kinematic Steering Analysis - Part 1
- Lecture 62 - Power Steering and Kinematic Steering Analysis - Part 2
- Lecture 63 - Wheel Alignment - Part 1
- Lecture 64 - Wheel Alignment - Part 2

[Lecture 65 - Introduction to Suspension System - Part 1](#)

[Lecture 66 - Introduction to Suspension System - Part 2](#)

[Lecture 67 - Shock Absorbers and Independent Suspension - Part 1](#)

[Lecture 68 - Shock Absorbers and Independent Suspension - Part 2](#)

[Lecture 69 - Dependent Suspension and Suspension Analysis - Part 1](#)

[Lecture 70 - Dependent Suspension and Suspension Analysis - Part 2](#)

[Lecture 71 - Introduction to Electric and Hybrid Powertrain - Part 1](#)

[Lecture 72 - Introduction to Electric and Hybrid Powertrain - Part 2](#)

[Lecture 73 - Tyres - Part 1](#)

[Lecture 74 - Tyres - Part 2](#)

Lecture 1 - Introduction

Lecture 2 - Birth and Growth of a Product

Lecture 3 - Types of Design

Lecture 4 - Stage-Gate and Spiral Design

Lecture 5 - Stages in New Product Development

Lecture 6 - Laboratory Exercise - 1

Lecture 7 - Reverse Engg. and Redesign

Lecture 8 - Technical Questioning and Mission Statement

Lecture 9 - Mission Statement- Examples

Lecture 10 - Laboratory Exercise - 2

Lecture 11 - Identifying Customer Needs

Lecture 12 - Customer Need Analysis

Lecture 13 - Product Specifications

Lecture 14 - Laboratory Exercise - 3

Lecture 15 - Need - Metric Matrix

Lecture 16 - Establishing Target Specifications

Lecture 17 - HoQ

Lecture 18 - Laboratory Exercise - 4

Lecture 19 - Functional Decomposition

Lecture 20 - FAST Method

Lecture 21 - Laboratory Exercise - 5

Lecture 22 - Function Structure (Flow Method)

Lecture 23 - Flow Method Examples

Lecture 24 - Laboratory Exercise - 6

Lecture 25 - Product and Portfolio Architecture

Lecture 26 - Portfolio Architecture Selection

Lecture 27 - Laboratory Exercise - 7

Lecture 28 - Product Architecture

Lecture 29 - Identification of Modules

Lecture 30 - Laboratory Exercise - 8

Lecture 31 - Concept Development

[Lecture 32 - Intuitive Methods](#)

[Lecture 33 - Laboratory Exercise - 9](#)

[Lecture 34 - Logical Method- TRIZ](#)

[Lecture 35 - Concept Selection](#)

[Lecture 36 - Laboratory Exercise - 10](#)

[Lecture 37 - Concept Scoring](#)

[Lecture 38 - Laboratory Exercise - 11](#)

Lecture 1 - Introduction

Lecture 2 - Evolution of Robotics

Lecture 3 - Kinematics- Coordinate transformations

Lecture 4 - Homogeneous Transformation Matrix

Lecture 5 - Industrial Robot- Kinematic Structures

Lecture 6 - Robot Architectures

Lecture 7 - Kinematic Parameters

Lecture 8 - DH Algorithm

Lecture 9 - DH Algorithm- Examples

Lecture 10 - Forward Kinematics

Lecture 11 - Forward Kinematics- Examples

Lecture 12 - Inverse Kinematics

Lecture 13 - Inverse Kinematics- Examples

Lecture 14 - Differential Relations

Lecture 15 - Manipulator Jacobian and Statics

Lecture 16 - Overview of Electric Actuators and Operational Needs

Lecture 17 - Principles of DC Motor Operation

Lecture 18 - DC Motor Equations and Principles of Control

Lecture 19 - DC Motor Control Regions and Principles of Power Electronics

Lecture 20 - Power Electronic Switching and Current Ripple

Lecture 21 - The H-Bridge and DC Motor Control Structure

Lecture 22 - The Brushless DC Machine

Lecture 23 - Control of the Brushless DC Motor

Lecture 24 - The PM Synchronous Motor (PMSM) and SPWM

Lecture 25 - Principles of PMSM Control

Lecture 26 - Encoders for Speed and Position Estimation

Lecture 27 - Stepper Motors

Lecture 28 - Introduction to Probabilistic Robotics.

Lecture 29 - Recursive State Estimation: Bayes Filter

Lecture 30 - Recursive State Estimation: Bayes Filter Illustration

Lecture 31 - Probability basics



[Lecture 32 - Probability basics](#)

[Lecture 33 - Kalman Filter](#)

[Lecture 34 - Extended Kalman Filter](#)

[Lecture 35 - Particle Filter](#)

[Lecture 36 - Binary Bayes](#)

[Lecture 37 - Velocity Motion Model](#)

[Lecture 38 - Odometry Motion Model](#)

[Lecture 39 - Occupa Grid Mapping](#)

[Lecture 40 - Range Finder Measurement Model](#)

[Lecture 41 - Localization Taxonomy](#)

[Lecture 42 - Markov Localization](#)

[Lecture 43 - Path Planning](#)

**NPTEL : Introduction to Japanese Language and Culture (General)**

**Co-ordinators : Mrs. Vatsala Misra**

Lecture 1 - Introduction to Japanese scripts

Lecture 2 - Jiko shoukai (Self introduction)

Lecture 3 - Dochira kara desu ka ( Where are you from?)

Lecture 4 - Senmon wa nan desu ka (What is your specialization?)

Lecture 5 - Kore wa hon desu (This is a book)

Lecture 6 - Ikura desu ka (How much is it?)

Lecture 7 - Ima nan-ji desu ka (What is the time now?)

Lecture 8 - Kaigi wa roku-ji-han kara desu (The meeting is from 6:30)

Lecture 9 - Ashita Tokyo e ikimasu. (I will go to Tokyo tomorrow)

Lecture 10 - Watashi wa mainichi roku-ji ni okimasu (I wake up at 6 o'clock everyday)

Lecture 11 - Itsu Kanpur e kimashita ka (When did you come to Kanpur?)

Lecture 12 - Y?binkyoku wa asoko ni arimasu (The post office is over there)

Lecture 13 - Rao san wa doko ni imasu ka (Where is Mr. Rao?)

Lecture 14 - Pikuniku e ikimash? (Let's go for a picnic)

Lecture 15 - Kesa pan to tamago o tabemashita (I ate eggs and bread for breakfast)

Lecture 16 - Depa-to no tonari no biru wa gink? desu (The building next to the department store is the bank)

Lecture 17 - Taj hoteru wa ookii hoteru desu(Hotel Taj is a big hotel)

Lecture 18 - Hoteru de nani o tabemashita ka (What did you eat at the hotel?)

Lecture 19 - Tokyo wa ?kikute kirei desu (Tokyo is big and beautiful)

Lecture 20 - Ko-hi- wa oishiku arimasen(Coffee is not tasty)

Lecture 21 - Hantai kotoba (Opposites)

Lecture 22 - Watashi wa mainichi miruku o nomimasu (I drink milk everyday)

Lecture 23 - Watashi wa oniisan ni kamera o moratta(I received a camera from my brother)

Lecture 24 - Nani o tabetai desu ka(What do you want to eat?)

Lecture 25 - Nani o sashiagemasu ka (Giving and Receiving)

Lecture 26 - Sensei wa watashi ni hon o kuremashita (My teacher gave me a book)

Lecture 27 - Chotto matte kudasai ( Just a minute please)

Lecture 28 - Ke-ki o tabete mite kudasai ( Eat and see how is the cake)

Lecture 29 - Nani o shite imasu ka(What are you doing?)

Lecture 30 - Tokyo ni sunde imasu ( I live in Tokyo)

Lecture 31 - Kanji ga kakemasu (I can write Kanji)

[Lecture 32 - Im?to wa ningy? o hoshigatte imasu \(My sister wants a doll\)](#)

[Lecture 33 - Aisukuri-mu ga ke-ki yori suki desu \(I like ice-cream more than cakes\)](#)

[Lecture 34 - Kutsu o kai ni ikimasu \( I am going to buy shoes\)](#)

[Lecture 35 - Ashita motto atsuku narimasu \(It is going to become very hot tomorrow\)](#)

[Lecture 36 - Rainen Tokyo e iku to omoimasu \(I think I will go to Tokyo next year\)](#)

[Lecture 37 - Pen de kaite mo ii desu ka\(Is it alright to write in pen?\)](#)

[Lecture 38 - Comprehensions and Expressions](#)

[Lecture 39 - Basic Kanji](#)

[Lecture 40 - Basic Kanji](#)

[Lecture 1 - Introduction](#)

[Lecture 2 - Pre Siddhantic Astronomy](#)

[Lecture 3 - Siddhantic Astronomy](#)

[Lecture 4 - Astronomy in Medieval India](#)

[Lecture 5 - Introduction to Telescopic Astronomy and Concluding remarks](#)

**NPTEL : NOC:Stress Management (General)**

**Co-ordinators : Prof. Rajlakshmi Guha**

- Lecture 1 - What is Stress
- Lecture 2 - Sources of stress
- Lecture 3 - Types of Stress
- Lecture 4 - Personality Factors and Stress
- Lecture 5 - Stress and the College Student
- Lecture 6 - Stress and Nervous System
- Lecture 7 - Hypothalamic-Pituitary-Adrenal (HPA) Axis
- Lecture 8 - Effect of Stress on Immune System
- Lecture 9 - Health Risk Associated with Chronic Stress
- Lecture 10 - Stress and Major Psychiatric Disorders
- Lecture 11 - Understanding your stress level
- Lecture 12 - Role of Personality Pattern, Self Esteem, Locus of Control
- Lecture 13 - Role of Thoughts Beliefs and Emotions - I
- Lecture 14 - Role of Thoughts Beliefs and Emotions - II
- Lecture 15 - Life Situation Intrapersonal : (Assertiveness, Time Management)
- Lecture 16 - Developing Cognitive Coping Skills
- Lecture 17 - Autogenic Training, Imagery and Progressive Relaxation
- Lecture 18 - Other Relaxation Techniques
- Lecture 19 - Exercise and Health
- Lecture 20 - DIY Strategies Stress Management

[Lecture 1 - Introduction to Need of 21st Century Education](#)

[Lecture 2 - Accreditation](#)

[Lecture 3 - Outcome based Learning](#)

[Lecture 4 - Approach to Design Outcome based Learning](#)

[Lecture 5 - Approach to Design Outcome based Learning \(Continued...\)](#)

[Lecture 6 - Instructional Design for Active Learning](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

**NPTEL : Ayurvedic Inheritance of India (General)**

**Co-ordinators : Dr. M.S. Valiathan**

Lecture 1 - Roots of Ayurveda

Lecture 2 - Traditional Medicine in Buddhist India

Lecture 3 - Period of Systematization

Lecture 4 - Philosophical ideas in Ayurveda

Lecture 5 - Human Body in Health

Lecture 6 - Human Body in Disease

Lecture 7 - Food and Drinks

Lecture 8 - Code for Healthy Living

Lecture 9 - Diseases

Lecture 10 - Diagnosis and Prognosis

Lecture 11 - Medical Treatment of Diseases

Lecture 12 - Materia Medica

Lecture 13 - Surgical Treatment of Diseases

Lecture 14 - Surgical Instruments

Lecture 15 - Treatment of fractures; some surgical procedures

Lecture 16 - Principles and methods of rejuvenation: enhancement of sexual potency and fertility

Lecture 17 - Selection of Students: Oath at initiation: Process of Training

Lecture 18 - A Science Initiative in Ayurveda (ASIIA)

Lecture 19 - Ayurvedic Biology: Illustrative Studies

Lecture 20 - Conclusion: An Ayurvedic View of Life

**Co-ordinators : Dr. G. Phanikumar, Prof. C. Balaji, Dr. Arun K.Tangirala, Dr. Abhijit P. Deshpande, Prof. M.S. Ananth, Dr. Prathap Haridoss**

Lecture 1 - Insight into research

Lecture 2 - Role of Guide and Student

Lecture 3 - Art of Re-Search

Lecture 4 - Persistent small steps towards success

Lecture 5 - Overview of research

Lecture 6 - Overview of Literature Survey

Lecture 7 - Literature Survey using Web of Science

Lecture 8 - Literature Survey using Scopus

Lecture 9 - Writing Up

Lecture 10 - Tutorial on using BibTeX with LaTeX to add references to a document

Lecture 11 - Tutorial on using Microsoft Word with Bibliographic Sources

Lecture 12 - Tutorial on using Microsoft Word with endnote entries

Lecture 13 - Experimental skills

Lecture 14 - Data analysis - Part 1

Lecture 15 - Data analysis - Part 2

Lecture 16 - Modelling skills - Part 1

Lecture 17 - Modelling skills - Part 2

Lecture 18 - Safety in laboratory

Lecture 19 - How to make Technical presentation

Lecture 20 - Technical Writing

Lecture 21 - Creativity in research - Part 1

Lecture 22 - Creativity in research - Part 2

Lecture 23 - Creativity in Research - Part 3

Lecture 24 - Group discussion on Ethics in Research

Lecture 25 - Intellectual property - Part 1

Lecture 26 - Intellectual property - Part 2

Lecture 27 - DOE Part 1

Lecture 28 - DOE part 2

Lecture 29 - DOE part 3

Lecture 30 - DOE part 4



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[Lecture 31 - DOE part 5](#)

[Lecture 32 - Research in Applied Mechanics](#)

[Lecture 33 - Research in Chemical Engineering](#)

[Lecture 34 - Research in Civil Engineering](#)

[Lecture 35 - Research in Computer Science and Engineering](#)

[Lecture 36 - Research in Engineering Design](#)

[Lecture 37 - Research in Humanities and Social Sciences](#)

[Lecture 38 - Research in Mechanical Engineering](#)

[Lecture 39 - Research in Metallurgical and Materials Engineering](#)

[Lecture 40 - Research in Ocean Engineering](#)

[Lecture 41 - Research in Management Studies](#)

[Lecture 42 - Research in Aerospace Engineering](#)

[Lecture 43 - Research in Biotechnology](#)

[Lecture 44 - Research in Chemistry](#)

[Lecture 45 - Research in Electrical Engineering](#)

[Lecture 46 - Research in Mathematics](#)

[Lecture 47 - Research in Physics](#)

[Lecture 48 - Discussion with Research Scholars](#)

Lecture 1 - Introduction

Lecture 2 - Origin of Life

Lecture 3 - Evolution

Lecture 4 - Cells

Lecture 5 - Biomolecules: Lipids

Lecture 6 - Biomolecules: Carbohydrates, Water

Lecture 7 - Biomolecules: Amino acids, Proteins

Lecture 8 - Biomolecules: Enzymes

Lecture 9 - Biomolecules: Nucleotides

Lecture 10 - Cell structure and function – Prokaryotes

Lecture 11 - Cell structure and function – Eukaryotes

Lecture 12 - Cell cycle

Lecture 13 - Cell division – mitosis

Lecture 14 - Cell division – meiosis

Lecture 15 - Culture growth

Lecture 16 - Mendelian genetics: Genetic disorders

Lecture 17 - Mendelian genetics: Mendelian inheritance principles

Lecture 18 - Mendelian genetics: Pedigree analysis

Lecture 19 - Mendelian genetics: Non-Mendelian inheritance

Lecture 20 - DNA replication

Lecture 21 - Transcription

Lecture 22 - Translation

Lecture 1 - Introduction to the Course

Lecture 2 - Introduction to the Winter School

Lecture 3 - Socio-algorithmic processes and the Everyday - Part 1

Lecture 4 - Socio-algorithmic processes and the Everyday - Part 2

Lecture 5 - Socio-algorithmic processes and the Everyday - Part 3

Lecture 6 - Data Protection and Privacy Regulation in the Digital Era - Part 1

Lecture 7 - Data Protection and Privacy Regulation in the Digital Era - Part 2

Lecture 8 - Data Protection and Privacy Regulation in the Digital Era - Part 3

Lecture 9 - Data-driven Identities - Part 1

Lecture 10 - Data-driven Identities - Part 2

Lecture 11 - Data-driven Identities - Part 3

Lecture 12 - Promises and Challenges of e-Health - Part 1

Lecture 13 - Promises and Challenges of e-Health - Part 2

Lecture 14 - Promises and Challenges of e-Health - Part 3

Lecture 15 - Digital Finance - Part 1

Lecture 16 - Digital Finance - Part 2

Lecture 17 - Digital and our everyday interactions with the state - Part 1

Lecture 18 - Digital and our everyday interactions with the state - Part 2

Lecture 19 - Digital and our everyday interactions with the state - Part 3

Lecture 20 - Creating a Machine Zone through Affected Feedback: Leisure and Entertainment on Social Media - Part 1

Lecture 21 - Creating a Machine Zone through Affected Feedback: Leisure and Entertainment on Social Media - Part 2

Lecture 22 - Creating a Machine Zone through Affected Feedback: Leisure and Entertainment on Social Media - Part 3

Lecture 1 - Introduction to the course

Lecture 2 - An Inexperienced Engineering Teacher's View

Lecture 3 - From traditional lecturing to helping students learn - 1

Lecture 4 - From traditional lecturing to helping students learn - 2

Lecture 5 - Better learning (Bloom's Taxonomy)

Lecture 6 - Problem based learning (PBL) and Problem Solving - Part 1

Lecture 7 - Problem based learning (PBL) and Problem Solving - Part 2

Lecture 8 - Writing Learning Outcomes for a Course

Lecture 9 - Active Learning

Lecture 10 - Cooperative Group Learning

Lecture 11 - Flipped Classroom

Lecture 12 - Effective Laboratory Courses

Lecture 13 - Assessment - Part 1

Lecture 14 - Assessment - Part 2

Lecture 15 - How can we use research in education? - Part A1

Lecture 16 - How can we use research in education? - Part A2

Lecture 17 - The Class, as a Whole - Part A3

Lecture 18 - Psychological Type (Orientation) and Learning - Part B

Lecture 19 - Cognitive Development Theories - Two Main Examples - Part C

Lecture 20 - Learning Theories - Part D

Lecture 21 - Feedback and Reflection - Part 1

Lecture 22 - Feedback and Reflection - Part 2

Lecture 23 - Feedback and Reflection - Part 3

Lecture 24 - Live Session 1

Lecture 25 - Live Session 2

Lecture 1 - Course mechanics

Lecture 2 - Goals and VR definitions

Lecture 3 - Historical perspective

Lecture 4 - Birds-eye view (general)

Lecture 5 - Birds-eye view (general) (Continued...)

Lecture 6 - Birds-eye view (hardware)

Lecture 7 - Birds-eye view (software)

Lecture 8 - Birds-eye view (sensation and perception)

Lecture 9 - Geometric modeling

Lecture 10 - Transforming models

Lecture 11 - Matrix algebra and 2D rotations

Lecture 12 - 3D rotations and yaw, pitch, and roll

Lecture 13 - 3D rotations and yaw, pitch, and roll (Continued...)

Lecture 14 - Axis-angle representations

Lecture 15 - Quaternions

Lecture 16 - Converting and multiplying rotations

Lecture 17 - Converting and multiplying rotations (Continued...)

Lecture 18 - Homogeneous transforms

Lecture 19 - The chain of viewing transforms

Lecture 20 - Eye transforms

Lecture 21 - Eye transforms (Continued...)

Lecture 22 - Canonical view transform

Lecture 23 - Viewport transform

Lecture 24 - Viewport transform (Continued...)

Lecture 25 - Three interpretations of light

Lecture 26 - Refraction

Lecture 27 - Simple lenses

Lecture 28 - Diopters

Lecture 29 - Imaging properties of lenses

Lecture 30 - Lens aberrations

Lecture 31 - Optical system of eyes

Lecture 32 - Photoreceptors

Lecture 33 - Sufficient resolution for VR

Lecture 34 - Light intensity

Lecture 35 - Eye movements

Lecture 36 - Eye movements (Continued...)

Lecture 37 - Eye movement issues for VR

Lecture 38 - Neuroscience of vision

Lecture 39 - Three Psychophysical Laws

Lecture 40 - Sensation and Perception

Lecture 41 - Psychophysics of Visual Perception

Lecture 42 - Gamma Encoding

Lecture 43 - Limiting Resolution

Lecture 44 - Depth perception

Lecture 45 - Depth perception (Continued...)

Lecture 46 - Motion perception from Visual System

Lecture 47 - Frame rates and displays

Lecture 48 - Frame rates and displays (Continued...)

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Lecture 26 - Donald MacKenzie and Judy Wajcman - II

Lecture 27 - Thomas Edison

Lecture 28 - Capitalism, class, gender, city, machine, workplace - I

Lecture 29 - Capitalism, class, gender, city, machine, workplace - II

Lecture 30 - Capitalism, class, gender, city, machine, workplace - III

Lecture 31 - Alvin Toffler and Daniel Bell

[Lecture 32 - Themes and Factors of Information Technology](#)

[Lecture 33 - Information Technology and Reconceptualization of Class](#)

[Lecture 34 - Reception of Modern Science in India](#)

[Lecture 35 - Science Policies in India](#)

[Lecture 36 - Summary of the Course](#)

[Lecture 1 - A Brief Overview of the Course](#)

[Lecture 2 - Performativity and Embodiment](#)

[Lecture 3 - The Chess Players - Part 1](#)

[Lecture 4 - The Chess Players - Part 2](#)

[Lecture 5 - Shooting an Elephant - Part 1](#)

[Lecture 6 - Shooting an Elephant - Part 2](#)

[Lecture 7 - Heart of Darkness - Part 1](#)

[Lecture 8 - Heart of Darkness - Part 2](#)

[Lecture 9 - Heart of Darkness - Part 3](#)

[Lecture 10 - The Fly - Part 1](#)

[Lecture 11 - The Fly - Part 2](#)

[Lecture 12 - Look Back in Anger - Part 1](#)

[Lecture 13 - Look Back in Anger - Part 2](#)

[Lecture 14 - Look Back in Anger - Part 3](#)

[Lecture 15 - Look Back in Anger - Part 4](#)

[Lecture 16 - Look Back in Anger - Part 5](#)

[Lecture 17 - Look Back in Anger - Part 6](#)

[Lecture 18 - Gender and Popular Culture Lecture - 1](#)

[Lecture 19 - Gender and Popular Culture Lecture - 2](#)

[Lecture 20 - Gender and Popular Culture Lecture - 3](#)

[Lecture 21 - Gender and Popular Culture Final Lecture](#)



Lecture 1 - Ecology and Society - 1

Lecture 2 - Ecology and Society - 2

Lecture 3 - Culture and Cultural Ecology

Lecture 4 - Cultural Ecology and Economic

Lecture 5 - Cultural Ecological Theory

Lecture 6 - Human Ecology: Concept and Meaning

Lecture 7 - Human Ecology - Theoretical Approach

Lecture 8 - Ecological Anthropology

Lecture 9 - Ecosystem-based and Actor-based Model of Human Ecology

Lecture 10 - Nature and Culture Debate

Lecture 11 - Nature - A Contested Concept

Lecture 12 - Conceptions of Nature

Lecture 13 - Contested Domains and Boundaries of Culture

Lecture 14 - MCQs Discussion

Lecture 15 - Paradigms in Humanâ€™Environmental Relations - Part I

Lecture 16 - Paradigms in Humanâ€™Environmental Relations - Part II

Lecture 17 - Nature, Culture, Magic and Science

Lecture 18 - Religion, Nature and Environment

Lecture 19 - Religion, Nature and Environment Continue

Lecture 20 - The Historical Roots of our Ecological Crisis

Lecture 21 - Biodiversity Conservation Ethics in Buddhism

Lecture 22 - Hinduism and Nature Conservation, Christian Religion Response to Ecological Crisis

Lecture 23 - Hinduism and Nature Conservation, Christian Religion Response to Ecological Crisis

Lecture 24 - Deep Ecology

Lecture 25 - Social Ecology

Lecture 26 - Ecological Feminist Philosophies

Lecture 27 - Indigenous Knowledge

Lecture 28 - Ecological Journey

Lecture 29 - Kuki Jhumming Practices

Lecture 30 - Debates on Shifting Cultivation

Lecture 31 - Course Summary



- Lecture 1 - Thematic Preliminaries - I
- Lecture 2 - Thematic Preliminaries - II
- Lecture 3 - Thematic Preliminaries - III
- Lecture 4 - Sociological Modernism: Karl Marx - I
- Lecture 5 - Sociological Modernism: Karl Marx - II
- Lecture 6 - Sociological Modernism: Karl Marx - III
- Lecture 7 - Sociological Modernism: Max Weber - I
- Lecture 8 - Sociological Modernism: Max Weber - II
- Lecture 9 - Sociological Modernism: Max Weber - III
- Lecture 10 - Sociological Modernism: Max Weber - IV
- Lecture 11 - Sociological Modernism: Marx vs. Weber
- Lecture 12 - Structuralist Interpretation - I
- Lecture 13 - Structuralist Interpretation - II
- Lecture 14 - Structuralist Interpretation - III
- Lecture 15 - Western Marxism - I
- Lecture 16 - Western Marxism - II
- Lecture 17 - Modernity and Social Theory - I
- Lecture 18 - Modernity and Social Theory - II
- Lecture 19 - Modernity and Social Theory - III
- Lecture 20 - Modernity and Social Theory - IV
- Lecture 21 - Deconstruction of Modernity: The Feminist Challenge - I
- Lecture 22 - Deconstruction of Modernity: The Feminist Challenge - II
- Lecture 23 - Deconstruction of Modernity: Towards Cultural Studies - I
- Lecture 24 - Deconstruction of Modernity: Towards Cultural Studies - II
- Lecture 25 - Deconstruction of Modernity: The Postmodernist Critique - I
- Lecture 26 - Deconstruction of Modernity: The Postmodernist Critique - II
- Lecture 27 - A New Totality - I
- Lecture 28 - A New Totality - II
- Lecture 29 - Modernity in India
- Lecture 30 - What have we discussed?

Lecture 1 - A Brief History of Cognitive Psychology - 1

Lecture 2 - A Brief History of Cognitive Psychology - 2

Lecture 3 - Studying Cognition

Lecture 4 - Perception:Basic Principles

Lecture 5 - Models of Perception - 1

Lecture 6 - Models of Perception - 2

Lecture 7 - Basic Attention Processes

Lecture 8 - Models of Attention

Lecture 9 - Automization and Attention

Lecture 10 - Memory Introduction

Lecture 11 - Short Term Memory

Lecture 12 - Working Memory

Lecture 13 - Long-Term Memory Encoding

Lecture 14 - Retrieval from Long-Term Memory

Lecture 15 - Semantic Memory Basics

Lecture 16 - Models of Semantic Memory

Lecture 17 - Introducing Concepts and Categories - 1

Lecture 18 - Introducing Concepts and Categories - 2

Lecture 19 - Basics of Visual Memory

Lecture 20 - Object Transformation in Visual Memory

Lecture 21 - Basic Issues in Language

Lecture 22 - Comprehension and Understanding of Language

Lecture 23 - Introduction to Problem Solving

Lecture 24 - Factors Influencing Problem Solving

Lecture 25 - Insight and Creativity

Lecture 26 - Reasoning - 1

Lecture 27 - Reasoning - 2

Lecture 28 - Classical Theory of Decision Making

Lecture 29 - Prospect Theory of Decision Making

Lecture 30 - Course Summary

- Lecture 1 - Introduction to the course
- Lecture 2 - Raja Rammohan Roy : Religious reforms
- Lecture 3 - Raja Rammohan Roy : Modern education
- Lecture 4 - Raja Rammohan Roy : Freedom of Press
- Lecture 5 - Rabindranath Tagore : Nationalism
- Lecture 6 - Rabindranath Tagore : Cosmopolitanism
- Lecture 7 - Rabindranath Tagore : Idea of man
- Lecture 8 - Aurobindo Ghosh : Self
- Lecture 9 - Aurobindo Ghosh : Community and Religion
- Lecture 10 - Vivekananda : Introduction
- Lecture 11 - Vivekananda : Revitalisation of Indian life
- Lecture 12 - Mahatma Gandhi : Introduction
- Lecture 13 - Mahatma Gandhi : Hind swaraj and Critique of Modern Civilisation
- Lecture 14 - Mahatma Gandhi : India of His Dreams
- Lecture 15 - Muhammad Iqbal : Community
- Lecture 16 - Muhammad Iqbal : Religion and Nation
- Lecture 17 - Savarkar : Introduction
- Lecture 18 - Savarkar : Hinduism and Hindutva
- Lecture 19 - Jawaharlal Nehru : Discovery of India
- Lecture 20 - Jawaharlal Nehru : Secularism
- Lecture 21 - Jawaharlal Nehru : Internationalism
- Lecture 22 - B.R.Ambedkar : Introduction
- Lecture 23 - B.R.Ambedkar : Caste
- Lecture 24 - B.R.Ambedkar : Liberal Democracy and Constitutional Morality
- Lecture 25 - Pandita Ramabai : Introduction
- Lecture 26 - Pandita Ramabai : Gender and Caste
- Lecture 27 - Rammanohar Lohia : Introduction
- Lecture 28 - Rammanohar Lohia : Caste and Class
- Lecture 29 - Rammanohar Lohia : Views on Indian Languages
- Lecture 30 - Conclusion

Lecture 1 - Introduction to Consumer Psychology - I

Lecture 2 - Introduction to Consumer Psychology - II

Lecture 3 - Problem Recognition - I

Lecture 4 - Problem Recognition - II

Lecture 5 - Alternate Evaluation - I

Lecture 6 - Alternate Evaluation - II

Lecture 7 - Alternate Evaluation - III

Lecture 8 - Post Purchase and Consumption - I

Lecture 9 - Post Purchase and Consumption - II

Lecture 10 - Perception and Cognition - I

Lecture 11 - Perception and Cognition - II

Lecture 12 - Memory and Learning - I

Lecture 13 - Memory and Learning - II

Lecture 14 - Emotion Motivation and Mood - I

Lecture 15 - Emotion Motivation and Mood - II

Lecture 16 - Attitude and Attitude Change - I

Lecture 17 - Attitude and Attitude Change - II

Lecture 18 - Communication and Persuasion - I

Lecture 19 - Communication and Persuasion - II

Lecture 20 - Summary

Lecture 1 - Sanskrit and National Theatre

Lecture 2 - History of Parsi Theatre and Female Impersonation

Lecture 3 - Female Impersonation and Indian Folk Traditions

Lecture 4 - Early Indian Playwrights

Lecture 5 - Silence! The Court is in Session

Lecture 6 - A Friend's Story

Lecture 7 - Ghashiram Kotwal

Lecture 8 - Kanyadaan

Lecture 9 - Hayavadana

Lecture 10 - Tughlaq

Lecture 11 - The Dreams of Tipu Sultan

Lecture 12 - The Fire and the Rain

Lecture 13 - Broken Images

Lecture 14 - Summary

Lecture 15 - Introduction and Garbo

Lecture 16 - Old Stone Mansion

Lecture 17 - Desire in the Rocks

Lecture 18 - Sonata

Lecture 19 - Summary of Mahesh Elkunchwar

Lecture 20 - Introduction and Final Solutions

Lecture 21 - Bravely Fought the Queen

Lecture 22 - Dance Like a Man

Lecture 23 - Summary of Mahesh Dattani

Lecture 24 - Introduction and Procession

Lecture 25 - Bhoma

Lecture 26 - Stale News and Summary

Lecture 27 - Conclusion

Lecture 1 - General Outline and methods

Lecture 2 - Political theories and ideologies

Lecture 3 - Liberty: republican conception of freedom

Lecture 4 - Freedom as autonomy; Positive and negative liberty

Lecture 5 - Freedom as Swaraj, Free speech and hate speech

Lecture 6 - Introduction: Equity and egalitarianism

Lecture 7 - Equality of opportunity; preferential treatment

Lecture 8 - Luck Egalitarianism and its critiques; Equality and Liberty

Lecture 9 - Introduction and forms of rights

Lecture 10 - Conflicts between rights

Lecture 11 - Rights and Duties

Lecture 12 - Justice : A distributive concept

Lecture 13 - Justice : Procedural and Substantive; Justice as fairness

Lecture 14 - Justice : Capability approach; libertarian, communitarian conception of Justice

Lecture 15 - Justice : Feminist conceptions of justice; Global justice

Lecture 16 - Introduction to Power and authority

Lecture 17 - Power, legitimacy and hegemony

Lecture 18 - Power and knowledge; different conceptions of power

Lecture 19 - Introduction and different conceptions of state and sovereignty

Lecture 20 - Modern nation state; liberal, Marxist and feminist conceptions of state

Lecture 21 - State and governmentality

Lecture 22 - Introduction: Procedural and Substantive Democracy

Lecture 23 - Various models of democracy

Lecture 24 - Challenges and Limits of Democracy; Free press and Democracy

Lecture 25 - Citizenship: Subject and Citizen

Lecture 26 - T H Marshal and liberal conceptions of citizenship as legal and equal member

Lecture 27 - Multiculturalism and Cosmopolitan Citizenship

Lecture 28 - Introduction; Doom and Gloom; Democracy and environmental crisis

Lecture 29 - Climate change and environmental justice

Lecture 30 - Revisiting some key themes and concepts



Lecture 1 - Introduction to the Science of Human Behavior - I

Lecture 2 - Introduction to the Science of Human Behavior - II

Lecture 3 - Sensation - I

Lecture 4 - Sensation - II

Lecture 5 - Perception - I

Lecture 6 - Perception - II

Lecture 7 - Learning - I

Lecture 8 - Learning - II

Lecture 9 - Memory - I

Lecture 10 - Memory - II

Lecture 11 - Language - I

Lecture 12 - Language - II

Lecture 13 - Intelligence - I

Lecture 14 - Intelligence - II

Lecture 15 - Emotion - I

Lecture 16 - Emotion - II

Lecture 17 - Personality - I

Lecture 18 - Personality - II

Lecture 19 - Social Influence and Cognition - I

Lecture 20 - Social Influence and Cognition - II

Lecture 21 - Summary

Lecture 1 - Communication and Language - I

Lecture 2 - Communication and Language - II

Lecture 3 - Science of Language - I

Lecture 4 - Science of Language - II

Lecture 5 - Speech Perception - I

Lecture 6 - Speech Perception - II

Lecture 7 - Speech Production - I

Lecture 8 - Speech Production - II

Lecture 9 - Words - I

Lecture 10 - Words - II

Lecture 11 - Words - III

Lecture 12 - Sentences - I

Lecture 13 - Sentences - II

Lecture 14 - Discourse - I

Lecture 15 - Discourse - II

Lecture 16 - Reading and Writing - I

Lecture 17 - Reading and Writing - II

Lecture 18 - Bilingualism - I

Lecture 19 - Bilingualism - II

Lecture 20 - Overall Review

Lecture 1 - Reflections on Development Studies and Development Research

Lecture 2 - Types, Forms, and Processes of Development Studies Research

Lecture 3 - The Rigour in Development Studies Research

Lecture 4 - Paradigms of Development Research

Lecture 5 - Development Research-Development Work Continuum and Action Research in Development Studies

Lecture 6 - Ethics in Development Studies and Development Research

Lecture 7 - Literature Study

Lecture 9 - Introducing Qualitative Research Methods

Lecture 10 - Introducing Qualitative Research Methods (Continued...)

Lecture 11 - Interviews and Focus Group Discussions

Lecture 12 - Participatory Methods and Approaches

Lecture 13 - Conducting Case Studies and Maintaining Field Diaries

Lecture 14 - Introducing Quantitative Research Methods

Lecture 15 - An Overview of Mixed Methods Research

Lecture 16 - Field Surveys and Inventories

Lecture 17 - Logical Framwork and SWOT Analysis

Lecture 18 - The importance of Census and other Secondary Data in Development Studies

Lecture 19 - Communicating Research

Lecture 20 - Operationalizing Rights-based Approaches to Development

Lecture 21 - Poverty Measures and Analysis

Lecture 22 - Gender-sensitive Indicators and Gender Analysis

Lecture 23 - Social Capital Assessment Tools

Lecture 24 - Moitoring and Evaluation

Lecture 25 - A Final Note

Lecture 1 - Introduction and General Outline

Lecture 2 - Sources and Methodology to Study Indian Business History

Lecture 3 - East India Company's early ventures in India

Lecture 4 - Agency Houses: Jagat Seths and Early Banking operations

Lecture 5 - Emergence of Bombay and Cotton Trade, 1750-1850

Lecture 6 - Indian Business: Changes and Styles

Lecture 7 - Emergence of Calcutta: Impact on Industries

Lecture 8 - Swadeshi Movement: Impact on Indian Industries

Lecture 9 - Case Studies: Indian Business Houses: TATAs

Lecture 10 - Indian Economy and Business during WW I

Lecture 11 - Impact of the Second World War WW II

Lecture 12 - Political Economy of the Global wars for India; Case Study: Hindustan Aeronautics Limited (HAL)

Lecture 13 - Impact of Independence and Partition: Evolution of the Railways in India

Lecture 14 - Planning, Statistics and Industrialization Policies

Lecture 15 - Global Currents of economic Thought, 1947-1960

Lecture 16 - Industrial Licensing Policies, Institutions 1947-1964

Lecture 17 - Industrial Licensing Policies, 1966-1980

Lecture 18 - Case Study: Amul and Rural Cooperatives

Lecture 19 - Liberalisation of the Indian Economy, 1990s

Lecture 20 - Business Developments in India; India's Energy Diplomacy through ONGC

Lecture 21 - Indian Business History: Trends and Prospects

Lecture 22 - Learning Outcomes from Indian Business History

Lecture 1 - General Outline and Method

Lecture 2 - Method: Text and Context

Lecture 3 - Intro and Justice

Lecture 4 - State and Philosopher King

Lecture 5 - Communism of Wives and Property and Critical Assessment of his Thought

Lecture 6 - Intro and Ethics or Virtue

Lecture 7 - Politics and His Ideal State

Lecture 8 - Aristotle-III: Citizenship, Views on Revolution and Critical Assessment of his Thought

Lecture 9 - Machiavelli-I: Intro and Virtue and Fortuna

Lecture 10 - Machiavelli-II: Politics, Violence, and Religion

Lecture 11 - Machiavelli-III: Republicanism and Critical Assessment of his Thought

Lecture 12 - Intro and Human Nature

Lecture 13 - The Leviathan or Sovereign

Lecture 14 - Political Obligation and Critical Assessment of his Thought

Lecture 15 - Intro, State of Nature and Natural Rights

Lecture 16 - Limited Government

Lecture 17 - Right to Dissent and Critical Assessment of his Thought

Lecture 18 - Rousseau-I: Intro and Social Contract

Lecture 19 - Rousseau-II: General Will and Critical Assessment of his Thought

Lecture 20 - Kant-I: Intro and What is Enlightenment?

Lecture 21 - Kant-II: Morality, Autonomy and Freedom

Lecture 22 - Kant-III: Kingdom of Ends and Critical Assessment of his Thought

Lecture 23 - Hegel-I: Intro and Freedom

Lecture 24 - Hegel-II: Civil Society and State

Lecture 25 - Hegel-III: Rights and Critical Assessment of his Thought

Lecture 26 - Marx-I: Intro and Historical Materialism

Lecture 27 - Marx-II: State and Class

Lecture 28 - Marx-III: Views on Politics, Communism and Critical Assessment of his Thought

Lecture 29 - Mill-I: Intro, Utilitarianism and Subjection of Women

Lecture 30 - Mill-II: On Liberty, Representative Government and Critical Assessment of his Thought

Lecture 1 - The Nature of Stress - 1

Lecture 2 - The Nature of Stress - 2

Lecture 3 - The Biology of Stress

Lecture 4 - Stress, Health, and Non-infectious Diseases

Lecture 5 - Stress and Infectious Diseases

Lecture 6 - Stress and Psychological Disorders

Lecture 7 - Stress, Trauma and Posttraumatic growth - 1

Lecture 8 - Stress, Trauma and Posttraumatic growth - 2

Lecture 9 - Factors Influencing Stress Tolerance

Lecture 10 - Coping Strategies: Definition and Types

Lecture 11 - Unconscious mind and defensive coping

Lecture 12 - Characteristics of constructive coping; Physical ways of coping

Lecture 13 - Coping with relaxation exercises

Lecture 14 - Mental ways of coping

Lecture 15 - Coping with social support

Lecture 16 - Coping with meditation and mindfulness

Lecture 17 - Positive mental health and well-being

Lecture 18 - Well-being and resilience

Lecture 19 - What is happiness? What makes us happy?

Lecture 20 - Socio-demographic factors and happiness

Lecture 21 - Positive emotions

Lecture 22 - Genetic set point and hedonic adaptation

Lecture 23 - Sustainable happiness model

Lecture 24 - Sustainable happiness with intentional activities

Lecture 25 - Cultivating happiness with gratitude

Lecture 26 - Cultivating happiness with acts of kindness

Lecture 27 - Social comparison and happiness

Lecture 28 - Cultivating happiness with signature strengths 1 (VIA character strengths)

Lecture 29 - Cultivating happiness with signature strengths 2 (Gallup's/Clifton strength finder)

Lecture 30 - Cultivating happiness with Flow

Lecture 31 - Humanistic psychology and self-actualization

[Lecture 32 - Self-determination, motivation, and well-being](#)

[Lecture 33 - Meaning in life and well-being](#)

[Lecture 34 - Life goals and well-being](#)

Lecture 1 - Articulation of consonants - 1

Lecture 2 - Articulation of consonants - 2

Lecture 3 - Articulation of vowels

Lecture 4 - Language endangerment and linguistic diversity

Lecture 5 - Linguistic diversity - consonants in the languages of the world

Lecture 6 - Linguistic diversity - consonants and vowels in the languages of the world

Lecture 7 - Linguistic diversity - conclusion

Lecture 8 - Acoustic analysis: sound waves

Lecture 9 - Acoustic analysis: source filter theory and spectrograms

Lecture 10 - Acoustic analysis: vowels and formants

Lecture 11 - Acoustic analysis: formant calculation

Lecture 12 - Perceptual cues, variability in the speech signal, acoustic-phonetic invariance

Lecture 13 - Segmentation problem, categorical perception, cp in infants and animals

Lecture 14 - Measuring perceptual distinctiveness, multidimensional scaling, speech perception theories

Lecture 15 - development of the ideas of phonemes and features

Lecture 16 - phonemes as categories, phonemes in different languages, allophonic rules

Lecture 17 - problems in phonemic analysis, context and phonotactics

Lecture 18 - Psychological reality of phonemes

Lecture 19 - Distinctive features and natural classes

Lecture 20 - Phonological rule application

Lecture 21 - Distinctive features, feature economy and markedness

Lecture 22 - Morphophonological rules

Lecture 23 - Syllables

Lecture 24 - Stress

Lecture 25 - Phonetics and phonology of intonation, microprosody, stylization

Lecture 26 - Nuclear tone, pitch accent and boundary tones

Lecture 27 - Focus, givenness



Lecture 1 - Empiricism and Rationalism

Lecture 2 - Comte and Positivism; Epistemology and Ontology

Lecture 3 - The Rules of Sociological Method

Lecture 4 - Sociology of Knowledge

Lecture 5 - Religion and the Division of Labour in Society

Lecture 6 - Positivism and Neo-Kantianism

Lecture 7 - Methodology of the Social Sciences

Lecture 8 - Interpretive Sociology

Lecture 9 - Methodological Individualism and Interpretative Understanding of Social Action

Lecture 10 - Weberian Social Sciences: Methodological Implications

Lecture 11 - Materialist Conception of History

Lecture 12 - Dialectic

Lecture 13 - Nature, Ideology and Science

Lecture 14 - Systematic Falsification

Lecture 15 - Hypothetico - Deductive Model

Lecture 16 - The Structure of Scientific Revolutions

Lecture 17 - Popper Versus Kuhn

Lecture 18 - Positivism Versus Hermeneutics - I

Lecture 19 - Positivism Versus Hermeneutics - II

Lecture 20 - Philosophy of Social Sciences: Taking Stock

Lecture 21 - End of the Philosophy of the Social Sciences

Lecture 22 - Return of Grand Theory in the Human Sciences

Lecture 23 - An Overview of the Course

- Lecture 1 - Sociology of development: An overview
- Lecture 2 - Development historically
- Lecture 3 - Decolonization, nationalism and development - I
- Lecture 4 - Decolonization, nationalism and development - II
- Lecture 5 - Decolonization, nationalism and development - III
- Lecture 6 - Social evolution and social change
- Lecture 7 - Social change and progress
- Lecture 8 - Modernization Theory: An Overview
- Lecture 9 - State and Class under Peripheral Capitalism
- Lecture 10 - Critique of Samuel Huntington
- Lecture 11 - Class, State and Revolution
- Lecture 12 - The Empirical Peasantry and the Hypothetical Proletariat
- Lecture 13 - Class and Classness: Substitutes and Realities
- Lecture 14 - Modernization and Huntington's Argument
- Lecture 15 - Huntington, Social Sciences and Ideology
- Lecture 16 - The Ideological, Empirical and Methodological Critiques - I
- Lecture 17 - The Ideological, Empirical and Methodological Critiques - II
- Lecture 18 - Dependency Theory: Intellectual Antecedents
- Lecture 19 - The Latin American Debates on Underdevelopment - I
- Lecture 20 - The Latin American Debates on Underdevelopment - II
- Lecture 21 - Dependency Theory in Transition - I
- Lecture 22 - Dependency Theory in Transition - II
- Lecture 23 - Critiques of Dependency Theory - I
- Lecture 24 - Critiques of Dependency Theory - II
- Lecture 25 - Limits to Growth - I
- Lecture 26 - Limits to Growth - II
- Lecture 27 - E. F. Schmacher's Small is Beautiful
- Lecture 28 - Ivan Illich's Towards a History of Needs
- Lecture 29 - Paradigms Lost, Paradigms Regained: Development studies in the 21st century - I
- Lecture 30 - Paradigms Lost, Paradigms Regained: Development studies in the 21st century - II

- Lecture 1 - Development, Economic Growth and Sustainable Development
- Lecture 2 - Basic Ecosystem Ecology
- Lecture 3 - Environmentalism
- Lecture 4 - Environmental movement
- Lecture 5 - Environmentalism in the global south
- Lecture 6 - Ecofeminism
- Lecture 7 - Feminist political ecology
- Lecture 8 - Marx and ecology
- Lecture 9 - Deep ecology
- Lecture 10 - Gandhi and ecology
- Lecture 11 - Social ecology
- Lecture 12 - Religion, environment and historical roots of ecological crisis
- Lecture 13 - Biodiversity conservation ethics in Buddhism and Hinduism
- Lecture 14 - Christian religion in the age of ecological crisis
- Lecture 15 - Natural resource management
- Lecture 16 - Common property vs. private property
- Lecture 17 - Livelihoods, forests, and conservation
- Lecture 18 - Conservation-induced displacement
- Lecture 19 - Environment impact assessment and national rehabilitation and resettlement policy
- Lecture 20 - Dispossession and land acquisition
- Lecture 21 - Mining, development, and indigenous people
- Lecture 22 - Competing visions of development along the Narmada
- Lecture 23 - Dams, development, and resistance: Case studies
- Lecture 24 - Development theory and gendered approach to development
- Lecture 25 - Gender, environment and sustainable development
- Lecture 26 - Climate change interventions and policy framework
- Lecture 27 - Eastern Himalayas and climate change
- Lecture 28 - Ecological knowledge, biodiversity conservation and sustainability
- Lecture 29 - Traditional religion and conservation of nature in Northeast India: Case study
- Lecture 30 - Indigenous knowledge, environment and development
- Lecture 31 - Relevance of indigenous knowledge: Case study



- Lecture 1 - Introduction to Industrial Organization, Preferences
- Lecture 2 - Utility maximization and derivation of demand curve
- Lecture 3 - Examples of utility maximization, demand curve and market demand curve
- Lecture 4 - Tutorial Module 1
- Lecture 5 - Production Function
- Lecture 6 - Cost minimization problem
- Lecture 7 - Derivation of cost curves
- Lecture 8 - Tutorial on Production and cost curves
- Lecture 9 - Optimal output and supply curve of a firm
- Lecture 10 - Derivation of Market price in competitive market
- Lecture 11 - Long run market price and Pareto optimality
- Lecture 12 - Tutorial on Perfectly Competitive Market
- Lecture 13 - Monopoly price
- Lecture 14 - Price Discrimination - I
- Lecture 15 - Price Discrimination - II
- Lecture 16 - Tutorial on Monopoly
- Lecture 17 - Introduction to Game Theory, Iterated Elimination of Dominated Strategy
- Lecture 18 - Pure Strategy Nash Equilibrium
- Lecture 19 - Mixed Strategy Nash Equilibrium
- Lecture 20 - Existence of Nash Equilibrium in Games with 2 Players and 2 Strategies
- Lecture 21 - Tutorial on Normal Form Games
- Lecture 22 - Dynamic Games, Backward Induction
- Lecture 23 - Subgame Perfect Nash Equilibrium
- Lecture 24 - Tutorial on Dynamic Games
- Lecture 25 - Cournot Duopoly
- Lecture 26 - Cournot Oligopoly
- Lecture 27 - Tutorial on Cournot Competition
- Lecture 28 - Bertrand Competition with and without fixed cost
- Lecture 29 - Bertrand Competition with capacity constraint
- Lecture 30 - Bertrand Competition with capacity constraint
- Lecture 31 - Tutorial on Bertrand Competition

[Lecture 32 - Bertrand Competition with Decreasing returns to scale](#)

[Lecture 33 - Stackelberg Quantity Competition](#)

[Lecture 34 - Tutorial on Bertrand Competition and Stackelberg Quantity Competition](#)

[Lecture 35 - Stackelberg Price Competition](#)

[Lecture 36 - Simultaneous move Hotelling Model](#)

[Lecture 37 - Tutorial on Stackelberg Price Competition](#)

[Lecture 38 - Sequential Move Hotelling Model](#)

[Lecture 39 - Dixit's Model of Entry Deterrence](#)

[Lecture 40 - Tutorial on Sequential move Hotelling Model](#)

[Lecture 41 - Dixit's Model of Entry Deterrence](#)

[Lecture 42 - Bundling and Tying](#)

[Lecture 43 - Tutorial on Dixit's Model of Entry Deterrence](#)

Lecture 1 - Aim of the course, real numbers

Lecture 2 - Logic, proof

Lecture 3 - Definitions

Lecture 4 - Set operations

Lecture 5 - Definitions

Lecture 6 - Linear functions

Lecture 7 - Quadratic functions

Lecture 8 - Exponential functions, etc.

Lecture 9 - Differentiation: preliminaries

Lecture 10 - Rules of differentiation

Lecture 11 - Partial differentiation

Lecture 12 - Higher order differentiations

Lecture 13 - Approximations and elasticities

Lecture 14 - Differentiability, series, PDV

Lecture 15 - NPV, evaluation of investment projects

Lecture 16 - Exponential, logarithmic functions

Lecture 17 - Tutorials - 1a

Lecture 18 - Tutorials - 1b

Lecture 19 - Tutorials - 1c

Lecture 20 - Extreme, stationary points, first derivative test

Lecture 21 - Global and local extreme points

Lecture 22 - Second derivative test

Lecture 23 - Inflection points

Lecture 24 - Profit maximizations

Lecture 25 - Area under a curve, indefinite integral

Lecture 26 - Definite integral

Lecture 27 - Oil extraction, income distribution, PDV

Lecture 28 - Integration by parts, substitution, Lorenz curve

Lecture 29 - First order difference equations, solution

Lecture 30 - Dynamic stability, Cobweb model

Lecture 31 - Market model with inventory, Phase diagrams, Higher order equations

[Lecture 32 - Multiplier-acceleration model](#)

[Lecture 33 - Tutorials - 2a](#)

[Lecture 34 - Tutorials - 2b](#)



Lecture 1 - Nature of human thought - I

Lecture 2 - Brain and cognition, Seat of thought - II

Lecture 3 - Language, meaning, reality - III

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Lecture 5 - Categorization: (Continued...)

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- Lecture 53 - Shashin o totte mo ii desu ka?
- Lecture 54 - Mainichi kaisha ni ikanakereba narimasen
- Lecture 55 - Tanaka san wa yoku hatarakimasu

Lecture 1 - Kore wa watashi no hon desu (This is my book)

Lecture 2 - Ima nan ji desu ka? (What is the time now?)

Lecture 3 - Hon wa tsukue no ue ni arimasu (The book is on the table)

Lecture 4 - Ashita kurabu e ikimasen ka? (Will you please come to the club tomorrow?)

Lecture 5 - Kodoma-tachi wa ima asonde imasu (Children are playing now)

Lecture 6 - Kodomotachi wa asonde kara benkyou shimasu (Children will study after playing)

Lecture 7 - Douzo meshiagatte kudasai (Please eat it)

Lecture 8 - Tabete mite kudasai (Please eat and see)

Lecture 9 - Koko de tabenaide kudasai (Please do not eat here)

Lecture 10 - Hitori de ikimasu ka? (Will you go alone?)

Lecture 11 - Irasshaimase ! (Welcome !)

Lecture 12 - Shiken wa dou deshita ka? (How was the exam?)

Lecture 13 - Tomodachi wa tanjoubi ni hana o kuremashita (My friend gave me flowers on my birthday)

Lecture 14 - Tomodachi wa ke-ki o tsukutte kuremashita (My friend made a cake and gave it to me)

Lecture 15 - Kimura to moushimasu (I am Kimura)

Lecture 16 - O-genki desu ka ? (How are you ?)

Lecture 17 - Kare wa 'happyou wa ashita desu' to iimashita (He said, 'the presentation is tomorrow')

Lecture 18 - Tanaka to iu hito ni aimashita (I met a person called Tanaka)

Lecture 19 - Tomodachi ga kuru to omoimasu (I think my friend will come)

Lecture 20 - Watashi wa hitori de ikemasu (I can go alone)

Lecture 21 - Ikka-getsu de dekimasu (I can do it in one mouth)

Lecture 22 - Kare wa Indo no shuukan no koto o yoku shitte imasu (He know a lot about Indian customs)

Lecture 23 - Aisatsu (Greetings)

Lecture 24 - Aisatsu (Greetings)

Lecture 25 - Chokore-to yori aisukuri-mu ga suki desu (I like ice cream more than chocolate)

Lecture 26 - Dochira ga suki desu ka ? (Which do you like ?)

Lecture 27 - Mira san asobi ni irashite kudasai (Mira san please visit us)

Lecture 28 - Houmon (Visiting)

Lecture 29 - Pen de kaite mo ii desu ka ? (Can I write with a pen?)

Lecture 30 - Konakute mo ii desu ka ? (Is is alright if I do not come ?)

Lecture 31 - Nani mo tabetakunai desu (I do not want to eat anything)

Lecture 32 - Watashi wa eiwa jiten ga hoshii desu (I want an English-Japanese dictionary)

Lecture 33 - Rainen kekkon suru tsumori desu (I intend to get married next year)

Lecture 34 - Soto wa kuraku narimashita (It has become dark outside)

Lecture 35 - Kyuujitai and Shinjitai

Lecture 36 - Nihon e itta koto ga arimasu (I have been to Japan)

Lecture 37 - Minikui ahiru no ko - I (Ugly duckling - I)

Lecture 38 - Minikui ahiru no ko - II (Ugly duckling - II)

Lecture 39 - Working in Japan

Lecture 40 - Haru ni naru to sakura ga saku (When it is spring cherry blossoms will bloom)

Lecture 41 - Mira wa konai kamoshirenai (Mira may not come)

Lecture 42 - Okane ga attara uchi o kaimasu (If I have money I will buy a house)

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- Lecture 17 - The Term Structure of Interest Rates - V
- Lecture 18 - The Term Structure of Interest Rates - VI
- Lecture 19 - The Term Structure of Interest Rates - VII
- Lecture 20 - The Term Structure of Interest Rates - VIII
- Lecture 21 - Determination of Theoretical Spot Rate and Forward Yield Curves
- Lecture 22 - Interest Rate Risk
- Lecture 23 - Bond Duration
- Lecture 24 - Bond Convexity
- Lecture 25 - Default Risk
- Lecture 26 - Short-Term Government Bond Markets
- Lecture 27 - Long-Term Government Bond Markets
- Lecture 28 - Issuance and Trading Mechanism of Government Securities
- Lecture 29 - Short-Term Corporate Bond Markets
- Lecture 30 - Medium and Long-term Corporate Bond Markets
- Lecture 31 - Issuance and Trading Mechanism of Corporate Securities

- Lecture 32 - Municipal Bonds - I
- Lecture 33 - Municipal Bonds - II
- Lecture 34 - Debt Securities of Commercial Banks
- Lecture 35 - International Bonds
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- Lecture 37 - Binomial Valuation of Callable Bonds - I
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- Lecture 39 - Binomial Valuation of Puttable and Sinking-Fund Bonds
- Lecture 40 - Binomial Valuation of Convertible Bonds
- Lecture 41 - Estimation of Binomial Trees - I
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- Lecture 44 - Estimation of Binomial Trees - IV
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- Lecture 46 - Bond Investment Strategies - I
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- Lecture 53 - Mortgage Backed Securities - III
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- Lecture 55 - Mortgage Backed Securities - V
- Lecture 56 - Fixed Income Securities Derivatives - I
- Lecture 57 - Fixed Income Securities Derivatives - II
- Lecture 58 - Fixed Income Securities Derivatives - III
- Lecture 59 - Fixed Income Securities Derivatives - IV
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Lecture 1 - Relevance and Syllabus

Lecture 2 - Role of Oil

Lecture 3 - Energy and Sustainability

Lecture 4 - North-South conflict, Way to future

Lecture 5 - Introduction

Lecture 6 - Analysis of demand

Lecture 7 - Determinants of demand

Lecture 8 - Analysis of supply

Lecture 9 - Equilibrium

Lecture 10 - Elasticity

Lecture 11 - Revenue and price elasticity of demand

Lecture 12 - Petroleum rents and petroleum taxes

Lecture 13 - Welfare analysis

Lecture 14 - Government Intervention - I

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Lecture 17 - Movement of oil price

Lecture 18 - Sector wise use of oil

Lecture 19 - Oil Price Movements 2010-15/16

Lecture 20 - Oil Price since 2018

Lecture 21 - Oil price in the recent times

Lecture 22 - Structure of OPEC

Lecture 23 - Cartel

Lecture 24 - Role of OPEC in explaining oil price

Lecture 25 - Role of Saudi Arabia

Lecture 26 - Petroleum as a depleting resource

Lecture 27 - Can depletion explain price development ?

Lecture 28 - Cost performance of global oil industry and Oil Spills

Lecture 29 - Structural change and resource discovery

Lecture 30 - Theory of Production: A brief overview

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- Lecture 32 - Labour Demand
- Lecture 33 - Theoretical model - I
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- Lecture 35 - Country Experiences
- Lecture 36 - Market structure
- Lecture 37 - Oligopoly and Market structure
- Lecture 38 - Introduction to Game Theory - I
- Lecture 39 - Introduction to Game Theory - II
- Lecture 40 - Nash Equilibrium
- Lecture 41 - Competition versus collusion
- Lecture 42 - Collusive Oligopoly: Price Leadership
- Lecture 43 - Price Leadership Dominant Firm Model - I
- Lecture 44 - Price Leadership Dominant Firm Model - II
- Lecture 45 - Cartel
- Lecture 46 - Intemporal Allocation and Utility
- Lecture 47 - Optimum Choice of a Consumer: Problem of Utility Maximisation
- Lecture 48 - Optimal Division of Natural Resources
- Lecture 49 - Hotelling's rule
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- Lecture 51 - Model of Economic Growth - I
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- Lecture 53 - Discovery of Natural Resources
- Lecture 54 - Model of Economic growth with uncertainty
- Lecture 55 - Exchange Rate and its Determination
- Lecture 56 - Oil Price Shock
- Lecture 57 - BoP Crisis of the Indian Economy in 1991
- Lecture 58 - Crisis and efficiency of exchange rate policies
- Lecture 59 - Concluding Remarks - I
- Lecture 60 - Concluding Remarks - II

Lecture 1 - Introduction: Why Happiness Matters and How We Will Go About Exploring It

Lecture 2 - Can We Define Happiness?

Lecture 3 - Happiness and Wellbeing : Do Cultures and Environments Call the Shots!

Lecture 4 - Doing Happiness' - Philosophical and existential questions, and responses

Lecture 5 - Happiness - antecedents and implications

Lecture 6 - Basic Issues

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Lecture 8 - Happiness - the unanswered questions

Lecture 9 - Evolution of Happiness

Lecture 10 - Belief and Gene

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Lecture 13 - Exploring the self and the other

Lecture 14 - Pro-sociality and happiness - Generosity, give and take

Lecture 15 - Pro-sociality and happiness - Virtues and strengths

Lecture 16 - Relationship - Connected and happy

Lecture 17 - Networking and its relevance for happiness and wellbeing

Lecture 18 - Money and Happiness

Lecture 19 - How does optimism affect happiness?

Lecture 20 - Sharing and Belonging

Lecture 21 - Happiness and body language

Lecture 22 - Failure and Resilience

Lecture 23 - Innovation and Happiness

Lecture 24 - Conflicts and Stress

Lecture 25 - Stress and Coping

Lecture 26 - Reconnecting happiness: beyond pandemic

Lecture 27 - Meditation and Mindfulness: An Overview

Lecture 28 - Meditation and Mindfulness: Practice Toolkit

Lecture 29 - Creativity, Intuition and Flow

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Lecture 31 - Emotional intelligence

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[Lecture 33 - Nudging and Decision-making](#)

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Lecture 2 - Population Growth Models

Lecture 3 - Resource Consumption and Pollution

Lecture 4 - Measuring Environmental Impacts - the IPAT Model and Ecological Footprint

Lecture 5 - Measuring - Earth Overshoot Day, Energy Performance Index and Lifecycle Assessment

Lecture 6 - Principles of Sustainable Development

Lecture 7 - Principles of Sustainable Development (Sustainable Development Goals)

Lecture 8 - Principles of Sustainable Development (Achieving SDGs and Sustainability Indices)

Lecture 9 - Principles of Sustainable Development (Case Study I: Sustainable Urbanization)

Lecture 10 - Principles of Sustainable Development (Case Study II: Green Buildings)

Lecture 11 - Air Pollution (Definition, Causes, Sources and Types)

Lecture 12 - Air Pollution (Influence of Meteorology)

Lecture 13 - Air Pollution (Local Effects and Mitigation Measures)

Lecture 14 - Air Pollution (Regional Issues and Mitigation Measures)

Lecture 15 - Air Pollution (Global Issues and Mitigation Measures, Indoor Air Quality)

Lecture 16 - Climate Change (Definition and Evidence)

Lecture 17 - Climate Change (Causes and Determinants)

Lecture 18 - Climate Change (Projections and Related Impacts)

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Lecture 20 - Climate Change (Adaption and Policy Responses)

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Lecture 22 - Renewable Energy - I (Solar Energy - I)

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Lecture 26 - Renewable Energy - II (Geothermal Energy)

Lecture 27 - Renewable Energy - II (Ocean Energy - I)

Lecture 28 - Renewable Energy - II (Ocean Energy - II)

Lecture 29 - Renewable Energy - II (Hydropower)

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- Lecture 32 - Circular Economy (Circular Economy Strategies - I)
- Lecture 33 - Circular Economy (Circular Economy Strategies - II)
- Lecture 34 - Circular Economy (Circular Business Models)
- Lecture 35 - Circular Economy (Industrial Symbiosis)
- Lecture 36 - Hydrologic cycle, sources of water and water pollution
- Lecture 37 - Water Quality Parameters - General
- Lecture 38 - Water Quality Parameters - Oxygen demanding wastes and Microbial
- Lecture 39 - Nitrogen species in rivers and the DO Sag Curve
- Lecture 40 - NGT, WQI and reuse and recycling of wastewater
- Lecture 41 - Importance and Integrated Solid Waste Management
- Lecture 42 - Sources of MSW, MSW Generation Rates and Composition
- Lecture 43 - MSW Composition and Collection
- Lecture 44 - MSW Treatment and Disposal
- Lecture 45 - E-Waste Management
- Lecture 46 - Sound, noise and its characteristics
- Lecture 47 - Audiometry
- Lecture 48 - Effects of noise
- Lecture 49 - Noise rating systems and modeling
- Lecture 50 - Noise control and regulations
- Lecture 51 - Fundamentals of Ecology - I
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- Lecture 53 - Fundamentals of Ecology - III
- Lecture 54 - Soil Pollution - I
- Lecture 55 - Soil Pollution - II
- Lecture 56 - The Environmental Movement and its global and local impacts
- Lecture 57 - Environmental Law and Rules in India
- Lecture 58 - Important legal judgments pertaining to the Environment
- Lecture 59 - NGT and its important judgments
- Lecture 60 - Rapid Environmental Impact Assessment - A case study of the River Ib Barrage

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- Lecture 10 - Major Theories of Learning (Continued...)
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- Lecture 21 - Motivation of Learning
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- Lecture 25 - Motivation of Learning (Continued...)
- Lecture 26 - Emotional Intelligence and Learning
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- Lecture 31 - Learning and Instruction

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- [Lecture 50 - Effective Learning: Assessment and Feedback \(Continued...\)](#)
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- [Lecture 60 - Learning for Sustainability \(Continued...\)](#)



- Lecture 1 - How do we define language?
- Lecture 2 - What is knowledge of language?
- Lecture 3 - How is Human communication unique?
- Lecture 4 - Universal properties of language
- Lecture 5 - What do we do in Linguistics?
- Lecture 6 - Transdisciplinary Approach to Linguistics
- Lecture 7 - Rules of Language
- Lecture 8 - Competence and Performance, Langue and Parole
- Lecture 9 - Universal Grammar
- Lecture 10 - Faculty of Language
- Lecture 11 - Introduction to Phonetics
- Lecture 12 - More about Phonetics
- Lecture 13 - Introduction to IPA
- Lecture 14 - Introduction to Phonology
- Lecture 15 - More about Phonology
- Lecture 16 - Introducing Morphology
- Lecture 17 - Morpheme, Morph and Allomorph
- Lecture 18 - Types of Morpheme
- Lecture 19 - Morphological Processes
- Lecture 20 - More about Morphological Process
- Lecture 21 - Morphological Typology
- Lecture 22 - Introducing Syntax
- Lecture 23 - Syntactic Categories and Subcategories
- Lecture 24 - Constituents and Phrase Structures Rules
- Lecture 25 - More about Trees
- Lecture 26 - Different parts of a tree
- Lecture 27 - From Transformation to GB Theory
- Lecture 28 - Introducing Minimalism
- Lecture 29 - Introducing Semantics
- Lecture 30 - Lexical Semantics
- Lecture 31 - Introducing Pragmatics

- Lecture 32 - Language and Script
- Lecture 33 - Defining Computational Linguistics
- Lecture 34 - An Introduction to Corpus Linguistics
- Lecture 35 - Introducing Linguistic Typology
- Lecture 36 - More about Linguistic Typology
- Lecture 37 - Typology through Indian Languages
- Lecture 38 - Language Families of India
- Lecture 39 - More about Language Families of India
- Lecture 40 - India as a Linguistic Area
- Lecture 41 - Introducing Sociolinguistics
- Lecture 42 - Language Maintenance and Language Shift
- Lecture 43 - Multilingualism and Varieties of Language
- Lecture 44 - Language, Dialect and Standardization
- Lecture 45 - Standard Language Ideology
- Lecture 46 - Language Variation
- Lecture 47 - Language Change
- Lecture 48 - Language and Identity
- Lecture 49 - Language Endangerment
- Lecture 50 - Different Aspects of Language Endangerment
- Lecture 51 - Language Documentation
- Lecture 52 - Language Documentation and Revitalization
- Lecture 53 - A Discussion on Field Linguistics
- Lecture 54 - Language Teaching
- Lecture 55 - More about Language Teaching
- Lecture 56 - Sociolinguistics and language teaching
- Lecture 57 - Language Policy
- Lecture 58 - Endangered Languages and its Revitization through Classrooms
- Lecture 59 - Summing up
- Lecture 60 - Summing up

Lecture 1 - Introduction

Lecture 2 - Branches of Philosophy

Lecture 3 - Philosophy and other Subjects

Lecture 4 - History of Western Philosophy

Lecture 5 - Pre Socrates-Philosopher

Lecture 6 - Pre Socrates-Philosopher

Lecture 7 - Socrates

Lecture 8 - Plato

Lecture 9 - Aristotle

Lecture 10 - Rene Descartes

Lecture 11 - Rene Descartes

Lecture 12 - Rene Descartes

Lecture 13 - Benedict Spinoza

Lecture 14 - Benedict Spinoza

Lecture 15 - John Lock

Lecture 16 - John Lock

Lecture 17 - Hume

Lecture 18 - Hume

Lecture 19 - Critical argument against empiricism

Lecture 20 - Ethics

Lecture 21 - Branches of Ethics

Lecture 22 - Virtue Ethics

Lecture 23 - Hedonism

Lecture 24 - Utilitarianism

Lecture 25 - Mill on happiness

Lecture 26 - Immanuel Kant

Lecture 27 - Immanuel Kant

Lecture 28 - Immanuel Kant

Lecture 29 - Indian Philosophy

Lecture 30 - Indian Philosophy

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[Lecture 32 - Indian Philosophy](#)

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[Lecture 34 - Sankara's philosophy](#)

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[Lecture 49 - Samkhya Philosophy](#)

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[Lecture 52 - Samkhya Philosophy](#)

[Lecture 53 - Samkhya Philosophy](#)

[Lecture 54 - The Jaina Philosophy](#)

[Lecture 55 - The Jaina Philosophy](#)

[Lecture 56 - The Jaina Philosophy](#)

[Lecture 57 - The Jaina Philosophy](#)

[Lecture 58 - The Jaina Philosophy](#)

Lecture 1 - Greek Philosophy: Ionians, Pythagoras, Parmenides, Heraclitus and Democritus

Lecture 2 - Sophists, Socrates; philosophy of man; relativism and subjectivism; the idea of good

Lecture 3 - Platos idealism: theory of ideas

Lecture 4 - Plato: theory of knowledge, method of dialectic; theory of soul

Lecture 5 - Aristotles criticism of Platonic idealism and the concepts of Form and Matter

Lecture 6 - Aristotles theory of causation; potentiality and actuality

Lecture 7 - Medieval philosophy: St. Augustine and the Problem of evil; St. Thomas Aquinass concepts of faith and reason; proofs for the existence of God.

Lecture 8 - Modern Philosophy: mail characteristic features; renaissance and scientific revolution; rationalism and empiricism: main features.

Lecture 9 - Descartes: the method in philosophy; the concepts of doubt and indubitable knowledge.

Lecture 10 - Descartes: the mind-body dualism; the concept of God and proofs for Gods existence

Lecture 11 - Spinoza: the concepts of Substance, attributes and modes.

Lecture 12 - Spinozas pantheism-God and nature

Lecture 13 - Leibniz: Monadology; the mind-body problem revisited; concept of God; the concept of pre-established harmony

Lecture 14 - The empiricism of John Locke: ideas and their classification; refutation of innate ideas

Lecture 15 - John Locke: theory of knowledge; concept of substance; the primary and secondary qualities

Lecture 16 - Berkeley: the refutation of the distinction between primary and secondary qualities, immaterialism

Lecture 17 - Berkeleys critique of abstract ideas, esse est percipi, the problem of solipsism; God and self

Lecture 18 - Hume : Impressions and ideas, knowledge concerning relations of ideas and knowledge concerning matters of fact, induction and causality.

Lecture 19 - The external world and the self, personal identity, rejection of metaphysics, scepticism, reason and the passions.

Lecture 20 - Critical Philosophy: characteristic features; kantd objectives: the classification of judgements, possibility of synthetic a priori judgements, the Copernican revolution

Lecture 21 - Kant: forms of sensibility, categories of understanding; the process of knowledge acquisition; phenomenon and noumenon,

Lecture 22 - The Ideas of Reason-soul, God and world as a whole; antinomies; rejection of speculative metaphysics.

Lecture 23 - Kants ethics; freedom and immortality, problems with Kant.

Lecture 24 - Hegel : The conception of Geist (spirit), the dialectical method, concepts of being, non-being and becoming,

Lecture 25 - Absolute idealism; consciousness, self consciousness and reason.

Lecture 26 - Karl Marx: historical materialism; the significance of the proletariat; the base structure-superstructure division.

Lecture 27 - Nietzsche : Critique of western culture, religion and morality; will to power; the idea of superman.

Lecture 28 - Linguistic turn in British philosophy: Russells logical atomism and the refutation of idealism.

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Lecture 29 - Wittgenstein : early Wittgensteins conception of language and reality; the picture theory of meaning

Lecture 30 - Later Wittgensteins conception of language games and forms of life; meaning and use.

Lecture 31 - Logical positivism; against metaphysics and a scientific conception of philosophy; the limitation of logical positivism

Lecture 32 - Husserl : Phenomenology and the methods of reduction; the principle of intentionality.

Lecture 33 - Phenomenological reduction, eidetic reduction and transcendental reduction; transcendental subjectivity; the pure subject.

Lecture 34 - Heidegger : phenomenological hermeneutics; concept of Being; man as being-in-the-world; destruction of the western intellectual tradition.

Lecture 35 - Authentic and inauthentic existence; Truth as disclosure

Lecture 36 - Existentialism: main features; existence precedes essence; freedom and responsibility; finiteness and situatedness of human existence

Lecture 37 - Sartres conception of human existence; man is condemned to be free; rejection of essentialism

Lecture 38 - The concept of being-in-itself, being-for-itself and being-for-others

Lecture 39 - Postmodernism: major trends and chief characteristic features; conceptions of human subject; different postmodern approaches

Lecture 40 - Deconstruction, feminism, discourse theory etc.

Lecture 1 - Introduction to Drama

Lecture 2 - Harold Pinter

Lecture 3 - The Dumb Waiter

Lecture 4 - The Dumb Waiter (Continued...)

Lecture 5 - Six Degrees of Separation

Lecture 6 - Six Degrees of Separation

Lecture 7 - Six Degrees of Separation

Lecture 8 - Six Degrees of Separation

Lecture 9 - Six Degrees of Separation

Lecture 10 - Tom Stoppard - Dogg's Hamlet, Cahoot's Macbeth

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Lecture 16 - Arthur Miller Clara

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Lecture 19 - Albert Camus The Fall

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Lecture 21 - Albert Camus The Fall

Lecture 22 - Girish Karnad - Nagamandala

Lecture 23 - Girish Karnad - Nagamandala

Lecture 24 - Girish Karnad - Nagamandala

Lecture 25 - Short Story - Salman Rushdie's

Lecture 26 - Short Story2 - Hanif Kureishi's

Lecture 27 - Modernism Post

Lecture 28 - Kazuo Ishiguro - Remains of the Day

Lecture 29 - Kazuo Ishiguro - Remains of the Day

Lecture 30 - Kazuo Ishiguro - Remains of the Day

Lecture 31 - Kazuo Ishiguro - Remains of the Day

[Lecture 32 - Michael Ondaatje - The English Patient](#)

[Lecture 33 - Michael Ondaatje - The English Patient](#)

[Lecture 34 - Michael Ondaatje - The English Patient](#)

[Lecture 35 - Asian-American Writing](#)

[Lecture 36 - Amy Tan's - The Joy Luck Club](#)

[Lecture 37 - Amy Tan's - The Joy Luck Club](#)

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- Lecture 2 - The Process of Construction of Knowledge
- Lecture 3 - The Roles of Faith and Experience
- Lecture 4 - From Orphism to the Milesians in ancient Greece
- Lecture 5 - Pythagoras and Heraclitus
- Lecture 6 - From Parmenides to the atomists
- Lecture 7 - From the ancient Greece to the emergence of Feudalism
- Lecture 8 - Feudalism and the growth of the Church
- Lecture 9 - The age of Faith: Europe until the crusades
- Lecture 10 - The beginnings of modernity
- Lecture 11 - Scholasticism and St.Thomas
- Lecture 12 - Transformation of Europe towards modernity
- Lecture 13 - Birth of political economy: mercantilism
- Lecture 14 - The debate over mercantilism: Hume and Cantillon
- Lecture 15 - A postscript to mercantilism: Hume and James Stewart
- Lecture 16 - "Natural Order"™ and the market: Quesney and Galiani
- Lecture 17 - Smith: the Invisible Hand
- Lecture 18 - Smith: Growth theory, long run equilibrium and Institutions
- Lecture 19 - Ricardo-Malthus debate
- Lecture 20 - Ricardian economics and more
- Lecture 21 - Equilibrium of the market: from Say to Walras
- Lecture 22 - More on Equilibrium: Cournot, Dupuit, Gossen, von Thunen
- Lecture 23 - Socialists and Marx
- Lecture 24 - The economics of Marx
- Lecture 25 - Marx as an ideologue of revolution
- Lecture 26 - Arrival of modern universals in Economics: Neo classical school
- Lecture 27 - Economic Theory at the time arrival of Keynes
- Lecture 28 - The centrality of the idea of efficiency in the study of market
- Lecture 29 - Keynesian Revolution: Macroeconomics
- Lecture 30 - Keynesian economics
- Lecture 31 - Economics of Institutions

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[Lecture 35 - The social construction of knowledge: Case of Economics](#)

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**Co-ordinators : Dr. P GaneshKumar, Dr. P. Manickam, Dr. Prabhdeep Kaur, Dr. Tarun Bhatnagar, Dr. R Ramakrishnan, Dr. Manoj V Murhekar, Dr. Sanjay Mehendale**

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Lecture 12 - Issues in Contemporary Patent

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- Lecture 3 - Language in Society
- Lecture 4 - Acquisition
- Lecture 5 - Vocal Apparatus
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- Lecture 7 - Word Formation Phonotactic Rules
- Lecture 8 - Rules of Word Formation
- Lecture 9 - Sentences- an introduction
- Lecture 10 - Components of a Sentence
- Lecture 11 - Grammaticality and Acceptability
- Lecture 12 - Subject and Verb in a sentence
- Lecture 13 - Sentence : Objects and Verbs
- Lecture 14 - Application of linguistic structure in social theory
- Lecture 15 - Second Language Acquisition
- Lecture 16 - Language and Multilingualism
- Lecture 17 - Language, Culture and Cognition
- Lecture 18 - Classroom discussion on Language, Culture and Cognition
- Lecture 19 - Language and Gender
- Lecture 20 - Language, Media and Network society
- Lecture 21 - Language Teaching
- Lecture 22 - Language Teaching Methods - I
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- Lecture 24 - Materials and Assessment in Teaching Language
- Lecture 25 - Disability and Learning Disorder
- Lecture 26 - Language Development and Specific Difficulties
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- Lecture 28 - Specific Learning Difficulties
- Lecture 29 - Language and Computers
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Lecture 10 - Text - Completion

Lecture 11 - Analogy

Lecture 12 - Writing : Long Essays

Lecture 13 - Writing : Long Essays (Continued...)

Lecture 14 - Listening

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Lecture 19 - Reading Comprehension: Long Passages

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Lecture 22 - Vocabulary: word origins and confusable words

Lecture 23 - Vocabulary: Text Completion - Part 1

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**Co-ordinators : Prof. Bidisha**

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Lecture 8 - Accessibility Fundamentals: Disabilities, Guidelines, and Laws

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**Co-ordinators : Prof. Bidisha Chaudhuri**

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Lecture 2 - Infinitiv mit zu

Lecture 3 - Wir lernen das Verb lassen

Lecture 4 - Das Verb lassen / Äœber eine Reise sprechen und schreiben

Lecture 5 - Wir Machen Lektion 1 Zu Ende

Lecture 6 - Wir Sprechen Äœber Vorlieben Und Abneigungen

Lecture 7 - Mein Lieblingsurlaub

Lecture 8 - Wir beginnen mit Kapitel 2

Lecture 9 - Kapitel 2. Wir Lernen Die Konnektoren -- Weil, Deshalb, Obwohl Und Trotzdem

Lecture 10 - Der Genitiv

Lecture 11 - Der Genitiv -- Die PrÄœpositionen wegen und trotz -- Wir machen Lektion 2 zu Ende

Lecture 12 - Wir machen Lektion 3.

Lecture 13 - Das PrÄœteritum

Lecture 14 - Technik im Alltag

Lecture 15 - Die PrÄœpositionen vor, nach und wÄœhrend.

Lecture 16 - Neue Technologien - Eine Meinung

Lecture 17 - Wir Ä¼ben Konnektoren. Wir beginnen mit Lektion 4

Lecture 18 - Wir machen mit Lektion 4 weiter

Lecture 19 - Wir lernen das PrÄœteritum und den Konjunktiv 2

Lecture 20 - Verben mit PrÄœpositionen - Lektion 4

Lecture 21 - Wir machen Lektion 4 zu Ende

Lecture 22 - Was bedeutet GlÄ¼ck fÄ¼r mich?

Lecture 23 - Umweltfreundlich? Wir machen Lektion 5

Lecture 24 - GlÄ¼cklich sein und umweltfreundlich leben. Lektion 5: Komparativ und Superlativ

Lecture 25 - Wir wiederholen Adjektiv- und n-Deklination

Lecture 26 - Umweltschutz und Tierschutz. Wir machen Lektion 5 zu Ende.

Lecture 27 - Wir bereiten uns auf eine PrÄœsentation vor.

Lecture 28 - Relativsatz 1

Lecture 29 - Relativsatz 2. Und wir lesen eine kleine Geschichte.

Lecture 30 - Zukunftszeichen und VorsÄœtze fÄ¼rs neue Jahr: Wir lernen Futur I.

Lecture 31 - Relativsatz - eine Wiederholung | Zukunft: Hamburg 2030

Lecture 32 - Was kann ich für die Umwelt tun? (I)

Lecture 33 - Was kann ich für die Umwelt tun? (II)

Lecture 34 - Was kann ich für die Umwelt tun? (III)

Lecture 35 - Kleines Städte-Quiz

Lecture 36 - Was kann ich für die Umwelt tun? (IV)

Lecture 37 - Wir lernen und üben das Plusquamperfekt.

Lecture 38 - Wir beginnen mit Kapitel 7.

Lecture 39 - Thema Beziehungskisten. Wir lernen dabei temporale Nebensätze kennen.

Lecture 40 - Wir üben temporale Nebensätze.

Lecture 41 - Berühmte Paare. Wir machen Kapitel 7 zu Ende.

Lecture 42 - Wir beginnen mit Kapitel 8.

Lecture 43 - Im Krankenhaus. brauchen nicht und brauchen nur + zu | dass Satz und Infinitiv Satz

Lecture 44 - Wir wiederholen und üben das Reflexiv.

Lecture 45 - Wofür interessierst du dich? | Reflexiv und zweiteilige Konnektoren: Wir machen Kapitel 8 zu Ende.

Lecture 46 - Thema: Hotel Mama. Präsentationen der Lernenden. (I)

Lecture 47 - Hotel Mama. Präsentationen der Lernenden. (II)

Lecture 48 - Präsentationen der Lernenden zum Thema Hotel Mama (III)

Lecture 49 - Ergänzung der Adjektivdeklination. Wir beginnen mit Kapitel 9.

Lecture 50 - Präsentationen der Lernenden zum Thema Hotel Mama (IV)

Lecture 51 - Wir sehen einen Film zum Thema Hotel Mama.

Lecture 52 - Stellung von nicht im Satz. | Volkslieder

Lecture 53 - Wir lernen das Passiv.

Lecture 54 - Wir lernen und üben das Passiv.

Lecture 55 - Wir üben das Passiv. (II) | Präpositionen mit dem Genitiv | Wir machen Kapitel 10 zu Ende.

Lecture 56 - Adjektivdeklination - Wiederholung | Kapitel 11: Artikelwörter als Pronomen

Lecture 57 - Kapitel 11: Adjektiv als Nomen | Sprichwörter | Ergänzung zu den Relativsätzen

Lecture 58 - Kapitel 11: Städterankings | Relativsätze mit was und wo

Lecture 59 - Wir machen Kapitel 11 zu Ende. | Sätze mit je...desto

Lecture 60 - Kapitel 12: Verben als Adjektive - Partizip 2 und Partizip 1

Lecture 61 - Wir lernen und üben das Passiv.

Lecture 62 - Kapitel 12: Lesetexte zu den Themen Globalisierung und Gewissensfragen

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Lecture 64 - Kapitel 12: Lesetext -- Die Fuggerei in Augsburg

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[Lecture 68 - Präsentionen zum Thema: Leben - in der Stadt oder auf dem Land? \(V\) | Wir lernen](#)

[Lecture 69 - Wir lernen, wie man einen informellen Brief oder eine informelle E-Mail schreibt](#)

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- Lecture 10 - Determination of Injury, Definition of Industry, Domestic Industry and Casual Link
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- Lecture 12 - Agreement on Sanitary and Phytosanitary measures (SPS)
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- Lecture 15 - Technical Barriers to Trade Agreement (TBT) and Indian Institutions
- Lecture 16 - Basic TBT Commitments, Indian Laws, Rules and Regulations
- Lecture 17 - General Agreements on Trade in Services (GATS)
- Lecture 18 - Different Modes of Services
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**NPTEL : Managerial Accounting (Management)**

**Co-ordinators : Dr. Varadraj Bapat**

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- Lecture 2 - Double Entry System, Forms of Organisation
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- Lecture 7 - Accounting Concepts, Standards, IFRS
- Lecture 8 - Depreciation, Inventory, Goodwill
- Lecture 9 - Inventory Valuation, Cash Flow
- Lecture 10 - Cash Flow Statement Cases
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- Lecture 14 - Common-size, Comparative Statement Analysis
- Lecture 15 - Ratio Analysis
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- Lecture 24 - Job and Process Accounting including cost sheet and equivalent production
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**NPTEL : Managerial Economics (Management)**

**Co-ordinators : Dr. Trupti Mishra**

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[Lecture 21 - Theory of Cost \(Continued...\)](#)

[Lecture 22 - Theory of Cost \(Continued...\)](#)

[Lecture 23 - Theory of Cost \(Continued...\)](#)

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[Lecture 25 - Perfect Competition](#)

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Lecture 1 - Why the Course on Managing Self and Career

Lecture 2 - Present Context of Professional Work

Lecture 3 - State of Wellbeing of Indian Youth

Lecture 4 - Link between Self-Management and Career Management

Lecture 5 - Journey of Positive Psychology

Lecture 6 - Can there be a Universal Positive Psychology ?

Lecture 7 - Difference in Good Life and Life Satisfaction

Lecture 8 - Why Yoga with Positive Psychology ?

Lecture 9 - Genesis of this Course

Lecture 10 - Using Stories to Understand Optimal Experiences

Lecture 11 - Fundamental Questions in Positive Psychology

Lecture 12 - What Positive Psychology is Not

Lecture 13 - Positive-Negative Dialects of Well-Being

Lecture 14 - Positive Psychology: The Second Wave

Lecture 15 - Positivity and Human Potential in Yogic Traditions

Lecture 16 - Holistic Life Goals

Lecture 17 - Embracing Emotions and Positive Behavior

Lecture 18 - Discovering Dharma

Lecture 19 - Distinction with Negative Human Potential

Lecture 20 - Positive Events: 16 Sanskaras

Lecture 21 - Four Ashrams or Stations in Life

Lecture 22 - Yagna - Positive Event

Lecture 23 - Positive Institutions

Lecture 24 - Family - A Positive Institution

Lecture 25 - Yoga and Governance

Lecture 26 - Positive Governance

Lecture 27 - Macro and Micro Integration in Yogic Perspective

Lecture 28 - Self and Society

Lecture 29 - Point for Action and Reflection

Lecture 30 - Health and Wellbeing

Lecture 31 - How does wellbeing affect life ?

- Lecture 32 - Yogic Perspectives of Health and Wellbeing
- Lecture 33 - Doshas
- Lecture 34 - Mind-body Complex
- Lecture 35 - Diseases in Yogic Perspective
- Lecture 36 - Panch Kosha or Five Layers of Self
- Lecture 37 - Managing Mind
- Lecture 38 - Factors to Enhance Well-being
- Lecture 39 - Self-Realization - The Ultimate Joy
- Lecture 40 - What is the Indian Worldview ?
- Lecture 41 - Ways of Attaining Well-Being
- Lecture 42 - TattvaBodh and Wisdom
- Lecture 43 - Indriyajaya or Self-Control
- Lecture 44 - Indriyajaya in Positive Psychology
- Lecture 45 - Dharmic Drishti (Vision)
- Lecture 46 - Dharmic Desires and Pursuits
- Lecture 47 - Dharmakriya in Positive Psychology
- Lecture 48 - Sukhayu-Hitayu
- Lecture 49 - DharmahKriya, Sukhayu-Hitayu and Career Success ?
- Lecture 50 - What is our real nature ?
- Lecture 51 - How the Mind Works: A Yogic Perspective
- Lecture 52 - Obstacles in Attaining Wellbeing
- Lecture 53 - Reflection on Functioning of the Mind
- Lecture 54 - How to avoid Klisht Vrittis ?
- Lecture 55 - Crossing Obstacles to Well-Being
- Lecture 56 - Six Inner Treasures
- Lecture 57 - How are the Six Inner Treasures Valuable
- Lecture 58 - Mental, Vital and Physical Consciousness
- Lecture 59 - Major Forms of Yoga in Indian Tradition
- Lecture 60 - Ashtanga Yoga or Raj Yoga
- Lecture 61 - Yoga for Panch Koshas
- Lecture 62 - Three Pillars of Health
- Lecture 63 - Spiritual Significance of Food
- Lecture 64 - Eight Factors about Food

- Lecture 65 - Seasons with Revolving Sun and Impact on Physiology
- Lecture 66 - Contemporary Knowledge about Food and Mental Health
- Lecture 67 - Food and Activities during the Cycle of the Day
- Lecture 68 - Yogasanas to Integrate Body and Emotions
- Lecture 69 - Interoception, Asanas and Well-Being
- Lecture 70 - Characteristics of Asanas
- Lecture 71 - Process for Moving into Posture
- Lecture 72 - Asanas for Different Body Constitution
- Lecture 73 - Notes on Pranayama
- Lecture 74 - Contemporary Evidences of Prana
- Lecture 75 - Prana Vayu, Nadi System and Chakras
- Lecture 76 - Pranayama Practices and Conscious Breathing
- Lecture 77 - Process and Benefits of Diaphragmatic Breathing
- Lecture 78 - Guidelines for Pranayama
- Lecture 79 - Nadi Shodhana Pranayama (Alternate Nostril Breathing)
- Lecture 80 - Tranquilizing Pranayamas
- Lecture 81 - Organizational Suffering and Dysfunctional Behaviors
- Lecture 82 - Introduction to Pratyahara
- Lecture 83 - Indriya-Pratyahara: Control of the Senses
- Lecture 84 - Methods of Pratyahara
- Lecture 85 - Understanding Emotional Intelligence
- Lecture 86 - Emotional Intelligence and its Relation to Everyday Behavior
- Lecture 87 - How Yoga Helps in Emotional Balance
- Lecture 88 - Positive and Negative Emotions
- Lecture 89 - Dealing with Negative Emotions
- Lecture 90 - How Yoga Helps in Equanimity of Mind
- Lecture 91 - What are the 7 Stages of Wisdom
- Lecture 92 - What Yoga does for Balancing Emotions and Cognitions
- Lecture 93 - How Yoga Impacts Student's Performance: Empirical Studies



Lecture 1 - Module 1 - Part 1

Lecture 2 - Module 1 - Part 2

Lecture 3 - Module 2 - Part 1

Lecture 4 - Module 2 - Part 2

Lecture 5 - Module 3 - Part 1

Lecture 6 - Module 3 - Part 2

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Lecture 16 - Module 8 - Part 1

Lecture 17 - Module 8 - Part 2

Lecture 18 - Module 9 - Part 1

Lecture 19 - Module 9 - Part 2

Lecture 20 - Module 10

- Lecture 1 - Introduction of Supply Chain Management
- Lecture 2 - Fundamentals of Supply Chain Management
- Lecture 3 - Supply Chain Drivers
- Lecture 4 - Supply Chain Processes - I
- Lecture 5 - Supply Chain Processes - II
- Lecture 6 - Supply Chain Challenges
- Lecture 7 - Need/Strategies
- Lecture 8 - Push Vs Pull
- Lecture 9 - Case Study on Product Segmentation
- Lecture 10 - Case Study on Inventory Segmentation
- Lecture 11 - Link between Corporate and Supply Chain Strategy
- Lecture 12 - Interface between Operations and Finance
- Lecture 13 - Procurement Strategy (Make Vs Buy)
- Lecture 14 - Procurement Strategy (Kraljic Matrix) - I and II
- Lecture 15 - Procurement Strategy (Kraljic Matrix) - I and II
- Lecture 16 - Introduction to Platform Economy
- Lecture 17 - Introduction to Platform Economy - Example
- Lecture 18 - Introduction to Channel Structures and Supply Chain Coordination
- Lecture 19 - Newsvendor Case Example (Deterministic Setting) - I and II
- Lecture 20 - Newsvendor Case Example (Deterministic Setting) - I and II
- Lecture 21 - Newsvendor Case (Probabilistic Setting and Contracts) - I and II
- Lecture 22 - Newsvendor Case (Probabilistic Setting and Contracts) - I and II
- Lecture 23 - Channel Structure Designs in Supply Chains (Brick and Mortar)
- Lecture 24 - Channel Structure Designs in Supply Chains (Dual Channels)
- Lecture 25 - Channel Structure Designs in Supply Chains (Multi and Omni Channels)
- Lecture 26 - Introduction to Analytics and Big Data
- Lecture 27 - Different Types of Analytics and its Applications in Supply Chain Management
- Lecture 28 - Predictive Analytics: Case Study on Predictive Maintenance
- Lecture 29 - Predictive Analytics: Classification Tree Model
- Lecture 30 - Predictive Analytics: Building Classification Tree Model using Python
- Lecture 31 - Role of AI/ML in Forecasting and Demand Analytics

- Lecture 32 - Demand Forecasting using AI/ML: A Case Study
- Lecture 33 - Demand Forecasting using AI/ML: Regression Tree Model
- Lecture 34 - Demand Forecasting using AI/ML: Building Regression Tree Model using Python
- Lecture 35 - Demand Forecasting using AI/ML: Random Forest Regression Model
- Lecture 36 - Supply Chain Network Optimization: Break even analysis
- Lecture 37 - Supply Chain Network Optimization: Facility location using Centre of Gravity
- Lecture 38 - Supply Chain Network Optimization: Case on Capacitated Plant Location Model
- Lecture 39 - Case on Supply Chain Network Design - I
- Lecture 40 - Case on Supply Chain Network Design - II
- Lecture 41 - Location of Distribution Centers using Clustering Technique: A Case Study
- Lecture 42 - Steps of building K-Means Clustering Algorithm: A Case Study
- Lecture 43 - Location of Distribution Centers: Building K-Means Clustering Model using Python
- Lecture 44 - Measuring Efficiency of Manufacturing Facilities: A DEA Model - I
- Lecture 45 - Measuring Efficiency of Manufacturing Facilities: A DEA Model - II
- Lecture 46 - Role of Product Tracking and Traceability
- Lecture 47 - Track and Trace Systems - I and II
- Lecture 48 - Track and Trace Systems - I and II
- Lecture 49 - ERP, WMS and TMS - I and II
- Lecture 50 - ERP, WMS and TMS - I and II
- Lecture 51 - Introduction to Supply Chain Digital Twin
- Lecture 52 - Supply Chain Digital Twin: Greenfield Analysis - A Case Study - I
- Lecture 53 - Supply Chain Digital Twin: Greenfield Analysis - A Case Study - II
- Lecture 54 - Supply Chain Digital Twin: Network Optimization - A Case Study
- Lecture 55 - Network Optimization with Capacity Constraints and Control Tower
- Lecture 56 - Digital Infrastructure for Supply Chains: Industry 4.0
- Lecture 57 - Industry 4.0 - IIoT, Cloud Computing, Horizontal and Vertical System Integration
- Lecture 58 - Industry 4.0 - Cybersecurity, Big Data Analytics, Simulation, AR, Robots, AM
- Lecture 59 - Blockchain
- Lecture 60 - Supply Chain and Industry 4.0

**NPTEL : NOC:Business Forecasting (Management)**

**Co-ordinators : Prof. Pankaj Dutta**

Lecture 1 - Introduction to Business Forecasting

Lecture 2 - Data Driven Decision Making and Essentials of Predictive Analytics

Lecture 3 - Data Driven Decision Making and Essentials of Predictive Analytics

Lecture 4 - Types of Forecasting: Qualitative Approaches and Quantitative Approaches

Lecture 5 - Components of a Time Series and Measures of Forecast Accuracy

Lecture 6 - Components of a Time Series and Measures of Forecast Accuracy

Lecture 7 - Moving Average Methods: Simple, Weighted, and Exponential Moving Average

Lecture 8 - Moving Average Methods: Simple, Weighted, and Exponential Moving Average

Lecture 9 - Exponential Smoothing

Lecture 10 - Trend Projections and Holt Model

Lecture 11 - Simple Linear Regression and Measure of Goodness and Standard Error

Lecture 12 - Simple Linear Regression and Measure of Goodness and Standard Error

Lecture 13 - Simple Linear Regression and Measure of Goodness and Standard Error

Lecture 14 - Multiple Linear Regression and Multicollinearity

Lecture 15 - Multiple Linear Regression and Multicollinearity

Lecture 16 - Multiple Linear Regression and Multicollinearity

Lecture 17 - Seasonality, Seasonal Index, and Quarterly Average Method

Lecture 18 - Seasonality, Seasonal Index, and Quarterly Average Method

Lecture 19 - Seasonality and Trend: Winter's Holt Method

Lecture 20 - Seasonality and Trend: Winter's Holt Method

Lecture 21 - Multiplicative Decomposition Method

Lecture 22 - Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF)

Lecture 23 - ARIMA: Auto-Regressive (AR) Process

Lecture 24 - ARIMA: Moving Average (MA) Process

Lecture 25 - ARIMA: Auto-Regressive Moving Average (ARMA) Process

Lecture 26 - Auto-Regressive Integrated Moving Average (ARIMA) Model

Lecture 27 - Introduction to Machine Learning

Lecture 28 - Introduction to Machine Learning

Lecture 29 - Logistic Regression

Lecture 30 - Logistic Regression

Lecture 31 - Human Judgment in Time Series Analysis

[Lecture 32 - Monte Carlo Simulation: Discrete Case](#)

[Lecture 33 - Monte Carlo Simulation: Discrete Case](#)

[Lecture 34 - Monte Carlo Simulation: Continuous case](#)

[Lecture 35 - System Dynamics \(Additional Learning\)](#)

[Lecture 36 - Predictive Analytics using @Risk Software](#)

[Lecture 37 - Predictive Analytics using @Risk Software](#)

[Lecture 38 - Predictive Analytics using @Risk Software](#)

Lecture 1 - Market Research - Part 1

Lecture 2 - Market Research - Part 2

Lecture 3 - Customers and Segments - Part 1

Lecture 4 - Customers and Segments - Part 2

Lecture 5 - Value Based Marketing - Part 1

Lecture 6 - Value Based Marketing - Part 2

Lecture 7 - Marketing Communication - Part 1

Lecture 8 - Marketing Communication - Part 2

Lecture 9 - Sales Channels and Distribution - Part 1

Lecture 10 - Sales Channels and Distribution - Part 2

Lecture 11 - B2B and B2C Selling - Part 1

Lecture 12 - B2B and B2C Selling - Part 2

Lecture 13 - Customer Service Management - Part 1

Lecture 14 - Customer Service Management - Part 2

Lecture 15 - Supply Chain Management - Part 1

Lecture 16 - Supply Chain Management - Part 2

Lecture 17 - Quadrangle of Success

**NPTEL : Organisation Management (Management)**

**Co-ordinators : Prof. Vinayshil Gautam**

- Lecture 1 - Introduction to Organization Management,Nature, Scope and Complexity
- Lecture 2 - Longitudinal thinking and legacy factor:Organizational Growth
- Lecture 3 - Longitudinal thinking and legacy factor:Organizational Growth (Continued...)
- Lecture 4 - Longitudinal thinking and legacy factor:Organizational Growth (Continued...)
- Lecture 5 - Theory and majors schools of Thought and Framework of Organizational Analysis
- Lecture 6 - Theory and majors schools of thought and framework of organizational analysis (Continued...)
- Lecture 7 - Theory and majors schools of thought and framework of organizational analysis (Continued...)
- Lecture 8 - Systems contingency approach to organization theory and practice; techniques of organizational diagnosis
- Lecture 9 - Systems contingency approach to organization theory and practice; techniques of organizational diagnosis (Continued...)
- Lecture 10 - Systems contingency approach to organization theory and practice; techniques of organizational diagnosis (Continued...)
- Lecture 11 - Theory of organizational structures - nature and consequence of structure
- Lecture 12 - Theory of organizational structures - nature and consequence of structure (Continued...)
- Lecture 13 - Socio-culture dimension of work and behavior
- Lecture 14 - Socio-culture dimension of work and behavior (Continued...)
- Lecture 15 - Socio-culture dimension of work and behavior (Continued...)
- Lecture 16 - Impact of environment and cultural variables on organization structure & style
- Lecture 17 - Impact of environment and cultural variables on organization structure & style (Continued...)
- Lecture 18 - Impact of environment and cultural variables on organization structure & style (Continued...)
- Lecture 19 - Organization Change and Organisation Development
- Lecture 20 - Organization Change and Organisation Development (Continued...)
- Lecture 21 - Intervention strategies for organization development - individual, Group and Interpersonal Interventions
- Lecture 22 - Intervention strategies for organization development - individual, Group & interpersonal interventions (Continued...)
- Lecture 23 - Intervention strategies for organization development - individual, Group & interpersonal interventions (Continued...)
- Lecture 24 - Total System Intervention & Stabilizing Change Management by Objectives
- Lecture 25 - Total System Intervention & Stabilizing Change Management by Objectives (Continued...)
- Lecture 26 - Total System Intervention & Stabilizing Change Management by Objectives (Continued...)
- Lecture 27 - Nature of Organisational Processes
- Lecture 28 - Nature of Organisational Processes (Continued...)
- Lecture 29 - Nature of Organisational Processes (Continued...)
- Lecture 30 - Environmental analysis Techniques and impact for organizational growth
- Lecture 31 - Environmental analysis Techniques and impact for organizational growth (Continued...)

[Lecture 32 - Environmental analysis Techniques and impact for organizational growth \(Continued...\)](#)

[Lecture 33 - Issues of Mechnisation, Automation and Computerisation](#)

[Lecture 34 - Issues of Mechnisation, Automation and Computerisation \(Continued...\)](#)

[Lecture 35 - Organisation Interdependence](#)

[Lecture 36 - Organisation Interdependence \(Continued...\)](#)

[Lecture 37 - Organisation Interdependence \(Continued...\)](#)

[Lecture 38 - Organisation Evaluation](#)

[Lecture 39 - Organisation Evaluation \(Continued...\)](#)

[Lecture 40 - Organisation Evaluation \(Continued...\)](#)



Lecture 1 - Introduction to the subject and the course

Lecture 2 - Understanding organizations: nature and functions

Lecture 3 - Understanding organizations: nature and functions (Continued...)

Lecture 4 - Concerns of organising engineering business and systems

Lecture 5 - Concerns of organising engineering business and systems (Continued...)

Lecture 6 - Concerns of organising engineering business and systems (Continued...)

Lecture 7 - Structure and process issues in running organisations

Lecture 8 - Structure and process issues in running organisations (Continued...)

Lecture 9 - Design issues in running organisations

Lecture 10 - Design issues in running organisations (Continued...)

Lecture 11 - Operating organizations

Lecture 12 - Operating organizations (Continued...)

Lecture 13 - Operating organizations (Continued...)

Lecture 14 - Cybernetics and systems framework

Lecture 15 - Cybernetics and systems framework (Continued...)

Lecture 16 - Socio-technical systems

Lecture 17 - Socio-technical systems (Continued...)

Lecture 18 - Socio-technical systems (Continued...)

Lecture 19 - Dealing with efficiency and excellence

Lecture 20 - Dealing with efficiency and excellence (Continued...)

Lecture 21 - Dealing with efficiency and excellence (Continued...)

Lecture 22 - Man-machine relationship

Lecture 23 - Man-machine relationship (Continued...)

Lecture 24 - Longitudinal Thinking

Lecture 25 - Longitudinal Thinking (Continued...)

Lecture 26 - Concerns of recruitment, selection, skill formation and redeployment

Lecture 27 - Concerns of recruitment, selection, skill formation and redeployment (Continued...)

Lecture 28 - Concerns of recruitment, selection, skill formation and redeployment (Continued...)

Lecture 29 - Developing teams and leadership

Lecture 30 - Developing teams and leadership (Continued...)

Lecture 31 - Understanding motivation

[Lecture 32 - Understanding motivation \(Continued...\)](#)

[Lecture 33 - Elements of human resources planning](#)

[Lecture 34 - Elements of human resources planning \(Continued...\)](#)

[Lecture 35 - Elements of human resources planning \(Continued...\)](#)

[Lecture 36 - Indian Industrial Law and managing industrial](#)

[Lecture 37 - Indian Industrial Law and managing industrial \(Continued...\)](#)

[Lecture 38 - Indian Industrial Law and managing industrial \(Continued...\)](#)

Lecture 1 - Concepts of Economic Growth and Development

Lecture 2 - Structural features of developed and underdeveloped countries

Lecture 3 - The Global North and the Global South: Why the Divide?

Lecture 4 - Growth versus Development - some indices of economic development

Lecture 5 - Modern Economic Growth

Lecture 6 - Strategies of economic development and growth - I

Lecture 7 - Strategies of economic development and growth - II

Lecture 8 - Strategies of economic development and growth - III

Lecture 9 - Strategies of economic development and growth - IV

Lecture 10 - Strategies of economic development and growth - V

Lecture 11 - Strategies of economic development and growth - VI

Lecture 12 - Growth and Inequality

Lecture 13 - Economic Growth and Public Support

Lecture 14 - Measures of Inequality

Lecture 15 - Introduction to Human Development-Putting People First

Lecture 16 - The Human Development and Capability Approach

Lecture 17 - Utilitarianism, Basic Needs Approach and the Capability Approach

Lecture 18 - Measuring Human Development - I

Lecture 19 - Measuring Human Development - II

Lecture 20 - Other Human Development Indices

Lecture 21 - Multidimensional Poverty, MDGs and SDGs

Lecture 22 - Gender mainstreaming and Gender budgeting

Lecture 23 - In Conclusion

Lecture 1 - Understanding organizational behaviour:Tracing the evolution - 1

Lecture 2 - Understanding organizational behaviour:Tracing the evolution - 2

Lecture 3 - Individual in the organization: The building blocks

Lecture 4 - Understanding individual differences - 1

Lecture 5 - Understanding individual differences - 2

Lecture 6 - Diverse workforce, inclusive mindset - 1

Lecture 7 - Diverse workforce, inclusive mindset - 2

Lecture 8 - Perception of diversity and inclusion

Lecture 9 - Ableism and inclusion

Lecture 10 - Diversity management

Lecture 11 - The perceptual process

Lecture 12 - Factors that influence perception

Lecture 13 - Perception and decision making

Lecture 14 - What affects decisions?

Lecture 15 - Ethical decision making

Lecture 16 - Affect and emotions

Lecture 17 - Affective events theory

Lecture 18 - Emotional intelligence

Lecture 19 - Understanding stress

Lecture 20 - Emotions and moods: Application at workplace

Lecture 21 - Understanding self and personality

Lecture 22 - Types and theories of personality

Lecture 23 - Measuring personality

Lecture 24 - Personality traits relevant to organization

Lecture 25 - Assessing personality: caveats and concerns

Lecture 26 - Values and its importance

Lecture 27 - Sources and types of values

Lecture 28 - Values that cut across cultures

Lecture 29 - Person-job fit

Lecture 30 - Person-organization fit

Lecture 31 - Motivation: Basic understanding and definition

- Lecture 32 - Tracing the roots: Early theories - 1
- Lecture 33 - Tracing the roots: Early theories - 2
- Lecture 34 - Keeping up with times: Contemporary theories - 1
- Lecture 35 - Keeping up with times: Contemporary theories - 2
- Lecture 36 - Job Design and job characteristics model
- Lecture 37 - Employee involvement
- Lecture 38 - Motivating the employees: Strategies for organization - 1
- Lecture 39 - Motivating the employees: Strategies for organization - 2
- Lecture 40 - Organizational justice and employee motivation
- Lecture 41 - Defining learning
- Lecture 42 - How do individuals learn?
- Lecture 43 - Theories of learning - 1
- Lecture 44 - Theories of learning - 2
- Lecture 45 - Learning in an organizational setting
- Lecture 46 - Understanding creativity
- Lecture 47 - Stages of individual creativity
- Lecture 48 - Creativity and problem solving
- Lecture 49 - Defining psychological capital
- Lecture 50 - Using Psychological capital and mindfulness at work
- Lecture 51 - Understanding knowledge sharing
- Lecture 52 - Understanding knowledge hiding - what it is and what it is not
- Lecture 53 - Individual factors affecting knowledge hiding
- Lecture 54 - Integrating knowledge sharing and hiding behavior
- Lecture 55
- Lecture 56 - Understanding employee voice and silence
- Lecture 57 - Individual factors affecting voice behavior
- Lecture 58 - Individual factors affecting silence
- Lecture 59 - Can silence be strategic?
- Lecture 60 - Strategies for fostering safe environment at work

Lecture 1 - Strategic Marketing

Lecture 2 - Strategic Marketing

Lecture 3 - Strategic Marketing

Lecture 4 - Strategic Marketing

Lecture 5 - Strategic Marketing

Lecture 6 - Strategic Marketing

Lecture 7 - Strategic Marketing

Lecture 8 - Strategic Marketing

Lecture 9 - Strategic Marketing

Lecture 10 - Strategic Marketing

Lecture 11 - Strategic Marketing

Lecture 12 - Strategic Marketing

Lecture 13 - Strategic Marketing

Lecture 14 - Strategic Marketing

Lecture 15 - Strategic Marketing

Lecture 16 - Strategic Marketing

Lecture 17 - Strategic Marketing

Lecture 18 - Strategic Marketing

Lecture 19 - Strategic Marketing

Lecture 20 - Strategic Marketing

Lecture 21 - Strategic Marketing

Lecture 22 - Strategic Marketing

Lecture 23 - Strategic Marketing

Lecture 24 - Strategic Marketing

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[Lecture 37 - Strategic Marketing](#)

Lecture 1 - Introduction Examples: Markets / Politics / Auctions

Lecture 2 - Prisonersâ€™ Dilemma

Lecture 3 - Best Response and Nash Equilibrium

Lecture 4 - Another Example: Markets

Lecture 5 - Dominant Strategies

Lecture 6 - Stag Hunt â€™ Coordination and Bank Runs

Lecture 7 - Battle of Sexes and Multiple Nash Equilibria

Lecture 8 - Tragedy of Commons

Lecture 9 - Tragedy of Commons

Lecture 10 - Cournot Duopoly

Lecture 11 - Cournot Duopoly

Lecture 12 - Mixed Strategies

Lecture 13 - Battle of Sexes

Lecture 14 - Battle of Sexes: Best Response Dynamic

Lecture 15 - Paying Taxes

Lecture 16 - Portfolio Management Game

Lecture 17 - Rationality, Choice and Common Knowledge

Lecture 18 - Iterated Elimination of Domination Strategies

Lecture 19 - Auction

Lecture 20 - Auction: As a Normal Form Game

Lecture 21 - Traffic at Equilibrium and Braess Paradox

Lecture 22 - Linear Markets

Lecture 23 - Extensive Form Games

Lecture 24 - Game Tree and Information Sets

Lecture 25 - Strategies in Extensive form Games

Lecture 26 - Extensive form Games with Simultaneous Moves and Their Normal Form Representation

Lecture 27 - Sub Game Perfect Equilibrium Part-I

Lecture 28 - Sub Game Perfect Equilibrium Part-II

Lecture 29 - The Art of War: Lesson 1

Lecture 30 - Ultimatum Game

Lecture 31 - Stackelberg Model



[Lecture 32 - Bayesian Games](#)

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[Lecture 35 - Yield vs Fight](#)

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[Lecture 37 - Bayesian Cournot Game](#)

[Lecture 38 - Bayesian Games with mixed strategies](#)

[Lecture 39 - Auctions](#)

[Lecture 40 - Sealed Bid First Price Auction](#)

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[Lecture 45 - A Hawk-Dove Game](#)

[Lecture 46 - Evolutionary Biology](#)

[Lecture 47 - Evolutionary stable Strategy \(ESS\)](#)

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[Lecture 49 - Repeated Games](#)

[Lecture 50 - Finitely Repeated Game having Multiple Equilibriums](#)

[Lecture 51 - Chain-Store Paradox](#)

[Lecture 52 - Infinitely Repeated Game](#)

[Lecture 53 - Non Cooperative Bargaining](#)

[Lecture 54 - Axiomatic Bargaining](#)

[Lecture 55 - Extensive Form Game with Incomplete Information](#)

[Lecture 56 - Introduction to perfect Bayesian Equilibrium](#)

[Lecture 57 - Obtaining PBE](#)

[Lecture 58 - Gift Game](#)

**NPTEL : NOC:Managing Services (Management)**

**Co-ordinators : Prof. Jayanta Chatterjee**

Lecture 1 - What is Service?

Lecture 2 - Evolving Service Markets

Lecture 3 - The Service Customers

Lecture 4 - Product Service Systems

Lecture 5 - The Service Act

Lecture 6 - Seamless Service

Lecture 7 - Service Management Elements

Lecture 8 - Core Vs. Supplementary Services

Lecture 9 - Intangibility of Services

Lecture 10 - Response to IHIP Challenges

Lecture 11 - Process & Promotion

Lecture 12 - Process Issues in Service

Lecture 13 - Challenges of Services-1

Lecture 14 - Service Uniqueness-2

Lecture 15 - Consumer in the Services Flow-1

Lecture 16 - Service Consumer Behavior-2

Lecture 17 - Customer Co Creation of Services-1

Lecture 18 - Customer Co Creation of Services-2

Lecture 19 - Current Service Map to New Service Design

Lecture 20 - Current Service Map to New Service Design.

Lecture 21 - Case Study on Service Excellence-1

Lecture 22 - Case Study on Service Excellence-2

Lecture 23 - Services Excellence - Culture

Lecture 24 - People in Services

Lecture 25 - Position - Value Proposition-1

Lecture 26 - Position - Value Proposition-2

Lecture 27 - Branding Services-1

Lecture 28 - Distributing Services

Lecture 29 - Distributing Services

Lecture 30 - Network of Services

Lecture 31 - Strategy for Service Businesses

- Lecture 32 - Strategy for Service Businesses.
- Lecture 33 - Strategy for Service Businesses..
- Lecture 34 - Pricing - Basic Concepts
- Lecture 35 - Service Pricing
- Lecture 36 - Service Pricing.
- Lecture 37 - Service Quality-I
- Lecture 38 - Service Quality-II
- Lecture 39 - Service Quality-III
- Lecture 40 - Service Complaints and Recovery Strategies
- Lecture 41 - Loyalty - Relationship-I
- Lecture 42 - Loyalty - Relationship-II
- Lecture 43 - Strategy Canvas - Service Portfolio Analysis
- Lecture 44 - Loyalty - Relationship
- Lecture 45 - Managing Partner Relationships
- Lecture 46 - Global Service Ecosystem - Contemporary Issues
- Lecture 47 - Service Ecosystem - Service Innovation
- Lecture 48 - Services as Systems: A Holistic Approach

[Lecture 1](#)

[Lecture 2](#)

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[Lecture 2 \(Continued\) - Part 2](#)

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Lecture 2 - Core Concepts in Marketing

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Lecture 5 - Evolution of Marketing

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Lecture 27 - Socio-Cultural Influences on the Consumer Buying Process

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- [Lecture 33 - Industrial Buyer Behaviour - I](#)
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- [Lecture 35 - Industrial Marketing Program and Buying Process](#)
- [Lecture 36 - Three Dimension of Industrial Buyer Behaviour](#)
- [Lecture 37 - Consumer Decision-Making Process Revisited](#)
- [Lecture 38 - Identifying and Choosing Opportunities](#)
- [Lecture 39 - Market Segmentation - I](#)
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- [Lecture 45 - Segmentation and Targeting in B2B Market](#)
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**NPTEL : NOC:Project Management (Management)**

**Co-ordinators : Prof. Raghunandan Sengupta**

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Lecture 2 - Introduction to Agile Project Management

Lecture 3 - Project Management Process for a Project - I

Lecture 4 - Project Management Process for a Project - II

Lecture 5 - Project Management Process for a Project - III

Lecture 6 - Project Stakeholder and Risk Management

Lecture 7 - Project Risk Management

Lecture 8 - Solving Project Management Decision Problems

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Lecture 25 - Concepts of a Project Life Cycle

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Lecture 29 - Scheduling and Crashing of Jobs

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- Lecture 1 - Systems Engineering – What is, origin and examples
- Lecture 2 - Systems Engineering as a profession
- Lecture 3 - Systems Engineering Management (SEM)
- Lecture 4 - SEM - Lifecycle Integration
- Lecture 5 - Systems Engineering - Modern Version
- Lecture 6 - Overview of Systems Engineering Process
- Lecture 7 - System Design Process
- Lecture 8 - Systems View Point
- Lecture 9 - Complex Systems and System Development Process
- Lecture 10 - System Environments
- Lecture 11 - System Interfaces and Interactions
- Lecture 12 - System Development Process
- Lecture 13 - System Engineering Life Cycle Stages
- Lecture 14 - System Engineering Life Cycle Stages (Continued...)
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- Lecture 17 - Unmanned Aerial Systems - A Systems Engineering Case Study
- Lecture 18 - Discussion about Systems Engineering and System Thinking with Professor Ian Angell
- Lecture 19 - Demonstration of real life systems by the Indian Army
- Lecture 20 - Need Analysis
- Lecture 21 - Functional Analysis
- Lecture 22 - Functional Flow Block Diagram
- Lecture 23 - Quality Function Deployment
- Lecture 24 - Timeline Analysis Sheet and Requirement Allocation Sheet
- Lecture 25 - Design Synthesis
- Lecture 26 - Design Synthesis (Continued...)
- Lecture 27 - Design Synthesis Tools

- Lecture 1 - Quality and its Dimensions
- Lecture 2 - Quality and Variability
- Lecture 3 - History of Quality Control
- Lecture 4 - Management Aspects of Quality - I
- Lecture 5 - Management aspects of Quality - II
- Lecture 6 - Introduction to Concepts of Probability
- Lecture 7 - Six Sigma Overview
- Lecture 8 - DMAIC for Problem Solving
- Lecture 9 - DMAIC examples and DMADV
- Lecture 10 - Quality Improvement
- Lecture 11 - 7 Old Tools for Quality Assurance
- Lecture 12 - 7 New Tools for Quality Assurance
- Lecture 13 - CPM, PDPC and Introduction To House of Quality
- Lecture 14 - Building the House of Quality
- Lecture 15 - Introduction to Acceptance Sampling
- Lecture 16 - The Operating Characteristic Curve
- Lecture 17 - The OC curve and Sampling Plans
- Lecture 18 - Double Sampling
- Lecture 19 - Sequential Sampling, Military Standard and Introduction to R
- Lecture 20 - Basic Understanding of R and Introduction to Control Charts
- Lecture 21 - Basics of X bar and R chart
- Lecture 22 - Usage of X bar chart and R chart
- Lecture 23 - Variable Sample Size in X bar and R chart
- Lecture 24 - Patterns in Charts
- Lecture 25 - S chart and OC curve
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- Lecture 27 - Attribute charts- The p chart
- Lecture 28 - np control chart
- Lecture 29 - Estimating control limits with varying sample size
- Lecture 30 - OC curve, c and u charts
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- Lecture 1 - Similarities and Differences
- Lecture 2 - Theoretical Foundations I Competitive Strategy
- Lecture 3 - Theoretical Foundations II Product Strategy
- Lecture 4 - Theoretical Foundations III Understanding Customer Behaviour
- Lecture 5 - Theoretical Foundations IV Product Life Cycle (PLC) and Chasm
- Lecture 6 - Theoretical Foundations V Product Platforms and Portfolios
- Lecture 7 - Theoretical Foundations VI Understanding Customers (STP)
- Lecture 8 - STP continued
- Lecture 9 - Understanding Product Platforms
- Lecture 10 - The Idea Generation process
- Lecture 11 - Creating Customer Value Proposition
- Lecture 12 - Lean Product Process
- Lecture 13 - Estimating Marketing and Sales Potential
- Lecture 14 - Introduction to New Product Forecasting Techniques
- Lecture 15 - Diffusion process and Product Life Cycle
- Lecture 16 - Technology Adoption Life Cycle and Crossing the Chasm
- Lecture 17 - Managing New Products in Large Organizations
- Lecture 18 - Introduction to the Stage Gate model
- Lecture 19 - What is a Lean Startup
- Lecture 20 - The Business Model Canvas
- Lecture 21 - Introduction to Intellectual Property Rights
- Lecture 22 - Taking the Product to the Market - Deployment Strategies

Lecture 1 - Introduction to Statistics

Lecture 2 - Introduction to Probability Theory

Lecture 3 - Distribution of a Random Variable - I

Lecture 4 - Distribution of a Random Variable - II

Lecture 5 - Part-I : Interval Estimation - I

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Lecture 7 - Confidence Interval III and the introduction to Hypothesis Testing

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Lecture 9 - The Analysis of Variance (ANOVA) - I

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Lecture 24 - Two level Fractional Factorial Design - I

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Lecture 31 - Additional Design and Analysis Topics for Factorial and Fractional Factorial Designs - I



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- Lecture 2 - Analytics for Decision Making Support
- Lecture 3 - Decision Needs and Analytics
- Lecture 4 - Systems, Models and Modeling Process
- Lecture 5 - Types of Models
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- Lecture 7 - Overview of Probability
- Lecture 8 - Statistics and Analytics (Private)
- Lecture 9 - Descriptive Statistics “ Graphical Tools (Private)
- Lecture 10 - Frequency Distribution and Histogram
- Lecture 11 - Stem and Leaf Plot
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- Lecture 13 - Business Intelligence and Analytics
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- Lecture 18 - Hypothesis Testing continued
- Lecture 19 - Machine Learning
- Lecture 20 - Correlation
- Lecture 21 - Correlation continued
- Lecture 22 - Regression
- Lecture 23 - Analysis of Variance (ANOVA) - Part 1
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Lecture 6 - Conditional Probability

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Lecture 8 - Binomial Distribution

Lecture 9 - Hypergeometric, Poisson, Normal Distribution

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Lecture 13 - Some Distributions

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Lecture 19 - Hypothesis Testing:A

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Lecture 11 - Relationship Between AP, MP and Law of Diminishing Marginal Returns

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Lecture 24 - Ideal Healthcare Market Conditions

Lecture 25 - Imperfect in Healthcare Markets

Lecture 26 - Building Blocks of Health Systems and Health Financing

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Lecture 28 - Introduction to health insurance

Lecture 29 - Important concepts of health insurance

Lecture 30 - Strategies for Private Health Insurance companies

Lecture 31 - Types of health insurance and Death Spiral

Lecture 32 - Third Party Administrator.

Lecture 33 - Managed Care Organizations

Lecture 34 - Reinsurance

Lecture 35 - What is Economic Evaluation?

Lecture 36 - Cost Minimization Analysis and Cost Effectiveness Analysis

Lecture 37 - Cost-utility Analysis

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Lecture 39 - Types of Goods- Excludability and Rivalry in Consumption

Lecture 40 - Public Goods, Common Resources and decision making based on Cost-Benefit Analysis

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Lecture 44 - External cost, external benefit and efficient output

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Lecture 3 - How to Built Simulation Model

Lecture 4 - Components of Discrete Event Simulation

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Lecture 6 - Terminologies and Like Approaches

Lecture 7 - Monte-Carlo Simulation

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Lecture 9 - Basic Simulation terms and Illustrative examples

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Lecture 12 - Simulation experiments using ARENA

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**NPTEL : NOC:Management of Field Sales (Management)**

**Co-ordinators : Prof. Jayanta Chatterjee**

Lecture 1 - Introduction to Management of Field Sales

Lecture 2 - Sales Role and Activities

Lecture 3 - Value added selling and Non Verbal Messages

Lecture 4 - Communication Styles in Field Sales

Lecture 5 - Managing Product Life cycle

Lecture 6 - From Product To Benefit

Lecture 7 - The Sales Process

Lecture 8 - Prospecting

Lecture 9 - From Prospecting to Preparing the Sales Call

Lecture 10 - The Buying Process

Lecture 11 - Approaching the Customer with Adaptive Selling

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Lecture 13 - Consultative Questioning Strategy

Lecture 14 - Account Evaluation - Long Term Approach

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Lecture 19 - Forecasting Sales and Developing Budgets

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Lecture 9 - Decisions and Utility Analysis

Lecture 10 - Safety first principle

Lecture 11 - Loss Function

Lecture 12 - Loss Function

Lecture 13 - Balanced Loss Function

Lecture 14 - DEA

Lecture 15 - DEA

Lecture 16 - DEA

Lecture 17 - DEA

Lecture 18 - Decision Trees

Lecture 19 - Decision Trees

Lecture 20 - Decision Trees

Lecture 21 - AHP

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- Lecture 2 - Productivity in manufacturing
- Lecture 3 - Product lifecycle
- Lecture 4 - Introduction to optimization
- Lecture 5 - Mathematical modeling example
- Lecture 6 - Rules of modeling
- Lecture 7 - Modeling with continuous variable - Part 1
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- Lecture 9 - Value Engineering Green Plan: Introduction
- Lecture 10 - Value Engineering Green Plan: Methodology - Part 1
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- Lecture 12 - Value Engineering Green Plan - FAST diagramming
- Lecture 13 - Value Engineering - Case Study
- Lecture 14 - Value Engineering Green Plan - Paired comparison technique
- Lecture 15 - Creativity Techniques
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- Lecture 17 - Green Quality Function Deployment - Part 1
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- Lecture 19 - Solving optimization problems
- Lecture 20 - Solving optimization problems using MS Excel
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**NPTEL : Organizational Behaviour (Management)**

**Co-ordinators : Dr. Susmita Mukhopadhyay**

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**NPTEL : Security Analysis and Portfolio Management (Management)**

**Co-ordinators : Dr. Jitendra Mahakud, Dr. Chandra Sekhar Mishra**

Lecture 1 - Introduction to Investment Management

Lecture 2 - Markets for Investment

Lecture 3 - Risk and Return

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Lecture 5 - Organization and Function of Equity and Debt Markets

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Lecture 8 - Testing Market Efficiency

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Lecture 15 - Industry Analysis - I

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Lecture 26 - Multifactor Pricing Model

Lecture 27 - Markowitz Optimal Portfolio Selection Model

Lecture 28 - Other Optimal Portfolio Selection Models

Lecture 29 - Equity Portfolio Management Strategies - I

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**NPTEL : Six Sigma (Management)**

**Co-ordinators : Prof. Tapan P. Bagchi**

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- Lecture 2 - Concepts in Quality Management - II
- Lecture 3 - Concepts in Quality Management - III
- Lecture 4 - Initiating Six Sigma
- Lecture 5 - Review of Probability and Statistics - I
- Lecture 6 - Review of Probability and Statistics - II
- Lecture 7 - Review of Probability and Statistics - III
- Lecture 8 - Review of Probability and Statistics - IV
- Lecture 9 - QM Systems Overview
- Lecture 10 - Cost of Quality and TQM Tools
- Lecture 11 - QFD and ISO 9000
- Lecture 12 - QS 9000 and Awards
- Lecture 13 - Competing Through Service Quality
- Lecture 14 - Introduction to Project Management
- Lecture 15 - Project Life Cycle
- Lecture 16 - Critical Path Method
- Lecture 17 - Measurement System Analysis
- Lecture 18 - Acceptance Sampling
- Lecture 19 - Design of Sampling Plans
- Lecture 20 - MIL-STD-105E Sampling Plan
- Lecture 21 - Introduction to SPC
- Lecture 22 - Control Chart Examples
- Lecture 23 - Control Charts by Excel
- Lecture 24 - Process Capability
- Lecture 25 - Quality Function Deployment
- Lecture 26 - Design of Experiments - Overview
- Lecture 27 - Planning for DOE
- Lecture 28 - Factor Effect Calculations
- Lecture 29 - ANOVA in DOE
- Lecture 30 - Benchmarking in Six Sigma
- Lecture 31 - How to Benchmark

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Lecture 6 - Intercultural Communication - I

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**NPTEL : Consumer Behaviour (Management)**

**Co-ordinators : Dr. Sangeeta Sahney**

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Lecture 3 - Market Research and Consumer Behaviour

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Lecture 22 - Personality, Self Concept and Self Image

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**NPTEL : International Finance (Management)**

**Co-ordinators : Dr. Arun K. Misra**

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Lecture 4 - Purchasing Power Parity

Lecture 5 - Floating and Fixed Exchange Rate Regimes

Lecture 6 - Currency Boards and Currency Basket Systems

Lecture 7 - Features of Foreign Exchange Market

Lecture 8 - Exchange Rate Arithmetic

Lecture 9 - Understanding Merchant Rates

Lecture 10 - Foreign Exchange Forward Contracts

Lecture 11 - Value at Risk for Foreign Exchange Market

Lecture 12 - International Parity Conditions and Movement Exchange Rate

Lecture 13 - Exchange Rate Determination and Forecasting

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Lecture 18 - Foreign Currency Options : Transaction Exposure Management

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Lecture 24 - International Capital Budgeting

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Lecture 26 - Cross Listing of Shares : Depository Receipts

Lecture 27 - International Financial Integration

Lecture 28 - World Trade Organisation

Lecture 29 - India's Forex Reserves Composition and Determinants of Optimum Reserves

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- Lecture 14 - ANOVA (Analysis of Variance)
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- Lecture 21 - Multiple Regression – Introduction
- Lecture 22 - MLR - Sampling distribution of regression coefficients
- Lecture 23 - MLR - Model adequacy tests
- Lecture 24 - MLR - Test of assumptions
- Lecture 25 - MLR - Model diagnostics
- Lecture 26 - MLR - Case Study
- Lecture 27 - Multivariate Linear Regression
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- Lecture 29 - Multivariate Linear Regression - Model Adequacy tests
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- Lecture 5 - Finding what to read
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- Lecture 8 - Reviewing Literature
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- Lecture 12 - Literature review: Supporting your claim
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- Lecture 16 - Methodology
- Lecture 17 - Tools for writing up literature reviews and methodology
- Lecture 18 - Presenting quantitative data
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- Lecture 20 - Writing the results section
- Lecture 21 - Discussion of Results
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- Lecture 23 - Academic Integrity
- Lecture 24 - Using and acknowledging sources
- Lecture 25 - Writers Block
- Lecture 26 - Revising
- Lecture 27 - Mistakes and Fallacies
- Lecture 28 - Editing and Proofreading
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- Lecture 26 - Multicollinearity problem - III
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**NPTEL : NOC:Industrial Safety Engineering (Management)**

**Co-ordinators : Prof. Jhareswar Maiti**

- Lecture 1 - Introduction to Industrial Safety Engineering
- Lecture 2 - Key concepts and terminologies
- Lecture 3 - Key concepts and terminologies-Safety domain ontology
- Lecture 4 - Key concepts and terminologies-Risk Assessment and Control
- Lecture 5 - Safety Engineering and Accident causing mechanisms
- Lecture 6 - Preliminary Hazard List
- Lecture 7 - Preliminary Hazard Analysis
- Lecture 8 - Hazard and operability study (HAZOP)
- Lecture 9 - Failure Modes and Effects Analysis (FMEA)- Identification of Failure Modes
- Lecture 10 - Failure Modes and Effects Analysis (FMEA) (Continued...)
- Lecture 11 - Application of Hazard Identification Techniques
- Lecture 12 - Fault Tree Analysis (FTA) - Construction
- Lecture 13 - Fault Tree Analysis (FTA) - Gate by Gate method
- Lecture 14 - Fault Tree Analysis (FTA) - Cut-set method
- Lecture 15 - Fault Tree Analysis (FTA) - Importance measures
- Lecture 16 - Event Tree Analysis (ETA)
- Lecture 17 - Bowtie Tool
- Lecture 18 - Bow-tie: Common Cause Cut Sets
- Lecture 19 - Bow-tie: Cut-sets for Accident Scenarios
- Lecture 20 - Bow-tie: Cut-sets for Accident Scenarios (Continued...)
- Lecture 21 - Bow-tie: Identification of Safety Barriers
- Lecture 22 - Risk Assessment
- Lecture 23 - Consequence Assessment
- Lecture 24 - Energy Control Model and Hazard Control Hierarchy
- Lecture 25 - Safety Function Deployment
- Lecture 26 - Ranking of Design Solutions: AHP approach
- Lecture 27 - Quantification of Basic Events for Non-repairable Components
- Lecture 28 - Quantification of Basic Events: Hazard Rate
- Lecture 29 - Quantification of Basic Events: Exponential Distribution
- Lecture 30 - Quantification of Basic Events: Weibull Distribution
- Lecture 31 - Quantification of Basic Events: Failure to Repair Process



- Lecture 32 - Quantification of Basic Events: Combined Process
- Lecture 33 - Quantification of Basic Events: Failure and Repair Intensities
- Lecture 34 - Computation of combined process parameters: Laplace transform analysis
- Lecture 35 - Computation of combined process parameters: Markov Analysis
- Lecture 36 - Quantification of Systems Safety and Reliability Block Diagram
- Lecture 37 - Systems Safety Quantification: Truth Table Approach
- Lecture 38 - Systems Safety Quantification: Structure Function
- Lecture 39 - Systems Safety Quantification: Minimal Cut and Minimal Path Representation
- Lecture 40 - Systems Safety Quantification: Tutorial
- Lecture 41 - Human Error, Classification and Causes
- Lecture 42 - Human Error, Classification and Causes (Continued...)
- Lecture 43 - Human Error Identification
- Lecture 44 - Human Reliability Assessment
- Lecture 45 - Human Error Quantification from Experts'™ opinions – Fuzzy Set Approach
- Lecture 46 - Accident Investigation
- Lecture 47 - Accident Investigation and Analysis: Descriptive Analytics
- Lecture 48 - Control Chart Analysis
- Lecture 49 - Accident Data Analysis: Regression
- Lecture 50 - Accident Data Analysis: Classification Tree
- Lecture 51 - Occupational Health and Safety Management Systems(OH&SMS) and OHSAS 18001 - Part I
- Lecture 52 - Occupational Health and Safety Management Systems(OH&SMS) and OHSAS 18001 - Part II
- Lecture 53 - Occupational Health and Safety Management Systems(OH&SMS) and OHSAS 18001 - Part III
- Lecture 54 - Safety Performance Indicators - Part I
- Lecture 55 - Safety Performance Indicators - Part II
- Lecture 56 - Energy Isolations
- Lecture 57 - Virtual Reality - Introduction
- Lecture 58 - Geometry of virtual world
- Lecture 59 - VR roadmap - A case study
- Lecture 60 - Summary

**NPTEL : NOC:Management of Inventory Systems (Management)**

**Co-ordinators : Prof. PK Ray**

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- Lecture 2 - Introduction to Inventory and Materials Management (Continued...)
- Lecture 3 - Introduction to Inventory and Materials Management (Continued...)
- Lecture 4 - Introduction to Inventory and Materials Management (Continued...)
- Lecture 5 - Introduction to Inventory and Materials Management (Continued...)
- Lecture 6 - Inventory Problems and Selective Inventory Management
- Lecture 7 - Inventory Problems and Selective Inventory Management (Continued...)
- Lecture 8 - Inventory Problems and Selective Inventory Management (Continued...)
- Lecture 9 - Inventory Problems and Selective Inventory Management (Continued...)
- Lecture 10 - Inventory Problems and Selective Inventory Management (Continued...)
- Lecture 11 - Static Inventory Problem under Risk
- Lecture 12 - Static Inventory Problem under Risk (Continued...)
- Lecture 13 - Static Inventory Problem under Risk (Continued...)
- Lecture 14 - Static Inventory Problem under Risk (Continued...)
- Lecture 15 - Static Inventory Problem under Risk (Continued...)
- Lecture 16 - Static Inventory Problems under Uncertainty
- Lecture 17 - Static Inventory Problems under Uncertainty (Continued...)
- Lecture 18 - Static Inventory Problems under Uncertainty (Continued...)
- Lecture 19 - Static Inventory Problems under Uncertainty (Continued...)
- Lecture 20 - Static Inventory Problems under Uncertainty (Continued...)
- Lecture 21 - Dynamic Inventory Problems under Certainty
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- Lecture 24 - Dynamic Inventory Problems under Certainty (Continued...)
- Lecture 25 - Dynamic Inventory Problems under Certainty (Continued...)
- Lecture 26 - Dynamic Inventory Problems under Risk
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- Lecture 31 - MRP, MRP-II and DRP

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- [Lecture 34 - MRP, MRP-II and DRP \(Continued...\)](#)
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- [Lecture 37 - JIT-based Approaches for Materials Management \(Continued...\)](#)
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- Lecture 3 - An Investment Problem
- Lecture 4 - An Investment Problem (Continued...)
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- Lecture 6 - Machine Allocation and Cargo Loading Problem
- Lecture 7 - Knapsack Problem
- Lecture 8 - Probabilistic Dynamic Programming
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- Lecture 10 - Dijkstra's Algorithm
- Lecture 11 - Integer Programming: Introduction
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- Lecture 18 - Assignment and Travelling Salesman Problem
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- Lecture 23 - Multi-variable Unconstrained NLP
- Lecture 24 - Solving Unconstrained NLP
- Lecture 25 - Numerical Methods for Unconstrained NLP
- Lecture 26 - Constrained NLP: Lagrange Multipliers
- Lecture 27 - Constrained NLP: KKT Conditions
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- Lecture 30 - Example problems on Constrained NLP
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Lecture 3 - Introduction to Ethical Reasoning and Engineering Ethics (Continued...)

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Lecture 7 - Central Professional responsibilities of engineers (Continued...)

Lecture 8 - Workplace Rights and Responsibilities

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Lecture 10 - Ethics as Design doing Justice to Moral Problems

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Lecture 18 - Computer Software and Digital Information (Continued...)

Lecture 19 - Engineers, Nuclear Testing and Weapons

Lecture 20 - Engineers, Nuclear Testing and Weapons (Continued...)

Lecture 21 - Responsibility to Environment

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Lecture 23 - Environmental Ethics and Spirituality

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Lecture 25 - Research Ethics

Lecture 26 - Research Ethics (Continued...)

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Lecture 28 - Engineers as Managers Consultants and Leaders (Continued...)

Lecture 29 - Engineers as Managers Consultants and Leaders (Continued...)

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Lecture 21 - Commercial banks: Role and Services

Lecture 22 - Commercial banks: Financial statements

Lecture 23 - Commercial bank performance

Lecture 24 - Basel Accords

Lecture 25 - Measure of risk in commercial banks

Lecture 26 - Provident fund and pension fund

Lecture 27 - Insurance companies

Lecture 28 - Mutual funds - I

Lecture 29 - Mutual funds - II

Lecture 30 - NBFCs - I

Lecture 31 - NBFCs - II

Lecture 32 - Venture capital

Lecture 33 - Merchant banks

Lecture 34 - Credit Rating Agencies

Lecture 35 - Non-banking statutory financial organization

Lecture 36 - Call Money Market - I

Lecture 37 - Call Money Market - II

Lecture 38 - Treasury Bills Market

Lecture 39 - Miscellaneous short-term money market - I

Lecture 40 - Miscellaneous short-term money market - II

Lecture 41 - Bond Analysis - I

Lecture 42 - Bond Analysis - II

Lecture 43 - Bond Analysis - III

Lecture 44 - Bond Analysis - IV

Lecture 45 - Bond market in India

Lecture 46 - Stock market - I

Lecture 47 - Stock market - II

Lecture 48 - Stock market - III

Lecture 49 - Stock market - IV

Lecture 50 - Stock market - V

Lecture 51 - Derivatives Market - I

Lecture 52 - Derivatives Market - II

Lecture 53 - Derivatives Market - III

Lecture 54 - Derivatives Market - IV

Lecture 55 - Derivatives Market - V

Lecture 56 - Foreign Exchange Market - I

Lecture 57 - Foreign Exchange Market - II

Lecture 58 - Foreign Exchange Market - III

Lecture 59 - Foreign Exchange Market - IV

Lecture 60 - Foreign Exchange Market - V

**NPTEL : NOC:Sales and Distribution Management (Management)**

**Co-ordinators : Dr. Sangeeta Sahney**

Lecture 1 - Introduction to Sales Management

Lecture 2 - Sales Management, Personal Selling, and Salesmanship

Lecture 3 - Functions of Sales Executive and Roles played by Sales Managers

Lecture 4 - Duties and Responsibilities of Sales Managers and the Effective Sales Executive

Lecture 5 - Skills required in Sales Managers and Qualities in a Sales Managers

Lecture 6 - Determining Sales related Marketing Policies

Lecture 7 - Determining Sales related Marketing Policies

Lecture 8 - Strategic Planning, Sales Objectives, Strategies and Tactics

Lecture 9 - The Sales Organization

Lecture 10 - The Sales Organization

Lecture 11 - The Sales Department Relations

Lecture 12 - The Sales Department Relations

Lecture 13 - Planning, Sales forecasting and Budgeting

Lecture 14 - Planning, Sales forecasting and Budgeting

Lecture 15 - Planning, Sales forecasting and Budgeting

Lecture 16 - Buyer-Seller Dyads

Lecture 17 - Diversity of Personal-Selling Situations

Lecture 18 - Theories of Selling

Lecture 19 - Theories of Selling

Lecture 20 - The Selling Process

Lecture 21 - The Selling Process

Lecture 22 - Sales Force Management : Job Analysis

Lecture 23 - Sales Force Management : Recruitment

Lecture 24 - Sales Force Management : Selection

Lecture 25 - Sales Force Management : Training

Lecture 26 - Sales Force Management : Training

Lecture 27 - Sales Force Management : Motivation

Lecture 28 - Sales Force Management : Compensation

Lecture 29 - Sales Force Management : Managing Expenses of Sales Personnel

Lecture 30 - Sales Force Management : Evaluation

Lecture 31 - Sales Force Management : Evaluation

[Lecture 32 - Sales Quotas](#)

[Lecture 33 - Sales Quotas](#)

[Lecture 34 - Sales Territory](#)

[Lecture 35 - Sales Territory](#)

[Lecture 36 - Distribution Channel Management : Distribution Channels - Part I](#)

[Lecture 37 - Distribution Channel Management : Distribution Channels - Part II](#)

[Lecture 38 - Channel Systems, Channel Management, Logistics and Marketing Channels - Part I](#)

[Lecture 39 - Channel Systems, Channel Management, Logistics and Marketing Channels - Part II](#)

[Lecture 40 - International Sales and Channel Management](#)

- Lecture 1 - Brief overview of the course
- Lecture 2 - Quality concepts and definition
- Lecture 3 - History of continuous improvement
- Lecture 4 - Six Sigma Principles and Focus Areas - Part 1
- Lecture 5 - Six Sigma Principles and Focus Areas - Part 2
- Lecture 6 - Six Sigma Applications
- Lecture 7 - Quality Management: Basics and Key Concepts
- Lecture 8 - Fundamentals of Total Quality Management
- Lecture 9 - Cost of quality
- Lecture 10 - Voice of customer
- Lecture 11 - Quality Function Deployment (QFD)
- Lecture 12 - Management and Planning Tools - Part 1
- Lecture 13 - Management and Planning Tools - Part 2
- Lecture 14 - Six Sigma Project Identification, Selection and Definition
- Lecture 15 - Process characteristics and Monitoring
- Lecture 16 - Process characteristics and analysis
- Lecture 17 - Process Mapping: SIPOC
- Lecture 18 - Data Collection and Summarization - Part 1
- Lecture 19 - Data Collection and Summarization - Part 2
- Lecture 20 - Measurement systems: Fundamentals
- Lecture 21 - Measurement systems analysis: Gage R&R study
- Lecture 22 - Fundamentals of statistics
- Lecture 23 - Probability theory
- Lecture 24 - Process capability analysis: Key Concepts
- Lecture 25 - Process capability analysis: Measures and Indices
- Lecture 26 - Process capability analysis: Minitab Application
- Lecture 27 - Non-normal process capability analysis
- Lecture 28 - Hypothesis testing: Fundamentals
- Lecture 29 - Hypothesis Testing: Single Population Test
- Lecture 30 - Hypothesis Testing: Two Population Test
- Lecture 31 - Hypothesis Testing: Two Population: Minitab Application

- Lecture 32 - Correlation and Regression Analysis
- Lecture 33 - Regression Analysis: Model Validation
- Lecture 34 - One-Way ANOVA
- Lecture 35 - Two-Way ANOVA
- Lecture 36 - Multi-vari Analysis
- Lecture 37 - Failure Mode Effect Analysis (FMEA)
- Lecture 38 - Introduction to Design of Experiment
- Lecture 39 - Randomized Block Design
- Lecture 40 - Randomized Block Design: Minitab Application
- Lecture 41 - Factorial Design
- Lecture 42 - Factorial Design: Minitab Application
- Lecture 43 - Fractional Factorial Design
- Lecture 44 - Fractional Factorial Design: Minitab Application
- Lecture 45 - Taguchi Method: Key Concepts
- Lecture 46 - Taguchi Method: Illustrative Application
- Lecture 47 - Seven QC Tools
- Lecture 48 - Statistical Process Control: Key Concepts
- Lecture 49 - Statistical Process Control: Control Charts for Variables
- Lecture 50 - Operating Characteristic (OC) Curve for Variable Control charts
- Lecture 51 - Statistical Process Control: Control Charts for Attributes
- Lecture 52 - Operating Characteristic (OC) Curve for Attribute Control charts
- Lecture 53 - Statistical Process Control: Minitab Application
- Lecture 54 - Acceptance Sampling: Key Concepts
- Lecture 55 - Acceptance Sampling Plans for Attributes: Key Concepts
- Lecture 56 - Design of Acceptance Sampling Plans for Attributes
- Lecture 57 - Acceptance Sampling Plans for Variables
- Lecture 58 - Acceptance Sampling: Minitab Application
- Lecture 59 - Design for Six Sigma (DFSS): DMADV, DMADOV
- Lecture 60 - Design for Six Sigma (DFSS): DFX
- Lecture 61 - Team Management
- Lecture 62 - Six Sigma: Case study
- Lecture 63 - Six Sigma: Summary of key concepts

## NPTEL : NOC:Performance and Reward Management (Management)

**Co-ordinators : Dr. Susmita Mukhopadhyay**

Lecture 1 - Understanding meaning of performance management and reward systems management with performance management process

Lecture 2 - Understanding meaning of performance management and reward systems management with performance management process (Continued...)

Lecture 3 - Understanding meaning of performance management and reward systems management with performance management process (Continued...)

Lecture 4 - Understanding meaning of performance management and reward systems management with performance management process (Continued...)

Lecture 5 - Understanding meaning of performance management and reward systems management with performance management process (Continued...)

Lecture 6 - Developing an understanding as to why performance management and reward management are of strategic importance and their role in strategic planning

Lecture 7 - Developing an understanding as to why performance management and reward management are of strategic importance and their role in strategic planning (Continued...)

Lecture 8 - Developing an understanding as to why performance management and reward management are of strategic importance and their role in strategic planning (Continued...)

Lecture 9 - Developing an understanding as to why performance management and reward management are of strategic importance and their role in strategic planning (Continued...)

Lecture 10 - Developing an understanding as to why performance management and reward management are of strategic importance and their role in strategic planning (Continued...)

Lecture 11 - Implementation of a performance management system, defining performance and choosing a measurement approach and understanding the meaning of results

Lecture 12 - Implementation of a performance management system, defining performance and choosing a measurement approach and understanding the meaning of results (Continued...)

Lecture 13 - Implementation of a performance management system, defining performance and choosing a measurement approach and understanding the meaning of results (Continued...)

Lecture 14 - Implementation of a performance management system, defining performance and choosing a measurement approach and understanding the meaning of results (Continued...)

Lecture 15 - Implementation of a performance management system, defining performance and choosing a measurement approach and understanding the meaning of results (Continued...)

Lecture 16 - Implementing a performance management system in your organization

Lecture 17 - Implementing a performance management system in your organization (Continued...)

Lecture 18 - Implementing a performance management system in your organization (Continued...)

Lecture 19 - Implementing a performance management system in your organization (Continued...)

Lecture 20 - Implementing a performance management system in your organization (Continued...)

Lecture 21 - Role of performance management in employee development, addressing performance management skills and team reward management

Lecture 22 - Role of performance management in employee development, addressing performance management skills and team reward management (Continued...)



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Lecture 23 - Role of performance management in employee development, addressing performance management skills and team reward management (Continued...)

Lecture 24 - Role of performance management in employee development, addressing performance management skills and team reward management (Continued...)

Lecture 25 - Role of performance management in employee development, addressing performance management skills and team reward management (Continued...)

Lecture 26 - Overview, reward system, understanding total, strategic and international reward

Lecture 27 - Overview, reward system, understanding total, strategic and international reward (Continued...)

Lecture 28 - Overview, reward system, understanding total, strategic and international reward (Continued...)

Lecture 29 - Overview, reward system, understanding total, strategic and international reward (Continued...)

Lecture 30 - Overview, reward system, understanding total, strategic and international reward (Continued...)

Lecture 31 - Understanding linkage between performance management and reward, an overview of various types of reward; financial reward, non-financial reward; contingent pay scheme; bonus scheme; team pay ; rewarding for business performance; recognition sc

Lecture 32 - Understanding linkage between performance management and reward, an overview of various types of reward; financial reward, non-financial reward; contingent pay scheme; bonus scheme; team pay ; rewarding for business performance; recognition sc

Lecture 33 - Understanding linkage between performance management and reward, an overview of various types of reward; financial reward, non-financial reward; contingent pay scheme; bonus scheme; team pay ; rewarding for business performance; recognition sc

Lecture 34 - Understanding linkage between performance management and reward, an overview of various types of reward; financial reward, non-financial reward; contingent pay scheme; bonus scheme; team pay ; rewarding for business performance; recognition sc

Lecture 35 - Understanding linkage between performance management and reward, an overview of various types of reward; financial reward, non-financial reward; contingent pay scheme; bonus scheme; team pay ; rewarding for business performance; recognition sc

Lecture 36 - Understanding linkage between performance management and reward, an overview of various types of reward; financial reward, non-financial reward; contingent pay scheme; bonus scheme; team pay ; rewarding for business performance; recognition sc

Lecture 37 - Valuing and grading jobs, understanding pay levels, job evaluation schemes, equal pay, market rate analysis, designing of grade and pay structure

Lecture 38 - Valuing and grading jobs, understanding pay levels, job evaluation schemes, equal pay, market rate analysis, designing of grade and pay structure (Continued...)

Lecture 39 - Valuing and grading jobs, understanding pay levels, job evaluation schemes, equal pay, market rate analysis, designing of grade and pay structure (Continued...)

Lecture 40 - Valuing and grading jobs, understanding pay levels, job evaluation schemes, equal pay, market rate analysis, designing of grade and pay structure (Continued...)

Lecture 41 - Valuing and grading jobs, understanding pay levels, job evaluation schemes, equal pay, market rate analysis, designing of grade and pay structure (Continued...)

Lecture 42 - Rewarding Special Groups, rewarding directors and senior executives, sales and customer service staff, knowledge workers and manual workers

Lecture 43 - Rewarding Special Groups, rewarding directors and senior executives, sales and customer service staff, knowledge workers and manual workers (Continued...)

Lecture 44 - Rewarding Special Groups, rewarding directors and senior executives, sales and customer service staff, knowledge workers and manual workers (Continued...)

Lecture 45 - Rewarding Special Groups, rewarding directors and senior executives, sales and customer service staff, knowledge workers and manual workers (Continued...)

Lecture 46 - Rewarding Special Groups, rewarding directors and senior executives, sales and customer service staff, knowledge workers and manual workers (Continued...)

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[Lecture 47 - Rewarding Special Groups, rewarding directors and senior executives, sales and customer service staff, knowledge workers and manual workers \(Continued...\)](#)

[Lecture 48 - Understanding relevance of employee benefits and pension schemes, employee benefits, flexible benefits, pension scheme, 7th Pay Commission](#)

[Lecture 49 - Understanding relevance of employee benefits and pension schemes, employee benefits, flexible benefits, pension scheme, 7th Pay Commission \(Continued...\)](#)

[Lecture 50 - Understanding relevance of employee benefits and pension schemes, employee benefits, flexible benefits, pension scheme, 7th Pay Commission \(Continued...\)](#)

[Lecture 51 - Understanding relevance of employee benefits and pension schemes, employee benefits, flexible benefits, pension scheme, 7th Pay Commission \(Continued...\)](#)

[Lecture 52 - Understanding relevance of employee benefits and pension schemes, employee benefits, flexible benefits, pension scheme, 7th Pay Commission \(Continued...\)](#)

[Lecture 53 - Developing and Implementing Reward Systems](#)

[Lecture 54 - Developing and Implementing Reward Systems \(Continued...\)](#)

[Lecture 55 - Developing and Implementing Reward Systems \(Continued...\)](#)

[Lecture 56 - Developing and Implementing Reward Systems \(Continued...\)](#)

[Lecture 57 - Developing and Implementing Reward Systems \(Continued...\)](#)

[Lecture 58 - Understanding the implications of performance and reward management in present organizational dynamics through case studies](#)

[Lecture 59 - Understanding the implications of performance and reward management in present organizational dynamics through case studies \(Continued...\)](#)

[Lecture 60 - Understanding the implications of performance and reward management in present organizational dynamics through case studies \(Continued...\)](#)

[Lecture 61 - Understanding the implications of performance and reward management in present organizational dynamics through case studies \(Continued...\)](#)

[Lecture 62 - Understanding the implications of performance and reward management in present organizational dynamics through case studies \(Continued...\)](#)

[Lecture 63 - Understanding the implications of performance and reward management in present organizational dynamics through case studies \(Continued...\)](#)

**NPTEL : NOC:The Ethical Corporation (Management)**

**Co-ordinators : Prof. Chhanda Chakraborti**

Lecture 1 - What is a Corporation

Lecture 2 - Ethical Corporation

Lecture 3 - What is Ethics

Lecture 4 - Law and Ethics, and Responsibilities

Lecture 5 - Why should a Corporation be Ethical

Lecture 6 - Normative Ethical Theories : Utilitarianism

Lecture 7 - Normative Ethical Theories : Deontological Ethics

Lecture 8 - Normative Ethical Theories : Rights and Justice

Lecture 9 - Normative Ethical Theories : Virtue Ethics

Lecture 10 - Normative Ethical Theories : Care Ethics

Lecture 11 - Managing Ethics within the Corporation

Lecture 12 - Managing Ethics within the Organization : Formal Approach

Lecture 13 - Managing Ethics within a Corporation : Formal and Informal Approach

Lecture 14 - How to Manage Inter - Personal Ethical Misconduct at Workplace

Lecture 15 - How to Apply Ethics

Lecture 16 - Understanding Corporate Governance

Lecture 17 - Conflicts and Key Elements in Corporate Governance

Lecture 18 - Specific Areas of Concern in Corporate Governance and Countermeasures - I

Lecture 19 - Specific Areas of Concern in Corporate Governance and Countermeasures - II

Lecture 20 - Concluding Session on Corporate Governance

Lecture 21 - Investing in Human relations: Employees as stakeholders and Investors of Human Capital

Lecture 22 - Employer-employee: Duties and rights from both sides

Lecture 23 - Organization model and employer-employee relation

Lecture 24 - Some specific issues in employer-employee relationship

Lecture 25 - Employees All Over the World

Lecture 26 - The Ethical Corporation : Natural Environment

Lecture 27 - Corporate Obligations to Natural Environment through the Laws

Lecture 28 - Corporate Obligations to Natural Environment through Appeal to Business Sense and Strategy

Lecture 29 - Corporate Obligations to Natural Environment on Ethical Grounds

Lecture 30 - Environmental Obligations : What Can an Ethical Corporation Do?

Lecture 31 - Consumers as Stakeholders and Consumer Protection

[Lecture 32 - Ethics of Consumer Protection](#)

[Lecture 33 - Consumer ethics: Duty of a Corporation in marketing communication and promotion](#)

[Lecture 34 - Consumer ethics: Ethical issues in Marketing Management](#)

[Lecture 35 - Consumer Ethics: Duty of the Consumers](#)

[Lecture 36 - Competitors as Stakeholders and Fair Competition](#)

[Lecture 37 - What is NOT Fair Competition](#)

[Lecture 38 - Competitors as Stakeholders; Global Competition](#)

[Lecture 39 - Suppliers as Stakeholders : Ethics in Supply Chain](#)

[Lecture 40 - Competitors and Suppliers : What can an Ethical Corporation Do?](#)

- Lecture 1 - Concept of Intellectual Property Law Patents
- Lecture 2 - Trademark
- Lecture 3 - Geographical Indications
- Lecture 4 - Copyright
- Lecture 5 - Industrial Designs
- Lecture 6 - Integrated Circuits Layout Designs
- Lecture 7 - Trade Secrets or Undisclosed Information
- Lecture 8 - Information Competition Law
- Lecture 9 - Introduction to Competition Law (Continued...)
- Lecture 10 - Introduction Competition Law Anti-Competitive Practices
- Lecture 11 - Bid-Rigging
- Lecture 12 - Introduction Competition Law - Vertical Agreements
- Lecture 13 - Abuse of Dominance, Combinations
- Lecture 14 - Regulation of Combinations
- Lecture 15 - Economic Theory of IP And Competition
- Lecture 16 - Interface Between IP And Competition
- Lecture 17 - The United States Anti-Trust Law
- Lecture 18 - Tying Arrangements And Intellectual Property Under Sherman Act
- Lecture 19 - United States Jurisprudence: Unilateral Refusal To License Or Deal
- Lecture 20 - Price Fixing And Antitrust Law
- Lecture 21 - Market Allocation And IP
- Lecture 22 - Vertical Restraints
- Lecture 23 - Vertical Restraints (Contd)
- Lecture 24 - Enforcement of Anti-Trust Law in United States
- Lecture 25 - Introduction To EU Competition Policy And IPR
- Lecture 26 - IP Based Conduct under Article 101
- Lecture 27 - IP Based Conduct under Article 102
- Lecture 28 - IP Based Conduct under Article 102
- Lecture 29 - Technology Transfer Agreements
- Lecture 30 - TTBER and safe harbor provisions
- Lecture 31 - Standard Essential Patents and FRAND Terms

[Lecture 32 - Introduction to Competition Law in India \(Continued...\)](#)

[Lecture 33 - Introduction to Competition Law in India \(Continued...\)](#)

[Lecture 34 - Introduction to Competition Law in India \(Continued...\)](#)

[Lecture 35 - IP Licensing and Indian Competition Law](#)

[Lecture 36 - IP Licensing and Indian Competition Law \(Continued...\)](#)

[Lecture 37 - IP Licensing and Indian Competition Law \(Continued...\)](#)

[Lecture 38 - IP Licensing and Indian Competition Law \(Continued...\)](#)

[Lecture 39 - Patent and Competition Law](#)

[Lecture 40 - Trademark, Copyright and Competition Law](#)

[Lecture 41 - TRIPS and Competition Law](#)

[Lecture 42 - TRIPS and Competition Law \(Continued...\)](#)

[Lecture 43 - Summary](#)

- Lecture 1 - Introduction to IPR
- Lecture 2 - IP-Economic Rationale
- Lecture 3 - Patentability-Novelty - I
- Lecture 4 - Patentability-Novelty - II
- Lecture 5 - Non-Obviousness
- Lecture 6 - How to read a patent document
- Lecture 7 - How to read a patent document
- Lecture 8 - Introduction to patent search
- Lecture 9 - Introduction to patent search
- Lecture 10 - Fundamentals of patent search
- Lecture 11 - Fundamentals of patent search
- Lecture 12 - Hands on Patent Search
- Lecture 13 - Hands on Patent Search
- Lecture 14 - Hands on Patent Search - Sequence Search
- Lecture 15 - Hands on Patent Search - Emerging areas of Technology
- Lecture 16 - Types of patent Search
- Lecture 17 - Types of patent Search (Continued...)
- Lecture 18 - Types of patent Search (Continued...)
- Lecture 19 - Types of patent Search, Validity Search
- Lecture 20 - Invalidity Search
- Lecture 21 - Types of Patent Search FTO
- Lecture 22 - Types of Patent Search
- Lecture 23 - Introduction to patent landscape
- Lecture 24 - Introduction to patent landscape (Continued...)
- Lecture 25 - Introduction to patent landscape (Continued...)
- Lecture 26 - Hands on Patent Landscape
- Lecture 27 - Hands on Patent Landscape (Continued...)
- Lecture 28 - Hands on Patent Landscape (Continued...)
- Lecture 29 - Hands on Patent Landscape (Continued...)
- Lecture 30 - Hands on Patent Landscape (Continued...)
- Lecture 31 - Analytical tools for Patent search and analysis

[Lecture 32 - Analytical tools for Patent search and analysis \(Continued...\)](#)

[Lecture 33 - Analytical tools for Patent search and analysis \(Continued...\)](#)

[Lecture 34 - Analytical tools for Patent search and analysis \(Continued...\)](#)

[Lecture 35 - Analytical tools for Patent search and analysis \(Continued...\)](#)

[Lecture 36 - Analytical tools for Patent search and analysis \(Continued...\)](#)

[Lecture 37 - Administrative Enforcement](#)

[Lecture 38 - Judicial Enforcement](#)

[Lecture 39 - DOE](#)

[Lecture 40 - Patent Infringement](#)



Lecture 1 - Introduction to Modelling and Analytics for Supply Chain Management

Lecture 2 - Introduction to Modelling and Analytics In Supply Network

Lecture 3 - Decisions and Performance Measures In Supply Chain

Lecture 4 - Introduction to Analytics in Supply Chain

Lecture 5 - Analytics Framework Based on SCOR Model

Lecture 6 - Design Options for Distribution Network

Lecture 7 - Supplier selection Analytics

Lecture 8 - Supplier selection Analytics (Continued...)

Lecture 9 - Supplier selection Analytics (Continued...)

Lecture 10 - Supplier selection Analytics (Continued...)

Lecture 11 - Supplier selection Analytics (Continued...)

Lecture 12 - Transportation cost - I

Lecture 13 - Transportation cost - II

Lecture 14 - Transportation cost - III

Lecture 15 - Transportation cost - IV

Lecture 16 - Warehouse location models - I

Lecture 17 - Warehouse location models - II

Lecture 18 - Warehouse location models - III

Lecture 19 - Warehouse location models - IV

Lecture 20 - Warehouse layout

Lecture 21 - Space calculation - I

Lecture 22 - Space calculation - II

Lecture 23 - Performance of the entire supply chain

Lecture 24 - Data envelopment analysis

Lecture 25 - Concepts in inventory management - I

Lecture 26 - Concepts in inventory management - II

Lecture 27 - Concepts in inventory management - III

Lecture 28 - Concepts in inventory management - IV

Lecture 29 - Concepts in inventory management - V

Lecture 30 - Safety Stock and Reorder Level

Lecture 31 - Continuous Review System

- Lecture 32 - Continuous Review System (Continued...)
- Lecture 33 - Periodic Review System
- Lecture 34 - Periodic Review System (Continued...)
- Lecture 35 - Transportation system - India and World
- Lecture 36 - Transport Costing
- Lecture 37 - Public transport costing
- Lecture 38 - Fixing Fare for public transportation system
- Lecture 39 - Foreign trade logistics
- Lecture 40 - Analytical Hierarchy Processing (AHP) Method
- Lecture 41 - Technique of Order Preference by Similarity to Ideal Solution (TOPSIS) Method
- Lecture 42 - TOPSIS and VIKOR Method
- Lecture 43 - VIKOR and ISM Method
- Lecture 44 - VIKOR and ISM Method
- Lecture 45 - Forecasting Simple and Weighted Average Mean Square Error
- Lecture 46 - Forecasting Exponential Smoothing Method
- Lecture 47 - Forecasting Seasonality in Forecasting
- Lecture 48 - Forecasting Trend Regression and Holt's Method
- Lecture 49 - Forecasting Trend Holt's and Winters Method
- Lecture 50 - Forecasting Multi Period Forecasting
- Lecture 51 - Information Distortions; Coordination and Collaboration Modelling
- Lecture 52 - Information Distortions; Coordination and Collaboration Modelling
- Lecture 53 - Six Sigma and queuing in Coordination
- Lecture 54 - Queuing in Coordination; Measuring the Degree of Coordination
- Lecture 55 - Risk Analytics in Supply Network Design
- Lecture 56 - Risk Analytics in Supply Network Design (Continued...)
- Lecture 57 - Designing the global supply chain : Tax advantages
- Lecture 58 - Designing the global supply chain : Tax advantages (Continued... )
- Lecture 59 - Designing the global supply chain : Transshipment
- Lecture 60 - Designing the global supply chain : Flexibility and Total Cost
- Lecture 61 - Designing the global supply chain : Flexibility and Total Cost (Continued...)
- Lecture 62 - Designing the global supply chain : Echelons

- Lecture 1 - Introduction to R programming
- Lecture 2 - Introduction to R programming (Continued...)
- Lecture 3 - Introduction to R programming (Continued...)
- Lecture 4 - Introduction to R programming (Continued...)
- Lecture 5 - Introduction to R programming (Continued...)
- Lecture 6 - Introduction to R programming (Continued...)
- Lecture 7 - What Consumers Want
- Lecture 8 - What Consumers Want (Continued...)
- Lecture 9 - What Consumers Want (Continued...)
- Lecture 10 - What Consumers Want (Continued...)
- Lecture 11 - What Consumers Want (Continued...)
- Lecture 12 - What Consumers Want (Continued...)
- Lecture 13 - Segmentation Targeting and Positioning
- Lecture 14 - Segmentation Targeting and Positioning (Continued...)
- Lecture 15 - Segmentation Targeting and Positioning (Continued...)
- Lecture 16 - Segmentation Targeting and Positioning (Continued...)
- Lecture 17 - Segmentation Targeting and Positioning (Continued...)
- Lecture 18 - Demand Forecasting and Pricing
- Lecture 19 - Demand Forecasting and Pricing (Continued...)
- Lecture 20 - Demand Forecasting and Pricing (Continued...)
- Lecture 21 - Demand Forecasting and Pricing (Continued...)
- Lecture 22 - Pricing
- Lecture 23 - Pricing (Continued...)
- Lecture 24 - Pricing (Continued...)
- Lecture 25 - Pricing (Continued...)
- Lecture 26 - Pricing (Continued...)
- Lecture 27 - Pricing (Continued...)
- Lecture 28 - Pricing (Continued...)
- Lecture 29 - Marketing Mix Models and Advertising Models
- Lecture 30 - Marketing Mix Models and Advertising Models (Continued...)
- Lecture 31 - Marketing Mix Models and Advertising Models (Continued...)

[Lecture 32 - Marketing Mix Models and Advertising Models \(Continued...\)](#)

[Lecture 33 - Marketing Mix Models and Advertising Models \(Continued...\)](#)

[Lecture 34 - Recommendation Engine and Retail Analytics](#)

[Lecture 35 - Recommendation Engine and Retail Analytics \(Continued...\)](#)

[Lecture 36 - Recommendation Engine and Retail Analytics \(Continued...\)](#)

[Lecture 37 - Recommendation Engine and Retail Analytics \(Continued...\)](#)

[Lecture 38 - Recommendation Engine and Retail Analytics \(Continued...\)](#)

[Lecture 39 - Recommendation Engine and Retail Analytics \(Continued...\)](#)

[Lecture 40 - RFM and Market Basket Analysis](#)

[Lecture 41 - RFM and Market Basket Analysis \(Continued...\)](#)

[Lecture 42 - RFM and Market Basket Analysis \(Continued...\)](#)

[Lecture 43 - RFM and Market Basket Analysis \(Continued...\)](#)

[Lecture 44 - RFM and Market Basket Analysis \(Continued...\)](#)

[Lecture 45 - Customer Churn and Customer Lifetime Value](#)

[Lecture 46 - Customer Churn and Customer Lifetime Value \(Continued...\)](#)

[Lecture 47 - Customer Churn and Customer Lifetime Value \(Continued...\)](#)

[Lecture 48 - Customer Churn and Customer Lifetime Value \(Continued...\)](#)

[Lecture 49 - Customer Churn and Customer Lifetime Value \(Continued...\)](#)

[Lecture 50 - Customer Churn and Customer Lifetime Value \(Continued...\)](#)

[Lecture 51 - Text Mining and Sentiment Analytics](#)

[Lecture 52 - Text Mining and Sentiment Analytics \(Continued...\)](#)

[Lecture 53 - Text Mining and Sentiment Analytics \(Continued...\)](#)

[Lecture 54 - Text Mining and Sentiment Analytics \(Continued...\)](#)

[Lecture 55 - Text Mining and Sentiment Analytics \(Continued...\)](#)

[Lecture 56 - Text Mining and Sentiment Analytics \(Continued...\)](#)

[Lecture 57 - Text Mining and Sentiment Analytics \(Continued...\)](#)

[Lecture 58 - Text Mining and Sentiment Analytics \(Continued...\)](#)

[Lecture 59 - Text Mining and Sentiment Analytics \(Continued...\)](#)

[Lecture 60 - Text Mining and Sentiment Analytics \(Continued...\)](#)

[Lecture 61 - Social Network Analysis and Excel Dashboards](#)

[Lecture 62 - Social Network Analysis and Excel Dashboards \(Continued...\)](#)

[Lecture 63 - Social Network Analysis and Excel Dashboards \(Continued...\)](#)

[Lecture 64 - Social Network Analysis and Excel Dashboards \(Continued...\)](#)

[Lecture 65 - Social Network Analysis and Excel Dashboards \(Continued...\)](#)

[Lecture 66 - Social Network Analysis and Excel Dashboards \(Continued...\)](#)

Lecture 1 - Importance and Forms of Commercial Banks

Lecture 2 - Functions, Goals and Constraints of Commercial Banks

Lecture 3 - Regulation of Commercial Banks

Lecture 4 - Financial Statements of Commercial Banks - I

Lecture 5 - Financial Statements of Commercial Banks - II

Lecture 6 - Bank Performance Measures - I

Lecture 7 - Bank Performance Measures - II

Lecture 8 - Bank Performance Measures - III

Lecture 9 - Bank Performance Measures - IV

Lecture 10 - Bank Performance Measures - V

Lecture 11 - Valuation of Bank Stocks - I

Lecture 12 - Valuation of Bank Stocks - II

Lecture 13 - Valuation of Fixed Assets - I

Lecture 14 - Valuation of Fixed Assets - II

Lecture 15 - Valuation of Fixed Assets - III

Lecture 16 - Commercial Bank Risk - I

Lecture 17 - Commercial Bank Risk - II

Lecture 18 - Commercial Bank Risk - III

Lecture 19 - Commercial Bank Risk - IV

Lecture 20 - Commercial Bank Risk - V

Lecture 21 - Overview of Asset Liability Management

Lecture 22 - Dollar Gap Analysis

Lecture 23 - Earnings Sensitivity Analysis

Lecture 24 - Duration Gap Analysis - I

Lecture 25 - Duration Gap Analysis - II

Lecture 26 - Use of Derivatives in ALM - I

Lecture 27 - Use of Derivatives in ALM - II

Lecture 28 - Use of Derivatives in ALM - III

Lecture 29 - Use of Derivatives in ALM - IV

Lecture 30 - Use of Derivatives in ALM - V

Lecture 31 - Management of Lending Activities - I

[Lecture 32 - Management of Lending Activities - II](#)

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[Lecture 34 - Management of Lending Activities - IV](#)

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Lecture 3 - Economics of Decision Making

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Lecture 12 - Beliefs, Biases and Heuristics

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- Lecture 5 - Co-Creation
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- Lecture 8 - Building Customer Relationships
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- Lecture 11 - Building Customer Relationships (Continued...)
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- Lecture 14 - Economics of CRM
- Lecture 15 - Economics of CRM (Continued...)
- Lecture 16 - Economics of CRM (Continued...)
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- Lecture 19 - Economics of CRM (Continued...)
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- Lecture 21 - Social CRM
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- Lecture 23 - Social CRM (Continued...)
- Lecture 24 - Tchibo Case Study
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- Lecture 26 - Customer Equity in CRM
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- Lecture 28 - CRM in B2C Markets
- Lecture 29 - CRM in B2C Markets (Continued...)
- Lecture 30 - CRM in B2C Markets (Continued...)
- Lecture 31 - CRM in B2C Markets (Continued...)

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- Lecture 1 - Definition, Nature, Purpose and Scope of Management
- Lecture 2 - Skills, Roles and Functions of Management
- Lecture 3 - Principles of Management
- Lecture 4 - Scientific Management
- Lecture 5 - Evolution of Management Thought
- Lecture 6 - Concept, Types, Importance and Process of Planning
- Lecture 7 - Characteristics, Nature and Scope and Principles of Planning
- Lecture 8 - Traditional objective setting and methods of Planning
- Lecture 9 - Strategic Management and Planning
- Lecture 10 - Premising and Forecasting of Planning
- Lecture 11 - Concept, Types, Importance and Process of Decision Making
- Lecture 12 - Different Models of Decision Making
- Lecture 13 - Decision Making Styles and Cognitive biases in decision making
- Lecture 14 - Barriers of Effective Decision Making
- Lecture 15 - Group Decision Making
- Lecture 16 - Concept, Importance and Steps of Management by Objectives
- Lecture 17 - Concept, Importance and Steps of Management by exception
- Lecture 18 - Style of Management (American, Japanese and Indian)
- Lecture 19 - Approaches of management including McKinsey's 7A's approach
- Lecture 20 - Introduction, strategies, techniques, benefits and rules of Self Management
- Lecture 21 - Concept, Importance, Process, Nature, and Principle of Organisation
- Lecture 22 - Organisational Design and Structure
- Lecture 23 - Coordination in Management
- Lecture 24 - Differentiation in management
- Lecture 25 - Concept, Types, Importance, Steps, Factors and Advantages of Integration
- Lecture 26 - Concept, Types, Importance and Process of Span of Management
- Lecture 27 - Concept, types, factors, advantages and disadvantages of Centralisation and Decentralisation
- Lecture 28 - Delegation
- Lecture 29 - Different issues relating to authority and power
- Lecture 30 - Different aspects of line and staff organisation
- Lecture 31 - Concept, importance, process and methods of Staffing and HRM

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[Lecture 39 - Coordination-Concept, Issues and Techniques](#)

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[Lecture 41 - Concept, importance, elements of organisational change](#)

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[Lecture 48 - Behavioural reaction to organisational Change](#)

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[Lecture 52 - Organisational development](#)

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[Lecture 54 - Team and Team Work in Management](#)

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[Lecture 56 - Communication and Its Barriers](#)

[Lecture 57 - Controlling: Issues, Types, Techniques and Importance](#)

[Lecture 58 - Budgeting, concept, importance, process and benefits](#)

[Lecture 59 - Reporting- concepts, types, importance and advantages](#)

**NPTEL : NOC:Decision Support System for Managers (Management)**

**Co-ordinators : Prof Sujoy Bhattacharya, Prof. Anupam Ghosh, Prof. Kunal Kanti Ghosh**

Lecture 1 - Introduction to decision support systems

Lecture 2 - Components of a decision support systems

Lecture 3 - Components of a decision support systems (Continued...)

Lecture 4 - Models in decision support systems

Lecture 5 - Models in decision support systems (Continued...)

Lecture 6 - Structured, Semi-Structured and Unstructured problems; Models

Lecture 7 - Purpose of models; classification of models

Lecture 8 - Solution Techniques - Optimization : Linear Programming

Lecture 9 - Solution Techniques - Optimization : Linear Programming (Continued...)

Lecture 10 - Solution Techniques - Optimization : Integer Programming

Lecture 11 - Decision Support Systems for Forecasting

Lecture 12 - Decision Support Systems for Forecasting (Continued...)

Lecture 13 - Decision Support Systems for Forecasting (Continued...)

Lecture 14 - Decision Support Systems for Forecasting (Continued...)

Lecture 15 - Decision Support Systems for Forecasting (Continued...)

Lecture 16 - Decision Making for Warehouse Location : Factor Rating and Break - Even Method

Lecture 17 - Decision Making for Warehouse Location (Continued..): Centre of gravity; Ardalan heuristic and transportation cost models

Lecture 18 - Estimation of space requirement in a warehouse and concept of economic order quantity (EOQ)

Lecture 19 - Economic order quantity (EOQ) (Continued...)

Lecture 20 - ABC-FSN-VED Analysis; space calculation in a warehouse - for Staging area

Lecture 21 - Space calculation in a warehouse : Space calculation for racks

Lecture 22 - Order Picking; Material handling equipment's

Lecture 23 - Material Safety and Safety Equipment's

Lecture 24 - Automated storage and replenishment systems (AS/RS)

Lecture 25 - Managerial Decision making in the context of warehousing and materials management

Lecture 26 - Issues in HR; Employee Selection

Lecture 27 - Employee Selection, Promotion and Deployment Method - Lp Method

Lecture 28 - Employee Selection, Promotion and Deployment Method - Rating and ranking Method ; Clustering

Lecture 29 - Employee Selection, Promotion and Deployment Method - BCG

Lecture 30 - Strategizing for Business, the SWOT and Porter's Framwork Revisited

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Lecture 31 - Fortune at the Bottom of the Pyramid, GE, Rule of Three

Lecture 32 - Self Actualisation Needs, Rural Marketing Challenges

Lecture 33 - Rural Marketing; Balanced ScoreCard

Lecture 34 - Evaluating Investment Proposals : NPV, IRR

Lecture 35 - Costing and Pricing for Public Transport

Lecture 36 - Costing and Pricing for Hospitals

Lecture 37 - Decision Support Systems for Marketing : Decision Support Systems for Media Selection Model

Lecture 38 - Decision Support Systems for Marketing : Decision Support Systems for Media Selection Model (Continued...)

Lecture 39 - Decision Support Systems for Marketing : Decision Support Systems for Product Pricing Model

Lecture 40 - Pricing : Model Selection Using Cross - Validation

Lecture 41 - Taxation and the Distribution Network

Lecture 42 - Transshipment; Flexibility and Six Sigma

Lecture 43 - Flexibility and Total Cost of the Network

Lecture 44 - Risk Analysis for the Distribution Network

Lecture 45 - Echelons in the Network

Lecture 46 - Concept of Variability and Six Sigma

Lecture 47 - Concept of Variability and Six Sigma (Continued...)

Lecture 48 - Roadmap to Six Sigma; Ishikawa Diagram and SIPOC

Lecture 49 - Service Systems : Characteristics; Failure and Recovery

Lecture 50 - Decision Support Systems for Inventory

Lecture 51 - Decision Support Systems for Inventory (Continued...)

Lecture 52 - Decision Support Systems for Inventory (Continued...)

Lecture 53 - Decision Support Systems for Inventory (Continued...)

Lecture 54 - Decision Support Systems for Inventory (Continued...)

Lecture 55 - Decision Support Systems for Operations Management

Lecture 56 - Decision Support Systems for Operations Management (Continued...)

Lecture 57 - Decision Support Systems for Operations Management (Continued...)

Lecture 58 - Decision Support Systems for Operations Management (Continued...)

Lecture 59 - Decision Support Systems for Operations Management (Continued...)

Lecture 60 - DSS for Multi - Item Production - Distribution Planning

Lecture 1 - Introduction - Part 1

Lecture 2 - Introduction - Part 2

Lecture 3 - Dimensions of Information System

Lecture 4 - Information Management in the digital world

Lecture 5 - Class discussions and conclusion

Lecture 6 - Data bases and information management

Lecture 7 - Data warehouse and business intelligence

Lecture 8 - Introduction to data mining

Lecture 9 - Data analytics tools and techniques

Lecture 10 - What is ERP ?

Lecture 11 - ERP - Evolution and Benefits

Lecture 12 - Business Benefits of ERP

Lecture 13 - ERP project management: Challenge, risks and best practices

Lecture 14 - Change management and conclusion

Lecture 15 - Customer relationship management

Lecture 16 - Supply Chain Management - Part 1

Lecture 17 - Supply Chain Management - Part 2

Lecture 18 - Supplier relationship management

Lecture 19 - Product lifecycle maintenance

Lecture 20 - Information Systems for manufacturing management

Lecture 21 - Information Systems for manufacturing management (Continued...)

Lecture 22 - Information Systems for materials management

Lecture 23 - Information Systems for quality management

Lecture 24 - Information Systems for marketing

Lecture 25 - Information Systems for marketing (Continued...)

Lecture 26 - Information Systems for sales and distribution

Lecture 27 - Information Systems for finance and accounting

Lecture 28 - Information Systems for human resource management

Lecture 29 - Information Systems for human resource management (Continued...)

Lecture 30 - Information Systems (IS) strategy

Lecture 31 - Aligning IT with business objectives



- Lecture 32 - Balanced Score Card
- Lecture 33 - Data Centers, Virtualization and cloud computing
- Lecture 34 - Cloud computing and selection of cloud vendor
- Lecture 35 - Introduction to E-Commerce
- Lecture 36 - B2C Business Models
- Lecture 37 - B2C Business Models (Continued...)
- Lecture 38 - Unique E-Commerce Business Models
- Lecture 39 - Social Commerce and M-Commerce
- Lecture 40 - Cloud Computing - Part I
- Lecture 41 - Cloud Computing - Part II
- Lecture 42 - Internet of Things - Part I
- Lecture 43 - Internet of Things - Part II
- Lecture 44 - Internet of Things - Part III
- Lecture 45 - Big Data and other Emerging Technologies
- Lecture 46 - Knowledge Management Systems (KMS)
- Lecture 47 - Decision Support Systems
- Lecture 48 - Executive Support Systems
- Lecture 49 - Expert Systems
- Lecture 50 - Learning Management Systems (LMS)
- Lecture 51 - Ethical and Social Issues in MIS - I
- Lecture 52 - Ethical and Social Issues in MIS - II
- Lecture 53 - Security Issues in MIS - I
- Lecture 54 - Security Issues in MIS - II
- Lecture 55 - Security Issues in MIS - III
- Lecture 56 - Managing Global Organization - Globalization - Part 1
- Lecture 57 - Global Strategies and Business Organization
- Lecture 58 - Shared Services
- Lecture 59 - Offshoring/Transitioning Global IT Systems
- Lecture 60 - Globalization of Corporates in a Flat World

Lecture 1 - Overview of Module 1 and Introduction of Causality

Lecture 2 - Correlation and Causality

Lecture 3 - Correlation and Causality (Continued...)

Lecture 4 - Correlation and Causality (Continued...)

Lecture 5 - Probability Theory

Lecture 6 - Probability Theory (Continued...)

Lecture 7 - Probability Theory (Continued...)

Lecture 8 - Probability Theory (Continued...)

Lecture 9 - Posterior Probability

Lecture 10 - Bayesian Theorem

Lecture 11 - Bayesian Theorem (Continued...): Repeated Trial

Lecture 12 - Bayesian Theorem (Continued...): Example of Diamond Identification

Lecture 13 - Probability Distribution

Lecture 14 - Double Structure of Variable

Lecture 15 - Probability Distribution (Discrete/Continuous Variable) Random Variable

Lecture 16 - Probability Mass Function (PMF) Probability Density Function (PDF)

Lecture 17 - Expectation, Variance, Covariance

Lecture 18 - Expectation, Variance, Covariance (Continued...)

Lecture 19 - Covariance Rule

Lecture 20 - Bernoulli Distribution

Lecture 21 - Bernoulli Distribution (Continued...)

Lecture 22 - Normal Approximation of Bernoulli Distribution

Lecture 23 - Sampling

Lecture 24 - Sampling (Continued...)

Lecture 25 - Central Limit Theorem

Lecture 26 - Law of Large Numbers LLN

Lecture 27 - Properties of Estimator

Lecture 28 - Conflict Between Unbiasedness and Min Variance

Lecture 29 - T-Distribution

Lecture 30 - Normal Distribution

Lecture 31 - Normal Distribution (Continued...)

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[Lecture 36 - Power of a Test](#)

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[Lecture 38 - Confidence Interval Example](#)

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[Lecture 41 - Error Term, Coefficient of Determination, Regression Coefficient](#)

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[Lecture 43 - Error Term, Coefficient of Determination, Regression Coefficient \(Continued...\)](#)

[Lecture 44 - Definition : Variable, Parameter and Coefficient](#)

[Lecture 45 - Introduction to Regression: Recapitulating Correlation and Causal Thinking](#)

[Lecture 46 - Adjusted R-Squared](#)

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[Lecture 55 - Multicollinearity \(Continued...\)](#)

[Lecture 56 - Multicollinearity \(Continued...\)](#)

[Lecture 57 - Dummy Variable](#)

[Lecture 58 - Dummy variable \(Continued...\)](#)

[Lecture 59 - Dummy variable \(Continued...\)](#)

[Lecture 60 - Dummy variable \(Continued...\)](#)

[Lecture 61 - Dummy variable \(Continued...\)](#)

[Lecture 62 - Dummy variable \(Continued...\)](#)

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[Lecture 64 - Heteroscedasticity](#)

[Lecture 65 - Heteroscedasticity \(Continued...\)](#)

[Lecture 66 - Heteroscedasticity \(Continued...\)](#)

[Lecture 67 - Heteroscedasticity \(Continued...\)](#)

[Lecture 68 - Heteroscedasticity \(Continued...\)](#)

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[Lecture 70 - Autocorrelation](#)

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[Lecture 73 - Autocorrelation \(Continued...\)](#)

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[Lecture 81 - Autocorrelation \(Continued...\)](#)

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[Lecture 85 - Model Specification \(Continued...\)](#)

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[Lecture 88 - Model Specification \(Continued...\)](#)

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[Lecture 101 - Problem of Endogeneity](#)

[Lecture 102 - Simultaneous Equation Model](#)

[Lecture 103 - Instrumental Variable for Endogeneity Bias Problem](#)

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[Lecture 105 - Overidentification Underidentification Exact Identification - Instrumental Variable](#)

[Lecture 106 - Two Stage Least Square and Instrumental Variable](#)

[Lecture 107 - 2SLS and IV with Stata](#)

Lecture 1 - Group and Types, Characteristics

Lecture 2 - Group Properties and Determinants of Group Behaviour

Lecture 3 - Stages, Theories and Models of Group Development

Lecture 4 - Effectiveness of Work Group Behaviour

Lecture 5 - Group Decision Making and Limitations of Group Behaviour

Lecture 6 - Concept and Types of Team

Lecture 7 - How to improve team performance, difference between Team and Group

Lecture 8 - Effectiveness of Teamwork

Lecture 9 - Teamwork Process

Lecture 10 - Teamwork and Leadership

Lecture 11 - Concept and Types of Cooperation and Competition

Lecture 12 - Factors leading to Competition and Cooperation

Lecture 13 - Functions of Cooperation and Competition

Lecture 14 - Models on Competition and Cooperation

Lecture 15 - Benefits and drawbacks of competition and cooperation

Lecture 16 - Communication

Lecture 17 - Communication (Continued...)

Lecture 18 - Communication (Continued...)

Lecture 19 - Communication (Continued...)

Lecture 20 - Communication (Continued...)

Lecture 21 - Conflict

Lecture 22 - Conflict (Continued...)

Lecture 23 - Conflict (Continued...)

Lecture 24 - Conflict (Continued...)

Lecture 25 - Conflict (Continued...)

Lecture 26 - Power and Political Behaviour

Lecture 27 - Power and Political Behaviour (Continued...)

Lecture 28 - Power and Political Behaviour (Continued...)

Lecture 29 - Power and Political Behaviour (Continued...)

Lecture 30 - Power and Political Behaviour (Continued...)

Lecture 31 - Decision making

- Lecture 32 - Decision making (Continued...)
- Lecture 33 - Decision making (Continued...)
- Lecture 34 - Decision making (Continued...)
- Lecture 35 - Decision making (Continued...)
- Lecture 36 - Leadership Concept Types and Importance
- Lecture 37 - Team Leadership Context, Actions
- Lecture 38 - Theories of Leadership: Trait, Behavioural, Contingency, LMX, Three Dimensional
- Lecture 39 - Leadership Qualities, Techniques and Skills
- Lecture 40 - Leadership and Management
- Lecture 41 - Problem Solving-Concept, Types and Importance
- Lecture 42 - Problem Solving Process, Decision Making and Comparison between
- Lecture 43 - Creativity
- Lecture 44 - Problem Solving and Creativity in Team
- Lecture 45 - Creativity Across Different Paradigms
- Lecture 46 - Team and Organization
- Lecture 47 - Organizational Culture
- Lecture 48 - International Organizational Behaviour
- Lecture 49 - Interpersonal Behaviour Across Cultures
- Lecture 50 - Organizational Characteristics in Global Context
- Lecture 51 - Virtual Team-Concept and importance
- Lecture 52 - Virtual Team Models
- Lecture 53 - Skills and Competencies of Virtual Team Members
- Lecture 54 - Process of Virtual Team Development
- Lecture 55 - Factors of Success, Advantages and Disadvantages of Virtual Teams
- Lecture 56 - Evaluating Teams
- Lecture 57 - Steps of Evaluation
- Lecture 58 - Tools, Techniques and Methods of Evaluation
- Lecture 59 - Rewarding Teams
- Lecture 60 - Rewarding Teams (Continued...)

Lecture 1 - Basic Concepts of Manufacturing Systems, Evolution of Manufacturing Systems

Lecture 2 - Types of Manufacturing Systems and Role of Automation

Lecture 3 - Product-Process-Flexibility Matrices, Four-Plane Concept of Manufacturing

Lecture 4 - Product Design and Manufacturing Systems

Lecture 5 - Definitions and Design Criteria for Production Systems

Lecture 6 - Manufacturing System Components - I

Lecture 7 - Manufacturing System Components - II

Lecture 8 - Industry 4.0

Lecture 9 - Automation Principles and Strategies for Process Improvement

Lecture 10 - Automated Production System Framework

Lecture 11 - Product Development Process: Approaches and stages

Lecture 12 - Mathematical Models for Interaction between Design and Manufacturing

Lecture 13 - Sequential and Concurrent Engineering Approaches for Product Development

Lecture 14 - Characterization of Concurrent Engineering Framework

Lecture 15 - Concurrent Engineering Techniques

Lecture 16 - Introduction to Concept and Application of Numerical Control (NC) Technology

Lecture 17 - Basic Concepts of an NC System

Lecture 18 - NC Coordinate System, NC Motion Control System

Lecture 19 - Features of CNC, Configuration of CNC Machine Control System

Lecture 20 - Numerical Examples

Lecture 21 - Distributed Numerical Control (DNC) and its Configuration

Lecture 22 - NC Part Programming-I (Manual, Computer-assisted)

Lecture 23 - NC Part Programming-II (CAD/CAM, MDI)

Lecture 24 - Interpolation and Part Programming

Lecture 25 - Numerical Examples

Lecture 26 - Group Technology (GT): Concept and Definition

Lecture 27 - Methods and Implementation of GT for Automation

Lecture 28 - Part Family Formation: Tools and Techniques

Lecture 29 - Numerical Examples on Part Family Formation

Lecture 30 - Application of GT for Designing Flexible and Programmable Automation

Lecture 31 - Concept and Definition of Cellular Manufacturing System (CMS)



- Lecture 32 - Cell Formation Approaches - I
- Lecture 33 - Cell Formation Approaches - II
- Lecture 34 - Evaluation of Cell Design, Numerical Examples
- Lecture 35 - Production Planning and Control in CMS, Assessment of Solution by Heuristics
- Lecture 36 - Types and Definitions of Flexibility in Manufacturing Systems
- Lecture 37 - Volume-Variety Relationships in Production Systems, What is FMS?
- Lecture 38 - Basic Features of FMS: Physical Subsystems
- Lecture 39 - Basic Features of FMS: Control Subsystems and Manufacturing Control Activities.
- Lecture 40 - Types of Problems in FMS
- Lecture 41 - Operational Problems in FMS: Tools and Techniques - 1, Problem Formulation
- Lecture 42 - Operational Problems in FMS: Tools and Techniques - 2, Numerical Examples
- Lecture 43 - Tool Allocation Policies in FMS, Numerical Examples
- Lecture 44 - Fixture and Pallet Selection Problems: Numerical Examples
- Lecture 45 - Types of FMS Layout, Relative Advantages
- Lecture 46 - Fundamentals of Robotics and its Applications
- Lecture 47 - Robot Movement and Precision
- Lecture 48 - Robot Motion Analysis, Robotic Joints and Links
- Lecture 49 - Robot Classification System, Industrial Robot Applications
- Lecture 50 - Numerical Examples
- Lecture 51 - Definition of Process Planning: Function of Process Plan
- Lecture 52 - Basic Steps in Process Plan Development
- Lecture 53 - Process Planning Approaches: Manual Experience-based Process Planning
- Lecture 54 - Process Planning Approaches: Computer-aided Process Planning
- Lecture 55 - CIN and CAPP, Process Optimization and CAPP
- Lecture 56 - Process Optimization and CAPP
- Lecture 57 - FMS and CAPP
- Lecture 58 - Process Optimization and CAPP: Numerical Examples
- Lecture 59 - Process Planning and Concurrent Engineering
- Lecture 60 - Automation (and other TPS Areas and Approaches)

Lecture 1 - Introduction to Corporate Finance

Lecture 2 - Corporate Finance and Corporate Governance

Lecture 3 - Sources of Finance for a Firm

Lecture 4 - Return and Risk

Lecture 5 - Return, Risk and Portfolio Theory

Lecture 6 - Time Value of Money

Lecture 7 - Valuation of Future Cash Flows

Lecture 8 - Valuation of Future Cash Flows (Continued...)

Lecture 9 - Valuation of Bonds

Lecture 10 - Valuation of Stocks

Lecture 11 - Capital Budgeting Decisions

Lecture 12 - Capital Budgeting Decisions (Continued...)

Lecture 13 - Capital Budgeting Techniques - I

Lecture 14 - Capital Budgeting Techniques - II

Lecture 15 - Capital Budgeting Techniques - III

Lecture 16 - Introduction to Cost of Capital

Lecture 17 - Cost of Capital - I

Lecture 18 - Cost of Capital - II

Lecture 19 - Cost of Capital and Firm Value - I

Lecture 20 - Cost of Capital and Firm Value - II

Lecture 21 - Measures of Leverage

Lecture 22 - Measures of Leverage (Continued...)

Lecture 23 - Theories of Capital Structure - I

Lecture 24 - Theories of Capital Structure - II

Lecture 25 - Practical Issues in Capital Structure

Lecture 26 - Working Capital Management - I

Lecture 27 - Working Capital Management - II

Lecture 28 - Measuring Liquidity - I

Lecture 29 - Measuring Liquidity - II

Lecture 30 - Inventory Management - I

Lecture 31 - Inventory Management - II

[Lecture 32 - Inventory Management - III](#)

[Lecture 33 - Credit Management - I](#)

[Lecture 34 - Credit Management - II](#)

[Lecture 35 - Credit Management - III](#)

[Lecture 36 - Dividend Decisions - I](#)

[Lecture 37 - Dividend Decisions - II](#)

[Lecture 38 - Applications of Dividend Theories - I](#)

[Lecture 39 - Applications of Dividend Theories - II](#)

[Lecture 40 - Some Issues in Corporate Finance](#)

**NPTEL : NOC:International Marketing (Management)**

**Co-ordinators : Prof. Biswarup Ghosh**

- Lecture 1 - Introduction to International Marketing
- Lecture 2 - Introduction to International Marketing
- Lecture 3 - Introduction to International Marketing
- Lecture 4 - Introduction to International Marketing
- Lecture 5 - International Business, Entry Modes and Theories
- Lecture 6 - International Business, Entry Modes and Theories
- Lecture 7 - International Business, Entry Modes and Theories
- Lecture 8 - International Business, Entry Modes and Theories
- Lecture 9 - International Business, Entry Modes and Theories
- Lecture 10 - Hofstede's Cultural Dimensions, Cross-cultural Sales Negotiations
- Lecture 11 - Hofstede's Cultural Dimensions, Cross-cultural Sales Negotiations (Continued...)
- Lecture 12 - Hofstede's Cultural Dimensions, Cross-cultural Sales Negotiations (Continued...)
- Lecture 13 - Hofstede's Cultural Dimensions, Cross-cultural Sales Negotiations (Continued...)
- Lecture 14 - Hofstede's Cultural Dimensions, Cross-cultural Sales Negotiations (Continued...)
- Lecture 15 - Import Export Procedures
- Lecture 16 - Import Export Procedures (Continued...)
- Lecture 17 - Import Export Procedures (Continued...)
- Lecture 18 - Import Export Procedures (Continued...)
- Lecture 19 - Import Export Procedures (Continued...)
- Lecture 20 - Designing a Global Marketing Program
- Lecture 21 - Designing a Global Marketing Program (Continued...)
- Lecture 22 - Designing a Global Marketing Program (Continued...)
- Lecture 23 - Designing a Global Marketing Program (Continued...)
- Lecture 24 - Designing a Global Marketing Program (Continued...)
- Lecture 25 - International Business Case Analysis
- Lecture 26 - International Business Case Analysis
- Lecture 27 - International Business Case Analysis (Continued...)
- Lecture 28 - International Business Case Analysis (Continued...)
- Lecture 29 - International Business Case Analysis (Continued...)
- Lecture 30 - Learning Session by Practicing Manager
- Lecture 31 - Learning session by Practicing Manager (Continued ...)

[Lecture 32 - Interaction with Practicing Manager - Question and Answer Session](#)

[Lecture 33 - Learning Session by Practicing Manager](#)

[Lecture 34 - Learning Session by Practicing Manager followed by Conclusion session](#)

[Lecture 35 - Interaction with Practicing Manager](#)

[Lecture 36 - Interaction with Practicing Manager \(Continued...\)](#)

[Lecture 37 - Interaction with Practicing Manager \(Continued...\)](#)

[Lecture 38 - Interaction with Practicing Manager \(Continued...\)](#)

[Lecture 39 - Concluding Session](#)

**NPTEL : NOC:Retail Management (Management)**

**Co-ordinators : Prof. Swagato Chatterjee**

Lecture 1 - Introduction to Retailing - Part 1

Lecture 2 - Introduction to Retailing - Part 2

Lecture 3 - Introduction to Retailing - Part 3

Lecture 4 - Relationship Management in Retailing

Lecture 5 - Value-based Retailing

Lecture 6 - Retailing Services

Lecture 7 - Loyalty and Reward Programs

Lecture 8 - Strategic Planning in Retailing

Lecture 9 - Global Retailing

Lecture 10 - Retail Business Models by Ownership

Lecture 11 - Franchising in Retail

Lecture 12 - Retail Institutions by Store - Based Strategy Mix

Lecture 13 - Retail Institutions by Store - Based Strategy Mix (Continued...)

Lecture 14 - Retail Institutions by Store - Based Strategy Mix (Continued...)

Lecture 15 - Retail Institutions by Store - Based Strategy Mix (Continued...)

Lecture 16 - Web, Non store-based and Other Forms of Nontraditional Retailing

Lecture 17 - Web, Non store-based and Other Forms of Nontraditional Retailing (Continued...)

Lecture 18 - Identifying and Understanding the Customers

Lecture 19 - Trading Area Analysis

Lecture 20 - Trading Area Analysis (Continued...)

Lecture 21 - Trading Area Analysis (Continued...)

Lecture 22 - Site Selection

Lecture 23 - Site ownership vs Site Leasing

Lecture 24 - Retail Supply Chain Management

Lecture 25 - Retail Supply Chain Management (Continued...)

Lecture 26 - Retail Operations Management - 1

Lecture 27 - Retail Operations Management - 2

Lecture 28 - Retail Operations Management - 3

Lecture 29 - Image in Retail

Lecture 30 - Pricing in Retail

Lecture 31 - Pricing in Retail (Continued...)

[Lecture 32 - Pricing in Retail \(Continued...\)](#)

[Lecture 33 - Merchandising in Retail](#)

[Lecture 34 - Merchandising in Retail \(Continued...\)](#)

[Lecture 35 - Category Management and Merchandise Planning](#)

[Lecture 36 - Retail Promotions](#)

[Lecture 37 - Retail Promotions: non-Ad Promotions](#)

[Lecture 38 - OBHR Issues in Retail - 1](#)

[Lecture 39 - HR Issues in Retail](#)

[Lecture 40 - Vendor Negotiations](#)

[Lecture 41 - Special Merchandising Contexts - 1](#)

[Lecture 42 - Special Merchandising Contexts - 2](#)

[Lecture 43 - Store Layout in Retail](#)

[Lecture 44 - Retail Operations: Financial Aspects](#)

[Lecture 45 - Budgeting and Costing](#)

[Lecture 46 - Financial Merchandise Management](#)

[Lecture 47 - Merchandise Forecasting, Dollar Control](#)

- Lecture 1 - Concept, Definition and Features of Company
- Lecture 2 - Various Types of Companies and Their Memberships
- Lecture 3 - Meetings of a Company and Memorandum of Associations
- Lecture 4 - Corporate Social Responsibility (CSR)
- Lecture 5 - Reporting and Various Activities under CSR
- Lecture 6 - Concept, Definition and Features of Corporate Governance
- Lecture 7 - Effect of Corporate Governance
- Lecture 8 - Major Structural Issues
- Lecture 9 - Duties and Responsibilities of Directors
- Lecture 10 - Corporate Governance a Way Forward
- Lecture 11 - Concept, Scope and Features of PIT
- Lecture 12 - Investigation and Prohibition on Dealing, Counselling
- Lecture 13 - Key Changes in PIT Amendment, 2020
- Lecture 14 - Model Code of Conduct for PIT, Trading Initiatives
- Lecture 15 - Insider trading examples, PIT Recent Cases and Insider Trading Initiatives
- Lecture 16 - Concept, Elements, Importance and Forms of Contracts
- Lecture 17 - Concept of Offer, Valid Offer and Essentials of Valid Offer
- Lecture 18 - Concept of Fraud, Misrepresentation and Consideration
- Lecture 19 - Major Issues related to Contract
- Lecture 20 - Law of Insurance
- Lecture 21 - Background, Concept and Salient Features of Factories Act
- Lecture 22 - Health and Safety
- Lecture 23 - Labour Welfare
- Lecture 24 - Working Hours
- Lecture 25 - Duties of Inspecting Officials
- Lecture 26 - Background, Concept and Importance of Legislation for Wages
- Lecture 27 - Payment of Wages
- Lecture 28 - Minimum Wages
- Lecture 29 - Payment of Bonus Act
- Lecture 30 - Equal Remuneration Act
- Lecture 31 - Social Securities



- [Lecture 32 - Social securities in unorganised sector](#)
- [Lecture 33 - The Employeesâ€™ Provident Fund Act](#)
- [Lecture 34 - Payment of Gratuity Act 1972](#)
- [Lecture 35 - Employee State Insurance \(ESI\)](#)
- [Lecture 36 - Concept and Salient Features of Industries](#)
- [Lecture 37 - Industrial Relation](#)
- [Lecture 38 - Industrial Dispute Act](#)
- [Lecture 39 - Various Authorities under Industrial Dispute Act, 1947](#)
- [Lecture 40 - Procedure, Power and Duties of Authorities](#)

- Lecture 1 - Introduction to Safety and Risk Management
- Lecture 2 - Hazard Triangle
- Lecture 3 - Safety Ontology
- Lecture 4 - Qualitative Risk Assessment
- Lecture 5 - Quantitative Risk Assessment
- Lecture 6 - Hazard and Risk Data - I
- Lecture 7 - Hazard and Risk Data - II
- Lecture 8 - Incident Investigation Data
- Lecture 9 - Inspection and Audit Data
- Lecture 10 - Behavioral and Organizational Safety Data
- Lecture 11 - Data Dimensions and Information Quality
- Lecture 12 - Missing Data Handling
- Lecture 13 - Data Transformation - I
- Lecture 14 - Data Transformation - II
- Lecture 15 - Data Reduction - I
- Lecture 16 - Data Reduction - II
- Lecture 17 - Probability Distribution
- Lecture 18 - Sample and Statistics
- Lecture 19 - Safety Data Visualization Tools - I
- Lecture 20 - Safety Data Visualization Tools - II
- Lecture 21 - Safety Data Exploration
- Lecture 22 - Leading and Lagging Indicators for Measuring Safety Performance
- Lecture 23 - Control Charts for Safety Performance Evaluation and Monitoring
- Lecture 24 - Safety Capability Analysis - I
- Lecture 25 - Safety Capability Analysis - II
- Lecture 26 - Safety Reports and Use of Text Analytics
- Lecture 27 - Preprocessing of Text Data - I
- Lecture 28 - Preprocessing of Text Data - II
- Lecture 29 - Document Classification using KNN
- Lecture 30 - Topic Modeling - Latent Dirichlet Allocation
- Lecture 31 - Bow-Tie Construction

- Lecture 32 - Bow-Tie Quantification - I
- Lecture 33 - Bow-Tie Quantification - II: Accident Scenarios/Paths
- Lecture 34 - Bow-Tie Quantification - III: Accident Path Quantification
- Lecture 35 - Bow-Tie Quantification - IV: Probabilistic Approach using Monte Carlo Simulation
- Lecture 36 - Consequence Modeling and Risk Distribution
- Lecture 37 - Introduction to Predictive Safety and Risk Analytics
- Lecture 38 - Logistic Regression
- Lecture 39 - Application of Logistic Regression
- Lecture 40 - Classification and Regression Tree (CART)
- Lecture 41 - Classification and Regression Tree (CART): Case Study
- Lecture 42 - Support Vector Machine
- Lecture 43 - Support Vector Machine (Continued...)
- Lecture 44 - Application of Support Vector Machine
- Lecture 45 - Association Rule Mining
- Lecture 46 - Application of Association Rule Mining
- Lecture 47 - Statistical Measures of Safety Program Effectiveness - I
- Lecture 48 - Statistical Measures of Safety Program Effectiveness - II
- Lecture 49 - Statistical Measures of Safety Program Effectiveness - III
- Lecture 50 - Intervention Design
- Lecture 51 - Risk Based Decision Making - I
- Lecture 52 - Risk Based Decision Making - II
- Lecture 53 - Risk Based Maintenance - I
- Lecture 54 - Risk Based Maintenance - II
- Lecture 55 - Introduction to Behavioral Safety
- Lecture 56 - Behavioral Safety Data Collection and Preliminary Analysis
- Lecture 57 - Causal Modelling - I
- Lecture 58 - Causal Modelling - II: Application of Path Model
- Lecture 59 - Injury Epidemiology
- Lecture 60 - Occupational Safety, Health and Working Conditions Code, 2020 Analytics

Lecture 1 - Introduction and Concept - I

Lecture 2 - Introduction and Concept - II

Lecture 3 - Analysis of micro and macro environment - I

Lecture 4 - Analysis of micro and macro environment - II

Lecture 5 - Competition and Competitive Advantage - I

Lecture 6 - Competition and Competitive Advantage - II

Lecture 7 - Competition and Competitive Advantage - III

Lecture 8 - Framework for Internal Analysis of Firm - I

Lecture 9 - Framework for Internal Analysis of Firm - II

Lecture 10 - Value Chain Analysis

Lecture 11 - Resource-based view of firm and sustainability

Lecture 12 - Strategy Formulation - I

Lecture 13 - Strategy Formulation - II

Lecture 14 - Strategy Formulation - III

Lecture 15 - Diversification - I

Lecture 16 - Diversification - II

Lecture 17 - Mergers and Acquisitions - I

Lecture 18 - Mergers and Acquisitions - II

Lecture 19 - Portfolio Analysis and Display Matrices - I

Lecture 20 - Portfolio Analysis and Display Matrices - II

Lecture 21 - Operating and Financial Analysis

Lecture 22 - Complexities and Challenges of Competing in Global Markets - I

Lecture 23 - Complexities and Challenges of Competing in Global Markets - II

Lecture 24 - Entry Mode Strategies and Main Approaches for International Business

Lecture 25 - Building Competitive Advantage in International Markets

Lecture 26 - Strategies for competing in developing markets, and defending against global giants

Lecture 27 - Resource Allocation

Lecture 28 - 7-S Framework for Organizational Change

Lecture 29 - Strategy Implementation Issues

Lecture 30 - Matching organization structure to strategy

Lecture 31 - Forms of Organization

- Lecture 32 - Boundaryless Organization
- Lecture 33 - Strategic Leadership - I
- Lecture 34 - Strategic Leadership - II
- Lecture 35 - Universal Inner Structure of Effective Leaders
- Lecture 36 - Strategic Leadership - IV
- Lecture 37 - Business and Operational Excellence
- Lecture 38 - Strategic and Operational Control
- Lecture 39 - Balanced Scorecard Approach
- Lecture 40 - Roles and Responsibilities of Board of Directors
- Lecture 41 - Strategic Management Role and Style of the Board
- Lecture 42 - Composition, structure and other requirements of Board
- Lecture 43 - Improve Board Effectiveness, Board and Directorsâ€™ Performance Evaluation
- Lecture 44 - Corporate Governance Code
- Lecture 45 - Corporate Social Responsibility and Sustainability
- Lecture 46 - Social Auditing
- Lecture 47 - Innovation for Survival and Growth - I
- Lecture 48 - Innovation for Survival and Growth - II
- Lecture 49 - Entrepreneurship and Intrapreneurship
- Lecture 50 - Technology Management - I
- Lecture 51 - Technology Management - II
- Lecture 52 - In-house Development of Technology
- Lecture 53 - Strategic Importance of Knowledge and Organizational Learning
- Lecture 54 - Strategies for Knowledge Management
- Lecture 55 - Developing Strategic Plan of a Major Oil Company - I
- Lecture 56 - Developing Strategic Plan of a Major Oil Company - II
- Lecture 57 - Developing Strategic Plan of a Major Oil Company - III
- Lecture 58 - Summary of Modules 1-6
- Lecture 59 - Summary of Modules 7-11
- Lecture 60 - Summary of Modules 12-18

- Lecture 1 - Definition, purpose, and development of Human Factors and Ergonomics
- Lecture 2 - Types and components of worksystems, their interactions and evaluations
- Lecture 3 - Human components, machine components and environment components of worksystems
- Lecture 4 - Modern worksystems, FMJ vs FJM
- Lecture 5 - Contribution of human factors in systems design, engineering and management
- Lecture 6 - Anthropometry in product/process design, MHD, anthropometric design motto
- Lecture 7 - Types of anthropometric data, principles of applied anthropometry
- Lecture 8 - Examples of anthropometric design, numerical exercises
- Lecture 9 - Working Posture Analysis, Postural Triangle, Design for Seated and Standing Workers - Part 1
- Lecture 10 - Working Posture Analysis, Postural Triangle, Design for Seated and Standing Workers - Part 2
- Lecture 11 - Metabolism during work, Aerobic and anaerobic work, oxygen uptake
- Lecture 12 - Physical work capacity and energy expenditure, Individual differences, RWL, MOW
- Lecture 13 - MOE expenditure, Subjective measures of physical effort, Borg RPE scale, Factors
- Lecture 14 - EE of various operations in agriculture, construction and manufacturing industry - I
- Lecture 15 - EE of various operations in agriculture, construction and manufacturing industry - II
- Lecture 16 - Types of Injury Problems in Manual Handling Tasks, Types of Activities and Body Movements
- Lecture 17 - Biomechanical Modelling and Analysis of Manual Lifting
- Lecture 18 - Definitions and Standards of Lifting: NIOSH Lifting Equation
- Lecture 19 - EC Guidelines, UK Health and Safety Commission Guidelines
- Lecture 20 - Use of Material Handling Aids, Types of Material Handling Devices, Numerical Problems
- Lecture 21 - Ergonomic Problems in Computer Workstations, Design Elements of Computer Workstation
- Lecture 22 - Specifications of Computer Workstation Design Elements
- Lecture 23 - Methods to Reduce Glare/Reflection on Screen
- Lecture 24 - Design of Human-Computer Interaction
- Lecture 25 - Evolution of Technology in Computer Screen, Numerical Problems
- Lecture 26 - Work Postures and Related Complaints, Work Postures for Different Tasks, Task Analysis
- Lecture 27 - Power Law of Practice, Learning Curve, Numerical Pro
- Lecture 28 - Work Posture Assessment, Rapid Entire Body Assessment (REBA), MSDs/RMIs
- Lecture 29 - Hand tool design: Fitting the task, user and hand, Usage of hand tools and types of
- Lecture 30 - Design guidelines for hand tools
- Lecture 31 - Environment Component in Worksystems, Ergonomic Design of Physical Environment

- Lecture 32 - Ergonomic Design Framework for Environment, Importance of Illumination
- Lecture 33 - Measurement of Illuminance, Luminance, and Contrast
- Lecture 34 - Measures of Contrast, Contrast Ratio under Different Work Situations
- Lecture 35 - Direct and Indirect Glare or Reflection, Illumination for Inspection and Quality
- Lecture 36 - Problem of Heat Stress at Workplaces, Thermoregulation Process, Acclimation and
- Lecture 37 - Thermal Balance Equation and Heat Stress
- Lecture 38 - Quality of Thermal Environment, Evaluation of Thermal Environment
- Lecture 39 - Whole Body Vibration and Sources of Vibration Discomfort
- Lecture 40 - Design guidelines for hand tools
- Lecture 41 - Auditory Environment and Human Performance, Measurement of Sound and Noise Exposure
- Lecture 42 - Noise Exposure and Hearing Loss, Noise Analysis and Noise Reduction using Engineering
- Lecture 43 - Effects of Noise on Performance, Broadbent and Poulton Theories, Interference of Noise
- Lecture 44 - Octave bands and examples
- Lecture 45 - Ergonomic design of auditory environment in different workplaces
- Lecture 46 - Concepts of Design for Manufacturing (DFM), Design for Assembly (DHA), and Design
- Lecture 47 - Product Design Assessment and Important Measures, Manual Assembly Design Efficiency
- Lecture 48 - Assembly Time Determination with PMTS Methods, Human Factors Principles in DHA
- Lecture 49 - Maintenance in Manufacturing/Production System - Important Ergonomic Design Issues - Part I
- Lecture 50 - Maintenance in Manufacturing/Production System - Important Ergonomic Design Issues - Part II
- Lecture 51 - Definition of Shift Work, Problems with Shift Work, Effect on Circadian Rhythms
- Lecture 52 - Problems of shift workers, Shift Work and Human Performance
- Lecture 53 - Recommended Shift Work Schedules
- Lecture 54 - Major Ergonomic Issues and Problems in Shift Work Design - Part 1
- Lecture 55 - Major Ergonomic Issues and Problems in Shift Work Design - Part 2
- Lecture 56 - Concepts of Ergonomic Performance and its Indicators
- Lecture 57 - EPI Assessment Tool Development
- Lecture 58 - Factors and their level of assessment
- Lecture 59 - Application of EPI Model in Different Worksystems
- Lecture 60 - Epilogue

Lecture 1 - Introduction to Organizational Design

Lecture 2 - Introduction to Organizational Design

Lecture 3 - Introduction to Organizational Design

Lecture 4 - Introduction to Organizational Design

Lecture 5 - Introduction to Organizational Design

Lecture 6 - Organizational Environment

Lecture 7 - Organizational Environment

Lecture 8 - Organizational Environment

Lecture 9 - Organizational Environment

Lecture 10 - Organizational Environment

Lecture 11 - Organizational Structure

Lecture 12 - Organizational Structure

Lecture 13 - Organizational Structure

Lecture 14 - Organizational Structure

Lecture 15 - Organizational Structure

Lecture 16 - Organizational Design and Strategy in a changing Global environment

Lecture 17 - Organizational Design and Strategy in a changing Global environment

Lecture 18 - Organizational Design and Strategy in a changing Global environment

Lecture 19 - Organizational Design and Strategy in a changing Global environment

Lecture 20 - Organizational Design and Strategy in a changing Global environment

Lecture 21 - Organizational Change

Lecture 22 - Organizational Change

Lecture 23 - Organizational Change

Lecture 24 - Organizational Change

Lecture 25 - Organizational Change

Lecture 26 - Managing Conflict, Power, and Politics

Lecture 27 - Managing Conflict, Power, and Politics

Lecture 28 - Managing Conflict, Power, and Politics

Lecture 29 - Managing Conflict, Power, and Politics

Lecture 30 - Managing Conflict, Power, and Politics

Lecture 31 - Organizational culture



- Lecture 32 - Organizational culture and socialization
- Lecture 33 - Organizational culture and climate
- Lecture 34 - Managing organizational culture
- Lecture 35 - International aspects of organizational culture
- Lecture 36 - Organizational design and technology
- Lecture 37 - Technologies and organizational structure
- Lecture 38 - Technological theories and organizational design
- Lecture 39 - Organizational design and technology: Challenges
- Lecture 40 - Organizational competencies
- Lecture 41 - Decision making
- Lecture 42 - Learning
- Lecture 43 - Knowledge management
- Lecture 44 - IT and IS
- Lecture 45 - IT in Management and Organization
- Lecture 46 - Organizational Birth and Growth
- Lecture 47 - Organizational Decline and Death
- Lecture 48 - Organizational Inertia and Resilience
- Lecture 49 - Organizational Transformation
- Lecture 50 - Organizational Development and Intervention
- Lecture 51 - Innovation: Concept, Types
- Lecture 52 - Innovation Framework Model
- Lecture 53 - Intrapreneurship
- Lecture 54 - Creativity
- Lecture 55 - Creativity and Related Issues
- Lecture 56 - Creativity and Design Thinking
- Lecture 57 - Turnaround Situation: Strategic, Operational and Cultural
- Lecture 58 - IT and ICT Intervention
- Lecture 59 - Human Resource Intervention
- Lecture 60 - Organizational Culture, Transformation and Ethical Values
- Lecture 61 - Future Trends for Organizational Transformation

Lecture 1 - Introduction to Mergers and Acquisitions - I

Lecture 2 - Introduction to Mergers and Acquisitions - II

Lecture 3 - Theories of Mergers and Acquisitions

Lecture 4 - Legal Environment of M and A in India

Lecture 5 - Case Studies - DO M and A PAY ?

Lecture 6 - Takeover Tactics and Anti-takeover Defenses - 1

Lecture 7 - Takeover Tactics and Anti-takeover Defenses - 1

Lecture 8 - Takeover Tactics and Anti-takeover Defenses - 2

Lecture 9 - Takeover Tactics and Anti-takeover Defenses - 3

Lecture 10 - Acquisition Search and Due Diligence - 1

Lecture 11 - Acquisition Search and Due Diligence - 2

Lecture 12 - Valuation in M and A: Cash Flow Based Approach - 1

Lecture 13 - Valuation in M and A: Cash Flow Based Approach - 3 (Cost of Capital)

Lecture 14 - Valuation in M and A: Cash Flow Based Approach - 4 (Dividend Discount Model)

Lecture 15 - Valuation in M and A: Cash Flow Based Approach - 4 (Dividend Discount Model)

Lecture 16 - Valuation in M and A: Cash Flow Based Approach - 5 (Free Cash Flow Models)

Lecture 17 - Valuation in M and A: Cash Flow Based Approach - 6 (Free Cash Flow Models) (Continued...)

Lecture 18 - Valuation in M and A: Valuation of Synergies - 1

Lecture 19 - Valuation in M and A: Valuation of Synergies - 2

Lecture 20 - Valuation in M and A: Asset Based Valuation

Lecture 21 - Valuation in M and A: Relative Valuation - 1

Lecture 22 - Valuation in M and A: Relative Valuation - 2

Lecture 23 - Alternative Exit and Restructuring Strategies - 1

Lecture 24 - Alternative Exit and Restructuring Strategies - 2

Lecture 25 - Alternative Exit and Restructuring Strategies - 3

Lecture 26 - M and A Deal Structuring - 1

Lecture 27 - M and A Deal Structuring - 2

Lecture 28 - M and A Deal Structuring - 3

Lecture 29 - M and A Deal Structuring - 4

Lecture 30 - M and A Deal Structuring - 5

Lecture 31 - Legal Aspects of M and A - 1

[Lecture 32 - Legal Aspects of M and A - 2](#)

[Lecture 33 - Legal Aspects of M and A - 3](#)

[Lecture 34 - Accounting Aspects of M and A - I](#)

[Lecture 35 - Accounting Aspects of M and A - II](#)

[Lecture 36 - Alternative Exit and Restructuring Strategies - 1](#)

[Lecture 37 - Alternative Exit and Restructuring Strategies - 2](#)

[Lecture 38 - Alternative Exit and Restructuring Strategies - 3](#)

[Lecture 39 - Leveraged Buyouts](#)

[Lecture 40 - Alternative Exit and Restructuring Strategies - Insolvency and Bankruptcy](#)

- Lecture 1 - Investment Management as a Process
- Lecture 2 - Role of Financial Markets and Institutions
- Lecture 3 - Types of Investments
- Lecture 4 - Ecology of Financial Markets
- Lecture 5 - Investment Philosophies
- Lecture 6 - Present and Future Values of Investments
- Lecture 7 - Bonds as an Investment
- Lecture 8 - Pricing and Valuation of Bonds
- Lecture 9 - Pricing and Valuation of Bonds (Continued...)
- Lecture 10 - Prices, Yields, and Duration of Bonds
- Lecture 11 - Equity as an Asset Class
- Lecture 12 - Equity Valuation Models
- Lecture 13 - Equity Valuation Models (Continued...)
- Lecture 14 - Equity Valuation Ratios
- Lecture 15 - Equity Investment Strategies
- Lecture 16 - Portfolio Theory - Primer
- Lecture 17 - Capital Asset Pricing Model
- Lecture 18 - The CAPM and Index Models
- Lecture 19 - The CAPM and Index Models (Continued...)
- Lecture 20 - Consumption-Based Asset Pricing
- Lecture 21 - Two-fund Theorem
- Lecture 22 - Mutual Fund Basics
- Lecture 23 - Mutual Fund Basics (Continued...)
- Lecture 24 - Risk Indicator of a Mutual Fund
- Lecture 25 - Risk Indicator of a Mutual Fund (Continued...)
- Lecture 26 - Market Efficiency
- Lecture 27 - Market Efficiency (Continued...)
- Lecture 28 - Fundamental Analysis of Securities
- Lecture 29 - Value Investing using PV Models
- Lecture 30 - Asset Allocation and Portfolio Strategies
- Lecture 31 - Exchange Traded Funds (ETFs)

[Lecture 32 - Forming Portfolio with ETFs](#)

[Lecture 33 - Forming Portfolio with ETFs \(Continued...\)](#)

[Lecture 34 - Cryptocurrencies](#)

[Lecture 35 - Cryptocurrencies \(Continued...\)](#)

[Lecture 36 - Behavioral Anomalies in Investments](#)

[Lecture 37 - Behavioral Anomalies in Investments \(Continued...\)](#)

[Lecture 38 - Portfolio Evaluation](#)

[Lecture 39 - Portfolio Evaluation \(Continued...\)](#)

[Lecture 40 - Wrapping up](#)

- Lecture 1 - Basic Concepts and Introduction
- Lecture 2 - Drivers of Project Management
- Lecture 3 - Linkages between Organization Strategy and Projects
- Lecture 4 - Project Governance and Design of Project Portfolio System
- Lecture 5 - Non-Financial and Multi-Criteria Project Selection Models
- Lecture 6 - Organization Structure
- Lecture 7 - Organization Culture
- Lecture 8 - Project Scope of Work and Deliverables
- Lecture 9 - Responsibility Matrices and Project Communication Plan
- Lecture 10 - Estimating Guidelines and Methods, Top-down Estimation
- Lecture 11 - Level of Details, Type of Costs and Refining Estimates
- Lecture 12 - Concept of Project Network and Development Rules
- Lecture 13 - Construction of Network and Computation Process
- Lecture 14 - Extended Network Techniques to Represent Reality
- Lecture 15 - Probability of Completion of Project on Time
- Lecture 16 - Managing Risk and Risk Identification
- Lecture 17 - Risk Assessment
- Lecture 18 - Risk Response Development and Contingency Planning
- Lecture 19 - Risk Response Control and Change Control Management
- Lecture 20 - Risk Assessment of Capital projects
- Lecture 21 - Classification of Scheduling Problems: Time-constrained Project
- Lecture 22 - Resource-constrained Project
- Lecture 23 - Time-phased Budget, Critical Chain Project Management
- Lecture 24 - Rationale and Options for Project Crashing
- Lecture 25 - Crashing - Reducing Project Duration
- Lecture 26 - Reducing Project Duration - Solving Numerical
- Lecture 27 - Project Monitoring and Control Process
- Lecture 28 - Development of Performance Indexes for Monitoring
- Lecture 29 - Forecasting Project Completion Time and Cost
- Lecture 30 - Strategic Dimensions and Decision Logic of Outsourcing
- Lecture 31 - Best Practices in Outsourcing Project Work

[Lecture 32 - Partnering and Traditional Approaches for Managing Relations](#)

[Lecture 33 - The Art of Negotiating](#)

[Lecture 34 - Customer's Satisfaction and Managing Customer Relations](#)

[Lecture 35 - Types of Contract and their Salient Features](#)

[Lecture 36 - Preparation and Evaluation of RFP: Best Practices](#)

[Lecture 37 - Project Closure Activities and Post-Implementation Evaluation](#)

[Lecture 38 - Retrospectives](#)

[Lecture 39 - Oversight Activities and Levels](#)

[Lecture 40 - Phase Gate System, Project Management Maturity Model](#)

Lecture 1 - Introduction to Commodity Market

Lecture 2 - Commodity Spot Market and Different Types of Auction

Lecture 3 - Commodity Spot Market and Different Types of Auction

Lecture 4 - Introduction to forward contract

Lecture 5 - Introduction to Futures Contract

Lecture 6 - Futures Contract Specification

Lecture 7 - Futures Contract Specification (Continued...)

Lecture 8 - Futures Contract Specification (Continued...)

Lecture 9 - Futures Contract (Different Types of Margins)

Lecture 10 - Futures Contract (Mark-to-Market/MTM Margin)

Lecture 11 - Hedgers Vs. Speculators

Lecture 12 - Measures of Speculation

Lecture 13 - Spot Price, Futures Price and Basis Risk

Lecture 14 - Spot Price, Futures Price and Basis Risk (Continued...)

Lecture 15 - Pricing of Futures

Lecture 16 - Pricing of Futures (Continued...)

Lecture 17 - Convenience Yield, Minimum Variance Hedge Ratio

Lecture 18 - Hedge Effectiveness, Cross Hedge, Stack and Roll Vs. Strip Hedge

Lecture 19 - Calendar Spread, Valuation of Futures vs. Forwards, Commodity Swaps

Lecture 20 - Commodity Swaps

Lecture 21 - Commodity Index

Lecture 22 - Commodity Index (Continued...)

Lecture 23 - Commodity options

Lecture 24 - Introduction to Commodity Options (Continued...), Hedgers vs. Speculators

Lecture 25 - Pricing of Commodity Options

Lecture 26 - Commodity Options (Continued...), Put-Call Parity and Put-Call Ratio

Lecture 27 - Put-Call Parity, Implied Volatility, Swaptions

Lecture 28 - Commodity Swaption (Continued...) and Asian Options on Commodities

Lecture 29 - Commodity Derivatives Market : Value Proposition

Lecture 30 - Commodity Derivatives Market : Value Proposition

Lecture 31 - Agricultural Commodity Price Risk Management



- Lecture 32 - Agricultural Commodity Price Risk Management (Continued...)
- Lecture 33 - Agricommodities Price Risk, Seasonality, Crush Spread Futures
- Lecture 34 - Agri-commodity Seasonality, Crush Spread Futures, Salmon Futures
- Lecture 35 - Crush Spread Futures, Salmon Futures, Agri-commodity risk Management Practices
- Lecture 36 - Gold and other Precious Metal Derivatives
- Lecture 37 - Gold as Asset, LBMA Spot Price Fix
- Lecture 38 - Gold as Asset, ETF, Gold-Silver Ratio
- Lecture 39 - Gold Price Risk Management, Dehedge, Zero Cost Derivatives
- Lecture 40 - Gold Quanto Futures, Delta Hedge Trap
- Lecture 41 - Crude oil and Crude oil Derivatives Price Risk Management
- Lecture 42 - Crude oil and Crude oil Derivatives Price Risk Management (Continued...)
- Lecture 43 - Crack Spread Futures, Spread Options and Crude Oil Price Risk
- Lecture 44 - Crude Oil Price Risk Management: 3-Way Collar, Spread Options and Swaps
- Lecture 45 - Swaps, Calendar Spreads: Crude Oil and Natural Gas Risk Management
- Lecture 46 - Weather Derivatives
- Lecture 47 - Weather Derivatives (Continued...)
- Lecture 48 - Weather Derivatives (Snowfall, Rainfall and Hurricane)
- Lecture 49 - Weather Derivatives (Rainfall and Hurricane)
- Lecture 50 - Spot and Derivatives Contracts on Electricity
- Lecture 51 - Electricity Trading in Day Ahead Market (DAM)
- Lecture 52 - Spot and Derivatives in Electricity (System Price and Area Clearing Price)
- Lecture 53 - Spot and Derivatives in Electricity (Green DAM, Duck Curve, Dark/Spark Spread)
- Lecture 54 - Carbon Credits and Carbon Credit Derivatives Market
- Lecture 55 - Carbon Credits (CDM, JI, RGGI, REC, ESCerts)
- Lecture 56 - Carbon Credits (REC, ESCerts, CORSIA) and Carbon Derivatives
- Lecture 57 - Freight Rates Derivatives
- Lecture 58 - Freight Rates Derivatives (Continued...)
- Lecture 59 - Water Derivatives
- Lecture 60 - Real Estate Derivatives and Derivatives Losses

**NPTEL : Infrastructure Finance (Management)**

**Co-ordinators : Dr. A. Thillai Rajan**

- Lecture 1 - Introduction
- Lecture 2 - Overview on Infrastructure Financing Sources
- Lecture 3 - Basics of Financial Management - Part-1
- Lecture 4 - Basics of Financial Management - Part-2
- Lecture 5 - Basics of Financial Management - Part-3
- Lecture 6 - Basics of Financial Management - Part-4
- Lecture 7 - Analysis of company Performance - Part-1
- Lecture 8 - Analysis of company Performance - Part-2
- Lecture 9 - Analysis of Project Viability Time value of money
- Lecture 10 - Analysis of Project Viability Cost of Capital
- Lecture 11 - Analysis of Project Viability Capital Budgeting Techniques - I
- Lecture 12 - Analysis of Project Viability Capital Budgeting Guidelines - II
- Lecture 13 - Analysis of Project Viability Capital Budgeting Guidelines - III
- Lecture 14 - Analysis of Project Viability Capital Budgeting Guidelines - IV
- Lecture 15 - Overview and introduction to project finance
- Lecture 16 - Project Financing Attributes and Motivations - I
- Lecture 17 - Project Financing Attributes and Motivations - II
- Lecture 18 - Project Finance Markets - I
- Lecture 19 - Project Finance Markets - II
- Lecture 20 - Project Finance Markets - III
- Lecture 21 - Project Finance Markets Mezzanine / Sub-ordinated Debt
- Lecture 22 - Project Finance Markets - Type of Debt and Leasing
- Lecture 23 - Project Finance Markets - Financial Intermediation
- Lecture 24 - Project Finance Markets - Loan Refinancing
- Lecture 25 - Project Finance Markets - Project Bonds - I
- Lecture 26 - Project Finance Markets - Project Bonds - II
- Lecture 27 - Public Private Partnerships
- Lecture 28 - Risk Management - I
- Lecture 29 - Risk Management - II
- Lecture 30 - Risk Management - III
- Lecture 31 - Risk Management - Market Risks

[Lecture 32 - Risk Management - Country / Political risks - I](#)

[Lecture 33 - Risk Management - Country / Political risks - II](#)

[Lecture 34 - Risk Management - Country / Political risks - III](#)

[Lecture 35 - Risk Management - Country / Political risks - IV](#)

[Lecture 36 - Context of infrastructure development - I](#)

[Lecture 37 - Context of infrastructure development - II](#)

[Lecture 38 - Context of infrastructure development - III](#)

[Lecture 39 - Context of infrastructure development - IV](#)

[Lecture 40 - Context of infrastructure development - V](#)

**NPTEL : Manufacturing Systems Management (Management)**

**Co-ordinators : Prof. G. Srinivasan**

- Lecture 1 - Introduction to Manufacturing Systems Management
- Lecture 2 - Different types of Manufacturing Systems
- Lecture 3 - Introduction to Cellular Manufacturing
- Lecture 4 - Cellular Manufacturing Applications, Production Flow Analysis
- Lecture 5 - Production Flow Analysis
- Lecture 6 - Cellular Manufacturing - Unidirectional flow, Capacity Planning, Layout
- Lecture 7 - Exercise on Production Flow Analysis
- Lecture 8 - Rank Order Clustering, Similarity Coefficient based algorithm
- Lecture 9 - Similarity Coefficient based clustering algorithm
- Lecture 10 - Hierarchical and Non hierarchical clustering algorithms
- Lecture 11 - Optimization based algorithms
- Lecture 12 - Optimization based algorithms, Assignment based algorithm
- Lecture 13 - Assignment model, Algorithm considering sequence of visit of machines
- Lecture 14 - Algorithm considering sequence of visit of machines
- Lecture 15 - Algorithm considering cell load data, alternate process plans
- Lecture 16 - Reducing Intercell moves
- Lecture 17 - Part subcontracting, Incremental cell formation
- Lecture 18 - Product based cells
- Lecture 19 - Branching algorithm for product based cells, Operator and task assignment
- Lecture 20 - Operator and task assignment
- Lecture 21 - Operator and task assignment continued
- Lecture 22 - Static and dynamic Operator allocation, Multiple products and incremental cells
- Lecture 23 - Cell scheduling and sequencing
- Lecture 24 - Cell scheduling and sequencing continued
- Lecture 25 - Single piece transportation
- Lecture 26 - Cell Layout, Introduction to Just-in-time manufacturing
- Lecture 27 - Cell control and JIT
- Lecture 28 - Basic elements of JIT, Kanban systems
- Lecture 29 - Role of basic elements, Critical success factors
- Lecture 30 - Models in JIT
- Lecture 31 - Models in JIT continued

[Lecture 32 - CONWIP, Introduction to synchronous manufacturing](#)

[Lecture 33 - Theory of constraints, Product mix problem](#)

[Lecture 34 - Statistical Fluctuations, Random events, principles of SM](#)

[Lecture 35 - Scheduling in SM](#)

[Lecture 36 - Drum Buffer Rope system](#)

[Lecture 37 - Flexible Manufacturing System, Part selection problem](#)

[Lecture 38 - FMS Loading problem](#)

[Lecture 39 - FMS Loading, multiple batches and changeover times](#)

[Lecture 40 - FMS Loading and scheduling, Summary of the course contents](#)

**NPTEL : Operations and Supply Chain Management (Management)**

**Co-ordinators : Prof. G. Srinivasan**

Lecture 1 - Introduction - (Challenges, Methodologies)

Lecture 2 - Forecasting - Time series models - Simple Exponential smoothing

Lecture 3 - Forecasting - Linear Models, Regression, Holt's , seasonality

Lecture 4 - Forecasting - Winter's model, causal models, Goodness of forecast, Aggregate Planning, Tabular method

Lecture 5 - Aggregate Planning, Tabular method, Linear Programming

Lecture 6 - Aggregate Planning, Transportation model

Lecture 7 - Aggregate Planning, Dynamic Programming, backordering

Lecture 8 - Aggregate Planning, Quadratic model, Demand and capacity planning

Lecture 9 - Inventory Models - Costs, EOQ model

Lecture 10 - Inventory - EOQ model graphs, with backordering

Lecture 11 - Inventory - Models for all quantity and marginal quantity Discount

Lecture 12 - Multiple Quantity Discount, Multiple item inventory - Constraint on numbers of orders

Lecture 13 - Multiple item inventory - Constraint on money value, space, equal number of orders

Lecture 14 - Multiple item inventory - combining orders, production consumption model

Lecture 15 - Inventory - Production consumption model with backordering, Economic lot scheduling problem

Lecture 16 - Economic lot scheduling problem, Supply Chain inventory

Lecture 17 - Lot sizing

Lecture 18 - Lot sizing - heuristics

Lecture 19 - Disaggregation

Lecture 20 - Disaggregation - time varying demand, Safety stock - ROL for discrete demand distribution

Lecture 21 - Safety stock - ROL for normal distribution of lead time demand

Lecture 22 - Integrated model, ROL for normal distribution of LTD and given mean

Lecture 23 - Safety stock reduction - delayed Product differentiation, substitution. MOM

Lecture 24 - Sequencing and scheduling - Assumptions, objectives and shop settings

Lecture 25 - Single machine sequencing. Two machine flow shop - Johnson's algorithm

Lecture 26 - Flow shop scheduling - Three machines, Johnson's algorithm and Branch and bound algorithm

Lecture 27 - Flow shop scheduling - heuristics - Palmer, Campbell Dudek Smith algorithm

Lecture 28 - Job shop scheduling - Gantt chart, Different dispatching rules

Lecture 29 - Job shop scheduling - Shifting bottleneck heuristic

Lecture 30 - Job shop scheduling - Shifting bottleneck heuristic. Line Balancing

Lecture 31 - Line Balancing

[Lecture 32 - Location problems - p median problem, Fixed charge problem](#)

[Lecture 33 - Location allocation problems in supply chain. Layout](#)

[Lecture 34 - Quantitative models for layout, Summary](#)

[Lecture 35 - Introduction to Supply Chain Management](#)

[Lecture 36 - Location Problems](#)

[Lecture 37 - Transportation and Distribution Models](#)

[Lecture 38 - Transportation and Distribution Models\(continued\)](#)

[Lecture 39 - Bin Packing and Travelling Salesman Problems](#)

[Lecture 40 - Vehicle Routeing Problems](#)

[Lecture 41 - Value of Information](#)

- Lecture 1 - Introduction to Business Analysis for Engineers
- Lecture 2 - Introduction to Accounting
- Lecture 3 - Accounting Principles - 1
- Lecture 4 - Balance Sheet Fundamentals
- Lecture 5 - Balance Sheet Fundamentals
- Lecture 6 - Accounting Principles - 2
- Lecture 7 - Introduction to Income Statement & Double Entry
- Lecture 8 - Double Entry Examples - 1
- Lecture 9 - Double Entry Examples - 2
- Lecture 10 - Preparation of Financial Statement
- Lecture 11 - Cash Flow Statement - 1
- Lecture 12 - Cash Flow Statement - 2
- Lecture 13 - Special Accounts Illustrations
- Lecture 14 - Final Illustrative Example
- Lecture 15 - Summary of Financial Accounting
- Lecture 16 - Introduction to Management Accounting & Behaviour of Cost
- Lecture 17 - Cost-Volume Relationship
- Lecture 18 - Cost-Objects & Variance
- Lecture 19 - Labour & Over Heads Variance Analysis
- Lecture 20 - Cash Conversion Cycle
- Lecture 21 - Inventory Management
- Lecture 22 - What is Strategy?
- Lecture 23 - Porter's Diamond Model
- Lecture 24 - Industry Analysis
- Lecture 25 - Industry Analysis & Sources of Strategy
- Lecture 26 - The Need for Value
- Lecture 27 - Value Chain Analysis
- Lecture 28 - Corporate Portfolio Analysis
- Lecture 29 - External & Internal Environ Analysis
- Lecture 30 - Models for Strategy,Ansoff matrix
- Lecture 31 - Porter's Generic Strategy



[Lecture 32 - Prahlad's Core Competency](#)

[Lecture 33 - Case study to understand strategy](#)

[Lecture 34 - Case study to understand strategy](#)

[Lecture 35 - Blue ocean and conclusion](#)

[Lecture 36 - Introduction to Economics](#)

[Lecture 37 - Introduction to GDP](#)

[Lecture 38 - Supply vs Demand](#)

[Lecture 39 - Price & Income Elasticity and Utility](#)

[Lecture 40 - Macroeconomic Variables](#)

[Lecture 41 - Fiscal & Monetary Policy](#)

[Lecture 42 - Union Budget & Conclusion](#)

- Lecture 1 - Linear Programming Introduction and formulations - Product Mix problem and Notations
- Lecture 2 - Linear Programming Introduction and formulations - Manpower and Production planning formulations
- Lecture 3 - Linear Programming Introduction and formulations - Media selection problem and Bicycle problem
- Lecture 4 - Linear Programming Introduction and formulations - Caterer problem
- Lecture 5 - Linear Programming Introduction and formulations - Maximum flow and bin packing problems
- Lecture 6 - Graphical and Algebraic methods - Graphical method (maximization)
- Lecture 7 - Graphical and Algebraic methods - Graphical method (minimization)
- Lecture 8 - Graphical and Algebraic methods - Algebraic method (maximization)
- Lecture 9 - Graphical and Algebraic methods - Algebraic method (minimization)
- Lecture 10 - Graphical and Algebraic methods - Comparing graphical and algebraic methods
- Lecture 11 - Simplex Algorithm - Algebraic form of simplex algorithm
- Lecture 12 - Simplex Algorithm - Tabular form of simplex (maximization)
- Lecture 13 - Simplex Algorithm - Tabular form (minimization)
- Lecture 14 - Simplex Algorithm - Unboundedness
- Lecture 15 - Simplex Algorithm - Infeasibility
- Lecture 16 - Dual - Motivation to the dual
- Lecture 17 - Dual - Writing the dual for a general LP
- Lecture 18 - Dual - Writing the dual for a general LP (Continued...)
- Lecture 19 - Dual - Duality theorems
- Lecture 20 - Dual - Complimentary slackness theorem
- Lecture 21 - Primal dual relationships - Dual solution using complimentary slackness
- Lecture 22 - Primal dual relationships - Dual solution from simplex table; economic interpretation of dual
- Lecture 23 - Primal dual relationships - Economic Interpretation of the dual; Dual Simplex algorithm
- Lecture 24 - Primal dual relationships - Solving LPs with mixed type of constraints
- Lecture 25 - Primal dual relationships - Matrix method for LP problems
- Lecture 26 - Introducing the transportation problem
- Lecture 27 - North West corner Rule and minimum cost method
- Lecture 28 - Penalty cost method
- Lecture 29 - Stepping stone method and Modified Distribution method
- Lecture 30 - MODI method; Dual of the transportation problem and the optimality of the MODI method
- Lecture 31 - Introducing the Assignment problem

[Lecture 32 - Solving the Assignment problem](#)

[Lecture 33 - Hungarian algorithm; Alternate optimum](#)

[Lecture 34 - Unequal number of rows and columns; Dual of the assignment problem](#)

[Lecture 35 - Optimality of the Hungarian algorithm](#)

[Lecture 36 - Setting up the problem and solving simple LP problems](#)

[Lecture 37 - Unboundedness and infeasibility](#)

[Lecture 38 - Solving other formulations](#)

[Lecture 39 - Solving a transportation problem](#)

[Lecture 40 - Solving an assignment problem](#)

- Lecture 1 - Course Overview
- Lecture 2 - Course Overview (Continued...)
- Lecture 3 - Descriptive Statistics - Graphical Approaches
- Lecture 4 - Descriptive Statistics - Measures of Central Tendency
- Lecture 5 - Descriptive Statistics - Measures of Dispersion
- Lecture 6 - Random Variables and Probability Distributions
- Lecture 7 - Probability Distributions (Continued...)
- Lecture 8 - Probability Distributions (Continued...)
- Lecture 9 - Inferential Statistics - Motivation
- Lecture 10 - Inferential Statistics - Single sample tests
- Lecture 11 - Two Sample tests
- Lecture 12 - Type 1 and Type 2 Errors
- Lecture 13 - Confidence Intervals
- Lecture 14 - ANOVA and Test of Independence
- Lecture 15 - Short Introduction to Regression
- Lecture 16 - Introduction to Machine Learning
- Lecture 17 - Supervised Learning
- Lecture 18 - Unsupervised Learning
- Lecture 19 - Ordinary Least Squares Regression
- Lecture 20 - Simple and Multiple Regression in Excel and Matlab
- Lecture 21 - Regularization/ Coefficients Shrinkage
- Lecture 22 - Data Modelling and Algorithmic Modelling Approaches
- Lecture 23 - Logistic Regression
- Lecture 24 - Training a Logistic Regression Classifier
- Lecture 25 - Classification and Regression Trees
- Lecture 26 - Classification and Regression Trees (Continued...)
- Lecture 27 - Bias Variance Dichotomy
- Lecture 28 - Model Assessment and Selection
- Lecture 29 - Support Vector Machines
- Lecture 30 - Support Vector Machines (Continued...)
- Lecture 31 - Support Vector Machines for Non Linearly Separable Data

- [Lecture 32 - Support Vector Machines and Kernel Transformations](#)
- [Lecture 33 - Ensemble Methods and Random Forests](#)
- [Lecture 34 - Artificial Neural Networks](#)
- [Lecture 35 - Artificial Neural Networks \(Continued...\)](#)
- [Lecture 36 - Deep Learning](#)
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- [Lecture 39 - Big Data - A small introduction](#)
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- [Lecture 41 - Clustering Analysis](#)
- [Lecture 42 - Clustering Analysis \(Continued...\)](#)
- [Lecture 43 - Introduction to Experimentation and Active Learning](#)
- [Lecture 44 - Introduction to Experimentation and Active Learning \(Continued...\)](#)
- [Lecture 45 - An Introduction to Online Learning - Reinforcement Learning](#)
- [Lecture 46 - An Introduction to Online Learning - Reinforcement Learning \(Continued...\)](#)
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- [Lecture 48 - Tutorial on weka](#)
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- [Lecture 50 - Big Data - A Small Introduction \(Continued...\)](#)

Lecture 1 - Patent Law as Concepts

Lecture 2 - Understanding the Patents Act and the Rules

Lecture 3 - Preliminary Sections

Lecture 4 - Preliminary Rules

Lecture 5 - Patents (Amendment) Rules, 2016

Lecture 6 - Easy way to read the Patents Act and Rules

Lecture 7 - What can be Patented?

Lecture 8 - Inventions not Patentable

Lecture 9 - Novelty

Lecture 10 - Anticipation

Lecture 11 - Inventive Step

Lecture 12 - Capable of Industrial Application

Lecture 13 - Person Skilled in the Art

Lecture 14 - Complete and Provisional Specifications

Lecture 15 - Contents of Specifications

Lecture 16 - Structure of a Patent Specification

Lecture 17 - Reading a Patent Specification

Lecture 18 - Introduction to Patent Drafting: Provisional Specification

Lecture 19 - Introduction to Patent Drafting: Complete Specification

Lecture 20 - Who Can Apply for a Patent?

Lecture 21 - Form of Application

Lecture 22 - Patent Application: Making, What to include, and Types

Lecture 23 - Powers of Controller: Generally

Lecture 24 - Patents of Addition

Lecture 25 - Priority Dates

Lecture 26 - Professor's Interaction 01

Lecture 27 - Publication of Application

Lecture 28 - Request for Examination

Lecture 29 - Examination of Application

Lecture 30 - Expedited Examination of Application

Lecture 31 - Search for Anticipation



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[Lecture 33 - Consideration of Report of Examiner](#)

[Lecture 34 - Refuse, Require Amendment, and Division of Applications](#)

[Lecture 35 - Dating of Application and Anticipation](#)

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[Lecture 42 - Post-Grant Opposition](#)

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[Lecture 45 - Opposition in General](#)

[Lecture 46 - Secrecy Provisions](#)

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[Lecture 57 - Patent Agents](#)

[Lecture 58 - Use and Acquisition by Government](#)

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[Lecture 60 - Introduction to Compulsory Licensing](#)

[Lecture 61 - Working of Patents](#)

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[Lecture 73 - Groundless threat of Infringement Proceedings](#)

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Lecture 2 - Design Thinking - A Primer Start - Part 2

Lecture 3 - Design Thinking - A Primer Start - Part 3

Lecture 4 - Intro to Design Thinking

Lecture 5 - Case Study - Arcturus IV by John E. Arnold

Lecture 6 - Course Preview and History of Design Thinking

Lecture 7 - Discussion - Intro to Demo Problem

Lecture 8 - Empathize - Lecture 1

Lecture 9 - Empathize - Workshop 1

Lecture 10 - Empathize - Workshop 2

Lecture 11 - Empathize - Skit

Lecture 12 - Interviews

Lecture 13 - Analyze - Lecture-1 5 Whys

Lecture 14 - Analyze - 5ys - IIT Stadium levels

Lecture 15 - Analyze - Lecture 2 Conflict of Interest

Lecture 16 - Analyze - Workshop - Part 1

Lecture 17 - Analyze - Workshop - Part 2

Lecture 18 - Solve - Tea cup story

Lecture 19 - Solve - Lecture 1

Lecture 20 - Solve - Workshop 1

Lecture 21 - Elephant and blind men

Lecture 22 - Test - Lecture 1

Lecture 23 - Test - Workshop 1

Lecture 24 - Test - Customer reactions to prototype

Lecture 25 - The END - Part 1

Lecture 26 - The END - Part 2

Lecture 27 - Finale and Appeal for proposals

- Lecture 1 - Tutorial - How to Install Octave and using Octave
- Lecture 2 - Background and relevance
- Lecture 3 - Examples of managing uncertainty and making decisions
- Lecture 4 - Risk, uncertainty and variability
- Lecture 5 - Probability: Events, Conditioning and Total Probability
- Lecture 6 - Discrete random variables
- Lecture 7 - Continuous random variables: characteristics and examples
- Lecture 8 - Expected Value: Mean, Variance and Functions
- Lecture 9 - Multiple Random Variables: Discrete and Continuous
- Lecture 10 - Criteria, Objectives and Settings for Decisions
- Lecture 11 - Introduction to one-time decisions
- Lecture 12 - Solving the secretary problem
- Lecture 13 - Which option to gamble just once?
- Lecture 14 - Utility Function
- Lecture 15 - Nested one-time decisions
- Lecture 16 - Decision Trees
- Lecture 17 - Decisions in Game Shows: Final Jeopardy
- Lecture 18 - Decisions in Game Shows: Monte Hall
- Lecture 19 - Project Network and Analysis
- Lecture 20 - Newsvendor Problem: Background, Model and Analysis
- Lecture 21 - Newsvendor Problem: Example and Proof
- Lecture 22 - Buffers to Cushion for Fluctuations
- Lecture 23 - Safety Stock for Inventories
- Lecture 24 - Safety Stock: Example and Derivation
- Lecture 25 - Route Planning
- Lecture 26 - Exploration and Exploitation
- Lecture 27 - Introduction to sequential decision making
- Lecture 28 - Costs, Ratings, Options and Choices for both Restaurants
- Lecture 29 - Two Stage Stochastic Optimization
- Lecture 30 - Concluding Remarks and Simpson's Paradox
- Lecture 31 - Markov Chains for Decisions

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[Lecture 4 - Two Financial Statements \(Continued...\)](#)

[Lecture 5 - Two Financial Statements \(Continued...\)](#)

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[Lecture 7 - Three Financial Statements \(Continued...\)](#)

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[Lecture 9 - Transaction and Financial Statements](#)

[Lecture 10 - Transaction and Financial Statements \(Continued...\)](#)

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[Lecture 12 - Lone Pine Cafe \(Case\)](#)

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[Lecture 19 - Final Accounts](#)

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[Lecture 25 - Reading the Financial Statements of a Annual Report - 1](#)

[Lecture 26 - Reading the Financial Statements of a Annual Report - 2](#)

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[Lecture 29 - Financial Statement Analysis - 2](#)

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**NPTEL : NOC:Entrepreneurship (Management)**

**Co-ordinators : Prof. C Bhaktavatsala Rao**

- Lecture 1 - Entrepreneurial Journey - Part 1
- Lecture 2 - Entrepreneurial Journey - Part 2
- Lecture 3 - Entrepreneurial Journey - Part 3
- Lecture 4 - Entrepreneurial Discovery - Part 1
- Lecture 5 - Entrepreneurial Discovery - Part 2
- Lecture 6 - Entrepreneurial Discovery - Part 3
- Lecture 7 - Entrepreneurial Discovery - Part 4
- Lecture 8 - Ideation and Prototyping - Part 1
- Lecture 9 - Ideation and Prototyping - Part 2
- Lecture 10 - Ideation and Prototyping - Part 3
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- Lecture 12 - Ideation and Prototyping - Part 5
- Lecture 13 - Ideation and Prototyping - Part 6
- Lecture 14 - Testing and Validation - Part 1
- Lecture 15 - Testing and Validation - Part 2
- Lecture 16 - Commercialisation and Disruption as Success Drivers - Part 1
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- Lecture 18 - Commercialisation and Disruption as Success Drivers - Part 3
- Lecture 19 - Commercialisation and Disruption as Success Drivers - Part 4
- Lecture 20 - Commercialisation and Disruption as Success Drivers - Part 5
- Lecture 21 - Technological Innovation and Entrepreneurship - Part 1
- Lecture 22 - Technological Innovation and Entrepreneurship - Part 2
- Lecture 23 - Technological Innovation and Entrepreneurship - Part 3
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- Lecture 25 - Technological Innovation and Entrepreneurship - Part 5
- Lecture 26 - Technology, Business, and Operations Strategies - Part 1
- Lecture 27 - Technology, Business, and Operations Strategies - Part 2
- Lecture 28 - Technology, Business, and Operations Strategies - Part 3
- Lecture 29 - Technology, Business, and Operations Strategies - Part 4
- Lecture 30 - Technology, Business, and Operations Strategies - Part 5
- Lecture 31 - Raising Finances and Developing Financial Strategy - Part 1



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**Co-ordinators : Prof. Arshinder Kaur**

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- Lecture 28 - Negotiation supply management
- Lecture 29 - Planning for negotiation
- Lecture 30 - Negotiation strategy
- Lecture 31 - Negotiation strategy (Continued...)

[Lecture 32 - Supply Contracts](#)

[Lecture 33 - Types of supply contracts - 1](#)

[Lecture 34 - Types of supply contracts - 2](#)

[Lecture 35 - Supplier selection and evaluation - 1](#)

[Lecture 36 - Supplier selection and evaluation - 2](#)

[Lecture 37 - Supplier selection and evaluation - 3](#)

[Lecture 38 - Outsourcing decisions - 1](#)

[Lecture 39 - Outsourcing decisions - 2](#)

[Lecture 40 - TOPSIS](#)

[Lecture 41 - Goal Programming](#)

[Lecture 42 - Interpretive structural model - 1](#)

[Lecture 43 - Interpretive structural model - 2](#)

[Lecture 44 - Supply risk management](#)

[Lecture 45 - Risk management framework](#)

[Lecture 46 - Supply risk examples](#)

[Lecture 47 - Assessment of risk](#)

[Lecture 48 - Risk metrics](#)



**NPTEL : NOC:Financial Statement Analysis and Reporting (Management)**

**Co-ordinators : Prof. Anil K. Sharma**

Lecture 1 - Introduction

Lecture 2 - Accounting Process

Lecture 3 - Accounting Concepts

Lecture 4 - Trial Balance and its Relevance

Lecture 5 - Relevant Accounting Statements

Lecture 6 - Journal (Part-I) - The first and original book of accounting

Lecture 7 - Journal (Part-II) - The first and original book of accounting

Lecture 8 - Ledger-The second book of accounts

Lecture 9 - Financial Statements

Lecture 10 - Financial Statements - Income Statement

Lecture 11 - Financial Statements - Balance Sheet

Lecture 12 - Financial Statements with Adjustments (Part-1)

Lecture 13 - Financial Statements with Adjustments (Part-2)

Lecture 14 - Financial Statements with Adjustments (Part-3)

Lecture 15 - Financial Statements with Adjustments (Part-4)

Lecture 16 - Financial Statements with Adjustments (Part-5)

Lecture 17 - Financial Statements with Adjustments (Part-6)

Lecture 18 - Financial Statements with Adjustments (Part-7)

Lecture 19 - Financial Statements with Adjustments (Part-8)

Lecture 20 - Financial Statements with Adjustments (Part-9)

Lecture 21 - Financial Statements with Adjustments (Part-10)

Lecture 22 - Financial Statements with Adjustments (Part-11)

Lecture 23 - Financial Statements with Adjustments (Part-12)

Lecture 24 - Financial Statements with Adjustments (Part-13)

Lecture 25 - Corporate Financial Statements (Part-1)

Lecture 26 - Corporate Financial Statements (Part-2)

Lecture 27 - Corporate Financial Statements (Part-3)

Lecture 28 - Corporate Financial Statements (Part-4)

Lecture 29 - Corporate Financial Statements (Part-5)

Lecture 30 - Corporate Financial Statements (Part-6)

Lecture 31 - Corporate Financial Statements (Part-7)

- Lecture 32 - Corporate Financial Statements (Part-8)
- Lecture 33 - Corporate Financial Statements (Part-9)
- Lecture 34 - Financial Statement Analysis
- Lecture 35 - Ratio Analysis (Part-1)
- Lecture 36 - Ratio Analysis (Part-2)
- Lecture 37 - Ratio Analysis (Part-3)
- Lecture 38 - Different Sets of Ratios (Part-1)
- Lecture 39 - Different Sets of Ratios (Part-2)
- Lecture 40 - Ratio Analysis - A case of Grasim Industries (Part-1)
- Lecture 41 - Ratio Analysis - A case of Grasim Industries (Part-2)
- Lecture 42 - Liquidity Ratios - Grasim Industries (Part-1)
- Lecture 43 - Liquidity Ratios - Grasim Industries (Part-2)
- Lecture 44 - Liquidity Ratios - Grasim Industries (Part-3)
- Lecture 45 - Profitability Ratios- Grasim Industries (Part-1)
- Lecture 46 - Profitability Ratios- Grasim Industries (Part-2)
- Lecture 47 - Profitability Ratios- Grasim Industries (Part-3)
- Lecture 48 - DuPont Ratios (Part-1)
- Lecture 49 - DuPont Ratios (Part-2)
- Lecture 50 - Valuation or Capital Market Ratios (Part-1)
- Lecture 51 - Valuation or Capital Market Ratios (Part-2)
- Lecture 52 - Cash Flow Statement - Introduction (Part-1)
- Lecture 53 - Cash Flow Statement (Part-2)
- Lecture 54 - Preparation of Cash Flow Statement- Basic Cash Flow Statement
- Lecture 55 - Cash Flow Statement - Further Analysis (Part-1)
- Lecture 56 - Cash Flow Statement - Further Analysis (Part-2)
- Lecture 57 - Final Cash Flow Statement (Part-1)
- Lecture 58 - Final Cash Flow Statement (Part-2)
- Lecture 59 - Financial Reporting (Part-1)
- Lecture 60 - Financial Reporting (Part-2)

**NPTEL : NOC:Supply Chain Analytics (Management)**

**Co-ordinators : Prof. Rajat Agrawal**

- Lecture 1 - Introduction to Supply Chain Management
- Lecture 2 - Evolution of Supply Chain Management
- Lecture 3 - Analytics in Supply Chain Management
- Lecture 4 - Supply Chain Planning
- Lecture 5 - Different views of Supply Chain
- Lecture 6 - Supply Chain Strategy
- Lecture 7 - Supply Chain Drivers
- Lecture 8 - Developing Supply Chain Strategy
- Lecture 9 - Strategic Fit in Supply Chain
- Lecture 10 - Demand Forecasting in Supply Chain
- Lecture 11 - Bullwhip Effect and Time Series Analysis
- Lecture 12 - Exponential Smoothing Method of Forecasting
- Lecture 13 - Measures of Forecasting Errors
- Lecture 14 - Tracking Signal and Seasonality Models
- Lecture 15 - Forecasting using multiple characteristics in Demand Data and Inventory Management in Supply Chain
- Lecture 16 - Inventory Management in Supply Chain
- Lecture 17 - Multi echelon Inventory Management
- Lecture 18 - Multi echelon Inventory Management (Continued...)
- Lecture 19 - Multi echelon Inventory Management for four stations
- Lecture 20 - Multi echelon Inventory Management for four stations (Numerical Example)
- Lecture 21 - Multi echelon Inventory Management for four stations (Numerical Example) (Continued...)
- Lecture 22 - Network Design in Supply Chain
- Lecture 23 - Network Design of Global Supply Chain
- Lecture 24 - Alternative channels of Distribution
- Lecture 25 - Location Decisions in Supply Chain
- Lecture 26 - Network Optimization Models
- Lecture 27 - Using Excel Solver for Network Optimization
- Lecture 28 - Uncertainty in Network Design
- Lecture 29 - Network Design in Uncertain Environment and Flexibility
- Lecture 30 - Flexibility in Supply Chain
- Lecture 31 - Optimal Level of Product Availability in Supply chain

[Lecture 32 - Time Value of money in Supply Chain](#)

[Lecture 33 - Different types of Analytics in Supply Chain](#)

[Lecture 34 - Predictive Modelling in Forecasting in Supply Chain](#)

[Lecture 35 - Representation on Uncertainty in Supply Chain](#)

[Lecture 36 - Using Decision Tree for handling Uncertainty](#)

[Lecture 37 - Example of using Decision Tree incorporating Uncertainty in Single Factor](#)

[Lecture 38 - Example of using Decision Tree incorporating Uncertainty in two Key Factors](#)

[Lecture 39 - Modelling Flexibility in Supply Chain](#)

[Lecture 40 - Trends, Challenges and Future of Supply Chain](#)

Lecture 1 - Introduction to Marketing Research

Lecture 2 - Defining Research Problem

Lecture 3 - Developing Research Approach and Developing Research Design: Non- Conclusive

Lecture 4 - Research Design: Conclusive

Lecture 5 - Qualitative Research: Nature and Approaches

Lecture 6 - Qualitative Research: Depth Interview, Focus Group Discussion

Lecture 7 - Projective Technique, Case Study

Lecture 8 - Case Study, Descriptive Research Design and Research Errors

Lecture 9 - Primary and Secondary Data, Research Error

Lecture 10 - Measurement and Scaling: Comparative and Non-comparative Scaling

Lecture 11 - Scale Development Process

Lecture 12 - Questionnaire and Form Design

Lecture 13 - Causal Research and Types

Lecture 14 - Experimental Design and Sampling

Lecture 15 - Sampling Design and Procedure

Lecture 16 - Sampling and Sample Size Determination

Lecture 17 - Hypothesis Development: Null and Alternate, Type I and Type II Errors

Lecture 18 - Data Preparation

Lecture 19 - Hypothesis Testing: T-Test, Z-Test

Lecture 20 - T, Z and F Test

Lecture 21 - Hypothesis Testing: Anova and Manova

Lecture 22 - Cross Tabulation and Chi Square Test

Lecture 23 - Correlation and Regression

Lecture 24 - Regression

Lecture 25 - Factor Analysis

Lecture 26 - Factor Analysis

Lecture 27 - SEM and CFA - 1

Lecture 28 - SEM and CFA - 2

Lecture 29 - SEM and CFA - 3

Lecture 30 - Cluster Analysis - I

Lecture 31 - Cluster Analysis - II

[Lecture 32 - Discriminant Analysis](#)

[Lecture 33 - Discriminant Analysis - 1](#)

[Lecture 34 - Researching Rural Market](#)

[Lecture 35 - International Marketing Research](#)

[Lecture 36 - Ethics in Marketing Research](#)

[Lecture 37 - Ethics in Marketing Research - 1](#)

[Lecture 38 - Report Preparation and Presentation](#)

[Lecture 39 - Multi Dimensional Scaling](#)

[Lecture 40 - Conjoint Analysis](#)

Lecture 1 - Introduction of Project Management

Lecture 2 - Project Success

Lecture 3 - Types of Structure Organizations

Lecture 4 - Project Management Office

Lecture 5 - Stakeholders Management

Lecture 6 - Types of Projects and Project Life Cycle

Lecture 7 - Project Life Cycle Phases and Project Appraisal

Lecture 8 - Methods of Project Selection - I

Lecture 9 - Methods of Project Selection - II

Lecture 10 - Methods of Project Selection - MCDM-I

Lecture 11 - Methods of Project Selection - MCDM-II

Lecture 12 - Methods of Project Selection - MCDM-III

Lecture 13 - Market and Demand Analysis - I

Lecture 14 - Market and Demand Analysis - II

Lecture 15 - Financial Analysis

Lecture 16 - Capital Budgeting Techniques - I

Lecture 17 - Capital Budgeting Techniques - II

Lecture 18 - Financing of Projects

Lecture 19 - Risk Management - I

Lecture 20 - Risk Management - II

Lecture 21 - Risk Management (Control and Documentation)

Lecture 22 - Stand Alone Risk Analysis - I

Lecture 23 - Stand Alone Risk Analysis - II

Lecture 24 - Hillier Model

Lecture 25 - Simulation Analysis

Lecture 26 - Decision Tree Analysis - I

Lecture 27 - Decision Tree Analysis - II

Lecture 28 - Abandonment Analysis

Lecture 29 - Technical Analysis

Lecture 30 - Product Mix and Plant Capacity Analysis

Lecture 31 - Project Team Building, Conflict and Negotiation

- Lecture 32 - HRM Issues and time Management
- Lecture 33 - Project Time Management - Introduction
- Lecture 34 - Project Time Management - Project Scheduling
- Lecture 35 - Project time Management - Numbering of Nodes
- Lecture 36 - Project Time Management - PERT Networks
- Lecture 37 - Project Time Management - CPM
- Lecture 38 - Project Time Management - Laddering in PERT/CPM
- Lecture 39 - Probability Models in Networks - I
- Lecture 40 - Probability Models in Networks - II
- Lecture 41 - Probability Models in Networks - III
- Lecture 42 - Probability Models in Networks - IV
- Lecture 43 - Simulation of Networks - I
- Lecture 44 - Simulation of Networks - II
- Lecture 45 - Slacks and Floats - I
- Lecture 46 - Slacks and Floats - II
- Lecture 47 - Time and Cost Relationship
- Lecture 48 - Crashing of Networks - I
- Lecture 49 - Crashing of Networks - II
- Lecture 50 - Crashing of Networks - III (Free Float Method)
- Lecture 51 - Crashing of Networks - IV
- Lecture 52 - Introduction to Project Cost Management
- Lecture 53 - Cost Control (Tools and Techniques)
- Lecture 54 - Cost Estimation
- Lecture 55 - Introduction to Quality Management
- Lecture 56 - Cost of Quality
- Lecture 57 - Quality Management (Source of variability and Six Sigma)
- Lecture 58 - Quality Management (Six Sigma Tools)
- Lecture 59 - Procurement Management- I
- Lecture 60 - Procurement Management- II and Project Termination



Lecture 1 - Introduction

Lecture 2 - Data Mining Process

Lecture 3 - Introduction To R

Lecture 4 - Basic Statistics

Lecture 5 - Basic Statistics - Part 2

Lecture 6 - Partitioning Process

Lecture 7 - Visualization Techniques

Lecture 8 - Visualization Techniques - Part 2

Lecture 9 - Visualization Techniques - Part 3

Lecture 10 - Visualization Techniques - Part 4

Lecture 11 - Visualization Techniques - Part 5

Lecture 12 - Visualization Techniques - Part 6

Lecture 13 - Dimension Reduction Techniques

Lecture 14 - Dimension Reduction Techniques - Part 2

Lecture 15 - Dimension Reduction Techniques - Part 3

Lecture 16 - Performance Metrics

Lecture 17 - Performance Metrics - Part 2

Lecture 18 - Performance Metrics - Part 3

Lecture 19 - Performance Metrics - Part 4

Lecture 20 - Performance Metrics - Part 5

Lecture 21 - Prediction Performance

Lecture 22 - Multiple Linear Regression

Lecture 23 - Multiple Linear Regression - Part 2

Lecture 24 - Multiple Linear Regression - Part 3

Lecture 25 - Multiple Linear Regression - Part 4

Lecture 26 - Multiple Linear Regression - Part 5

Lecture 27 - Multiple Linear Regression - Part 6

Lecture 28 - Machine Learning Technique K-Nn

Lecture 29 - Machine Learning Technique K-Nn - Part 2

Lecture 30 - Machine Learning Technique K-Nn - Part 3

Lecture 31 - Naive Bayes

[Lecture 32 - Naive Bayes - Part 2](#)

[Lecture 33 - Naive Bayes - Part 3](#)

[Lecture 34 - Naive Bayes - Part 4](#)

[Lecture 35 - Naive Bayes - Part 5](#)

[Lecture 36 - Classification And Regression Trees](#)

[Lecture 37 - Classification And Regression Trees - Part 2](#)

[Lecture 38 - Classification And Regression Trees - Part 3](#)

[Lecture 39 - Classification And Regression Trees - Part 4](#)

[Lecture 40 - Classification And Regression Trees - Part 5](#)

[Lecture 41 - Classification And Regression Trees - Part 6](#)

[Lecture 42 - Pruning Process](#)

[Lecture 43 - Pruning Process - Part 2](#)

[Lecture 44 - Pruning Process - Part 3](#)

[Lecture 45 - Regression Trees](#)

[Lecture 46 - Logistic Regression](#)

[Lecture 47 - Logistic Regression - Part 2](#)

[Lecture 48 - Logistic Regression - Part 3](#)

[Lecture 49 - Logistic Regression - Part 4](#)

[Lecture 50 - Logistic Regression - Part 5](#)

[Lecture 51 - Logistic Regression - Part 6](#)

[Lecture 52 - Logistic Regression - Part 7](#)

[Lecture 53 - Artificial Neural Networks](#)

[Lecture 54 - Artificial Neural Network - Part 2](#)

[Lecture 55 - Artificial Neural Network - Part 3](#)

[Lecture 56 - Artificial Neural Network - Part 4](#)

[Lecture 57 - Artificial Neural Network - Part 5](#)

[Lecture 58 - Artificial Neural Network - Part 6](#)

[Lecture 59 - Discriminant Analysis](#)

[Lecture 60 - Discriminant Analysis - Part 2](#)

**NPTEL : NOC:Working Capital Management (Management)**

**Co-ordinators : Prof. Anil K. Sharma**

- Lecture 1 - Introduction - I
- Lecture 2 - Introduction - II
- Lecture 3 - Nature of the Working Capital Management
- Lecture 4 - Approaches of Working Capital Management - I
- Lecture 5 - Approaches of Working Capital Management - II
- Lecture 6 - Trade off between Profitability and Risk - I
- Lecture 7 - Trade off between Profitability and Risk - II
- Lecture 8 - Working Capital Management in Indian Business - I
- Lecture 9 - Working Capital Management in Indian Business - II
- Lecture 10 - Operating Cycle
- Lecture 11 - Weighted Operating Cycle
- Lecture 12 - Working Capital Requirement Assessment - I
- Lecture 13 - Working Capital Requirement Assessment - II
- Lecture 14 - Assessing Working Capital Requirements - Problem 2 and 5
- Lecture 15 - Working Capital Requirement- The Conclusion
- Lecture 16 - Working Capital Leverage
- Lecture 17 - Risk and Cost of Holding Inventory
- Lecture 18 - Inventory Costs
- Lecture 19 - Inventory Behaviour
- Lecture 20 - Inventory Management - Methods and Strategies
- Lecture 21 - EOQ Technique of Inventory Management
- Lecture 22 - Stockouts cause Walkouts
- Lecture 23 - Rationing of Working Capital - I
- Lecture 24 - Rationing of Working Capital - II
- Lecture 25 - Different Modes of Bank Finance
- Lecture 26 - Incremental Inventory - I
- Lecture 27 - Incremental Inventory - II
- Lecture 28 - Management of Accounts Receivables - I
- Lecture 29 - Management of Accounts Receivables - II
- Lecture 30 - Management of Accounts Receivables - III
- Lecture 31 - Motives of Credit Sale - I

- Lecture 32 - Motives of Credit Sale - II
- Lecture 33 - Limitations of Credit Time Period
- Lecture 34 - Written Credit Policy - I
- Lecture 35 - Written Credit Policy - II
- Lecture 36 - Goals and Functions of Accounts Receivables Management
- Lecture 37 - Valuation of Receivables at Cost or Sales Value
- Lecture 38 - Credit Policy Changes - I
- Lecture 39 - Credit Policy Changes - II
- Lecture 40 - Credit Policy Changes - III
- Lecture 41 - Optimum Credit Policy
- Lecture 42 - Credit Risk Analysis - I
- Lecture 43 - Credit Risk Analysis - II
- Lecture 44 - Credit Risk Analysis - III
- Lecture 45 - Credit Policy Variables
- Lecture 46 - Cash Management
- Lecture 47 - Cash Flow Presentation
- Lecture 48 - Models of Cash Management- Certainty Model by Baumol
- Lecture 49 - Certainty Model by Baumol Continued
- Lecture 50 - Uncertainty Model by Miller and Orr
- Lecture 51 - Miller and Orr (Continued...) and Cash Management Techniques
- Lecture 52 - Measures of Liquidity
- Lecture 53 - Window Dressing and Management of Current Liabilities
- Lecture 54 - Management of Accounts Payable
- Lecture 55 - Cost of Stretching Accounts Payable - I
- Lecture 56 - Cost of Stretching Accounts Payable - II
- Lecture 57 - Other Accruals and Overtrading
- Lecture 58 - Bank Finance - Introduction
- Lecture 59 - Recommendations of Tondon and Chore Committees
- Lecture 60 - Deciding a Suitable Mix

Lecture 1 - Analyzing the Current Business Scenario

Lecture 2 - Innovation and Creativity - An Introduction

Lecture 3 - Innovation in Current Environment

Lecture 4 - Types of Innovation

Lecture 5 - School of Innovation

Lecture 6 - Challenges of Innovation

Lecture 7 - Steps of Innovation Management

Lecture 8 - Idea Management System

Lecture 9 - Divergent v/s Convergent Thinking

Lecture 10 - Design Thinking and Entrepreneurship

Lecture 11 - Experimentation in Innovation Management

Lecture 12 - Idea Championship

Lecture 13 - Participation for Innovation

Lecture 14 - Co-creation for Innovation

Lecture 15 - Prototyping to Incubation

Lecture 16 - What is Business Model ?

Lecture 17 - Who is an Entrepreneur ?

Lecture 18 - Social Entrepreneurship ?

Lecture 19 - Blue Ocean Strategy - I

Lecture 20 - Blue Ocean Strategy - II

Lecture 21 - Marketing of Innovation

Lecture 22 - Technology Innovation Process

Lecture 23 - Technological Innovation Management Planning

Lecture 24 - Technological Innovation Management Strategies

Lecture 25 - Technology Forecasting

Lecture 26 - Sustainability Innovation and Entrepreneurship

Lecture 27 - Innovation Sustainable Conditions

Lecture 28 - Innovation: Context and Patterns

Lecture 29 - SMEs' strategic involvement in sustainable development

Lecture 30 - Insight and Entrepreneurship

Lecture 31 - Management of Innovation, creation of IPR - I

[Lecture 32 - Management of Innovation, creation of IPR - II](#)

[Lecture 33 - Types of IPR](#)

[Lecture 34 - Patents and Copyrights](#)

[Lecture 35 - Patents in India](#)

[Lecture 36 - Business Models and value proposition](#)

[Lecture 37 - Business Model Failure: Reasons and Remedies](#)

[Lecture 38 - Incubators: Business Vs Technology](#)

[Lecture 39 - Managing Investors for Innovation](#)

[Lecture 40 - Future markets and Innovation needs for India](#)

[Lecture 1 - Association Rules - Part I](#)

[Lecture 2 - Association Rules - Part II](#)

[Lecture 3 - Association Rules - Part III](#)

[Lecture 4 - Association Rules - Part IV](#)

[Lecture 5 - Cluster Analysis - Part I](#)

[Lecture 6 - Cluster Analysis - Part II](#)

[Lecture 7 - Cluster Analysis - Part III](#)

[Lecture 8 - Cluster Analysis - Part IV](#)

[Lecture 9 - Cluster Analysis - Part V](#)

[Lecture 10 - Cluster Analysis - Part VI](#)

[Lecture 11 - Cluster Analysis - Part VII](#)

[Lecture 12 - Understanding Time Series - Part I](#)

[Lecture 13 - Understanding Time Series - Part II](#)

[Lecture 14 - Understanding Time Series - Part III](#)

[Lecture 15 - Understanding Time Series - Part IV](#)

[Lecture 16 - Regression Based Forecasting Methods - Part I](#)

[Lecture 17 - Regression Based Forecasting Methods - Part II](#)

[Lecture 18 - Regression Based Forecasting Methods - Part III](#)

[Lecture 19 - Time Series Forecasting - Smoothing Methods - Part I](#)

[Lecture 20 - Time Series Forecasting - Smoothing Methods - Part II](#)

Lecture 1 - Globalization - Part 1

Lecture 2 - Globalization - Part 2

Lecture 3 - Global Economic Environment - Part 1

Lecture 4 - Global Economic Environment - Part 2

Lecture 5 - Global Economic Environment - Part 3

Lecture 6 - Financial Environment - Part 1

Lecture 7 - Financial Environment - Part 2

Lecture 8 - Cultural Issues and Buying Behavior - Part 1

Lecture 9 - Cultural Issues and Buying Behavior - Part 2

Lecture 10 - Political/ Legal Environment - Part 1

Lecture 11 - Political/ Legal Environment - Part 2

Lecture 12 - Global Marketing Research - Part 1

Lecture 13 - Global Marketing Research - Part 2

Lecture 14 - Global Segmentation and Positioning - Part 1

Lecture 15 - Global Segmentation and Positioning - Part 2

Lecture 16 - Global Marketing Strategies - Part 1

Lecture 17 - Global Marketing Strategies - Part 2

Lecture 18 - Global Market Entry Modes - Part 1

Lecture 19 - Global Market Entry Modes - Part 2

Lecture 20 - Global Product Development - Part 1

Lecture 21 - Global Product Development - Part 2

Lecture 22 - Marketing Products and Services - Part 1

Lecture 23 - Marketing Products and Services - Part 2

Lecture 24 - Global Pricing - Part 1

Lecture 25 - Global Pricing - Part 2

Lecture 26 - Communicating with the World Consumer - Part 1

Lecture 27 - Communicating with the World Consumer - Part 2

Lecture 28 - Sales Management - Part 1

Lecture 29 - Sales Management - Part 2

Lecture 30 - Global Logistics and Distribution - Part 1

Lecture 31 - Global Logistics and Distribution - Part 2



[Lecture 32 - Export/Import Management - Part 1](#)

[Lecture 33 - Export/Import Management - Part 2](#)

[Lecture 34 - Export/Import Management - Part 3](#)

[Lecture 35 - Planning, Organization and Control of Global Marketing Operations - Part 1](#)

[Lecture 36 - Planning, Organization and Control of Global Marketing Operations - Part 2](#)

[Lecture 37 - Marketing in Emerging Markets - Part 1](#)

[Lecture 38 - Marketing in Emerging Markets - Part 2](#)

[Lecture 39 - Global Marketing and the Internet - Part 1](#)

[Lecture 40 - Global Marketing and the Internet - Part 2](#)

Lecture 1 - Introduction to Marketing Research - I

Lecture 2 - Introduction to Marketing Research - II

Lecture 3 - Marketing Research Process - I

Lecture 4 - Marketing Research Process - II

Lecture 5 - Marketing Research Process - III

Lecture 6 - Marketing Research Process - IV

Lecture 7 - Hypothesis and Research Question - I (with real life example)

Lecture 8 - Hypothesis and Research Question - II (with real life example)

Lecture 9 - Hypothesis Development - I (with a real life case)

Lecture 10 - Hypothesis Development - II (with a real life case)

Lecture 11 - Research Design - I

Lecture 12 - Research Design - II

Lecture 13 - Research Design - III

Lecture 14 - Research Design - IV

Lecture 15 - Research Design - V

Lecture 16 - Research Design - VI

Lecture 17 - Data Purification and handling - I

Lecture 18 - Data Purification and handling - II

Lecture 19 - Data Purification and handling - III

Lecture 20 - Data Purification and handling - IV

Lecture 21 - Power of a Test and Sample Size Calculation (Problem Solving)

Lecture 22 - Sample Size Calculation and Hypothesis Testing (Problem Solving)

Lecture 23 - Hypothesis Testing - I (Problem Solving)

Lecture 24 - Hypothesis Testing - II (Problem Solving)

Lecture 25 - Non-Parametric Test - I

Lecture 26 - Non-Parametric Test - II

Lecture 27 - Non-Parametric Test - III

Lecture 28 - Non-Parametric Test - IV

Lecture 29 - Non-Parametric Test - V

Lecture 30 - Non-Parametric Test - VI

Lecture 31 - Non-Parametric Test - VII

- Lecture 32 - Non-Parametric Test - VIII
- Lecture 33 - Introduction to ANOVA and ANCOVA
- Lecture 34 - Conducting one-way ANOVA
- Lecture 35 - Solving n-way ANOVA - I
- Lecture 36 - Solving n-way ANOVA - II
- Lecture 37 - N-way ANOVA and MANOVA in SPSS
- Lecture 38 - MANOVA and ANCOVA in SPSS
- Lecture 39 - ANCOVA in SPSS
- Lecture 40 - ANCOVA and MANCOVA in SPSS
- Lecture 41 - Covariance and Correlation
- Lecture 42 - Correlation in SPSS
- Lecture 43 - Partial and Multiple Correlation
- Lecture 44 - Simple Regression Analysis in SPSS
- Lecture 45 - Multiple Regression Analysis in SPSS - I
- Lecture 46 - Multiple Regression Analysis in SPSS - II
- Lecture 47 - Stepwise Regression and Hierarchical Regression
- Lecture 48 - Hierarchical Regression and Dummy Variable Regression
- Lecture 49 - Logistic Regression Analysis
- Lecture 50 - Discriminant Analysis in SPSS
- Lecture 51 - Factor Analysis in SPSS - I
- Lecture 52 - Factor Analysis in SPSS - II
- Lecture 53 - Exploratory Factor Analysis in SPSS
- Lecture 54 - Confirmatory Factor Analysis in SPSS - I
- Lecture 55 - Confirmatory Factor Analysis in SPSS - II
- Lecture 56 - Confirmatory Factor Analysis in SPSS - III
- Lecture 57 - Structural Equation Modelling in SPSS
- Lecture 58 - Mediation and Moderation Analysis in SPSS
- Lecture 59 - Cluster Analysis in Practice - I
- Lecture 60 - Cluster Analysis in Practice - II

Lecture 1 - Introduction to Statistics and Data

Lecture 2 - Types of Statistics, types of Data and sources of Data, Population vs Sample

Lecture 3 - Scales of Measurement

Lecture 4 - Data representation techniques - Part 1

Lecture 5 - Data representation techniques - Part 2 and measures of central tendency - Part 1

Lecture 6 - Measures of Central Tendency - Part 2

Lecture 7 - Examples of introduction to data and data representation techniques

Lecture 8 - Measures of Variation

Lecture 9 - Applications of Measures of Central Tendency and Measures of Variation

Lecture 10 - Chapter concepts- Measures of central tendency and measures of variation, Outliers, and shape of a distribution

Lecture 11 - Numerical Descriptive Measures

Lecture 12 - Covariance and Coefficient of Correlation, Introduction to Probability

Lecture 13 - Probability - Part 1

Lecture 14 - Probability - Part 2

Lecture 15 - Probability - Part 3

Lecture 16 - Probability Distributions - Part 1

Lecture 17 - Probability Distributions - Part 2

Lecture 18 - Probability Distributions - Part 3

Lecture 19 - Examples for Standardized Normal Distribution

Lecture 20 - Evaluating Normality, Exponential Probability Distribution

Lecture 21 - Chapter Concepts - Probability Distributions

Lecture 22 - Sampling and Sampling Techniques

Lecture 23 - Sampling Distribution - I

Lecture 24 - Sampling Distribution - II

Lecture 25 - Sampling Distribution - III

Lecture 26 - Method of Estimation

Lecture 27 - Interval Estimation

Lecture 28 - Confidence Interval - I

Lecture 29 - Confidence Interval - II

Lecture 30 - Types of Hypothesis Testing

Lecture 31 - Hypothesis Testing Process - I

- Lecture 32 - Hypothesis Testing Process - II
- Lecture 33 - Hypothesis Testing Examples
- Lecture 34 - Hypothesis Testing of Proportions - I
- Lecture 35 - Hypothesis Testing of Proportions - II
- Lecture 36 - Hypothesis Testing-One sample Test
- Lecture 37 - Hypothesis Testing using Minitab
- Lecture 38 - Hypothesis Testing of Proportions using Minitab
- Lecture 39 - Hypothesis Testing Two Sample Test - I
- Lecture 40 - Hypothesis Testing Two Sample Test - II
- Lecture 41 - Hypothesis Testing Two sample Test - III
- Lecture 42 - Paired Sample Test
- Lecture 43 - Hypothesis Testing of Proportion
- Lecture 44 - Example of Hypothesis Testing
- Lecture 45 - Design of Experiment
- Lecture 46 - Analysis of variance - I
- Lecture 47 - Analysis of variance - II
- Lecture 48 - Analysis of variance - III
- Lecture 49 - Tukey Kramer test
- Lecture 50 - Randomized Blocked Design
- Lecture 51 - A Factorial Design - I
- Lecture 52 - A Factorial Design - II
- Lecture 53 - Chi-square test goodness of fit - I
- Lecture 54 - Chi-square test goodness of fit - II
- Lecture 55 - Chi-square test of independence
- Lecture 56 - Simple linear regression - I
- Lecture 57 - Simple linear regression - II
- Lecture 58 - Assumption of Regression
- Lecture 59 - Multiple Regression
- Lecture 60 - Example of multiple Regression

Lecture 1 - Introduction to MCDM Techniques - Part I

Lecture 2 - Introduction to MCDM Techniques - Part II

Lecture 3 - Introduction to MCDM Techniques - Part III

Lecture 4 - Analytic Hierarchy Process (AHP) - Part I

Lecture 5 - Analytic Hierarchy Process (AHP) - Part II

Lecture 6 - Analytic Hierarchy Process (AHP) - Part III

Lecture 7 - Analytic Hierarchy Process (AHP) - Part IV

Lecture 8 - ELECTRE - Part I

Lecture 9 - ELECTRE - Part II

Lecture 10 - ELECTRE - Part III

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**Co-ordinators : Dr. Jogendra Kumar Nayak**

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- Lecture 39 - Trade Promotion, Foreign Trade Regulations in India, Exporting, Stages, Difficulties
- Lecture 40 - Export-Import Plan, Foreign Trade Promotion Measures, Schemes, Trade Regulations
- Lecture 41 - Trade Promotions, Institution Involved in Export Finance, Foreign Trade Organisations
- Lecture 42 - Foreign Trade Organizations, PNB Scam
- Lecture 43 - Bretton Woods Agreement, IMF, Its Role and Function
- Lecture 44 - World Bank
- Lecture 45 - WTO, GATT, Origin and Functions, MFN Principles, Agreements
- Lecture 46 - Uruguay Round Agreement on Agriculture, GATS
- Lecture 47 - TRIMS, TRIPS, Patents, Copyrights
- Lecture 48 - Multifiber Agreement, Agreement on Textiles and Clothing, UNCTAD, GSP, GSTP
- Lecture 49 - Regional Economic Integration
- Lecture 50 - Regionalism, Multilateralism, NAFTA, EU, EURO
- Lecture 51 - International Marketing, Segmentation, Positioning
- Lecture 52 - Product Strategies, Product Adaptations, Pricing, Communication, Logistics
- Lecture 53 - Global Firms Success Strategies
- Lecture 54 - Marketing Orientations, Market Research
- Lecture 55 - Estimating Market Demand, Pitfalls in Research
- Lecture 56 - Survey Methods For International Research
- Lecture 57 - Supply Chain Management, Global Production and Distribution, Manufacturing Strategy
- Lecture 58 - Global Sourcing, Distribution System, Role Of Interest
- Lecture 59 - International HRM
- Lecture 60 - Recruitment and Training in International HRM

Lecture 1 - Setting The Scene

Lecture 2 - Introduction to the Path Integral

Lecture 3 - Probability Fundamentals, Generating Functions

Lecture 4 - Generating Functions, Gaussian Distribution

Lecture 5 - Gaussian Distribution, Gaussian Integration

Lecture 6 - Gaussian Integration, Central Limit Theorem

Lecture 7 - Elementary Theory of Stochastic Processes

Lecture 8 - Evolutionary Equations of Stochastic Processes

Lecture 9 - Brownian Motion

Lecture 10 - Diffusion Equation

Lecture 11 - Diffusion Equation Path Integral - 1

Lecture 12 - Diffusion Equation Path Integral - 2, Autocorrelators

Lecture 13 - Schrodinger Equation Path Integral, Langevin Equation

Lecture 14 - Langevin- Equation

Lecture 15 - Statistical Formalism of Path Integral

Lecture 16 - Langevin Equation Path Integral - 1

Lecture 17 - Langevin Equation Path Integral - 2

Lecture 18 - Langevin and Fokker Planck Equation; CLT Example

Lecture 19 - Basic Machinery of Quantum Mechanics

Lecture 20 - Quantum Mechanical Path Integral

Lecture 21 - Harmonic Oscillator Path Integral

Lecture 22 - Free Particle Path Integral

Lecture 23 - Equivalence of Schrodinger and Path Integral Formalisms, Matrix Elements of Operators

Lecture 24 - Ground State Expectation Values

Lecture 25 - Vacuum Persistence Amplitude

Lecture 26 - Harmonic Oscillator 2-Point Problem

Lecture 27 - Relativistic Path Integral

Lecture 28 - Interpretation of Path Integral

Lecture 29 - Need For Quantum Field Theory

Lecture 30 - Quantum Field Theory, Introduction

Lecture 31 - Field Theory Basics

- Lecture 32 - Field Theory In Zero Dimensions - 1
- Lecture 33 - Field Theory In Zero Dimensions - 2
- Lecture 34 - Schwinger Dyson Eqs, Convergence Of Integrals
- Lecture 35 - Sde, Feynman Diagrams
- Lecture 36 - Feynman Diagrams and Sde
- Lecture 37 - Effective Action, Renormalization
- Lecture 38 - Renormalization In 0-d
- Lecture 39 - Field Theory In 1-D - 1
- Lecture 40 - Field Theory in 1-d - 2
- Lecture 41 - Euclidean Field Theory - 1
- Lecture 42 - Euclidean Field Theory - 2
- Lecture 43 - Euclidean Field Theory - 3
- Lecture 44 - Field Theory In Minkowski Space
- Lecture 45 - Propagator In Minkowski Space
- Lecture 46 - Propagator Properties In Minkowski Space
- Lecture 47 - Interactive Field Theory In Minkowski Space
- Lecture 48 - Causality, Sde In Minkowski Space
- Lecture 49 - Sde For Field Theory In Minkowski Space
- Lecture 50 - Spinor Fields Path Integral
- Lecture 51 - Gauge Fields - 1
- Lecture 52 - Gauge Fields - 2
- Lecture 53 - Ito Equation, Stock Price Modelling
- Lecture 54 - Financial Derivatives
- Lecture 55 - Properties Of Options
- Lecture 56 - Pricing Of Options: Binomial Model - 1
- Lecture 57 - Pricing Of Options: Binomial Model - 2
- Lecture 58 - Black Scholes Model
- Lecture 59 - Path Integral Solution Of Black Scholes Pde
- Lecture 60 - Misc Financial Applications Of Path Integrals

**NPTEL : NOC:Introduction to Marketing Essentials (Management)**

**Co-ordinators : Prof. Zillur Rahman**

- Lecture 1 - Creating Customer Relationships and Value through Marketing - 1
- Lecture 2 - Creating Customer Relationships and Value through Marketing - 2
- Lecture 3 - The new realities of marketing
- Lecture 4 - Developing Successful Marketing and Organizational Strategies - 1
- Lecture 5 - Developing Successful Marketing and Organizational Strategies - 2
- Lecture 6 - Organizing and managing marketing department
- Lecture 7 - Developing marketing strategy
- Lecture 8 - Understanding the Marketing Environment, Ethical Behavior, and Social Responsibility - 1
- Lecture 9 - Understanding the Marketing Environment, Ethical Behavior, and Social Responsibility - 2
- Lecture 10 - Understanding Consumer Behavior - 1
- Lecture 11 - Understanding Consumer Behavior - 2
- Lecture 12 - Understanding Consumer Behavior - 3
- Lecture 13 - Understanding Organizations as Customers - 1
- Lecture 14 - Understanding Organizations as Customers - 2
- Lecture 15 - Understanding Organizations as Customers - 3
- Lecture 16 - Understanding and Reaching Global Consumers and Markets - 1
- Lecture 17 - Understanding and Reaching Global Consumers and Markets - 2
- Lecture 18 - Understanding and Reaching Global Consumers and Markets - 3
- Lecture 19 - Marketing Research: From Customer Insights to Actions - 1
- Lecture 20 - Marketing Research: From Customer Insights to Actions - 2
- Lecture 21 - Market Segmentation, Targeting, and Positioning - 1
- Lecture 22 - Market Segmentation, Targeting, and Positioning - 2
- Lecture 23 - Market Segmentation, Targeting, and Positioning - 3
- Lecture 24 - Crafting customer value proposition, sustainable competitive advantage and positioning - 1
- Lecture 25 - Crafting customer value proposition, sustainable competitive advantage and positioning - 2
- Lecture 26 - Developing New Products and Services - 1
- Lecture 27 - Developing New Products and Services - 2
- Lecture 28 - Developing New Products and Services - 3
- Lecture 29 - Developing New Products and Services - 4
- Lecture 30 - Developing New Products and Services - 5
- Lecture 31 - Developing New Products and Services - 6

- Lecture 32 - Developing New Products and Services - 7
- Lecture 33 - Managing Successful Products, Services, and Brands - 1
- Lecture 34 - Managing Successful Products, Services, and Brands - 2
- Lecture 35 - Managing Successful Products, Services, and Brands - 3
- Lecture 36 - Managing Successful Products, Services, and Brands - 4
- Lecture 37 - Managing Successful Products, Services, and Brands - 5
- Lecture 38 - Pricing Products and Services - 1
- Lecture 39 - Pricing Products and Services - 2
- Lecture 40 - Pricing Products and Services - 3
- Lecture 41 - Managing Marketing Channels and Supply Chains - 1
- Lecture 42 - Managing Marketing Channels and Supply Chains - 2
- Lecture 43 - Retailing and Wholesaling - 1
- Lecture 44 - Retailing and Wholesaling - 2
- Lecture 45 - Retailing and Wholesaling - 3
- Lecture 46 - Integrated Marketing Communications and Direct Marketing - 1
- Lecture 47 - Integrated Marketing Communications and Direct Marketing - 2
- Lecture 48 - Advertising, Sales Promotion, and Public Relations - 1
- Lecture 49 - Advertising, Sales Promotion, and Public Relations - 2
- Lecture 50 - Using Social Media to Connect with Consumers - 1
- Lecture 51 - Using Social Media to Connect with Consumers - 2
- Lecture 52 - Personal Selling and Sales Management - 1
- Lecture 53 - Personal Selling and Sales Management - 2
- Lecture 54 - Implementing Interactive and Multichannel Marketing - 1
- Lecture 55 - Implementing Interactive and Multichannel Marketing - 2
- Lecture 56 - Addressing Competition And Driving Growth - 1
- Lecture 57 - Addressing Competition And Driving Growth - 2
- Lecture 58 - Building Customer Loyalty - 1
- Lecture 59 - Building Customer Loyalty - 2
- Lecture 60 - Socially Responsible Marketing



Lecture 1 - Introduction to Management - I

Lecture 2 - Introduction to Management - II

Lecture 3 - Introduction to Management - III

Lecture 4 - Introduction to Management - IV

Lecture 5 - Evolution of Management - I

Lecture 6 - Evolution of Management - II

Lecture 7 - Evolution of Management - III

Lecture 8 - Evolution of Management - IV

Lecture 9 - Planning - I

Lecture 10 - Planning - II

Lecture 11 - Planning - III

Lecture 12 - Planning - IV

Lecture 13 - Planning - V

Lecture 14 - Forecasting and Premising - I

Lecture 15 - Forecasting and Premising - II

Lecture 16 - Forecasting and Premising - III

Lecture 17 - Forecasting and Premising - IV

Lecture 18 - Decision Making - I

Lecture 19 - Decision Making - II

Lecture 20 - Decision Making - III

Lecture 21 - Decision Making - IV

Lecture 22 - Decision Making - V

Lecture 23 - Management by Objectives - I

Lecture 24 - Management by Objectives - II

Lecture 25 - Management by Objectives - III

Lecture 26 - Styles of Management - I

Lecture 27 - Styles of Management - II

Lecture 28 - Styles of Management - III

Lecture 29 - Organizing and Directing - I

Lecture 30 - Organizing and Directing - II

Lecture 31 - Organizing and Directing - III

Lecture 32 - Organizing and Directing - IV  
Lecture 33 - Organizing and Directing - V  
Lecture 34 - Staffing and Coordination - I  
Lecture 35 - Staffing and Coordination - II  
Lecture 36 - Staffing and Coordination - III  
Lecture 37 - Staffing and Coordination - IV  
Lecture 38 - Staffing and Coordination - V  
Lecture 39 - Staffing and Coordination - VI  
Lecture 40 - Staffing and Coordination - VII  
Lecture 41 - Staffing and Coordination - VIII  
Lecture 42 - Career Development Strategy - I  
Lecture 43 - Career Development Strategy - II  
Lecture 44 - Career Development Strategy - III  
Lecture 45 - Career Development Strategy - IV  
Lecture 46 - Career Development Strategy - V  
Lecture 47 - Leadership Styles of Managers - I  
Lecture 48 - Leadership Styles of Managers - II  
Lecture 49 - Leadership Styles of Managers - III  
Lecture 50 - Leadership Styles of Managers - IV  
Lecture 51 - Organizational Communication - I  
Lecture 52 - Organizational Communication - II  
Lecture 53 - Organizational Communication - III  
Lecture 54 - Organizational Communication - IV  
Lecture 55 - Organizational Communication - V  
Lecture 56 - Change Management - I  
Lecture 57 - Change Management - II  
Lecture 58 - Change Management - III  
Lecture 59 - Change Management - IV  
Lecture 60 - Change Management - V  
Lecture 61 - Change Management - VI  
Lecture 62 - Change Management - VII

Lecture 1 - An Overview - Part 1

Lecture 2 - An Overview - Part 2

Lecture 3 - The Evolution of Organization Theory - Part 1

Lecture 4 - The Evolution of Organization Theory - Part 2

Lecture 5 - Organizational Effectiveness - Part 1

Lecture 6 - Organizational Effectiveness - Part 2

Lecture 7 - Organizational Effectiveness - Part 3

Lecture 8 - Dimensions of Organization Structure - Part 1

Lecture 9 - Dimensions of Organization Structure - Part 2

Lecture 10 - Dimensions of Organization Structure - Part 3

Lecture 11 - Strategy - Part 1

Lecture 12 - Strategy - Part 2

Lecture 13 - Strategy - Part 3

Lecture 14 - Organization Size - Part 1

Lecture 15 - Organization Size - Part 2

Lecture 16 - Technology - Part 1

Lecture 17 - Technology - Part 2

Lecture 18 - Environment - Part 1

Lecture 19 - Environment - Part 2

Lecture 20 - Environment - Part 3

Lecture 21 - Power Control - Part 1

Lecture 22 - Power Control - Part 2

Lecture 23 - Power Control - Part 3

Lecture 24 - Organizational Design Options - Part 1

Lecture 25 - Organizational Design Options - Part 2

Lecture 26 - Organizational Design Options - Part 3

Lecture 27 - Bureaucracy - Part 1

Lecture 28 - Bureaucracy - Part 2

Lecture 29 - Adhocracy - Part 1

Lecture 30 - Adhocracy - Part 2

Lecture 31 - Managing the Environment - Part 1

[Lecture 32 - Managing the Environment - Part 2](#)

[Lecture 33 - Managing Organizational Change - Part 1](#)

[Lecture 34 - Managing Organizational Change - Part 2](#)

[Lecture 35 - Managing Organizational Conflict - Part 1](#)

[Lecture 36 - Managing Organizational Conflict - Part 2](#)

[Lecture 37 - Managing Organizational Culture - Part 1](#)

[Lecture 38 - Managing Organizational Culture - Part 2](#)

[Lecture 39 - Managing Organizational Evolution - Part 1](#)

[Lecture 40 - Managing Organizational Evolution - Part 2](#)

**NPTEL : NOC:Talent Acquisition and Management (Management)**

**Co-ordinators : Prof. S. Rangnekar**

Lecture 1 - Introduction to Talent Acquisition and Management - I

Lecture 2 - Introduction to talent Acquisition and Management - II

Lecture 3 - Introduction to Talent Acquisition and Management - III

Lecture 4 - Introduction to Talent Acquisition and Management - IV

Lecture 5 - Nurturing the Leaders of Tomorrow

Lecture 6 - Talent Acquisition

Lecture 7 - Talent Acquisition Practices - Infosys

Lecture 8 - Talent Acquisition Practices - IBM

Lecture 9 - Talent Acquisition and Attracting Talent at Fedex

Lecture 10 - Talent Acquisition and Attracting Talent at Google

Lecture 11 - Introduction of Psychometric Test

Lecture 12 - Six principles of Talent Management

Lecture 13 - Employee Engagement

Lecture 14 - Employer Brand

Lecture 15 - Employee Retention

Lecture 16 - The Zinger Model of Employee Engagement

Lecture 17 - Integrating Competencies into Talent Process

Lecture 18 - Integrated Talent Management

Lecture 19 - Global Talent Management - Drivers-I

Lecture 20 - Global Talent Management - Drivers-II

Lecture 21 - Global Leadership Competencies - I

Lecture 22 - Global Leadership Competencies - II

Lecture 23 - Global Leadership Competencies - III

Lecture 24 - Global Leadership Competencies - IV

Lecture 25 - Talent Analytics

Lecture 26 - Talent Management Challenges - In the near Future

Lecture 27 - Talent Development

Lecture 28 - Talent Enhancement

Lecture 29 - Talent Mobility

Lecture 30 - Rewards Programs in Talent Management

Lecture 31 - Integrated Talent Management Models - I

- Lecture 32 - Integrated Talent Management Models - II
- Lecture 33 - Rewards Strategy for Talent Management - I
- Lecture 34 - Rewards Strategy for Talent Management - II
- Lecture 35 - Coaching and Development
- Lecture 36 - Talent Development - I
- Lecture 37 - Talent Development - II
- Lecture 38 - Talent Development - III
- Lecture 39 - Meta Analysis and Talent Analytics - I
- Lecture 40 - Meta Analysis and Talent Analytics - II
- Lecture 41 - Organization Culture - I
- Lecture 42 - Organization Culture - II
- Lecture 43 - Organization Culture - III
- Lecture 44 - Coaching with Compassion - I
- Lecture 45 - Coaching with Compassion - II
- Lecture 46 - Talent Success Drivers
- Lecture 47 - Talent Acquisition Strategy - I
- Lecture 48 - Talent Acquisition Strategy - II
- Lecture 49 - Talent Management at PepsiCo - I
- Lecture 50 - Talent Management at PepsiCo - II
- Lecture 51 - Automated Screening - Talent Analytics
- Lecture 52 - Big Data - Talent Analytics
- Lecture 53 - Management in the New Economy
- Lecture 54 - Employment to Consultation
- Lecture 55 - Embedding and Sustaining Talent Power
- Lecture 56 - Talent Enhancement and Drivers of Success
- Lecture 57 - Building Sustainable Talent through Talent Management
- Lecture 58 - Talent Powered Organization
- Lecture 59 - Critical issues in Talent Management
- Lecture 60 - Feeling and Sentiments Analysis

Lecture 1 - An Overview

Lecture 2 - Formulation of Econometric Modelling

Lecture 3 - Review of Basic Concepts - I

Lecture 4 - Review of Basic Concepts - II

Lecture 5 - Types of Data

Lecture 6 - Simple Regression - I

Lecture 7 - Simple Regression - II

Lecture 8 - Assumptions of Classical Linear Regression

Lecture 9 - Properties of OLS Estimators

Lecture 10 - Hypothesis Testing

Lecture 11 - Multiple Regression - I

Lecture 12 - Multiple Regression - II

Lecture 13 - Multiple Regression - III

Lecture 14 - Problem of Multicollinearity

Lecture 15 - Omitted Variables and Parameter Stability - I

Lecture 16 - Omitted Variables and Parameter Stability - II

Lecture 17 - Problem of Heteroscedasticity - I

Lecture 18 - Problem of Heteroscedasticity - II

Lecture 19 - T- Test

Lecture 20 - Wald Test

Lecture 21 - F-test - I

Lecture 22 - F-Test - II

Lecture 23 - Chow Test

Lecture 24 - Problem of Serial Correlation - I

Lecture 25 - Problem of Serial Correlation - II

Lecture 26 - AR, MA and ARMA Processes - I

Lecture 27 - AR, MA and ARMA Processes - II

Lecture 28 - Modelling Trend and Seasonal Variations - I

Lecture 29 - Modelling Trend and Seasonal Variations - II

Lecture 30 - Spline function and Categorical Variables

Lecture 31 - Linear Probability Model

[Lecture 32 - Probit and Logit Models](#)

[Lecture 33 - Tobit and Multinomial Logit Models](#)

[Lecture 34 - Panel Data Methods](#)

[Lecture 35 - Simultaneous Equations System - I](#)

[Lecture 36 - Simultaneous Equations System - II](#)

[Lecture 37 - Introduction to VARs](#)

[Lecture 38 - Stationarity and Unit Root Testing - I](#)

[Lecture 39 - Stationarity and Unit Root Testing - II](#)

[Lecture 40 - Basics of Cointegration](#)



- Lecture 1 - Overview and Introduction
- Lecture 2 - Introduction (Debt and Equity)
- Lecture 3 - Introduction (Derivatives I)
- Lecture 4 - Introduction (Derivatives II)
- Lecture 5 - Financial Risk
- Lecture 6 - Risk and Arbitrage - I
- Lecture 7 - Risk and Arbitrage - II
- Lecture 8 - Arbitrage Theorems, EMH, Money Markets
- Lecture 9 - Money Market Instruments, Bond Terminology
- Lecture 10 - Intrinsic Value of Bonds
- Lecture 11 - Yield to Maturity - I
- Lecture 12 - Yield to Maturity - II
- Lecture 13 - Yield to Maturity - III
- Lecture 14 - Yield to Maturity - IV
- Lecture 15 - Yield to Maturity - V
- Lecture 16 - Holding Period Yield etc.
- Lecture 17 - Clean and Dirty Price, Interest Rate Risk - I
- Lecture 18 - Interest Rate Risk - II
- Lecture 19 - Interest Rate Risk - III
- Lecture 20 - Immunization
- Lecture 21 - Immunization Example
- Lecture 22 - Price Sensitivities, Key Rates
- Lecture 23 - Term Structure of Interest Rates
- Lecture 24 - Yield Spreads, Equity Valuation - I
- Lecture 25 - Equity Valuation - II
- Lecture 26 - Equity Valuation - III
- Lecture 27 - Equity Valuation - IV
- Lecture 28 - Equity Valuation - V
- Lecture 29 - Equity Valuation - VI
- Lecture 30 - Equity Valuation - VII
- Lecture 31 - Equity Valuation - VIII

- Lecture 32 - Equity Valuation - IX
- Lecture 33 - Fundamental Analysis
- Lecture 34 - Balance Sheet Analysis - I
- Lecture 35 - Balance Sheet Analysis - II
- Lecture 36 - Balance Sheet Analysis - III
- Lecture 37 - Balance Sheet Analysis - IV
- Lecture 38 - Balance Sheet Analysis - V
- Lecture 39 - Balance Sheet Analysis - VI
- Lecture 40 - Income Statement, Cash Flow Statement, Ratio Analysis
- Lecture 41 - Mean Variance Portfolio Optimization - I
- Lecture 42 - Mean Variance Portfolio Optimization - II
- Lecture 43 - Mean Variance Portfolio Optimization - III
- Lecture 44 - Mean Variance Portfolio Optimization - IV
- Lecture 45 - Mean Variance Portfolio Optimization - V
- Lecture 46 - Mean Variance Portfolio Optimization - VI
- Lecture 47 - Mean Variance Portfolio Optimization - VII
- Lecture 48 - Mean Variance Portfolio Optimization - VIII
- Lecture 49 - Single Index Model - I
- Lecture 50 - Single Index Model - II
- Lecture 51 - Capital Asset Pricing Model - I
- Lecture 52 - Capital Asset Pricing Model - II
- Lecture 53 - Capital Asset Pricing Model - III
- Lecture 54 - Arbitrage Pricing Model - I
- Lecture 55 - Arbitrage Pricing Model - II
- Lecture 56 - Arbitrage Pricing Model - III, Portfolio Performance Evaluation
- Lecture 57 - Efficient Market Hypothesis - I
- Lecture 58 - Efficient Market Hypothesis - II, Financial Derivatives - I
- Lecture 59 - Financial Derivatives - II
- Lecture 60 - Financial Derivatives - III

Lecture 1 - Introduction

Lecture 2 - Cost, Revenue, and Profit Models, Break Even Analysis

Lecture 3 - Linear Programming Problem: Formulation and Assumptions

Lecture 4 - Linear Programming Problem: Graphical Solution Method

Lecture 5 - Graphical Calculator and Excel Solver for solving LPP

Lecture 6 - Sensitivity Analysis - 1

Lecture 7 - Sensitivity Analysis - 2

Lecture 8 - Sensitivity Analysis - 3

Lecture 9 - LPP Applications in Marketing

Lecture 10 - LPP Applications in Finance

Lecture 11 - LPP Applications in Operations - 1

Lecture 12 - LPP Applications in Operations - 2

Lecture 13 - LPP Applications in Operations - 3

Lecture 14 - Advanced LP Applications - Data Envelopment Analysis

Lecture 15 - Game Theory - 1

Lecture 16 - Game Theory - 2

Lecture 17 - Portfolio Management

Lecture 18 - Revenue Management

Lecture 19 - Distribution and Network Problems: Transportation Problem

Lecture 20 - Assignment and Shortest Path Problem

Lecture 21 - Maximal Flow, Production and Inventory Application, Scheduling and Assignment Problems

Lecture 22 - Integer Linear Programming

Lecture 23 - Integer Programming Distribution Problem

Lecture 24 - Nonlinear Optimization Models - I

Lecture 25 - Nonlinear Optimization Models - II

Lecture 26 - Nonlinear Optimization Models - III

Lecture 27 - Nonlinear Optimization Models - IV

Lecture 28 - Nonlinear Optimization Models - V

Lecture 29 - Project Scheduling: PERT/CPM - I

Lecture 30 - Project Scheduling: PERT/CPM - II

Lecture 31 - Project Scheduling For Uncertain Activity Duration: PERT/CPM - III

- Lecture 32 - Project Scheduling: PERT/CPM - IV
- Lecture 33 - Inventory Models: Economic Order Quantity (EOQ) Model - I
- Lecture 34 - Inventory Models: Economic Order Quantity (EOQ) Model - II
- Lecture 35 - Economic Production Lot Size Model
- Lecture 36 - Inventory Model with Planned Shortages
- Lecture 37 - Inventory Model - III
- Lecture 38 - Single-period Inventory model with Probabilistic demand
- Lecture 39 - Multi-period Order-Quantity, Reorder Point Model with Probabilistic Demand
- Lecture 40 - Periodic Review Model (P-type) with Probabilistic Demand
- Lecture 41 - Financial risks associated with the development of a new product - I
- Lecture 42 - Financial risks associated with the development of a new product - II
- Lecture 43 - Inventory Simulation
- Lecture 44 - Simulation - III
- Lecture 45 - Simulation - IV
- Lecture 46 - Decision Analysis - I
- Lecture 47 - Decision Analysis - II
- Lecture 48 - Decision Analysis - III
- Lecture 49 - Decision Analysis - IV
- Lecture 50 - Decision Analysis - V
- Lecture 51 - Formulation Of Goal Programming - I
- Lecture 52 - Formulation Of Goal Programming - II
- Lecture 53 - Multicriteria Decisions - I
- Lecture 54 - Multicriteria Decisions - II
- Lecture 55 - Multicriteria Decisions - III
- Lecture 56 - Time Series Analysis and Forecasting - I
- Lecture 57 - Time Series Analysis and Forecasting - II
- Lecture 58 - Time Series Analysis and Forecasting - III
- Lecture 59 - Time Series Analysis and Forecasting - IV
- Lecture 60 - Time Series Analysis and Forecasting - V

Lecture 1 - Introduction to Integrated Marketing Communication (IMC)

Lecture 2 - Defining Marketing Communication, Marketing and IMC

Lecture 3 - Relationship with Marketing and IMC

Lecture 4 - Effective Marketing Communication

Lecture 5 - Emerging trends in IMC - Part I

Lecture 6 - Emerging Trends in IMC - Part II

Lecture 7 - Design Thinking in IMC - Part I

Lecture 8 - Design Thinking in IMC - Part II

Lecture 9 - Effectiveness of Communication - Part I

Lecture 10 - Effectiveness of Communication - Part II

Lecture 11 - Communication Process and Reflexivity in IMC

Lecture 12 - Role of Consumer Behaviour in IMC

Lecture 13 - Consumer Decision Making Process - Part I

Lecture 14 - Consumer Decision Making Process - Part II

Lecture 15 - Relationship Between Consumer Behaviour and IMC

Lecture 16 - Role of Persuasion in IMC

Lecture 17 - Objectives and Budgeting

Lecture 18 - IMC as a Strategic Tool - Part I

Lecture 19 - IMC as a Strategic Tool - Part II

Lecture 20 - IMC and Branding

Lecture 21 - History of Advertising

Lecture 22 - History of Advertising Indian Perspective

Lecture 23 - Contribution of IMC in Brand Attitude

Lecture 24 - Advertising Agencies

Lecture 25 - Association of Research with IMC

Lecture 26 - Advertising Research Methods

Lecture 27 - IMC Planning - Part I

Lecture 28 - IMC Planning - Part II

Lecture 29 - IMC Planning - Part III

Lecture 30 - Case Studies

Lecture 31 - Advertising and Marketing Mix

Lecture 32 - Advertising and Support Media

Lecture 33 - Media Planning - Part I

Lecture 34 - Media Planning - Part II

Lecture 35 - Introduction to Creativity

Lecture 36 - Creativity Elements - Part I

Lecture 37 - Creativity Elements - Part II

Lecture 38 - Creative Execution in Advertising - Part I

Lecture 39 - Creative Execution in Advertising - Part II

Lecture 40 - Creative Execution in Print Advertising

Lecture 41 - Sales Promotion - Part I

Lecture 42 - Sales Promotion - Part II

Lecture 43 - Sales Promotion - Part III

Lecture 44 - Personal Selling - Part I

Lecture 45 - Personal Selling - Part II

Lecture 46 - Direct Marketing - Part I

Lecture 47 - Direct Marketing - Part II

Lecture 48 - Cause-Related Marketing

Lecture 49 - Public Relations

Lecture 50 - Word-of-Mouth and Corporate Advertising

Lecture 51 - Digital Advertising

Lecture 52 - Search Engine Optimization (SEO)

Lecture 53 - Social Media Advertising - Part I

Lecture 54 - Social Media Advertising - Part II

Lecture 55 - Social Media Advertising - Part III

Lecture 56 - Content Marketing

Lecture 57 - Ethics and Marketing Communications

Lecture 58 - Measuring Effectiveness of IMC - Part I

Lecture 59 - Measuring Effectiveness of IMC - Part II

Lecture 60 - Conclusion

- Lecture 1 - Introduction to Leadership and Team Management
- Lecture 2 - Leadership Myths and Facts - I
- Lecture 3 - Leadership Myths and Facts - II
- Lecture 4 - Interactional Framework for Analyzing Leadership
- Lecture 5 - Leadership Development: The First 90 Days as a Leader
- Lecture 6 - Leader Development: The Action-Observation-Reflection Model
- Lecture 7 - Leader’s Member Exchange (LMX) Theory
- Lecture 8 - Normative Decision Model
- Lecture 9 - Situational Leadership Model
- Lecture 10 - Contingency Model and Path-Goal Theory
- Lecture 11 - Charismatic and Transformational Leadership
- Lecture 12 - Leadership for Tomorrow
- Lecture 13 - Leadership Attributes
- Lecture 14 - Personality Traits and Leadership
- Lecture 15 - Personality Types and Leadership
- Lecture 16 - Intelligence and Leadership
- Lecture 17 - Emotional Intelligence and Leadership
- Lecture 18 - Power and Leadership
- Lecture 19 - The Art of Influence in Leadership
- Lecture 20 - Leadership and “Doing the Right Things”
- Lecture 21 - Character Based Approach to Leadership
- Lecture 22 - Role of Ethics and Values in Organisational Leadership
- Lecture 23 - Leadership Behaviour
- Lecture 24 - Leadership Pipeline
- Lecture 25 - Assessing Leadership Behaviors: Multi-rater feedback instruments
- Lecture 26 - The Dark Side of Leadership- Destructive Leadership
- Lecture 27 - Managerial Incompetence and Derailment
- Lecture 28 - Negotiation and Leadership
- Lecture 29 - Leadership in Crisis Situation
- Lecture 30 - The Situation and The Environment
- Lecture 31 - Culture and Leadership

[Lecture 32 - Global Leadership](#)

[Lecture 33 - Motivation and Leadership](#)

[Lecture 34 - Introduction to Groups and Teams](#)

[Lecture 35 - Characteristics of Leader, Follower and Situation](#)

[Lecture 36 - Group Dynamics](#)

[Lecture 37 - Team Formation](#)

[Lecture 38 - Delegation and Empowerment](#)

[Lecture 39 - Leading Teams: Enhancing Teamwork within a Group](#)

[Lecture 40 - The Leader's Role in Team-Based Organizations](#)

[Lecture 41 - Leader Actions That Foster Team Effectiveness](#)

[Lecture 42 - Offsite Training and Team Development](#)

[Lecture 43 - Understanding Team Processes and Team Coaching](#)

[Lecture 44 - Team Decision Making and Conflict Management](#)

[Lecture 45 - Virtual teams](#)

[Lecture 46 - Managing Multicultural Teams](#)

[Lecture 47 - Building Great Teams](#)

[Lecture 48 - Experiential Learning](#)

[Lecture 49 - Action Learning](#)

[Lecture 50 - Development Planning: GAPS Analysis](#)

[Lecture 51 - Coaching and Mentoring](#)

[Lecture 52 - Women in Leadership Roles](#)

[Lecture 53 - Building Effective Relationship with Subordinates and Peers](#)

[Lecture 54 - Fostering Followers Satisfaction](#)

[Lecture 55 - The Art of Communication](#)

[Lecture 56 - Setting Goals and Providing Constructive Feedback](#)

[Lecture 57 - Enhancing Creativity Problem Solving Skills](#)

[Lecture 58 - Building High-Performance Teams: The Rocket Model](#)

[Lecture 59 - Building Credibility and Trust](#)

[Lecture 60 - Skills for Developing Others](#)



Lecture 1 - Introduction to Product and Brand Management

Lecture 2 - Defining Product

Lecture 3 - Terminologies Associated with Product - 1

Lecture 4 - Terminologies Associated with Product - 2

Lecture 5 - Terminologies Associated with Product - 3

Lecture 6 - Terminologies Associated with Product - 4

Lecture 7 - Product Management and Concepts Associated with Product

Lecture 8 - Product Classification

Lecture 9 - Product Differentiation and its Elements - 1

Lecture 10 - Product Differentiation and its Elements - 2

Lecture 11 - Product Positioning - 1

Lecture 12 - Product Positioning - 2

Lecture 13 - Product Life cycle - 1

Lecture 14 - Product Life Cycle - 2

Lecture 15 - Product Life Cycle - 3

Lecture 16 - Saddle Effect and Relationship of Product with Marketing Mix Elements

Lecture 17 - Market and Product Planning - 1

Lecture 18 - Market and Product Planning - 2

Lecture 19 - Product Strategy and Decisions - 1

Lecture 20 - Product Strategy and Decisions - 2

Lecture 21 - Product Decisions

Lecture 22 - Product Portfolio Management

Lecture 23 - Product Category Management

Lecture 24 - Customer Analysis

Lecture 25 - Competitors Analysis

Lecture 26 - Product Pricing

Lecture 27 - Product Pricing and Packaging

Lecture 28 - Product Distribution

Lecture 29 - Design Thinking - 1

Lecture 30 - Design Thinking - 2

Lecture 31 - Design Thinking - 3

- Lecture 32 - Product Innovation - 1
- Lecture 33 - Product Innovation - 2
- Lecture 34 - New Product Development
- Lecture 35 - Reflexivity, Insight, and Value Co-Creation
- Lecture 36 - Brand Management
- Lecture 37 - Defining Brand
- Lecture 38 - Strategic Brand Management Process
- Lecture 39 - Brand Proposition
- Lecture 40 - Customer-based Brand Equity - 1
- Lecture 41 - Customer-based Brand Equity - 2
- Lecture 42 - Brand Positioning
- Lecture 43 - Brand Resonance Model
- Lecture 44 - Brand Value Chain - 1
- Lecture 45 - Brand Value Chain - 2
- Lecture 46 - Brand Equity Elements - 1
- Lecture 47 - Brand Equity Elements - 2
- Lecture 48 - Designing Marketing Programs to Build Brand Equity
- Lecture 49 - Secondary Brand Associations
- Lecture 50 - Brand Audit and Research
- Lecture 51 - Brand Architecture Strategies And Brand Portfolio
- Lecture 52 - Brand Portfolio And Brand Hierarchies
- Lecture 53 - Brand Equity: Measuring Outcomes - 1
- Lecture 54 - Brand Equity: Measuring Outcomes - 2
- Lecture 55 - Brand Extension
- Lecture 56 - Brand Experience and Brand Loyalty
- Lecture 57 - Brand Continuum and Brand Reinforcement
- Lecture 58 - Brand Revitalization and Repositioning
- Lecture 59 - Rebranding, Brand Demise and Brand Lifecycle
- Lecture 60 - Product and Brand Management - Conclusion

- Lecture 1 - Overview and Introduction, Debt and Equity
- Lecture 2 - Hybrids, Derivatives
- Lecture 3 - Financial Risk
- Lecture 4 - Arbitrage
- Lecture 5 - Arbitrage Free Pricing
- Lecture 6 - Arbitrage Free Pricing of Bonds
- Lecture 7 - Forward Rates, Bond Pricing with Forward Rates
- Lecture 8 - Binomial Interest Rate Tree
- Lecture 9 - Bond Pricing with Binomial Trees
- Lecture 10 - Bond Pricing (Continued...)
- Lecture 11 - Valuation of Bonds with Embedded Options
- Lecture 12 - Features of Option Embedded Bonds
- Lecture 13 - Yield to Maturity
- Lecture 14 - Bond Yields and Yield Spreads
- Lecture 15 - Z Spread and Option Adjusted Spread (OAS)
- Lecture 16 - Yield Spreads
- Lecture 17 - Interest Rate Risk
- Lecture 18 - Duration and Immunization
- Lecture 19 - Immunization and Bond Dynamics
- Lecture 20 - Duration: Properties
- Lecture 21 - Effective Duration
- Lecture 22 - Key Rate Duration
- Lecture 23 - One Sided Duration
- Lecture 24 - Modeling of Fixed Income Returns
- Lecture 25 - Immunizing a Single Liability
- Lecture 26 - The Barbell Strategy - 1
- Lecture 27 - The Barbell Strategy - 2
- Lecture 28 - Yield Shifts and Immunization
- Lecture 29 - Fixed Income Portfolio Strategies - 1
- Lecture 30 - Fixed Income Portfolio Strategies - 2
- Lecture 31 - Fixed Income Portfolio Strategies - 3

Lecture 32 - Floaters, Caps and Floors

Lecture 33 - Derivatives, A Recapitulation

Lecture 34 - Forward Pricing - Investment Assets

Lecture 35 - Forward Pricing - Consumption Assets

Lecture 36 - Introduction to Options

Lecture 37 - Put Call Parity and Arbitrage

Lecture 38 - American Options - 1

Lecture 39 - American Options - 2

Lecture 40 - Option Trading Strategies - 1

Lecture 41 - Option Trading Strategies - 2

Lecture 42 - Option Trading Strategies - 3

Lecture 43 - Option Pricing - Binomial Model - 1

Lecture 44 - Option Pricing - Binomial Model - 2

Lecture 45 - Option Pricing - American Options

Lecture 46 - Random Walks

Lecture 47 - Brownian Motion

Lecture 48 - Stochastic Calculus

Lecture 49 - Stock Price Modelling

Lecture 50 - Black Scholes Model

Lecture 51 - Futures - 1

Lecture 52 - Futures - 2

Lecture 53 - Forward vs Futures Prices

Lecture 54 - Futures Hedging

Lecture 55 - Issues in Futures Hedging

Lecture 56 - Perfect Futures Hedge, Cross Hedge, Tailing the Hedge

Lecture 57 - Stock Index Futures - 1

Lecture 58 - Stock Index Futures - 2

Lecture 59 - Interest Rate Futures - 1

Lecture 60 - Interest Rate Futures - 2

Lecture 1 - Breaking the Myths and Learning the Basics

Lecture 2 - Evolution and Role of Sales Management

Lecture 3 - Tactical Role of Sales Management

Lecture 4 - Complexities in Sales Management and Characteristics of Modern Selling

Lecture 5 - Difference Between Sales and Marketing

Lecture 6 - Selling in a VUCA World

Lecture 7 - Place of Selling in Overall Marketing Plan

Lecture 8 - Use of Marketing Principles in Creating Strategic Sales Plan

Lecture 9 - Sales Forecasting Methods for Informed Decision-Making

Lecture 10 - Tools to Assess Market While Developing Strategic Sales Plan

Lecture 11 - Models of Sales planning

Lecture 12 - Types of sales man and what makes a good sales man

Lecture 13 - Buying Centre and stages of sales call

Lecture 14 - Transformative Factors And Evolved Selling Process And Theories

Lecture 15 - Miller Heiman approach and virtual framework strategic selling

Lecture 16 - Miller Heiman Approach And Virtual Framework Strategic Selling (Continued...)

Lecture 17 - Buyer Persona and Consumer and B2B Decision Making process

Lecture 18 - Consumer and B2B Decision Making process Selling and Consumer Behavior

Lecture 19 - B2B Decision Making Process and Difference in B2B and B2C Selling

Lecture 20 - Key Account Management and Customer Centric Selling

Lecture 21 - Key Account Management, Customer Centric Selling and CRM Strategies (Continued...)

Lecture 22 - Key Responsibilities of Salespeople

Lecture 23 - Preparing for a Sales Role

Lecture 24 - Preparing for a Sales Role (Continued...)

Lecture 25 - Personal Selling Skills and Motivating Sales Team

Lecture 26 - Personal Selling Skills and Motivating Sales Team (Continued...)

Lecture 27 - Meaning and Role of Sales Intelligence

Lecture 28 - Data for Sales intelligence

Lecture 29 - Ideal Customer Profile

Lecture 30 - Data-Driven Approaches to Selling

Lecture 31 - Social Media for Lead Generation

[Lecture 32 - Understanding International Selling](#)

[Lecture 33 - Global Sales Dynamics and Sales Force Management](#)

[Lecture 34 - Do's and Don'ts of International Selling](#)

[Lecture 35 - Role of culture in International Selling](#)

[Lecture 36 - Challenges of Selling in International Markets](#)

[Lecture 37 - Role of technology management in selling](#)

[Lecture 38 - Use of Sales force Automation for Effective Selling](#)

[Lecture 39 - Role of AR/VR and AI in Selling](#)

[Lecture 40 - Managing a Diversified Sales-force](#)

[Lecture 41 - Ethical and Social issues in Selling](#)

**NPTEL : NOC:Retail Marketing Strategy (Management)**

**Co-ordinators : Prof. Sourabh Arora**

Lecture 1 - Understanding Retailing from a Strategic Standpoint

Lecture 2 - Why is Retailing so Important: Strategic Perspectives

Lecture 3 - Strategic Standpoint and Evolution of Retailing

Lecture 4 - Evolution of Retailing

Lecture 5 - Value Creation

Lecture 6 - Retailing Theories Role in Supply Chain

Lecture 7 - Retailing Theories and Retailers Role in Supply Chain

Lecture 8 - Retailers Role in Supply Chain and Retail Management Decision Process

Lecture 9 - Retail Management Decision Process (Continued...) and Kahn's Retailing Success Matrix

Lecture 10 - Retail Management Decision Process and Kahn's Retailing Success Matrix

Lecture 11 - Retail Management Decision Process, Kahn's Retailing Success Matrix and Success Factors

Lecture 12 - Kahn's Retailing Success Matrix and Success Factors for Retailing

Lecture 13 - Success Factors for Retailing and View of Consumer Decision Making Processes

Lecture 14 - Success Factors for Retailing and View of Consumer Decision Making Processes (Continued...)

Lecture 15 - Consumer Decision Making Processes (Continued...)

Lecture 16 - Consumer Decision Making Processes (Continued...)

Lecture 17 - Consumer Decision Making Processes (Continued...) and Consumer Motives

Lecture 18 - Tenets of Customer Centric Approach: A Retailers Perspective

Lecture 19 - Private Label Brands

Lecture 20 - Types of Private Label Brands and Introduction to Multi and Omni-Channel Retail

Lecture 21 - Introduction to Multi and Omni-Channel Retail

Lecture 22 - Introduction to Multi and Omni-Channel Retail (Continued...)

Lecture 23 - Introduction to Multi and Omni-Channel Retail (Continued...)

Lecture 24 - Formulating a Successful Retail Strategy

Lecture 25 - Formulating a Successful Retail Strategy

Lecture 26 - Formulating a Successful Retail Strategy (Continued...)

Lecture 27 - Formulating a Successful Retail Strategy (Continued...)

Lecture 28 - Formulating a Successful Retail Strategy (Continued...)

Lecture 29 - Formulating a Successful Retail Strategy (Continued...)

Lecture 30 - Formulating a Successful Retail Strategy (Continued...)

Lecture 31 - Location Decisions

[Lecture 32 - Location Decisions](#)

[Lecture 33 - Pricing Decisions](#)

[Lecture 34 - Merchandise Management and Planning](#)

[Lecture 35 - Merchandise Management and Planning \(Continued...\)](#)

[Lecture 36 - Role of HRM in Retailing](#)

[Lecture 37 - Role of HRM in Retailing \(Continued...\)](#)

[Lecture 38 - Motivating Employees](#)

[Lecture 39 - Showrooming and Webrooming](#)

[Lecture 40 - Showrooming and Webrooming](#)

[Lecture 41 - Virtual Reality, Augmented Reality and Artificial Intelligence in Retailing](#)



- Lecture 1 - Introduction to Business to Business Marketing
- Lecture 2 - Classification of Products and Customers in B2B
- Lecture 3 - B2B vs B2C Marketing - 1
- Lecture 4 - B2B vs B2C Marketing - 2
- Lecture 5 - Some Important Concepts and Case Study
- Lecture 6 - Value Chain Analysis, Core Competence and Outsourcing
- Lecture 7 - Introduction to Organisational Buying Behaviour
- Lecture 8 - Howard's Seth Model
- Lecture 9 - Seth's Model
- Lecture 10 - Webster and Wind Model, Buying Center and Buygrid Framework
- Lecture 11 - Purchasing function Goals and Kraljic's Model
- Lecture 12 - Purchasing Cycle and Procurement Development Process
- Lecture 13 - Strategic Sourcing and Case Study
- Lecture 14 - E-Procurement and Supplier Assessment
- Lecture 15 - B2B Marketing Strategy Formulation
- Lecture 16 - B2B Marketing Strategy Formulation and Balance Scorecard
- Lecture 17 - Balance Scorecard, Strategy Maps and Case Study
- Lecture 18 - Managing Products in B2B Markets: PLC Approach
- Lecture 19 - Managing Products in B2B Markets: TA Life Cycle Approach
- Lecture 20 - Managing Services in B2B Markets
- Lecture 21 - Introduction to STP
- Lecture 22 - Segmentation in B2B Markets
- Lecture 23 - Bonama and Shapiro's Nested Approach and Targeting in B2B
- Lecture 24 - Target Market Strategies
- Lecture 25 - Positioning in B2B Markets
- Lecture 26 - B2B Positioning Strategies
- Lecture 27 - Business Market Communication: Personal Selling
- Lecture 28 - Business Market Communication: Sales Force Management
- Lecture 29 - Business Market Communication: Advertising
- Lecture 30 - Business Market Communication: Social Media, Trade shows and more
- Lecture 31 - Business Market Communication: Promotional Budgeting

- Lecture 32 - Demand Forecasting in B2B Markets: Introduction
- Lecture 33 - Demand Forecasting in B2B Markets: Qualitative Methods
- Lecture 34 - Demand Forecasting in B2B Markets: Quantitative Methods - 1
- Lecture 35 - Demand Forecasting in B2B Markets: Quantitative Methods - 2
- Lecture 36 - B2B Product Management: New Product Development
- Lecture 37 - B2B Product Management: Identifying New Products
- Lecture 38 - B2B Product Management: Customer Value, Product Launch and more
- Lecture 39 - B2B Product Management: Branding
- Lecture 40 - B2B Pricing: Introduction
- Lecture 41 - B2B Pricing: Price Setting Process - 1
- Lecture 42 - B2B Pricing: Price Setting Process - 2
- Lecture 43 - B2B Pricing: Pricing Methods
- Lecture 44 - B2B Pricing: Geographical and Value Based Pricing
- Lecture 45 - B2B Pricing: Competitive Bidding
- Lecture 46 - Introduction to Relationship Management in B2B Markets
- Lecture 47 - Types of Relationships in B2B Markets and Customer Profitability
- Lecture 48 - Customer Relationship Management
- Lecture 49 - Customer Lifetime Value
- Lecture 50 - B2B Marketing Research: Introduction
- Lecture 51 - B2B Marketing Research: Research Methods
- Lecture 52 - Business Marketing Channels: Introduction and its Types
- Lecture 53 - Business Marketing Channels: Types of Participants
- Lecture 54 - Business Marketing Channels: E-Commerce
- Lecture 55 - Supply Chain Management and its Drivers
- Lecture 56 - Approaches to SCM and Logistics Management
- Lecture 57 - Strategic Business Units (SBU) and BCG Matrix
- Lecture 58 - GE Matrix and McKinsey 7S Framework
- Lecture 59 - Marketing Techniques Implementation and Control
- Lecture 60 - A Comprehensive Case Study

- Lecture 1 - Introduction to Organization Design
- Lecture 2 - Evolution of Organization Theory and Design
- Lecture 3 - Approaches to Design Based on Different Models
- Lecture 4 - Role of Strategy in Organization Design
- Lecture 5 - A Framework for Selecting Strategy and Design
- Lecture 6 - Assessing Organizational Effectiveness - 1
- Lecture 7 - Assessing Organizational Effectiveness - 2
- Lecture 8 - Understanding Organizational Structure
- Lecture 9 - Dimension of Organization Structure - 1
- Lecture 10 - Dimension of Organization Structure - 2
- Lecture 11 - Dimension of Organization Structure - 3
- Lecture 12 - Interorganizational Relationship - 1
- Lecture 13 - Interorganizational Relationship - 2
- Lecture 14 - The Impact of External Environment
- Lecture 15 - Framework for Response to Environmental Change
- Lecture 16 - Organization Resilience and Adaptability
- Lecture 17 - Introduction to Organization Decision-making
- Lecture 18 - Models of Organizational decision-making
- Lecture 19 - Contingency Decision-Making Framework
- Lecture 20 - Role of IT in decision making
- Lecture 21 - Strategic Role of Change
- Lecture 22 - Model of Change Management
- Lecture 23 - Managing Technology Change
- Lecture 24 - Leading in VUCA World
- Lecture 25 - Enhancing Organizational Readiness for Change
- Lecture 26 - Designing Organizations for Competitive Success
- Lecture 27 - Understanding and Developing Organization culture
- Lecture 28 - Managing Culture by Design
- Lecture 29 - Learning Organization
- Lecture 30 - Ethical values and Social Responsibility
- Lecture 31 - Organizational Design Challenges

- Lecture 32 - Interdepartmental Conflict in Organization
- Lecture 33 - Power and Organization
- Lecture 34 - Political Processes in an organization
- Lecture 35 - Communications Structure of Organization
- Lecture 36 - Leadership in Organization Design
- Lecture 37 - The strategic value of Information Technology
- Lecture 38 - E-business Organization Design
- Lecture 39 - Workplace Technology and Design - 1
- Lecture 40 - Workplace Technology and Design - 2
- Lecture 41 - Innovation Management and its Principles
- Lecture 42 - Models of Organizational Innovation
- Lecture 43 - Innovation for Impact
- Lecture 44 - Design Thinking for Innovation - 1
- Lecture 45 - Design Thinking for Innovation - 2
- Lecture 46 - Growth and Organization Life cycle
- Lecture 47 - Organization Size and Complexity of Organization
- Lecture 48 - Organization Bureaucracy and Control
- Lecture 49 - Organization Development and Tools - 1
- Lecture 50 - Organization Development and Tools - 2
- Lecture 51 - Understanding Global Organizational Design
- Lecture 52 - Designing Structure to Fit Global Strategy
- Lecture 53 - Building Global Capabilities
- Lecture 54 - Sustainable Organization Design
- Lecture 55 - Job Crafting
- Lecture 56 - Workplace Design for Well-being
- Lecture 57 - Organization Building in Context of Employee Engagement
- Lecture 58 - The Experience-Centric Organization
- Lecture 59 - The Wheel of Experience Centricity
- Lecture 60 - Designing Organization for Meaningful Experiences

- Lecture 1 - Introduction to Project Management - I
- Lecture 2 - Introduction to Project Management - II
- Lecture 3 - Agile Project Management
- Lecture 4 - Project Selection Models
- Lecture 5 - Examples of Project Selection Models
- Lecture 6 - Project Manager
- Lecture 7 - Attributes of Effective Project Manager
- Lecture 8 - Managing for Stakeholders
- Lecture 9 - Resolving Conflicts
- Lecture 10 - Negotiation
- Lecture 11 - Project in the Organization structure
- Lecture 12 - Human factors and the Project Team
- Lecture 13 - Traditional Project Activity Planning
- Lecture 14 - Agile Project Planning, Project Charter
- Lecture 15 - Coordination through Integration Management
- Lecture 16 - Project Feasibility Analysis
- Lecture 17 - Estimating Project Budgets
- Lecture 18 - Project Risk Management
- Lecture 19 - Quantitative Risk Assessment Methodologies
- Lecture 20 - Critical Path Method (CPM)
- Lecture 21 - Programme Evaluation And Review Technique PERT
- Lecture 22 - Risk Analysis with simulation for scheduling
- Lecture 23 - Gantt Chart and Scheduling with scrum
- Lecture 24 - Crashing a project
- Lecture 25 - Resource Loading
- Lecture 26 - Resource Levelling
- Lecture 27 - Goldratt's critical chain
- Lecture 28 - Planning monitoring controlling cycle
- Lecture 29 - Earned value analysis
- Lecture 30 - Agile tools for tracking project
- Lecture 31 - Three types of Project Controlling

[Lecture 32 - Control of change scope and scope creep](#)

[Lecture 33 - Project Audit](#)

[Lecture 34 - Essentials of an audit evaluation](#)

[Lecture 35 - When to close a project ?](#)

[Lecture 36 - Benefits realization, Case study on the success of Chandrayan 3](#)

[Lecture 37 - Software for Project Management](#)

[Lecture 38 - Demo on project management software](#)

[Lecture 39 - Simulations Software for Project Management](#)

[Lecture 40 - Course Summary](#)

**NPTEL : NOC:AI in Marketing (Management)**

**Co-ordinators : Prof. Zillur Rahman**

- Lecture 1 - Understanding the basics of AI in Marketing - I
- Lecture 2 - Understanding the basics of AI in Marketing - II
- Lecture 3 - Understanding the basics of AI in Marketing - III
- Lecture 4 - Introduction to AI Algorithms
- Lecture 5 - Designs of AI, Transition process and AI matrix
- Lecture 6 - Customer value and Role of AI in Value Delivery Process
- Lecture 7 - Transforming Marketing Strategy using AI - I
- Lecture 8 - Transforming Marketing Strategy using AI - II
- Lecture 9 - Transforming Marketing Strategy using AI - III
- Lecture 10 - Transforming Marketing Strategy using AI - IV
- Lecture 11 - Transforming Marketing Strategy using AI - V
- Lecture 12 - Using AI for STP
- Lecture 13 - Application of AI in Marketing Mix - I
- Lecture 14 - Application of AI in Marketing Mix - II
- Lecture 15 - Marketing Information Systems and its Components
- Lecture 16 - What is Marketing Research - I
- Lecture 17 - What is Marketing Research - II
- Lecture 18 - Individual Dynamics and its influence on Consumer Behaviour
- Lecture 19 - Consumer Buying Decision Process
- Lecture 20 - Understanding Customer Journey - I
- Lecture 21 - Understanding Customer Journey - II
- Lecture 22 - Customer Experience: Meaning and Characteristics
- Lecture 23 - Personalization: Going Beyond Segmentation - I
- Lecture 24 - Personalization: Going Beyond Segmentation - II
- Lecture 25 - Avatar marketing
- Lecture 26 - Standardization, Personalization and Relationalization of Brands using AI
- Lecture 27 - Understanding Networks and Brand Network Effect
- Lecture 28 - Understanding the Use of AI for Addressing Competition
- Lecture 29 - AI and Brand Equity
- Lecture 30 - AI and New Brand Realities - I
- Lecture 31 - AI and New Brand Realities - II

Lecture 32 - AI for Value Creation and Product Development

Lecture 33 - Personalization and hyper-personalization Using AI - I

Lecture 34 - Personalization and hyper-personalization Using AI - II

Lecture 35 - Personalization and hyper-personalization Using AI - III

Lecture 36 - Personalization and hyper-personalization Using AI - IV

Lecture 37 - Personalization and hyper-personalization Using AI - V

Lecture 38 - Implementation of AI by Product Managers

Lecture 39 - AI in Service

Lecture 40 - Pricing Strategies Using AI - I

Lecture 41 - Pricing Strategies Using AI - II

Lecture 42 - Pricing Strategies Using AI - III

Lecture 43 - Pricing Strategies Using AI - IV

Lecture 44 - Role of AI in Advertising - I

Lecture 45 - Role of AI in Advertising - II

Lecture 46 - AI in Sales promotion and Direct Marketing

Lecture 47 - AI in PR and Publicity and Social Media Marketing - I

Lecture 48 - AI in PR and Publicity and Social Media Marketing - II

Lecture 49 - Personal Selling using AI

Lecture 50 - Sales management using AI

Lecture 51 - AI and Marketing Channel Management

Lecture 52 - Omnichannel Marketing and Retailing

Lecture 53 - Changing face of Retailing in the age of AI

Lecture 54 - AI in Logistics Management - I

Lecture 55 - AI in Logistics Management - II

Lecture 56 - Navigating Ethical Challenges in AI - I

Lecture 57 - Navigating Ethical Challenges in AI - II

Lecture 58 - Navigating Ethical Challenges in AI - III

Lecture 59 - Navigating Ethical Challenges in AI - IV

Lecture 60 - AI and Sustainability



Lecture 1 - Introduction

Lecture 2 - Innovation

Lecture 3 - Innovations in Marketing and Marketing of Innovations

Lecture 4 - Innovations in Marketing

Lecture 5 - Need for Innovations in Marketing - 1

Lecture 6 - Need for Innovations in Marketing - 2

Lecture 7 - Change in Consumer Behaviour - 1

Lecture 8 - Change in Consumer Behaviour - 2

Lecture 9 - Innovative Perspectives about 4Pâ€™s for Innovation

Lecture 10 - Innovator's Dilemma

Lecture 11 - Go-To-Market Strategy

Lecture 12 - Targeting - Evolutionary Perspective

Lecture 13 - Innovations in Targeting and Positioning

Lecture 14 - Changing Concepts in Marketing of Products and Services

Lecture 15 - Changing Concepts of Marketing and Innovations in Service Marketing

Lecture 16 - Countering Commoditization: An Innovative Perspective

Lecture 17 - Innovations and Branding

Lecture 18 - Innovation in Pricing and Factors Affecting Pricing Innovations

Lecture 19 - Innovation in Pricing

Lecture 20 - Innovation in Pricing Strategies - 1

Lecture 21 - Innovation in Pricing Strategies - 2

Lecture 22 - Innovation in Distribution Channels

Lecture 23 - Innovation in Channel Management

Lecture 24 - Innovation in Retailing - 1

Lecture 25 - Innovation in Retailing - 2

Lecture 26 - Influence of distribution innovation on Marketing Mix

Lecture 27 - Innovation in Marketing Communication - 1

Lecture 28 - Innovation in Marketing Communication - 2

Lecture 29 - Innovation in Marketing Communication - 3

Lecture 30 - Innovative Marketing Communications: Direct Marketing

Lecture 31 - Innovative Marketing Communications: Sales Promotion and Public Relations

Lecture 32 - Innovative Marketing Communications: Advertising - Print, Radio and Television

Lecture 33 - Innovative Marketing Communications: Digital and Social Media Marketing

Lecture 34 - Influence of Innovation in Marketing Communications on the Marketing Mix

Lecture 35 - Co-Creation of Value and Value Co-Creation

Lecture 36 - Innovation and Value Chains - 1

Lecture 37 - Innovation and Value Chains - 2

Lecture 38 - Beyond Business

Lecture 39 - What is Marketing of Innovation? - Part 1

Lecture 40 - What is Marketing of Innovation? - Part 2

Lecture 41 - What is Marketing of Innovation? - Part 3

Lecture 42 - Marketing of Innovation - new products/new usage/ new services/ new perspective?

Lecture 43 - Marketing Research on Marketing of Innovation - Part 1

Lecture 44 - Marketing Research on Marketing of Innovation - Part 2

Lecture 45 - Marketing of Innovation - A fundamental change of thought process

Lecture 46 - Introduction to Innovation

Lecture 47 - Sources and Principles of Innovation

Lecture 48 - Strategy and Innovation

Lecture 49 - Connecting Innovation to Strategy

Lecture 50 - Understanding Consumers

Lecture 51 - Consumer Behavior and Innovations

Lecture 52 - Product Life Cycle in case of Innovations; Is it different?

Lecture 53 - Branding of Innovation

Lecture 54 - Marketing of Innovation in Service Industry - Part 1

Lecture 55 - Marketing of Innovation in Service Industry - Part 2

Lecture 56 - Positioning of Innovation

Lecture 57 - New Product Development

Lecture 58 - Monetizing and Delivering Innovation

Lecture 59 - What if it did not happen?

Lecture 60 - Conclusion

- Lecture 1 - Services and their Unique Characteristics
- Lecture 2 - Services in Modern Economy
- Lecture 3 - Trends and Challenges in Services Marketing
- Lecture 4 - Service Marketing Mix and Value Creation
- Lecture 5 - Services Ecosystem and Stakeholder Analysis
- Lecture 6 - Customer Journey Mapping and Touchpoint Analysis
- Lecture 7 - Designing memorable customer experiences
- Lecture 8 - Personalization and Customization in Services
- Lecture 9 - Emotional and Sensory marketing in Services
- Lecture 10 - Technology-enabled customer experiences
- Lecture 11 - Service Design Thinking and Design-driven Innovation
- Lecture 12 - Open Innovation and Collaboration in Services
- Lecture 13 - Crowdsourcing and customer involvement in service development
- Lecture 14 - Managing Service Failures and Service Recovery Strategies
- Lecture 15 - Leveraging Customer Feedback for Continuous Improvement
- Lecture 16 - Digitalization of Services and Digital Service Platforms
- Lecture 17 - Online Customer Engagement and Social Media Marketing
- Lecture 18 - Mobile Marketing and Location-based Services
- Lecture 19 - Artificial Intelligence and Chatbot Integration in Services
- Lecture 20 - Blockchain and its application in service industries
- Lecture 21 - Data-driven Decision-making in Services Marketing
- Lecture 22 - Customer Analytics and Segmentation Strategies
- Lecture 23 - Predictive Analytics for Personalized Marketing
- Lecture 24 - Sentiment Analysis and Social Listening in Services
- Lecture 25 - Ethical Considerations in Handling Customer Data
- Lecture 26 - Building a Strong Service Brand Identity
- Lecture 27 - Brand Positioning and Differentiation Strategies
- Lecture 28 - Online Brand Management and Reputation Monitoring
- Lecture 29 - Managing Brand Extensions and Brand Partnerships
- Lecture 30 - Internal Branding and Aligning Employees with the Brand
- Lecture 31 - Measuring and Improving Service Quality

- Lecture 32 - SERVQUAL and Other Service Quality Measurement Tools
- Lecture 33 - Service Guarantees and Service-level Agreements
- Lecture 34 - Service Recovery Strategies and Complaint Handling
- Lecture 35 - Cultivating a Culture of Service Excellence
- Lecture 36 - Pricing Strategies for Services and Value-based Pricing
- Lecture 37 - Dynamic Pricing and Revenue Optimization Techniques
- Lecture 38 - Bundling and Packaging Strategies in Service Pricing
- Lecture 39 - Subscription Models and Revenue Diversification
- Lecture 40 - Pricing Strategies for Freemium and Subscription-based Services
- Lecture 41 - Cultural Nuances and Their Impact on Service Marketing
- Lecture 42 - Adapting Services for Different Cultural Contexts
- Lecture 43 - Global Branding and Localization Strategies
- Lecture 44 - Managing Diversity and Inclusivity in Service Delivery
- Lecture 45 - Cross-cultural Communication and Customer Relationship Management
- Lecture 46 - Sustainable practices and corporate social responsibility in services
- Lecture 47 - Environmental consciousness and green marketing
- Lecture 48 - Eco-friendly service design and operations
- Lecture 49 - Ethical sourcing and responsible supply chain management
- Lecture 50 - Consumer attitudes towards sustainable services
- Lecture 51 - Developing service leadership skills
- Lecture 52 - Motivating and empowering service employees
- Lecture 53 - Service culture and service-oriented organizational behaviour
- Lecture 54 - Training and development for service excellence
- Lecture 55 - Managing service teams and fostering collaboration
- Lecture 56 - Innovations in Service Delivery and Technology
- Lecture 57 - Augmented Reality and Virtual Reality in Services
- Lecture 58 - Internet of Things (IoT) in Service Ecosystem
- Lecture 59 - Servitization and Product-Service Systems
- Lecture 60 - Future Prospects and Challenges in Services Marketing

**NPTEL : Strategic Management (Management)**

**Co-ordinators : Prof. R. Srinivasan**

Lecture 1 - Introduction to Strategic Management

Lecture 2 - Concept of Corporate Strategy

Lecture 3 - Strategic Management Process - 1

Lecture 4 - Strategic Management Process - 2

Lecture 5 - The 7-S Framework

Lecture 6 - Corporate Policy and Planning in India

Lecture 7 - Board of Directors - Role and Functions

Lecture 8 - Board of Directors - Role and Functions, Top Management - Role and Skills, Board Functioning - Indian Context

Lecture 9 - Board Functioning - Indian Context and Environmental Scanning

Lecture 10 - Environmental Scanning and Industry Analysis

Lecture 11 - The synthesis of External Factors and External Factors Analysis Summary (EFAS)

Lecture 12 - Internal Corporate Analysis and Impact Matrix

Lecture 13 - Value Chain Analysis

Lecture 14 - Synthesis of Internal Factors - 1

Lecture 15 - Synthesis of Internal Factors - 2

Lecture 16 - Internal Factors Analysis Summary (IFAS) and Case Study - 1

Lecture 17 - Case Analysis

Lecture 18 - Key Financial Ratios

Lecture 19 - Case Analysis - 2 and SFAS Matrix

Lecture 20 - Business Strategy

Lecture 21 - Corporate Strategy - 1

Lecture 22 - Corporate Strategy - 2

Lecture 23 - Corporate Strategy - 3 and Functional Strategy

Lecture 24 - Functional Strategy - 1

Lecture 25 - Functional Strategy - 2

Lecture 26 - Functional Strategy - 3 and Strategic Choice

Lecture 27 - Strategy Implementation - 1

Lecture 28 - Strategy Implementation - 2

Lecture 29 - Evaluation and Control

Lecture 30 - Strategic Information Systems - 1

Lecture 31 - Strategic Information Systems - 2

[Lecture 32 - Other Strategic Issues - 1](#)

[Lecture 33 - Other Strategic Issues - 2](#)

[Lecture 34 - Small and Medium Enterprises](#)

[Lecture 35 - Non- Profit Organizations](#)

[Lecture 36 - Summary - 1](#)

[Lecture 37 - Summary - 2](#)

**NPTEL : Global Supply Chain Management (Management)**

**Co-ordinators : Prof. N. Viswanadham**

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- Lecture 2 - Introduction to Global Supply Chain Networks Part - 2
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- Lecture 4 - The Supply Chain Eco-System Framework
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- Lecture 7 - Metro Cash and Carry
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- Lecture 10 - Supply Chain Risk - Part-2
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- Lecture 12 - Mattel Toy Recalls and Supply Chain Management
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- Lecture 16 - CEMEX - Part-1
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- Lecture 22 - Li & Fung - Part-1
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- Lecture 25 - Channel Management, Marketing Communication
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[Lecture 33 - I flex \(OFSS\)](#)

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- Lecture 5 - Strategic Management Process (SMP)
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- Lecture 14 - Industry structure, Competitor Analysis
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Lecture 1 - Introduction, Extended Real numbers

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Lecture 4 - (2B) Algebra and Sigma Algebra of Subsets of a Set

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Lecture 6 - (3B) Sigma Algebra generated by a Class

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Lecture 14 - (7B) Countably Additive Set Functions on Intervals

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Lecture 3 - Venn Diagrams, Operations on Sets

Lecture 4 - Operations on Sets, Cardinal Number, Real Numbers

Lecture 5 - Real Numbers, Sequences

Lecture 6 - Sequences, Convergent Sequences, Bounded Sequences

Lecture 7 - Limit Theorems, Sandwich Theorem, Monotone Sequences, Completeness of Real Numbers

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Lecture 9 - Functions, Graph of a Functions, Function Formulas

Lecture 10 - Function Formulas, Linear Models

Lecture 11 - Linear Models, Elasticity, Linear Functions, Nonlinear Models, Quadratic Functions

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Lecture 15 - Limit of a Function at a Point

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Lecture 3 - Motivation for Krull's Dimension

Lecture 4 - Chevalley's dimension

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Lecture 6 - Support of a Module

Lecture 7 - Primary Decomposition

Lecture 8 - Primary Decomposition (Continued...)

Lecture 9 - Uniqueness of Primary Decomposition

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Lecture 12 - Introduction to Krull's Dimension

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Lecture 15 - Nil Radical and Jacobson Radical of Finite type Algebras over a Field and digression of Integral Extension

Lecture 16 - Nagata's version of NNL

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Lecture 18 - Dimension of Polynomial Algebra over arbitrary Rings

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- Lecture 33 - Second proof of Krull's Principal Ideal Theorem
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- Lecture 37 - Connection between Regular local rings and associated graded rings
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- Lecture 45 - Preparation for Homological Dimension
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- Lecture 48 - Homological Dimension and Projective module
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- Lecture 50 - Homological characterization of Regular Local Rings (RLR)
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- Lecture 52 - Homological Characterization of Regular Local Rings (Continued...)
- Lecture 53 - Regular Local Rings are UFD
- Lecture 54 - RLR-Prime ideals of height 1
- Lecture 55 - Discrete Valuation Ring
- Lecture 56 - Discrete Valuation Ring (Continued...)
- Lecture 57 - Dedekind Domains
- Lecture 58 - Fractionary Ideals and Dedekind Domains
- Lecture 59 - Characterization of Dedekind Domain
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- Lecture 2 - Examples of Fields
- Lecture 3 - Polynomials and Basic properties
- Lecture 4 - Polynomial Rings
- Lecture 5 - Unit and Unit Groups
- Lecture 6 - Division with remainder and prime factorization
- Lecture 7 - Zeroes of Polynomials
- Lecture 8 - Polynomial functions
- Lecture 9 - Algebraically closed Fields and statement of FTA
- Lecture 10 - Gauss's Theorem (Uniqueness of factorization)
- Lecture 11 - Digression on Rings homomorphism, Algebras
- Lecture 12 - Kernel of homomorphisms and ideals in  $K[X], \mathbb{Z}$
- Lecture 13 - Algebraic elements
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- Lecture 15 - Minimal Polynomials
- Lecture 16 - Characterization of Algebraic elements
- Lecture 17 - Theorem of Kronecker
- Lecture 18 - Examples
- Lecture 19 - Digression on Groups
- Lecture 20 - Some examples and Characteristic of a Ring
- Lecture 21 - Finite subGroups of the Unit Group of a Field
- Lecture 22 - Construction of Finite Fields
- Lecture 23 - Digression on Group action - I
- Lecture 24 - Automorphism Groups of a Field Extension
- Lecture 25 - Dedekind-Artin Theorem
- Lecture 26 - Galois Extension
- Lecture 27 - Examples of Galois extension
- Lecture 28 - Examples of Automorphism Groups
- Lecture 29 - Digression on Linear Algebra
- Lecture 30 - Minimal and Characteristic Polynomials, Norms, Trace of elements
- Lecture 31 - Primitive Element Theorem for Galois Extension

- Lecture 32 - Fundamental Theorem of Galois Theory
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- Lecture 34 - Cyclotomic extensions
- Lecture 35 - Cyclotomic Polynomials
- Lecture 36 - Irreducibility of Cyclotomic Polynomials over  $\mathbb{Q}$
- Lecture 37 - Reducibility of Cyclotomic Polynomials over Finite Fields
- Lecture 38 - Galois Group of Cyclotomic Polynomials
- Lecture 39 - Extension over a fixed Field of a finite subGroup is Galois Extension
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- Lecture 41 - Correspondence of Normal SubGroups and Galois sub-extensions
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- Lecture 43 - Inverse Galois problem for Abelian Groups
- Lecture 44 - Elementary Symmetric Polynomials
- Lecture 45 - Fundamental Theorem on Symmetric Polynomials
- Lecture 46 - Gal  $(K[X_1, X_2, \dots, X_n]/K[S_1, S_2, \dots, S_n])$
- Lecture 47 - Digression on Symmetric and Alternating Group
- Lecture 48 - Discriminant of a Polynomial
- Lecture 49 - Zeroes and Embeddings
- Lecture 50 - Normal Extensions
- Lecture 51 - Existence of Algebraic Closure
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- Lecture 53 - Proof of The Fundamental Theorem of Algebra
- Lecture 54 - Galois Group of a Polynomial
- Lecture 55 - Perfect Fields
- Lecture 56 - Embeddings
- Lecture 57 - Characterization of finite Separable extension
- Lecture 58 - Primitive Element Theorem
- Lecture 59 - Equivalence of Galois extensions and Normal-Separable extensions
- Lecture 60 - Operation of Galois Group of Polynomial on the set of zeroes
- Lecture 61 - Discriminants
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Lecture 2 - Real Numbers and Sequences - Part II

Lecture 3 - Real Numbers and Sequences - Part III

Lecture 4 - Convergence of Sequences - Part I

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Lecture 16 - Topology of Real Numbers: Compact Sets and Connected Sets - Part I

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Lecture 19 - Topology of Real Numbers: Connected Sets; Limits and Continuity - Part I

Lecture 20 - Topology of Real Numbers: Connected Sets; Limits and Continuity - Part II

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Lecture 22 - Continuity and Uniform continuity - Part I

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Lecture 27 - Uniform continuity and connected sets - Part III

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Lecture 30 - Connected sets and continuity - Part III

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**Co-ordinators : Dr. S. Dharmaraja**

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Lecture 31 - Calculus of Variations and Integral Equations

[Lecture 32 - Calculus of Variations and Integral Equations](#)

[Lecture 33 - Calculus of Variations and Integral Equations](#)

[Lecture 34 - Calculus of Variations and Integral Equations](#)

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[Lecture 36 - Calculus of Variations and Integral Equations](#)

[Lecture 37 - Calculus of Variations and Integral Equations](#)

[Lecture 38 - Calculus of Variations and Integral Equations](#)

[Lecture 39 - Calculus of Variations and Integral Equations](#)

[Lecture 40 - Calculus of Variations and Integral Equations](#)

**NPTEL : Linear programming and Extensions (Mathematics)**

**Co-ordinators : Prof. Prabha Sharma**

Lecture 1 - Introduction to Linear Programming Problems

Lecture 2 - Vector space, Linear independence and dependence, basis

Lecture 3 - Moving from one basic feasible solution to another, optimality criteria

Lecture 4 - Basic feasible solutions, existence & derivation

Lecture 5 - Convex sets, dimension of a polyhedron, Faces, Example of a polytope

Lecture 6 - Direction of a polyhedron, correspondence between bfs and extreme points

Lecture 7 - Representation theorem, LPP solution is a bfs, Assignment 1

Lecture 8 - Development of the Simplex Algorithm, Unboundedness, Simplex Tableau

Lecture 9 - Simplex Tableau & algorithm ,Cycling, Bland's anti-cycling rules, Phase I & Phase II

Lecture 10 - Big-M method,Graphical solutions, adjacent extreme pts and adjacent bfs

Lecture 11 - Assignment 2, progress of Simplex algorithm on a polytope, bounded variable LPP

Lecture 12 - LPP Bounded variable, Revised Simplex algorithm, Duality theory, weak duality theorem

Lecture 13 - Weak duality theorem, economic interpretation of dual variables, Fundamental theorem of duality

Lecture 14 - Examples of writing the dual, complementary slackness theorem

Lecture 15 - Complementary slackness conditions, Dual Simplex algorithm, Assignment 3

Lecture 16 - Primal-dual algorithm

Lecture 17 - Problem in lecture 16, starting dual feasible solution, Shortest Path Problem

Lecture 18 - Shortest Path Problem, Primal-dual method, example

Lecture 19 - Shortest Path Problem-complexity, interpretation of dual variables, post-optimality analysis-changes in the cost vector

Lecture 20 - Assignment 4, postoptimality analysis, changes in b, adding a new constraint, changes in  $\{a_{ij}\}$  , Parametric analysis

Lecture 21 - Parametric LPP-Right hand side vector

Lecture 22 - Parametric cost vector LPP

Lecture 23 - Parametric cost vector LPP, Introduction to Min-cost flow problem

Lecture 24 - Mini-cost flow problem-Transportation problem

Lecture 25 - Transportation problem degeneracy, cycling

Lecture 26 - Sensitivity analysis

Lecture 27 - Sensitivity analysis

Lecture 28 - Bounded variable transportation problem, min-cost flow problem

Lecture 29 - Min-cost flow problem

Lecture 30 - Starting feasible solution, Lexicographic method for preventing cycling ,strongly feasible solution

Lecture 31 - Assignment 6, Shortest path problem, Shortest Path between any two nodes,Detection of negative cycles



[Lecture 32 - Min-cost-flow Sensitivity analysis Shortest path problem sensitivity analysis](#)

[Lecture 33 - Min-cost flow changes in arc capacities , Max-flow problem, assignment 7](#)

[Lecture 34 - Problem 3 \(assignment 7\), Min-cut Max-flow theorem, Labelling algorithm](#)

[Lecture 35 - Max-flow - Critical capacity of an arc, starting solution for min-cost flow problem](#)

[Lecture 36 - Improved Max-flow algorithm](#)

[Lecture 37 - Critical Path Method \(CPM\)](#)

[Lecture 38 - Programme Evaluation and Review Technique \(PERT\)](#)

[Lecture 39 - Simplex Algorithm is not polynomial time- An example](#)

[Lecture 40 - Interior Point Methods](#)

**NPTEL : Convex Optimization (Mathematics)**

**Co-ordinators : Dr. Joydeep Dutta**

Lecture 1 - Convex Optimization

Lecture 2 - Convex Optimization

Lecture 3 - Convex Optimization

Lecture 4 - Convex Optimization

Lecture 5 - Convex Optimization

Lecture 6 - Convex Optimization

Lecture 7 - Convex Optimization

Lecture 8 - Convex Optimization

Lecture 9 - Convex Optimization

Lecture 10 - Convex Optimization

Lecture 11 - Convex Optimization

Lecture 12 - Convex Optimization

Lecture 13 - Convex Optimization

Lecture 14 - Convex Optimization

Lecture 15 - Convex Optimization

Lecture 16 - Convex Optimization

Lecture 17 - Convex Optimization

Lecture 18 - Convex Optimization

Lecture 19 - Convex Optimization

Lecture 20 - Convex Optimization

Lecture 21 - Convex Optimization

Lecture 22 - Convex Optimization

Lecture 23 - Convex Optimization

Lecture 24 - Convex Optimization

Lecture 25 - Convex Optimization

Lecture 26 - Convex Optimization

Lecture 27 - Convex Optimization

Lecture 28 - Convex Optimization

Lecture 29 - Convex Optimization

Lecture 30 - Convex Optimization

Lecture 31 - Convex Optimization

[Lecture 32 - Convex Optimization](#)

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[Lecture 39 - Convex Optimization](#)

[Lecture 40 - Convex Optimization](#)

[Lecture 41 - Convex Optimization](#)

[Lecture 42 - Convex Optimization](#)

**NPTEL : Foundations of Optimization (Mathematics)**

**Co-ordinators : Dr. Joydeep Dutta**

Lecture 1 - Optimization

Lecture 2 - Optimization

Lecture 3 - Optimization

Lecture 4 - Optimization

Lecture 5 - Optimization

Lecture 6 - Optimization

Lecture 7 - Optimization

Lecture 8 - Optimization

Lecture 9 - Optimization

Lecture 10 - Optimization

Lecture 11 - Optimization

Lecture 12 - Optimization

Lecture 13 - Optimization

Lecture 14 - Optimization

Lecture 15 - Optimization

Lecture 16 - Optimization

Lecture 17 - Optimization

Lecture 18 - Optimization

Lecture 19 - Optimization

Lecture 20 - Optimization

Lecture 21 - Optimization

Lecture 22 - Optimization

Lecture 23 - Optimization

Lecture 24 - Optimization

Lecture 25 - Optimization

Lecture 26 - Optimization

Lecture 27 - Optimization

Lecture 28 - Optimization

Lecture 29 - Optimization

Lecture 30 - Optimization

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[Lecture 35 - Optimization](#)

[Lecture 36 - Optimization](#)

[Lecture 37 - Optimization](#)

[Lecture 38 - Optimization](#)

Lecture 1 - Basic principles of counting

Lecture 2 - Sample space, events, axioms of probability

Lecture 3 - Conditional probability, Independence of events

Lecture 4 - Random variables, cumulative density function, expected value

Lecture 5 - Discrete random variables and their distributions

Lecture 6 - Discrete random variables and their distributions

Lecture 7 - Discrete random variables and their distributions

Lecture 8 - Continuous random variables and their distributions

Lecture 9 - Continuous random variables and their distributions

Lecture 10 - Continuous random variables and their distributions

Lecture 11 - Function of random variables, Moment generating function

Lecture 12 - Jointly distributed random variables, Independent r. v. and their sums

Lecture 13 - Independent r. v. and their sums

Lecture 14 - Chi  $\chi^2$  square r. v., sums of independent normal r. v., Conditional distr

Lecture 15 - Conditional disti, Joint distr. of functions of r. v., Order statistics

Lecture 16 - Order statistics, Covariance and correlation

Lecture 17 - Covariance, Correlation, Cauchy- Schwarz inequalities, Conditional expectation

Lecture 18 - Conditional expectation, Best linear predictor

Lecture 19 - Inequalities and bounds

Lecture 20 - Convergence and limit theorems

Lecture 21 - Central limit theorem

Lecture 22 - Applications of central limit theorem

Lecture 23 - Strong law of large numbers, Joint mgf

Lecture 24 - Convolutions

Lecture 25 - Stochastic processes: Markov process

Lecture 26 - Transition and state probabilities

Lecture 27 - State prob., First passage and First return prob

Lecture 28 - First passage and First return prob. Classification of states

Lecture 29 - Random walk, periodic and null states

Lecture 30 - Reducible Markov chains

Lecture 31 - Time reversible Markov chains

[Lecture 32 - Poisson Processes](#)

[Lecture 33 - Inter-arrival times, Properties of Poisson processes](#)

[Lecture 34 - Queuing Models: M/M/I, Birth and death process, Little's formulae](#)

[Lecture 35 - Analysis of  \$L\$ ,  \$L\_q\$ ,  \$W\$  and  \$W\_q\$ , M/M/S model](#)

[Lecture 36 - M/M/S, M/M/I/K models](#)

[Lecture 37 - M/M/I/K and M/M/S/K models](#)

[Lecture 38 - Application to reliability theory failure law](#)

[Lecture 39 - Exponential failure law, Weibull law](#)

[Lecture 40 - Reliability of systems](#)

Lecture 1 - Numbers

Lecture 2 - Functions-1

Lecture 3 - Sequence-1

Lecture 4 - Sequence-2

Lecture 5 - Limits and Continuity-1

Lecture 6 - Limits and Continuity-2

Lecture 7 - Limits And Continuity-3

Lecture 8 - Derivative-1

Lecture 9 - Derivative-2

Lecture 10 - Maxima And Minima

Lecture 11 - Mean-Value Theorem And Taylors Expansion-1

Lecture 12 - Mean-Value Theorem And Taylors Expansion-2

Lecture 13 - Integration-1

Lecture 14 - Integration-2

Lecture 15 - Integration By Parts

Lecture 16 - Definite Integral

Lecture 17 - Riemann Integration-1

Lecture 18 - Riemann Integration-2

Lecture 19 - Functions Of Two Or More Variables

Lecture 20 - Limits And Continuity Of Functions Of Two Variable

Lecture 21 - Differentiation Of Functions Of Two Variables-1

Lecture 22 - Differentiation Of Functions Of Two Variables-2

Lecture 23 - Unconstrained Minimization Of Funtions Of Two Variables

Lecture 24 - Constrained Minimization And Lagrange Multiplier Rules

Lecture 25 - Infinite Series-1

Lecture 26 - Infinite Series-2

Lecture 27 - Infinite Series-3

Lecture 28 - Multiple Integrals-1

Lecture 29 - Multiple Integrals-2

Lecture 30 - Multiple Integrals-3



Lecture 1 - Basic Probability

Lecture 2 - Interesting Problems In Probability

Lecture 3 - Random variables, distribution function and independence

Lecture 4 - Chebyshev inequality, Borel-Cantelli Lemmas and related issues

Lecture 5 - Law of Large Number and Central Limit Theorem

Lecture 6 - Conditional Expectation - I

Lecture 7 - Conditional Expectation - II

Lecture 8 - Martingales

Lecture 9 - Brownian Motion - I

Lecture 10 - Brownian Motion - II

Lecture 11 - Brownian Motion - III

Lecture 12 - Ito Integral - I

Lecture 13 - Ito Integral - II

Lecture 14 - Ito Calculus - I

Lecture 15 - Ito Calculus - II

Lecture 16 - Ito Integral In Higher Dimension

Lecture 17 - Application to Ito Integral - I

Lecture 18 - Application to Ito Integral - II

Lecture 19 - Black Scholes Formula - I

Lecture 20 - Black Scholes Formula - II

Lecture 1 - Introduction to Several Variables and Notion Of distance in  $R^n$

Lecture 2 - Countinuity And Compactness

Lecture 3 - Countinuity And Connectdness

Lecture 4 - Derivatives: Possible Definition

Lecture 5 - Matrix Of Linear Transformation

Lecture 6 - Examples for Differentiable function

Lecture 7 - Sufficient condition of differentiability

Lecture 8 - Chain Rule

Lecture 9 - Mean Value Theorem

Lecture 10 - Higher Order Derivatives

Lecture 11 - Taylor's Formula

Lecture 12 - Maximum And Minimum

Lecture 13 - Second derivative test for maximum, minimum and saddle point

Lecture 14 - We formalise the second derivative test discussed in Lecture 2 and do examples

Lecture 15 - Specialisation to functions of two variables

Lecture 16 - Implicit Function Theorem

Lecture 17 - Implicit Function Theorem -a

Lecture 18 - Application of IFT: Lagrange's Multipliers Method

Lecture 19 - Application of IFT: Lagrange's Multipliers Method - b

Lecture 20 - Application of IFT: Lagrange's Multipliers Method - c

Lecture 21 - Application of IFT: Inverse Function Theorem - c

- Lecture 1 - Level curves and locus, definition of parametric curves, tangent, arc length, arc length parametrisation
- Lecture 2 - How much a curve is 'curved', signed unit normal and signed curvature, rigid motions, constant curvature
- Lecture 3 - Curves in  $\mathbb{R}^3$ , principal normal and binormal, torsion
- Lecture 4 - Frenet-Serret formula
- Lecture 5 - Simple closed curve and isoperimetric inequality
- Lecture 6 - Surfaces and parametric surfaces, examples, regular surface and non-example of regular surface, transition maps.
- Lecture 7 - Transition maps of smooth surfaces, smooth function between surfaces, diffeomorphism
- Lecture 8 - Reparameterization
- Lecture 9 - Tangent, Normal
- Lecture 10 - Orientable surfaces
- Lecture 11 - Examples of Surfaces
- Lecture 12 - First Fundamental Form
- Lecture 13 - Conformal Mapping
- Lecture 14 - Curvature of Surfaces
- Lecture 15 - Euler's Theorem
- Lecture 16 - Regular Surfaces locally as Quadratic Surfaces
- Lecture 17 - Geodesics
- Lecture 18 - Existence of Geodesics, Geodesics on Surfaces of revolution
- Lecture 19 - Geodesics on surfaces of revolution; Clairaut's Theorem
- Lecture 20 - Pseudosphere
- Lecture 21 - Classification of Quadratic Surface
- Lecture 22 - Surface Area and Equiareal Map

Lecture 1 - Basic Fundamental Concepts Of Modelling

Lecture 2 - Regression Model - A Statistical Tool

Lecture 3 - Simple Linear Regression Analysis

Lecture 4 - Estimation Of Parameters In Simple Linear Regression Model

Lecture 5 - Estimation Of Parameters In Simple Linear Regression Model (Continued...) : Some Nice Properties

Lecture 6 - Estimation Of Parameters In Simple Linear Regression Model (Continued...)

Lecture 7 - Maximum Likelihood Estimation of Parameters in Simple Linear Regression Model

Lecture 8 - Testing of Hypothesis and Confidence Interval Estimation in Simple Linear Regression Model

Lecture 9 - Testing of Hypothesis and Confidence Interval Estimation in Simple Linear Regression Model (Continued...)

Lecture 10 - Software Implementation in Simple Linear Regression Model using MINITAB

Lecture 11 - Multiple Linear Regression Model

Lecture 12 - Estimation of Model Parameters in Multiple Linear Regression Model

Lecture 13 - Estimation of Model Parameters in Multiple Linear Regression Model (Continued...)

Lecture 14 - Standardized Regression Coefficients and Testing of Hypothesis

Lecture 15 - Testing of Hypothesis (Continued...) and Goodness of Fit of the Model

Lecture 16 - Diagnostics in Multiple Linear Regression Model

Lecture 17 - Diagnostics in Multiple Linear Regression Model (Continued...)

Lecture 18 - Diagnostics in Multiple Linear Regression Model (Continued...)

Lecture 19 - Software Implementation of Multiple Linear Regression Model using MINITAB

Lecture 20 - Software Implementation of Multiple Linear Regression Model using MINITAB (Continued...)

Lecture 21 - Forecasting in Multiple Linear Regression Model

Lecture 22 - Within Sample Forecasting

Lecture 23 - Outside Sample Forecasting

Lecture 24 - Software Implementation of Forecasting using MINITAB

Lecture 1 - How to Learn and Follow the Course

Lecture 2 - Why R and Installation Procedure

Lecture 3 - Introduction \_Help\_ Demo examples \_packages\_ libraries

Lecture 4 - Introduction \_Command line\_ Data editor \_ Rstudio

Lecture 5 - Basics in Calculations

Lecture 6 - Basics of Calculations \_ Calculator \_Built in Functions Assignments

Lecture 7 - Basics of Calculations \_Functions \_Matrices

Lecture 8 - Basics Calculations: Matrix Operations

Lecture 9 - Basics Calculations: Matrix operations

Lecture 10 - Basics Calculations: Missing data and logical operators

Lecture 11 - Basics Calculations: Logical operators

Lecture 12 - Basics Calculations: Truth table and conditional executions

Lecture 13 - Basics Calculations: Conditional executions and loops

Lecture 14 - Basics Calculations: Loops

Lecture 15 - Data management - Sequences

Lecture 16 - Data management - sequences

Lecture 17 - Data management - Repeats

Lecture 18 - Data management - Sorting and Ordering

Lecture 19 - Data management - Lists

Lecture 20 - Data management - Lists (Continued...)

Lecture 21 - Data management - Vector indexing

Lecture 22 - Data management - Vector Indexing (Continued...)

Lecture 23 - Data management - Factors

Lecture 24 - Data management - factors (Continued...)

Lecture 25 - Strings - Display and Formatting, Print and Format Functions

Lecture 26 - Strings - Display and Formatting, Print and Format with Concatenate

Lecture 27 - Strings - Display and Formatting, Paste Function

Lecture 28 - Strings - Display and Formatting, Splitting

Lecture 29 - Strings - Display and Formatting, Replacement\_ Manipulations \_Alphabets

Lecture 30 - Strings - Display and Formatting, Replacement and Evaluation of Strings

Lecture 31 - Data frames

[Lecture 32 - Data frames \(Continued...\)](#)

[Lecture 33 - Data frames \(Continued...\)](#)

[Lecture 34 - Data Handling - Importing CSV and Tabular Data Files](#)

[Lecture 35 - Data Handling - Importing Data Files from Other Software](#)

[Lecture 36 - Statistical Functions - Frequency and Partition values](#)

[Lecture 37 - Statistical Functions - Graphics and Plots](#)

[Lecture 38 - Statistical Functions - Central Tendency and Variation](#)

[Lecture 39 - Statistical Functions - Boxplots, Skewness and Kurtosis](#)

[Lecture 40 - Statistical Functions - Bivariate three dimensional plot](#)

[Lecture 41 - Statistical Functions - Correlation and Examples of Programming](#)

[Lecture 42 - Examples of Programming](#)

[Lecture 43 - Examples of More Programming](#)

Lecture 1 - Introduction to R Software

Lecture 2 - Basics and R as a Calculator

Lecture 3 - Calculations with Data Vectors

Lecture 4 - Built-in Commands and Missing Data Handling

Lecture 5 - Operations with Matrices

Lecture 6 - Objectives, Steps and Basic Definitions

Lecture 7 - Variables and Types of Data

Lecture 8 - Absolute Frequency, Relative Frequency and Frequency Distribution

Lecture 9 - Frequency Distribution and Cumulative Distribution Function

Lecture 10 - Bar Diagrams

Lecture 11 - Subdivided Bar Plots and Pie Diagrams

Lecture 12 - 3D Pie Diagram and Histogram

Lecture 13 - Kernel Density and Stem - Leaf Plots

Lecture 14 - Arithmetic Mean

Lecture 15 - Median

Lecture 16 - Quantiles

Lecture 17 - Mode, Geometric Mean and Harmonic Mean

Lecture 18 - Range, Interquartile Range and Quartile Deviation

Lecture 19 - Absolute Deviation and Absolute Mean Deviation

Lecture 20 - Mean Squared Error, Variance and Standard Deviation

Lecture 21 - Coefficient of Variation and Boxplots

Lecture 22 - Raw and Central Moments

Lecture 23 - Sheppard's Correction, Absolute Moments and Computation of Moments

Lecture 24 - Skewness and Kurtosis

Lecture 25 - Univariate and Bivariate Scatter Plots

Lecture 26 - Smooth Scatter Plots

Lecture 27 - Quantile-Quantile and Three Dimensional Plots

Lecture 28 - Correlation Coefficient

Lecture 29 - Correlation Coefficient Using R Software

Lecture 30 - Rank Correlation Coefficient

Lecture 31 - Measures of Association for Discrete and Counting Variables - Part 1

[Lecture 32 - Measures of Association for Discrete and Counting Variables - Part 2](#)

[Lecture 33 - Least Squares Method - One Variable](#)

[Lecture 34 - Least Squares Method - R Commands and More than One Variables](#)



- Lecture 1 - Vectors in plane and space
- Lecture 2 - Inner product and distance
- Lecture 3 - Application to real world problems
- Lecture 4 - Matrices and determinants
- Lecture 5 - Cross product of two vectors
- Lecture 6 - Higher dimensional Euclidean space
- Lecture 7 - Functions of more than one real-variable
- Lecture 8 - Partial derivatives and Continuity
- Lecture 9 - Vector-valued maps and Jacobian matrix
- Lecture 10 - Chain rule for partial derivatives
- Lecture 11 - The Gradient Vector and Directional Derivative
- Lecture 12 - The Implicit Function Theorem
- Lecture 13 - Higher Order Partial Derivatives
- Lecture 14 - Taylor's Theorem in Higher Dimension
- Lecture 15 - Maxima and Minima for Several Variables
- Lecture 16 - Second Derivative Test for Maximum and Minimum
- Lecture 17 - Constrained Optimization and The Lagrange Multiplier Rule
- Lecture 18 - Vector Valued Function and Classical Mechanics
- Lecture 19 - Arc Length
- Lecture 20 - Vector Fields
- Lecture 21 - Multiple Integral - I
- Lecture 22 - Multiple Integral - II
- Lecture 23 - Multiple Integral - III
- Lecture 24 - Multiple Integral - IV
- Lecture 25 - Cylindrical and Spherical Coordinates
- Lecture 26 - Multiple Integrals and Mechanics
- Lecture 27 - Line Integral - I
- Lecture 28 - Line Integral - II
- Lecture 29 - Parametrized Surfaces
- Lecture 30 - Area of a surface Integral
- Lecture 31 - Area of parametrized surface

[Lecture 32 - Surface Integrals](#)

[Lecture 33 - Green's Theorem](#)

[Lecture 34 - Stoke's Theorem](#)

[Lecture 35 - Examples of Stoke's Theorem](#)

[Lecture 36 - Gauss Divergence Theorem](#)

[Lecture 37 - Facts about vector fields](#)

Lecture 1 - Notations, Motivation and Definition

Lecture 2 - Matrix: Examples, Transpose and Addition

Lecture 3 - Matrix Multiplication

Lecture 4 - Matrix Product Recalled

Lecture 5 - Matrix Product (Continued...)

Lecture 6 - Inverse of a Matrix

Lecture 7 - Introduction to System of Linear Equations

Lecture 8 - Some Initial Results on Linear Systems

Lecture 9 - Row Echelon Form (REF)

Lecture 10 - LU Decomposition - Simplest Form

Lecture 11 - Elementary Matrices

Lecture 12 - Row Reduced Echelon Form (RREF)

Lecture 13 - Row Reduced Echelon Form (RREF) (Continued...)

Lecture 14 - RREF and Inverse

Lecture 15 - Rank of a matrix

Lecture 16 - Solution Set of a System of Linear Equations

Lecture 17 - System of n Linear Equations in n Unknowns

Lecture 18 - Determinant

Lecture 19 - Permutations and the Inverse of a Matrix

Lecture 20 - Inverse and the Cramer's Rule

Lecture 21 - Vector Spaces

Lecture 22 - Vector Subspaces and Linear Span

Lecture 23 - Linear Combination, Linear Independence and Dependence

Lecture 24 - Basic Results on Linear Independence

Lecture 25 - Results on Linear Independence (Continued...)

Lecture 26 - Basis of a Finite Dimensional Vector Space

Lecture 27 - Fundamental Spaces associated with a Matrix

Lecture 28 - Rank - Nullity Theorem

Lecture 29 - Fundamental Theorem of Linear Algebra

Lecture 30 - Definition and Examples of Linear Transformations

Lecture 31 - Results on Linear Transformations

- Lecture 32 - Rank-Nullity Theorem and Applications
- Lecture 33 - Isomorphism of Vector Spaces
- Lecture 34 - Ordered Basis of a Finite Dimensional Vector Space
- Lecture 35 - Ordered Basis (Continued...)
- Lecture 36 - Matrix of a Linear Transformation
- Lecture 37 - Matrix of a Linear Transformation (Continued...)
- Lecture 38 - Matrix of a Linear Transformation (Continued...)
- Lecture 39 - Similarity of Matrices
- Lecture 40 - Inner Product Space
- Lecture 41 - Inner Product (Continued...)
- Lecture 42 - Cauchy Schwartz Inequality
- Lecture 43 - Projection on a Vector
- Lecture 44 - Results on Orthogonality
- Lecture 45 - Results on Orthogonality (Continued...)
- Lecture 46 - Gram-Schmidt Orthonormalization Process
- Lecture 47 - Orthogonal Projections
- Lecture 48 - Gram-Schmidt Process: Applications
- Lecture 49 - Examples and Applications on QR-decomposition
- Lecture 50 - Recapitulate ideas on Inner Product Spaces
- Lecture 51 - Motivation on Eigenvalues and Eigenvectors
- Lecture 52 - Examples and Introduction to Eigenvalues and Eigenvectors
- Lecture 53 - Results on Eigenvalues and Eigenvectors
- Lecture 54 - Results on Eigenvalues and Eigenvectors (Continued...)
- Lecture 55 - Results on Eigenvalues and Eigenvectors (Continued...)
- Lecture 56 - Diagonalizability
- Lecture 57 - Diagonalizability (Continued...)
- Lecture 58 - Schur's Unitary Triangularization (SUT)
- Lecture 59 - Applications of Schur's Unitary Triangularization
- Lecture 60 - Spectral Theorem for Hermitian Matrices
- Lecture 61 - Cayley Hamilton Theorem
- Lecture 62 - Quadratic Forms
- Lecture 63 - Sylvester's Law of Inertia
- Lecture 64 - Applications of Quadratic Forms to Analytic Geometry

[Lecture 65 - Examples of Conics and Quartics](#)

[Lecture 66 - Singular Value Decomposition \(SVD\)](#)

Lecture 1 - Introduction: Computation and Algebra

Lecture 2 - Background

Lecture 3 - GCD algorithm and Chinese Remainder Theorem

Lecture 4 - Fast polynomial multiplication

Lecture 5 - Fast polynomial multiplication (Continued...)

Lecture 6 - Fast integer multiplication and division

Lecture 7 - Fast integer arithmetic and matrix multiplication

Lecture 8 - Matrix Multiplication Tensor

Lecture 9 - Polynomial factoring over finite fields: Irreducibility testing

Lecture 10 - Equi-degree factorization and idea of Berlekamp's algorithm

Lecture 11 - Berlekamp's algorithm as a reduction method

Lecture 12 - Factoring over finite fields: Cantor-Zassenhaus algorithm

Lecture 13 - Reed Solomon Error Correcting Codes

Lecture 14 - List Decoding

Lecture 15 - Bivariate Factorization - Hensel Lifting

Lecture 16 - Bivariate polynomial factoring (Continued...)

Lecture 17 - Multivariate Polynomial Factorization

Lecture 18 - Multivariate Factoring - Hilbert's Irreducibility Theorem

Lecture 19 - Multivariate factoring (Continued...)

Lecture 20 - Analysis of LLL algorithm

Lecture 21 - Analysis of LLL algorithm (Continued...)

Lecture 22 - Analysis of LLL-reduced basis algorithm and Introduction to NTRU cryptosystem

Lecture 23 - NTRU cryptosystem (Continued...) and Introduction to Primality testing

Lecture 24 - Randomized Primality testing: Solovay-Strassen and Miller-Rabin tests

Lecture 25 - Deterministic primality test (AKS) and RSA cryptosystem

Lecture 26 - Integer factoring: Smooth numbers and Pollard's rho method

Lecture 27 - Pollard's p-1, Fermat, Morrison-Brillhart, Quadratic and Number field sieve methods

- Lecture 1 - Real numbers and Archimedean property
- Lecture 2 - Supremum and Decimal representation of Reals
- Lecture 3 - Functions
- Lecture 4 - Functions continued and Limits
- Lecture 5 - Limits (Continued...)
- Lecture 6 - Limits (Continued...) and Continuity
- Lecture 7 - Continuity and Intermediate Value Property
- Lecture 8 - Differentiation
- Lecture 9 - Chain Rule
- Lecture 10 - Nth derivative of a function
- Lecture 11 - Local extrema and Rolle's theorem
- Lecture 12 - Mean value theorem and Monotone functions
- Lecture 13 - Local extremum tests
- Lecture 14 - Concavity and points of inflection
- Lecture 15 - Asymptotes and plotting graph of functions
- Lecture 16 - Optimization and L'Hospital Rule
- Lecture 17 - L'Hospital Rule continued and Cauchy Mean value theorem
- Lecture 18 - Approximation of Roots
- Lecture 19 - Antiderivative and Riemann Integration
- Lecture 20 - Riemann's criterion for Integrability
- Lecture 21 - Integration and its properties
- Lecture 22 - Area and Mean value theorem for integrals
- Lecture 23 - Fundamental theorem of Calculus
- Lecture 24 - Integration by parts and Trapezoidal rule
- Lecture 25 - Simpson's rule and Substitution in integrals
- Lecture 26 - Area between curves
- Lecture 27 - Arc Length and Parametric curves
- Lecture 28 - Polar Co-ordinates
- Lecture 29 - Area of curves in polar coordinates
- Lecture 30 - Volume of solids
- Lecture 31 - Improper Integrals

[Lecture 32 - Sequences](#)

[Lecture 33 - Algebra of sequences and Sandwich theorem](#)

[Lecture 34 - Subsequences](#)

[Lecture 35 - Series](#)

[Lecture 36 - Comparison tests for Series](#)

[Lecture 37 - Ratio and Root test for series](#)

[Lecture 38 - Integral test and Leibniz test for series](#)

[Lecture 39 - Revision - I](#)

[Lecture 40 - Revision - II](#)



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**Co-ordinators : Prof. P.D. Srivastava**

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- Lecture 3 - Various Concepts in a Metric Space
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- Lecture 8 - Vector Spaces with Examples
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**NPTEL : Optimization (Mathematics)**

**Co-ordinators : Prof. A. Goswami, Dr. Debjani Chakraborty**

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Lecture 20 - Travelling Salesman Problem

Lecture 21 - Classical optimization techniques : Single variable optimization

Lecture 22 - Unconstrained multivariable optimization

Lecture 23 - Nonlinear programming with equality constraint

Lecture 24 - Nonlinear programming KKT conditions

Lecture 25 - Numerical optimization : Region elimination techniques

Lecture 26 - Numerical optimization : Region elimination techniques (Continued.)

Lecture 27 - Fibonacci Method

Lecture 28 - Golden Section Methods

Lecture 29 - Interpolation Methods

Lecture 30 - Unconstrained optimization techniques : Direct search method

Lecture 31 - Unconstrained optimization techniques : Indirect search method

[Lecture 32 - Nonlinear programming : constrained optimization techniques](#)

[Lecture 33 - Interior and Exterior penalty Function Method](#)

[Lecture 34 - Separable Programming Problem](#)

[Lecture 35 - Introduction to Geometric Programming](#)

[Lecture 36 - Constrained Geometric Programming Problem](#)

[Lecture 37 - Dynamic Programming Problem](#)

[Lecture 38 - Dynamic Programming Problem \(Continued.\)](#)

[Lecture 39 - Multi Objective Decision Making](#)

[Lecture 40 - Multi attribute decision making](#)

**NPTEL : Probability and Statistics (Mathematics)**

**Co-ordinators : Prof. Somesh Kumar**

Lecture 1 - Algebra of Sets - I

Lecture 2 - Algebra of Sets - II

Lecture 3 - Introduction to Probability

Lecture 4 - Laws of Probability - I

Lecture 5 - Laws of Probability - II

Lecture 6 - Problems in Probability

Lecture 7 - Random Variables

Lecture 8 - Probability Distributions

Lecture 9 - Characteristics of Distribution

Lecture 10 - Special Distributions - I

Lecture 11 - Special Distributions - II

Lecture 12 - Special Distributions - III

Lecture 13 - Special Distributions - IV

Lecture 14 - Special Distributions - V

Lecture 15 - Special Distributions - VI

Lecture 16 - Special Distributions - VII

Lecture 17 - Functions of a Random Variable

Lecture 18 - Joint Distributions - I

Lecture 19 - Joint Distributions - II

Lecture 20 - Joint Distributions - III

Lecture 21 - Joint Distributions - IV

Lecture 22 - Transformations of Random Vectors

Lecture 23 - Sampling Distributions - I

Lecture 24 - Sampling Distributions - II

Lecture 25 - Descriptive Statistics - I

Lecture 26 - Descriptive Statistics - II

Lecture 27 - Estimation - I

Lecture 28 - Estimation - II

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[Lecture 33 - Testing of Hypothesis - I](#)

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[Lecture 35 - Testing of Hypothesis - III](#)

[Lecture 36 - Testing of Hypothesis - IV](#)

[Lecture 37 - Testing of Hypothesis - V](#)

[Lecture 38 - Testing of Hypothesis - VI](#)

[Lecture 39 - Testing of Hypothesis - VII](#)

[Lecture 40 - Testing of Hypothesis - VIII](#)

**NPTEL : Regression Analysis (Mathematics)**

**Co-ordinators : Dr. Soumen Maity**

Lecture 1 - Simple Linear Regression

Lecture 2 - Simple Linear Regression (Continued...1)

Lecture 3 - Simple Linear Regression (Continued...2)

Lecture 4 - Simple Linear Regression (Continued...3)

Lecture 5 - Simple Linear Regression (Continued...4)

Lecture 6 - Multiple Linear Regression

Lecture 7 - Multiple Linear Regression (Continued...1)

Lecture 8 - Multiple Linear Regression (Continued...2)

Lecture 9 - Multiple Linear Regression (Continued...3)

Lecture 10 - Selecting the BEST Regression model

Lecture 11 - Selecting the BEST Regression model (Continued...1)

Lecture 12 - Selecting the BEST Regression model (Continued...2)

Lecture 13 - Selecting the BEST Regression model (Continued...3)

Lecture 14 - Multicollinearity

Lecture 15 - Multicollinearity (Continued...1)

Lecture 16 - Multicollinearity (Continued...2)

Lecture 17 - Model Adequacy Checking

Lecture 18 - Model Adequacy Checking (Continued...1)

Lecture 19 - Model Adequacy Checking (Continued...2)

Lecture 20 - Test for Influential Observations

Lecture 21 - Transformations and Weighting to correct model inadequacies

Lecture 22 - Transformations and Weighting to correct model inadequacies (Continued...1)

Lecture 23 - Transformations and Weighting to correct model inadequacies (Continued...2)

Lecture 24 - Dummy Variables

Lecture 25 - Dummy Variables (Continued...1)

Lecture 26 - Dummy Variables (Continued...2)

Lecture 27 - Polynomial Regression Models

Lecture 28 - Polynomial Regression Models (Continued...1)

Lecture 29 - Polynomial Regression Models (Continued...2)

Lecture 30 - Generalized Linear Models

Lecture 31 - Generalized Linear Models (Continued.)



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[Lecture 33 - Regression Models with Autocorrelated Errors](#)

[Lecture 34 - Regression Models with Autocorrelated Errors \(Continued.\)](#)

[Lecture 35 - Measurement Errors & Calibration Problem](#)

[Lecture 36 - Tutorial - I](#)

[Lecture 37 - Tutorial - II](#)

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- Lecture 2 - Basic Concepts of Point Estimations - I
- Lecture 3 - Basic Concepts of Point Estimations - II
- Lecture 4 - Finding Estimators - I
- Lecture 5 - Finding Estimators - II
- Lecture 6 - Finding Estimators - III
- Lecture 7 - Properties of MLEs
- Lecture 8 - Lower Bounds for Variance - I
- Lecture 9 - Lower Bounds for Variance - II
- Lecture 10 - Lower Bounds for Variance - III
- Lecture 11 - Lower Bounds for Variance - IV
- Lecture 12 - Sufficiency
- Lecture 13 - Sufficiency and Information
- Lecture 14 - Minimal Sufficiency, Completeness
- Lecture 15 - UMVU Estimation, Ancillarity
- Lecture 16 - Invariance - I
- Lecture 17 - Invariance - II
- Lecture 18 - Bayes and Minimax Estimation - I
- Lecture 19 - Bayes and Minimax Estimation - II
- Lecture 20 - Bayes and Minimax Estimation - III
- Lecture 21 - Testing of Hypotheses : Basic Concepts
- Lecture 22 - Neyman Pearson Fundamental Lemma
- Lecture 23 - Applications of NP lemma
- Lecture 24 - UMP Tests
- Lecture 25 - UMP Tests (Continued.)
- Lecture 26 - UMP Unbiased Tests
- Lecture 27 - UMP Unbiased Tests (Continued.)
- Lecture 28 - UMP Unbiased Tests : Applications
- Lecture 29 - Unbiased Tests for Normal Populations
- Lecture 30 - Unbiased Tests for Normal Populations (Continued.)
- Lecture 31 - Likelihood Ratio Tests - I

[Lecture 32 - Likelihood Ratio Tests - II](#)

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[Lecture 35 - Invariant Tests](#)

[Lecture 36 - Test for Goodness of Fit](#)

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[Lecture 38 - Sequential Procedure \(Continued.\)](#)

[Lecture 39 - Confidence Intervals](#)

[Lecture 40 - Confidence Intervals \(Continued.\)](#)

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Lecture 2 - Irrational numbers, Dedekind's Theorem

Lecture 3 - Continuum and Exercises

Lecture 4 - Continuum and Exercises (Continued.)

Lecture 5 - Cantor's Theory of Irrational Numbers

Lecture 6 - Cantor's Theory of Irrational Numbers (Continued.)

Lecture 7 - Equivalence of Dedekind and Cantor's Theory

Lecture 8 - Finite, Infinite, Countable and Uncountable Sets of Real Numbers

Lecture 9 - Types of Sets with Examples, Metric Space

Lecture 10 - Various properties of open set, closure of a set

Lecture 11 - Ordered set, Least upper bound, greatest lower bound of a set

Lecture 12 - Compact Sets and its properties

Lecture 13 - Weiersstrass Theorem, Heine Borel Theorem, Connected set

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Lecture 15 - Concept of limit of a sequence

Lecture 16 - Some Important limits, Ratio tests for sequences of Real Numbers

Lecture 17 - Cauchy theorems on limit of sequences with examples

Lecture 18 - Fundamental theorems on limits, Bolzano-Weiersstrass Theorem

Lecture 19 - Theorems on Convergent and divergent sequences

Lecture 20 - Cauchy sequence and its properties

Lecture 21 - Infinite series of real numbers

Lecture 22 - Comparison tests for series, Absolutely convergent and Conditional convergent series

Lecture 23 - Tests for absolutely convergent series

Lecture 24 - Raabe's test, limit of functions, Cluster point

Lecture 25 - Some results on limit of functions

Lecture 26 - Limit Theorems for functions

Lecture 27 - Extension of limit concept (one sided limits)

Lecture 28 - Continuity of Functions

Lecture 29 - Properties of Continuous Functions

Lecture 30 - Boundedness Theorem, Max-Min Theorem and Bolzano's theorem

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[Lecture 33 - Continuity and Compactness \(Continued.\), Connectedness](#)

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[Lecture 35 - Mean Value Theorem \(Continued.\)](#)

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[Lecture 44 - Fundamental Theorems of Integral Calculus](#)

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Lecture 2 - Laws of Probability

Lecture 3 - Random Variables

Lecture 4 - Moments and Special Distributions

Lecture 5 - Moments and Special Distributions (Continued...)

Lecture 6 - Special Distributions (Continued...)

Lecture 7 - Special Distributions (Continued...)

Lecture 8 - Sampling Distributions

Lecture 9 - Parametric Methods - I

Lecture 10 - Parametric Methods - II

Lecture 11 - Parametric Methods - III

Lecture 12 - Parametric Methods - IV

Lecture 13 - Parametric Methods - V

Lecture 14 - Parametric Methods - VI

Lecture 15 - Parametric Methods - VII

Lecture 16 - Multivariate Analysis - I

Lecture 17 - Multivariate Analysis - II

Lecture 18 - Multivariate Analysis - III

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Lecture 1 - Sets, Classes, Collection

Lecture 2 - Sequence of Sets

Lecture 3 - Ring, Field (Algebra)

Lecture 4 - Sigma-Ring, Sigma-Field, Monotone Class

Lecture 5 - Random Experiment, Events

Lecture 6 - Definitions of Probability

Lecture 7 - Properties of Probability Function - I

Lecture 8 - Properties of Probability Function - II

Lecture 9 - Conditional Probability

Lecture 10 - Independence of Events

Lecture 11 - Problems in Probability - I

Lecture 12 - Problems in Probability - II

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Lecture 14 - Probability Distribution of a Random Variable - I

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Lecture 19 - Special Discrete Distributions - I

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Lecture 24 - Special Continuous Distributions - I

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Lecture 26 - Special Continuous Distributions - III

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- Lecture 32 - Problems on Special Distributions - II
- Lecture 33 - Function of a random variable - I
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- Lecture 37 - Independence, Product Moments
- Lecture 38 - Linearity Property of Correlation and Examples
- Lecture 39 - Bivariate Normal Distribution - I
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- Lecture 41 - Additive Properties of Distributions - I
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- Lecture 43 - Transformation of Random Variables
- Lecture 44 - Distribution of Order Statistics
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- Lecture 47 - Chi-Square Distribution (Continued...), t-Distribution
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- Lecture 50 - Descriptive Statistics - II
- Lecture 51 - Descriptive Statistics - III
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- Lecture 53 - Introduction to Estimation
- Lecture 54 - Unbiased and Consistent Estimators
- Lecture 55 - LSE, MME
- Lecture 56 - Examples on MME, MLE
- Lecture 57 - Examples on MLE - I
- Lecture 58 - Examples on MLE - II, MSE
- Lecture 59 - UMVUE, Sufficiency, Completeness
- Lecture 60 - Rao - Blackwell Theorem and Its Applications
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Lecture 2 - Introduction to Multivariate Statistical Modeling: Data types, models, and modeling

Lecture 3 - Statistical approaches to model building

Lecture 4 - Statistical approaches to model building (Continued...)

Lecture 5 - Univariate Descriptive Statistics

Lecture 6 - Univariate Descriptive Statistics (Continued...)

Lecture 7 - Normal Distribution and Chi-squared Distribution

Lecture 8 - t-distribution, F-distribution, and Central Limit Theorem

Lecture 9 - Univariate Inferential Statistics: Estimation

Lecture 10 - Univariate Inferential Statistics: Estimation (Continued...)

Lecture 11 - Univariate Inferential Statistics: Hypothesis Testing

Lecture 12 - Hypothesis Testing (Continued...): Decision Making Scenarios

Lecture 13 - Multivariate Descriptive Statistics: Mean Vector

Lecture 14 - Multivariate Descriptive Statistics: Covariance Matrix

Lecture 15 - Multivariate Descriptive Statistics: Correlation Matrix

Lecture 16 - Multivariate Descriptive Statistics: Relationship between correlation and covariance matrices

Lecture 17 - Multivariate Normal Distribution

Lecture 18 - Multivariate Normal Distribution (Continued...)

Lecture 19 - Multivariate Normal Distribution (Continued...): Geometrical Interpretation

Lecture 20 - Multivariate Normal Distribution (Continued...): Examining data for multivariate normal distribution

Lecture 21 - Multivariate Inferential Statistics: Basics and Hotelling T-square statistic

Lecture 22 - Multivariate Inferential Statistics: Confidence Region

Lecture 23 - Multivariate Inferential Statistics: Simultaneous confidence interval and Hypothesis testing

Lecture 24 - Multivariate Inferential Statistics: Hypothesis testing for equality of two population mean vectors

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Lecture 31 - Multivariate Analysis of Variance (MANOVA): Conceptual Model

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Lecture 2 - Classification of PDE

Lecture 3 - Principle of Linear Superposition

Lecture 4 - Standard Eigen Value Problem and Special ODEs

Lecture 5 - Adjoint Operator

Lecture 6 - Generalized Sturm - Liouville Problem

Lecture 7 - Properties of Adjoint Operator

Lecture 8 - Separation of Variables: Rectangular Coordinate Systems

Lecture 9 - Solution of 3 Dimensional Parabolic Problem

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Lecture 11 - Solution of 4 Dimensional Parabolic Problem (Continued...)

Lecture 12 - Solution of Elliptical PDE

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Lecture 16 - Spherical Polar Coordinate System

Lecture 17 - Spherical Polar Coordinate System (Continued...)

Lecture 18 - Example of Generalized 3 Dimensional Problem

Lecture 19 - Example of Application Oriented Problems

Lecture 20 - Examples of Application Oriented Problems (Continued...)

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Lecture 5 - Open ball, Closed ball, Limit point of a set

Lecture 6 - Tutorial-I

Lecture 7 - Some theorems on Open and Closed sets

Lecture 8 - Ordered set, Least upper bound, Greatest lower bound of a set

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Lecture 11 - Properties of Compact sets

Lecture 12 - Tutorial-II

Lecture 13 - Heine Borel Theorem

Lecture 14 - Weierstrass Theorem

Lecture 15 - Cantor set and its properties

Lecture 16 - Derived set and Dense set

Lecture 17 - Limit of a sequence and monotone sequence

Lecture 18 - Tutorial-III

Lecture 19 - Some Important limits of sequences

Lecture 20 - Ratio Test Cauchy's theorems on limits of sequences of real numbers

Lecture 21 - Fundamental theorems on limits

Lecture 22 - Some results on limits and Bolzano-Weierstrass Theorem

Lecture 23 - Criteria for convergent sequence

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Lecture 25 - Criteria for Divergent Sequence

Lecture 26 - Cauchy Sequence

Lecture 27 - Cauchy Convergence Criteria for Sequences

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Lecture 29 - Convergence Criteria for Series of Positive Real Numbers

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Lecture 34 - Ratio and Integral Test for Convergence of Series

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Lecture 37 - Limit of Functions and Cluster Point

Lecture 38 - Limit of Functions (Continued...)

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Lecture 50 - Location of Root and Bolzano's Theorem

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Lecture 53 - Types of Discontinuities

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Lecture 55 - Types of Discontinuities (Continued...)

Lecture 56 - Relation between Continuity and Compact Sets

Lecture 57 - Differentiability of Real Valued Functions

Lecture 58 - Local Max. - Min. Cauchy's and Lagrange's Mean Value Theorem

Lecture 59 - Rolle's Mean Value Theorems and Its Applications

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Lecture 1 - Preliminary concepts: Fluid kinematics, stress, strain

Lecture 2 - Cauchy's equation of motion and Navier-Stokes equations

Lecture 3 - Reduced forms of Navier-Stokes equations and Boundary conditions

Lecture 4 - Exact solutions of Navier-Stokes equations in particular cases

Lecture 5 - Dimensional Analysis – Non-dimensionalization of Navier-Stokes's equations

Lecture 6 - Stream function formulation of Navier-Stokes equations

Lecture 7 - Stokes flow past a cylinder

Lecture 8 - Stokes flow past a sphere

Lecture 9 - Elementary Lubrication Theory

Lecture 10 - Hydrodynamics of Squeeze flow

Lecture 11 - Solution of arbitrary Stokes flows

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Lecture 17 - Flow through porous media – elementary geometries

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Lecture 19 - Modeling transport of particles inside capillaries

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Lecture 9 - Algorithm of BIG-M Method

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Lecture 17 - Problems on Sensitivity Analysis

Lecture 18 - Introduction to Duality Theory - I

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Lecture 23 - Interger Linear Programming

Lecture 24 - IPP: Branch and BBound Method

Lecture 25 - Mixed Integer Programming Problem

Lecture 26

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Lecture 33 - Types of NLP  
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Lecture 13 - Representing abstract groups

Lecture 14 - A quick introduction to group representations

Lecture 15 - Rotations and quaternions

Lecture 16 - Rotational symmetries of platonic solids

Lecture 17 - Finite subgroups of  $SO(3)$

Lecture 1 - Introduction, main definitions

Lecture 2 - Examples of rings

Lecture 3 - More examples

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Lecture 5 - Polynomial Rings - 2

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Lecture 7 - Kernels, ideals

Lecture 8 - Problems - 1

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Lecture 12 - First isomorphism and correspondence theorems

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Lecture 14 - Prime ideals

Lecture 15 - Maximal ideals, integral domains

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Lecture 18 - Problems - 5

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Lecture 20 - Field of fractions, Noetherian rings - 1

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Lecture 23 - Irreducible, prime elements

Lecture 24 - Irreducible, prime elements, GCD

Lecture 25 - Principal Ideal Domains

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Lecture 28 - Gauss Lemma

Lecture 29 -  $\mathbb{Z}[X]$  is a UFD

Lecture 30 - Eisenstein criterion and Problems - 7

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Lecture 4 - Random variable

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Lecture 6 - Conditional Expectation

Lecture 7 - Preliminary for Stochastic Integration - Part 1

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Lecture 9 - Definition and properties of Stochastic Integration - Part 1

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Lecture 13 - change of variable formula and proof - Part 1

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Lecture 15 - Brownian motion as the building block

Lecture 16 - Brownian motion and its martingale property - Part 1

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Lecture 22 - Example of a Dirichlet problem

Lecture 23 - Regular points at the boundary

Lecture 24 - Zarembas cone condition for regularity

Lecture 25 - Summary of the Zaremba's cone condition

Lecture 26 - Continuity of candidate solution at regular points - Part 1

Lecture 27 - Continuity of candidate solution at regular points - Part 2

Lecture 28 - Summary of bounded solution to the Dirichlet Problem

Lecture 29 - Stochastic representation of bounded solution to a heat equation - Part 1

Lecture 30 - Stochastic representation of bounded solution to a heat equation - Part 2

Lecture 31 - Uniqueness of solution to the heat equation



Lecture 32 - Remark on Tychonoff's Theorem

Lecture 33 - Widder's result and its extension on heat equation

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Lecture 35 - The Feynman-Kac formula

Lecture 36 - Kac's theorem on the stochastic representation of solution to a second-order linear ODE - Part 1

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Lecture 38 - Geometric Brownian motion

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Lecture 40 - Brownian bridge

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Lecture 42 - Stochastic differential equations: Uniqueness

Lecture 43 - Stochastic differential equations: Existence - Part 1

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Lecture 50 - Cauchy Problem with variable coefficients: Feynman-Kac formula - Part 2

Lecture 51 - Semigroup of bounded linear operators on Banach space - Part 1

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Lecture 56 - Mild solution to homogeneous initial value problem

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Lecture 61 - Non-autonomous evolution problem and mild/generalized solution

Lecture 62 - Sufficient condition for existence of an evolution system

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Lecture 3 - Vector Subspaces

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Lecture 5 - Linear Independence

Lecture 6 - Basis

Lecture 7 - Dimension

Lecture 8 - Replacement theorem consequences

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Lecture 12 - Linear Transformation and Matrices

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Lecture 14 - Linear Transformation and Matrices (Continued...)

Lecture 15 - Invertible Linear Transformations

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Lecture 2 - Group Axioms

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Lecture 4 - Subgroups

Lecture 5 - Problem solving

Lecture 6 - Group Actions

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Lecture 8 - Group Homomorphisms

Lecture 9 - Normal subgroups

Lecture 10 - Quotient Groups

Lecture 11 - Product and Chinese Remainder Theorem

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Lecture 14 - Problem solving

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Lecture 16 - Fixed points of group actions

Lecture 17 - Second application: Fixed points of group actions

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Lecture 19 - Sylow Theorem - I

Lecture 20 - Problem solving - I

Lecture 21 - Problem solving - II

Lecture 22 - Sylow Theorem - II

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Lecture 24 - Problem solving - I

Lecture 25 - Problem solving - II

Lecture 26 - Free Groups - I

Lecture 27 - Free Groups - IIa

Lecture 28 - Free Groups - IIb

Lecture 29 - Free Groups - III

Lecture 30 - Free Groups - IV

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Lecture 33 - Generators and relations for symmetric groups " II

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Lecture 39 - Factorization and the Noetherian Condition

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Lecture 43 - Fraction Fields

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Lecture 45 - Ideals In Non-Commutative Rings

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Lecture 47 - Ring Homomorphisms

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Lecture 49 - Problem solving

Lecture 50 - Tensor and Exterior Algebras

Lecture 51 - Modules: definition

Lecture 52 - Modules over polynomial rings  $K[x]$

Lecture 53 - Modules: alternative definition

Lecture 54 - Modules: more examples

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Lecture 56 - General constructions of submodules

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Lecture 58 - Quotient modules

Lecture 59 - Homomorphisms

Lecture 60 - More examples of homomorphisms

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Lecture 2 - Homomorphisms

Lecture 3 - Quotient rings

Lecture 4 - Noetherian rings

Lecture 5 - Monomials

Lecture 6 - Initial ideals

Lecture 7 - Division algorithm

Lecture 8 - Grobner basis

Lecture 9 - Solving Polynomial Equations

Lecture 10 - Nullstellensatz - Part 1

Lecture 11 - Nullstellensatz - Part 2

Lecture 12 - Buchberger criterion

Lecture 13 - Monomial basis

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Lecture 17 - Localisation

Lecture 18 - Nakayama Lemma

Lecture 19 - Spectrum - Part 1

Lecture 20 - Spectrum - Part 2

Lecture 21 - Associated primes

Lecture 22 - Primary Decomposition

Lecture 23 - Support of a module

Lecture 24 - Associated primes

Lecture 25 - Prime avoidance

Lecture 26 - Saturation - Part 1

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[Lecture 45 - Algebras over a field](#)

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[Lecture 56 - Computing syzygies](#)

[Lecture 57 - Koszul complex](#)

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[Lecture 59 - Castelnuovo Mumford regularity](#)

[Lecture 60 - Castelnuovo Mumford regularity](#)

**NPTEL : NOC:Laplace Transform (Mathematics)**

**Co-ordinators : Prof. Indrava Roy**

- Lecture 1 - Introduction and Motivation for Laplace transforms - Part 1
- Lecture 2 - Introduction and Motivation for Laplace transforms - Part 2
- Lecture 3 - Improper Riemann integrals: Definition and Existence - Part 1
- Lecture 4 - Improper Riemann integrals: Definition and Existence - Part 2
- Lecture 5 - Existence of Laplace transforms and Examples
- Lecture 6 - Properties of Laplace transforms-I - Part 1
- Lecture 7 - Properties of Laplace transforms-I - Part 2
- Lecture 8 - Existence of Laplace transforms for functions with vertical asymptote at the Y-axis - Part 1
- Lecture 9 - Existence of Laplace transforms for functions with vertical asymptote at the Y-axis - Part 2
- Lecture 10 - Properties of Laplace transforms-II - Part 1
- Lecture 11 - Properties of Laplace transforms-II - Part 2
- Lecture 12 - Laplace transform of Derivatives - Part 1
- Lecture 13 - Laplace transform of Derivatives - Part 2
- Lecture 14 - Laplace transform of Periodic functions and Integrals - I
- Lecture 15 - Laplace transform of Integrals-II - Part 1
- Lecture 16 - Laplace transform of Integrals-II - Part 2
- Lecture 17 - Inverse Laplace transform and asymptotic behaviour - Part 1
- Lecture 18 - Inverse Laplace transform and asymptotic behaviour - Part 2
- Lecture 19 - Methods of finding Inverse Laplace transform-I- Partial Fractions
- Lecture 20 - Methods of finding Inverse Laplace transform-II- Convolution theorem
- Lecture 21 - Convolution theorem for Laplace transforms
- Lecture 22 - Applications of Laplace transforms
- Lecture 23 - Applications of Laplace Transform to physical systems
- Lecture 24 - Solving Linear ODE's with polynomial coefficients
- Lecture 25 - Integral and Integro-differential equation
- Lecture 26 - Further application of Laplace transforms - Part 1
- Lecture 27 - Further application of Laplace transforms - Part 2

Lecture 1 - Finite Sets and Cardinality

Lecture 2 - Infinite Sets and the Banach-Tarski Paradox - Part 1

Lecture 3 - Infinite Sets and the Banach-Tarski Paradox - Part 2

Lecture 4 - Elementary Sets and Elementary measure - Part 1

Lecture 5 - Elementary Sets and Elementary measure - Part 2

Lecture 6 - Properties of elementary measure - Part 1

Lecture 7 - Properties of elementary measure - Part 2

Lecture 8 - Uniqueness of elementary measure and Jordan measurability - Part 1

Lecture 9 - Uniqueness of elementary measure and Jordan measurability - Part 2

Lecture 10 - Characterization of Jordan measurable sets and basic properties of Jordan measure - Part 1

Lecture 11 - Characterization of Jordan measurable sets and basic properties of Jordan measure - Part 2

Lecture 12 - Examples of Jordan measurable sets-I

Lecture 13 - Examples of Jordan measurable sets-II - Part 1

Lecture 14 - Examples of Jordan measurable sets-II - Part 2

Lecture 15 - Jordan measure under Linear transformations - Part 1

Lecture 16 - Jordan measure under Linear transformations - Part 2

Lecture 17 - Connecting the Jordan measure with the Riemann integral - Part 1

Lecture 18 - Connecting the Jordan measure with the Riemann integral - Part 2

Lecture 19 - Outer measure - Motivation and Axioms of outer measure

Lecture 20 - Comparing Inner Jordan measure, Lebesgue outer measure and Jordan Outer measure

Lecture 21 - Finite additivity of outer measure on Separated sets, Outer regularity - Part 1

Lecture 22 - Finite additivity of outer measure on Separated sets, Outer regularity - Part 2

Lecture 23 - Lebesgue measurable class of sets and their Properties - Part 1

Lecture 24 - Lebesgue measurable class of sets and their Properties - Part 2

Lecture 25 - Equivalent criteria for lebesgue measurability of a subset - Part 1

Lecture 26 - Equivalent criteria for lebesgue measurability of a subset - Part 2

Lecture 27 - The measure axioms and the Borel-Cantelli Lemma

Lecture 28 - Properties of the Lebesgue measure: Inner regularity, Upward and Downward Monotone convergence theorem, and Dominated convergence theorem for sets - Part 1

Lecture 29 - Properties of the Lebesgue measure: Inner regularity, Upward and Downward Monotone convergence theorem, and Dominated convergence theorem for sets - Part 2

Lecture 30 - Lebesgue measurability under Linear transformation, Construction of Vitali Set - Part 1

Lecture 31 - Lebesgue measurability under Linear transformation, Construction of Vitali Set - Part 2

Lecture 32 - Abstract measure spaces: Boolean and Sigma-algebras

Lecture 33 - Abstract measure and Caratheodory Measurability - Part 1

Lecture 34 - Abstract measure and Caratheodory Measurability - Part 2

Lecture 35 - Abstract measure and Hahn-Kolmogorov Extension

Lecture 36 - Lebesgue measurable class vs Caratheodory extension of usual outer measure on  $\mathbb{R}^d$

Lecture 37 - Examples of Measures defined on  $\mathbb{R}^d$  via Hahn Kolmogorov extension - Part 1

Lecture 38 - Examples of Measures defined on  $\mathbb{R}^d$  via Hahn Kolmogorov extension - Part 2

Lecture 39 - Measurable functions: definition and basic properties - Part 1

Lecture 40 - Measurable functions: definition and basic properties - Part 2

Lecture 41 - Egorov's theorem: abstract version

Lecture 42 - Lebesgue integral of unsigned simple measurable functions: definition and properties

Lecture 43 - Lebesgue integral of unsigned measurable functions: motivation, definition and basic properties

Lecture 44 - Fundamental convergence theorems in Lebesgue integration: Monotone convergence theorem, Tonelli's theorem and Fatou's lemma

Lecture 45 - Lebesgue integral for complex and real measurable functions: the space of  $L^1$  functions

Lecture 46 - Basic properties of  $L^1$ -functions and Lebesgue's Dominated convergence theorem

Lecture 47 -  $L^1$  functions on  $\mathbb{R}^d$ : Egorov's theorem revisited (Littlewood's third principle)

Lecture 48 -  $L^1$  functions on  $\mathbb{R}^d$ : Statement of Lusin's theorem (Littlewood's second principle), Density of simple functions, step functions, and continuous compactly supported functions in  $L^1$

Lecture 49 -  $L^1$  functions on  $\mathbb{R}^d$ : Proof of Lusin's theorem, space of  $L^1$  functions as a metric space

Lecture 50 -  $L^1$  functions on  $\mathbb{R}^d$ : the Riesz-Fischer theorem

Lecture 51 - Various modes of convergence of measurable functions

Lecture 52 - Easy implications from one mode of convergence to another

Lecture 53 - Implication map for modes of convergence with various examples

Lecture 54 - Uniqueness of limits across various modes of convergence

Lecture 55 - Some criteria for reverse implications for modes of convergence

Lecture 56 - Riesz Representation theorem- Motivation

Lecture 57 - Basics on Locally compact Hausdorff spaces

Lecture 58 - Borel and Radon measures on LCH spaces

Lecture 59 - Properties of Radon measures and Lusin's theorem on LCH spaces

Lecture 60 - Riesz Representation theorem - Complete statement and proof - Part 1

Lecture 61 - Riesz Representation theorem - Complete statement and proof - Part 2

Lecture 62 - Examples of measures constructed using RRT

Lecture 63 - Theorems of Tonelli and Fubini- interchanging the order of integration for repeated integrals: motivation and discussion of product measure spaces

Lecture 64 - Product measures

Lecture 65 - Tonelli's theorem for sets - Part 1

Lecture 66 - Tonelli's theorem for sets - Part 2

Lecture 67 - Fubini-Tonelli theorem: interchanging order of integration for measurable and  $L^1$  functions on sigma-finite measure spaces

Lecture 68 - Lebesgue's differentiation theorem: introduction and motivation

Lecture 69 - Lebesgue's differentiation theorem: statement and proof - Part 1

Lecture 70 - Lebesgue's differentiation theorem: statement and proof - Part 2

Lecture 71 - Differentiation theorems: Almost everywhere differentiability for Monotone and Bounded Variation functions - Part 1

Lecture 72 - Differentiation theorems: Almost everywhere differentiability for Monotone and Bounded Variation functions - Part 2

Lecture 73 - Riesz's Rising Sun Lemma

Lecture 74 - Differentiation theorem for monotone continuous functions

Lecture 75 - Differentiation theorem for general monotone functions and Second fundamental theorem of calculus for absolutely continuous functions

- Lecture 1 - Field of Complex Numbers
- Lecture 2 - Conjugation and Absolute value
- Lecture 3 - Topology on Complex plane
- Lecture 4 - Topology on Complex Plane (Continued...)
- Lecture 5 - Problem Session
- Lecture 6 - Isometries on the Complex Plane
- Lecture 7 - Functions on the Complex Plane
- Lecture 8 - Complex differentiability
- Lecture 9 - Power Series
- Lecture 10 - Differentiation of power series
- Lecture 11 - Problem Session
- Lecture 12 - Cauchy-Riemann equations
- Lecture 13 - Harmonic functions
- Lecture 14 - Möbius transformations
- Lecture 15 - Problem session
- Lecture 16 - Curves in the complex plane
- Lecture 17 - Complex Integration over curves
- Lecture 18 - First Fundamental theorem of Calculus
- Lecture 19 - Second Fundamental theorem of Calculus
- Lecture 20 - Problem session
- Lecture 21 - Homotopy of curves
- Lecture 22 - Cauchy-Goursat theorem
- Lecture 23 - Cauchy's theorem
- Lecture 24 - Problem Session
- Lecture 25 - Cauchy Integral Formula
- Lecture 26 - Principle of analytic continuation and Cauchy estimates
- Lecture 27 - Further consequences of Cauchy Integral Formula
- Lecture 28 - Problem session
- Lecture 29 - Winding number
- Lecture 30 - Open mapping theorem
- Lecture 31 - Schwarz reflection principle

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[Lecture 42 - Automorphisms of the Unit disk](#)

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Lecture 1 - WEEK 1 - INTRODUCTION

Lecture 2 - Why study Real Analysis

Lecture 3 - Square root of 2

Lecture 4 - Wason's selection task

Lecture 5 - Zeno's Paradox

Lecture 6 - Basic set theory

Lecture 7 - Basic logic

Lecture 8 - Quantifiers

Lecture 9 - Proofs

Lecture 10 - Functions and relations

Lecture 11 - Axioms of Set Theory

Lecture 12 - Equivalence relations

Lecture 13 - What are the rationals

Lecture 14 - Cardinality

Lecture 15 - WEEK 2 - INTRODUCTION

Lecture 16 - Field axioms

Lecture 17 - Order axioms

Lecture 18 - Absolute value

Lecture 19 - The completeness axiom

Lecture 20 - Nested intervals property

Lecture 21 - NIP+APâ†’ Completeness

Lecture 22 - Existence of square roots

Lecture 23 - Uncountability of the real numbers

Lecture 24 - Density of rationals and irrationals

Lecture 25 - WEEK 3 - INTRODUCTION

Lecture 26 - Motivation for infinite sums

Lecture 27 - Definition of sequence and examples

Lecture 28 - Definition of convergence

Lecture 29 - Uniqueness of limits

Lecture 30 - Achilles and the tortoise

Lecture 31 - Deep dive into the definition of convergence



Lecture 32 - A descriptive language for convergence

Lecture 33 - Limit laws

Lecture 34 - Subsequences

Lecture 35 - Examples of convergent and divergent sequences

Lecture 36 - Some special sequences-CORRECT

Lecture 37 - Monotone sequences

Lecture 38 - Bolzano-Weierstrass theorem

Lecture 39 - The Cauchy Criterion

Lecture 40 - MCT implies completeness

Lecture 41 - Definition and examples of infinite series

Lecture 42 - Cauchy tests-Corrected

Lecture 43 - Tests for convergence

Lecture 44 - Erdos\_s proof on divergence of reciprocals of primes

Lecture 45 - Resolving Zeno\_s paradox

Lecture 46 - Absolute and conditional convergence

Lecture 47 - Absolute convergence continued

Lecture 48 - The number e

Lecture 49 - Grouping terms of an infinite series

Lecture 50 - The Cauchy product

Lecture 51 - WEEK 5 - INTRODUCTION

Lecture 52 - The role of topology in real analysis

Lecture 53 - Open and closed sets

Lecture 54 - Basic properties of adherent and limit points

Lecture 55 - Basic properties of open and closed sets

Lecture 56 - Definition of continuity

Lecture 57 - Deep dive into epsilon-delta

Lecture 58 - Negating continuity

Lecture 59 - The functions  $x$  and  $x^2$

Lecture 60 - Limit laws

Lecture 61 - Limit of  $\sin x_x$

Lecture 62 - Relationship between limits and continuity

Lecture 63 - Global continuity and open sets

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- Lecture 65 - Operations on continuous functions
- Lecture 66 - Language for limits
- Lecture 67 - Infinite limits
- Lecture 68 - One sided limits
- Lecture 69 - Limits of polynomials
- Lecture 70 - Compactness
- Lecture 71 - The Heine-Borel theorem
- Lecture 72 - Open covers and compactness
- Lecture 73 - Equivalent notions of compactness
- Lecture 74 - The extreme value theorem
- Lecture 75 - Uniform continuity
- Lecture 76 - Connectedness
- Lecture 77 - Intermediate Value Theorem
- Lecture 78 - Darboux continuity and monotone functions
- Lecture 79 - Perfect sets and the Cantor set
- Lecture 80 - The structure of open sets
- Lecture 81 - The Baire Category theorem
- Lecture 82 - Discontinuities
- Lecture 83 - Classification of discontinuities and monotone functions
- Lecture 84 - Structure of set of discontinuities
- Lecture 85 - WEEK 8 and 9 - INTRODUCTION
- Lecture 86 - Definition and interpretation of the derivative
- Lecture 87 - Basic properties of the derivative
- Lecture 88 - Examples of differentiation
- Lecture 89 - Darboux's theorem
- Lecture 90 - The mean value theorem
- Lecture 91 - Applications of the mean value theorem
- Lecture 92 - Taylor's theorem NEW
- Lecture 93 - The ratio mean value theorem and L'Hospital's rule
- Lecture 94 - Axiomatic characterisation of area and the Riemann integral
- Lecture 95 - Proof of axiomatic characterization
- Lecture 96 - The definition of the Riemann integral
- Lecture 97 - Criteria for Riemann integrability

Lecture 98 - Linearity of integral

Lecture 99 - Sets of measure zero

Lecture 100 - The Riemann-Lebesgue theorem

Lecture 101 - Consequences of the Riemann-Lebesgue theorem

Lecture 102 - WEEK 10 and 11 - INTRODUCTION

Lecture 103 - The fundamental theorem of calculus

Lecture 104 - Taylor's theorem-Integral form of remainder

Lecture 105 - Notation for Taylor polynomials

Lecture 106 - Smooth functions and Taylor series

Lecture 107 - Power series

Lecture 108 - Definition of uniform convergence

Lecture 109 - The exponential function

Lecture 110 - The inverse function theorem

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Lecture 112 - Trigonometric functions

Lecture 113 - The number Pi

Lecture 114 - The graphs of sin and cos

Lecture 115 - The Basel problem

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Lecture 28 - Numerical differentiation - Part IV (Maxima and minima of a tabulated function and differentiation errors)

Lecture 29 - Numerical differentiation - Part V (Differentiation based on finite difference operators)

Lecture 30 - Numerical differentiation - Part VI (Method of undetermined coefficients and Derivatives with unequal intervals)

# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

Lecture 31 - Numerical Integration - Part I (Methodology of Numerical Integration and Rectangular rule )

Lecture 32 - Numerical Integration - Part II (Quadrature formula and Trapezoidal rule with associated errors)merical Integration Part-I (Methodology of Numerical Integration and Rectangular rule )

Lecture 33 - Numerical Integration - Part III (Simpsons 1/3rd rule with associated errors)

Lecture 34 - Numerical Integration - Part IV (Composite Simpsons 1/3rd rule and Simpsons 3/8th rule with examples)

Lecture 35 - Numerical Integration - Part V (Gauss Legendre 2-point and 3-point formula with examples)

Lecture 36 - Introduction to Ordinary Differential equations

Lecture 37 - Numerical methods for ODE-1

Lecture 38 - Numerical Methods - II

Lecture 39 - R-K Methods for solving ODEs

Lecture 40 - Multi-step Method for solving ODEs

- Lecture 1 - Matrix Operations and Types of Matrices
- Lecture 2 - Determinant of a Matrix
- Lecture 3 - Rank of a Matrix
- Lecture 4 - Vector Space - I
- Lecture 5 - Vector Space - II
- Lecture 6 - Linear dependence and independence
- Lecture 7 - Bases and Dimension - I
- Lecture 8 - Bases and Dimension - II
- Lecture 9 - Linear Transformation - I
- Lecture 10 - Linear Transformation - II
- Lecture 11 - Orthogonal Subspaces
- Lecture 12 - Row Space, Column Space and Null Space
- Lecture 13 - Eigen Values and Eigen Vectors - I
- Lecture 14 - Eigen Values and Eigen Vectors - II
- Lecture 15 - Diagonalizable Matrices
- Lecture 16 - Orthogonal Sets
- Lecture 17 - Gram Schmidt orthogonalization and orthogonal bases
- Lecture 18 - Introduction to Matlab
- Lecture 19 - Sign Integer Representation
- Lecture 20 - Computer Representation of Numbers
- Lecture 21 - Floating Point Representation
- Lecture 22 - Round-off Error
- Lecture 23 - Error Propagation in Computer Arithmetic
- Lecture 24 - Addition and Multiplication of Floating Point Numbers
- Lecture 25 - Conditioning and Condition Numbers - I
- Lecture 26 - Conditioning and Condition Numbers - II
- Lecture 27 - Stability of Numerical Algorithms - I
- Lecture 28 - Stability of Numerical Algorithms - II
- Lecture 29 - Vector Norms - I
- Lecture 30 - Vector Norms - II
- Lecture 31 - Matrix Norms - I

- Lecture 32 - Matrix Norms - II
- Lecture 33 - Convergent Matrices - I
- Lecture 34 - Convergent Matrices - II
- Lecture 35 - Stability of non linear system
- Lecture 36 - Condition number of a matrix: Elementary Properties
- Lecture 37 - Sensitivity Analysis - I
- Lecture 38 - Sensitivity Analysis - II
- Lecture 39 - Residual Theorem
- Lecture 40 - Nearness to Singularity
- Lecture 41 - Estimation of the Condition Number
- Lecture 42 - Singular value decomposition of a matrix - I
- Lecture 43 - Singular value decomposition of a matrix - II
- Lecture 44 - Orthonormal Projections
- Lecture 45 - Algebraic and geometric properties of SVD
- Lecture 46 - SVD and their applications
- Lecture 47 - Perturbation theorem for singular values
- Lecture 48 - Outer product expansion of a matrix
- Lecture 49 - Least square solutions - I
- Lecture 50 - Least square solutions - II
- Lecture 51 - Householder matrices
- Lecture 52 - Householder matrices and their applications
- Lecture 53 - Householder QR factorization - I
- Lecture 54 - Householder QR factorization - II
- Lecture 55 - Basic theorems on eigenvalues and QR method
- Lecture 56 - Power Method
- Lecture 57 - Rate of Convergence of Power Method
- Lecture 58 - Applications of Power Method with Shift
- Lecture 59 - Jacobi Method - I
- Lecture 60 - Jacobi Method - II

Lecture 1 - Introduction to Numerical solutions

Lecture 2 - Numerical Solution of ODE

Lecture 3 - Numerical solution of PDE

Lecture 4 - Finite difference approximation

Lecture 5 - Polynomial fitting and one-sided approximation

Lecture 6 - Solution of parabolic equation

Lecture 7 - Implicit and C-N scheme for solving 1D parabolic equation

Lecture 8 - Stability analysis of Explicit scheme for solving parabolic equation

Lecture 9 - Stability of Crank-Nicolson's scheme

Lecture 10 - Approximation of derivative boundary conditions

Lecture 11 - Solution of two-dimensional parabolic equation

Lecture 12 - Solution of 2D parabolic equation using ADI scheme

Lecture 13 - Solution of Elliptic Equation

Lecture 14 - Solution of Elliptic equation using SOR method

Lecture 15 - Solution of Elliptic equation using ADI scheme

Lecture 16 - Solution of Hyperbolic equation

Lecture 17 - Stability analysis for Hyperbolic equations

Lecture 18 - Characteristics of PDE

Lecture 19 - Lax-Wendroff's method

Lecture 20 - Wendroff's method



Lecture 1 - Functions of several variables

Lecture 2 - Limits for multivariable functions - I

Lecture 3 - Limits for multivariable functions - II

Lecture 4 - Continuity of multivariable functions

Lecture 5 - Partial Derivatives - I

Lecture 6 - Partial Derivatives - II

Lecture 7 - Differentiability - I

Lecture 8 - Differentiability - II

Lecture 9 - Chain rule - I

Lecture 10 - Chain rule - II

Lecture 11 - Change of variables

Lecture 12 - Euler's theorem for homogeneous functions

Lecture 13 - Tangent planes and Normal lines

Lecture 14 - Extreme values - I

Lecture 15 - Extreme values - II

Lecture 16 - Lagrange multipliers

Lecture 17 - Taylor's theorem

Lecture 18 - Error approximation

Lecture 19 - Polar-curves

Lecture 20 - Multiple Integrals

Lecture 21 - Change Of Order Of Integration

Lecture 22 - Change of Variables in Multiple Integral

Lecture 23 - Introduction to Gamma Function

Lecture 24 - Introduction to Beta Function

Lecture 25 - Properties of Beta and Gamma Functions - I

Lecture 26 - Properties of Beta and Gamma Functions - II

Lecture 27 - Dirichlet's Integral

Lecture 28 - Applications of Multiple Integrals

Lecture 29 - Vector Differentiation

Lecture 30 - Gradient of a Scalar Field and Directional Derivative

Lecture 31 - Normal Vector and Potential field

[Lecture 32 - Gradient \(Identities\), Divergence and Curl \(Identities\)](#)

[Lecture 33 - Some Identities on Divergence and Curl](#)

[Lecture 34 - Line Integral \(I\)](#)

[Lecture 35 - Applications of Line Integrals](#)

[Lecture 36 - Green's Theorem](#)

[Lecture 37 - Surface Area](#)

[Lecture 38 - Surface Integral](#)

[Lecture 39 - Divergence Theorem of Gauss](#)

[Lecture 40 - Stoke's Theorem](#)

- Lecture 1 - Introduction to differential equations - I
- Lecture 2 - Introduction to differential equations - II
- Lecture 3 - Existence and uniqueness of solutions of differential equations - I
- Lecture 4 - Existence and uniqueness of solutions of differential equations - II
- Lecture 5 - Existence and uniqueness of solutions of differential equations - III
- Lecture 6 - Existence and uniqueness of solutions of a system of differential equations
- Lecture 7 - Linear System
- Lecture 8 - Properties of Homogeneous Systems
- Lecture 9 - Solution of Homogeneous Linear System with Constant Coefficients - I
- Lecture 10 - Solution of Homogeneous Linear System with Constant Coefficients - II
- Lecture 11 - Solution of Homogeneous Linear System with Constant Coefficients - III
- Lecture 12 - Solution of Non-Homogeneous Linear System with Constant Coefficients
- Lecture 13 - Power Series
- Lecture 14 - Uniform Convergence of Power Series
- Lecture 15 - Power Series Solution of Second Order Homogeneous Equations
- Lecture 16 - Regular singular points - I
- Lecture 17 - Regular singular points - II
- Lecture 18 - Regular singular points - III
- Lecture 19 - Regular singular points - IV
- Lecture 20 - Regular singular points - V
- Lecture 21 - Critical points
- Lecture 22 - Stability of Linear Systems - I
- Lecture 23 - Stability of Linear Systems - II
- Lecture 24 - Stability of Linear Systems - III
- Lecture 25 - Critical Points and Paths of Non-linear Systems
- Lecture 26 - Boundary value problems for second order differential equations
- Lecture 27 - Self - adjoint Forms
- Lecture 28 - Sturm - Liouville problem and its properties
- Lecture 29 - Sturm - Liouville problem and its applications
- Lecture 30 - Green's function and its applications - I
- Lecture 31 - Green's function and its applications - II

- Lecture 32 - Origins and Classification of First Order PDE
- Lecture 33 - Initial Value Problem for Quasi-linear First Order Equations
- Lecture 34 - Existence and Uniqueness of Solutions
- Lecture 35 - Surfaces orthogonal to a given system of surfaces
- Lecture 36 - Nonlinear PDE of first order
- Lecture 37 - Cauchy method of characteristics - I
- Lecture 38 - Cauchy method of characteristics - II
- Lecture 39 - Compatible systems of first order equations
- Lecture 40 - Charpitâ€™s method - I
- Lecture 41 - Charpitâ€™s method - II
- Lecture 42 - Second Order PDE with Variable Coefficients
- Lecture 43 - Classification and Canonical Form of Second Order PDE - I
- Lecture 44 - Classification and Canonical Form of Second Order PDE - II
- Lecture 45 - Classification and Characteristic Curves of Second Order PDEs
- Lecture 46 - Review of Integral Transforms - I
- Lecture 47 - Review of Integral Transforms - II
- Lecture 48 - Review of Integral Transforms - II
- Lecture 49 - Review of Integral Transforms - III
- Lecture 50 - Laplace Equation - I
- Lecture 51 - Laplace Equation - II
- Lecture 52 - Laplace and Poisson Equations
- Lecture 53 - One dimensional wave equation and its solution - I
- Lecture 54 - One dimensional wave equation and its solution - II
- Lecture 55 - One dimensional wave equation and its solution - III
- Lecture 56 - Two dimensional wave equation and its solution - I
- Lecture 57 - Solution of non-homogeneous wave equation
- Lecture 58 - Solution of homogeneous diffusion equation - I
- Lecture 59 - Solution of homogeneous diffusion equation - II
- Lecture 60 - Duhamelâ€™s principle

Lecture 1 - Elementary row operations

Lecture 2 - Echelon form of a matrix

Lecture 3 - Rank of a matrix

Lecture 4 - System of Linear Equations - I

Lecture 5 - System of Linear Equations - II

Lecture 6 - Introduction to Vector Spaces

Lecture 7 - Subspaces

Lecture 8 - Basis and Dimension

Lecture 9 - Linear Transformations

Lecture 10 - Rank and Nullity

Lecture 11 - Inverse of a Linear Transformation

Lecture 12 - Matrix Associated with a LT

Lecture 13 - Eigenvalues and Eigenvectors

Lecture 14 - Cayley-Hamilton Theorem and Minimal Polynomial

Lecture 15 - Diagonalization

Lecture 16 - Special Matrices

Lecture 17 - More on Special Matrices and Gerschgorin Theorem

Lecture 18 - Inner Product Spaces

Lecture 19 - Vector and Matrix Norms

Lecture 20 - Gram Schmidt Process

Lecture 21 - Normal Matrices

Lecture 22 - Positive Definite Matrices

Lecture 23 - Positive Definite and Quadratic Forms

Lecture 24 - Gram Matrix and Minimization of Quadratic Forms

Lecture 25 - Generalized Eigenvectors and Jordan Canonical Form

Lecture 26 - Evaluation of Matrix Functions

Lecture 27 - Least Square Approximation

Lecture 28 - Singular Value Decomposition

Lecture 29 - Pseudo-Inverse and SVD

Lecture 30 - Introduction to Ill-Conditioned Systems

Lecture 31 - Regularization of Ill-Conditioned Systems

[Lecture 32 - Linear Systems: Iterative Methods - I](#)

[Lecture 33 - Linear Systems: Iterative Methods - II](#)

[Lecture 34 - Non-Stationary Iterative Methods: Steepest Descent - I](#)

[Lecture 35 - Non-Stationary Iterative Methods: Steepest Descent - II](#)

[Lecture 36 - Krylov Subspace Iterative Methods \(Conjugate Gradient Method\)](#)

[Lecture 37 - Krylov Subspace Iterative Methods \(CG and Pre-Conditioning\)](#)

[Lecture 38 - Introduction to Positive Matrices](#)

[Lecture 39 - Positive Matrices, Positive Eigenpair, Perron Root and vector, Example](#)

[Lecture 40 - Polar Decomposition](#)

- Lecture 1 - Introduction to Mathematical Modeling
- Lecture 2 - Discrete Time Linear Models in Population Dynamics - I
- Lecture 3 - Discrete Time Linear Models in Population Dynamics - II
- Lecture 4 - Discrete Time Linear Age Structured Models
- Lecture 5 - Numerical Methods to Compute Eigen Values
- Lecture 6 - Discrete Time Non-Linear Models in Population Dynamics - II
- Lecture 7 - Analysis on Logistic Difference Equation
- Lecture 8 - Classifications of Bifurcation
- Lecture 9 - Discrete Time Non - Linear Models in Population Dynamics - II
- Lecture 10 - Discrete Time Prey - Predator Model
- Lecture 11 - Introduction to Continuous Time Models
- Lecture 12 - Solution of First Order First Degree Differential Equations
- Lecture 13 - Continuous Time Models in Population Dynamics - I
- Lecture 14 - Continuous Time Models in Population Dynamics - II
- Lecture 15 - Stability and Linearization of System of Ordinary Differential Equations
- Lecture 16 - Continuous Time Single Species Models
- Lecture 17 - Qualitative Solution of Differential Equations - Phase Diagrams - I
- Lecture 18 - Qualitative Solution of Differential Equations - Phase Diagrams - II
- Lecture 19 - Continuous Time Lotka - Volterra Competition Model
- Lecture 20 - Continuous Time Prey - Predator Model

- Lecture 1 - Formulation of Dynamical Systems - I
- Lecture 2 - Formulation of Dynamical Systems - II
- Lecture 3 - Existence and Uniqueness Theorem - I
- Lecture 4 - Existence and Uniqueness Theorem - II
- Lecture 5 - Linear Systems - I
- Lecture 6 - Linear Systems - II
- Lecture 7 - Solutions of Linear Systems - I
- Lecture 8 - Solutions of Linear Systems - II
- Lecture 9 - Solutions of Linear Systems - III
- Lecture 10 - Fundamental Matrix - I
- Lecture 11 - Fundamental Matrix - II
- Lecture 12 - Fundamental Matrix for Non-Autonomous systems
- Lecture 13 - Solutions of Non-Homogeneous Systems
- Lecture 14 - Stability of Systems: Equilibrium Points
- Lecture 15 - Stability of Linear Autonomous Systems - I
- Lecture 16 - Stability of Linear Autonomous Systems - II
- Lecture 17 - Stability of Linear Autonomous Systems - III
- Lecture 18 - Stability of Weakly Non-Linear Systems - I
- Lecture 19 - Stability of Weakly Non-Linear Systems - II
- Lecture 20 - Stability of Non-Linear Systems using Linearization
- Lecture 21 - Properties of Phase Portrait
- Lecture 22 - Properties of Orbits
- Lecture 23 - Phase Portrait: Types of Critical Points
- Lecture 24 - Phase Portrait of Linear Differential Equations - I
- Lecture 25 - Phase Portrait of Linear Differential Equations - II
- Lecture 26 - Phase Portrait of Linear Differential Equations - III
- Lecture 27 - Poincare Bendixson Theorem
- Lecture 28 - Limit Cycle
- Lecture 29 - Lyapunov Stability - I
- Lecture 30 - Lyapunov Stability - II
- Lecture 31 - Introduction to Control Systems - I



- Lecture 32 - Introduction to Control Systems - II
- Lecture 33 - Controllability of Autonomous Systems
- Lecture 34 - Controllability of Non-autonomous Systems
- Lecture 35 - Observability - I
- Lecture 36 - Observability - II
- Lecture 37 - Results on Controllability and Observability
- Lecture 38 - Companion Form
- Lecture 39 - Feedback Control - I
- Lecture 40 - Feedback Control - II
- Lecture 41 - Feedback Control - III
- Lecture 42 - Feedback Control - IV
- Lecture 43 - State Observer
- Lecture 44 - Stabilizability
- Lecture 45 - Introduction to Discrete Systems - I
- Lecture 46 - Introduction to Discrete Systems - II
- Lecture 47 - Lyapunov Stability Theory - I
- Lecture 48 - Lyapunov Stability Theory - II
- Lecture 49 - Lyapunov Stability Theory - III
- Lecture 50 - Optimal Control - I
- Lecture 51 - Optimal Control - II
- Lecture 52 - Optimal Control - III
- Lecture 53 - Optimal Control - IV
- Lecture 54 - Optimal Control for Discrete Systems - I
- Lecture 55 - Optimal Control for Discrete Systems - II
- Lecture 56 - Controllability of Discrete Systems
- Lecture 57 - Observability of Discrete Systems
- Lecture 58 - Stability for Discrete Systems
- Lecture 59 - Relation between Continuous and Discrete Systems - I
- Lecture 60 - Relation between Continuous and Discrete Systems - II

Lecture 1 - Analytic Function

Lecture 2 - Cauchy-Riemann Equations

Lecture 3 - Harmonic Functions, Harmonic Conjugates and Milne's Method

Lecture 4 - Applications to the Problems of Potential Flow - I

Lecture 5 - Applications to the Problems of Potential Flow - II

Lecture 6 - Complex Integration

Lecture 7 - Cauchy's Theorem - I

Lecture 8 - Cauchy's Theorem - II

Lecture 9 - Cauchy's Integral Formula for the Derivatives of Analytic Function

Lecture 10 - Morera's Theorem, Liouville's Theorem and Fundamental Theorem of Algebra

Lecture 11 - Winding Number and Maximum Modulus Principle

Lecture 12 - Sequences and Series

Lecture 13 - Uniform Convergence of Series

Lecture 14 - Power Series

Lecture 15 - Taylor Series

Lecture 16 - Laurent Series

Lecture 17 - Zeros and Singularities of an Analytic Function

Lecture 18 - Residue at a Singularity

Lecture 19 - Residue Theorem

Lecture 20 - Meromorphic Functions

Lecture 21 - Evaluation of real integrals using residues - I

Lecture 22 - Evaluation of real integrals using residues - II

Lecture 23 - Evaluation of real integrals using residues - III

Lecture 24 - Evaluation of real integrals using residues - IV

Lecture 25 - Evaluation of real integrals using residues - V

Lecture 26 - Bilinear Transformations

Lecture 27 - Cross Ratio

Lecture 28 - Conformal Mapping - I

Lecture 29 - Conformal Mapping - II

Lecture 30 - Conformal mapping from half plane to disk and half plane to half plane - I

Lecture 31 - Conformal mapping from disk to disk and angular region to disk

[Lecture 32 - Application of Conformal Mapping to Potential Theory](#)

[Lecture 33 - Review of Z-transforms - I](#)

[Lecture 34 - Review of Z-transforms - II](#)

[Lecture 35 - Review of Z-transforms - III](#)

[Lecture 36 - Review of Bilateral Z-transforms](#)

[Lecture 37 - Finite Fourier Transforms](#)

[Lecture 38 - Fourier Integral and Fourier Transforms](#)

[Lecture 39 - Fourier Series](#)

[Lecture 40 - Discrete Fourier Transforms - I](#)

[Lecture 41 - Discrete Fourier Transforms - II](#)

[Lecture 42 - Basic Concepts of Probability](#)

[Lecture 43 - Conditional Probability](#)

[Lecture 44 - Bayes Theorem and Probability Networks](#)

[Lecture 45 - Discrete Probability Distribution](#)

[Lecture 46 - Binomial Distribution](#)

[Lecture 47 - Negative Binomial Distribution and Poisson Distribution](#)

[Lecture 48 - Continuous Probability Distribution](#)

[Lecture 49 - Poisson Process](#)

[Lecture 50 - Exponential Distribution](#)

[Lecture 51 - Normal Distribution](#)

[Lecture 52 - Joint Probability Distribution - I](#)

[Lecture 53 - Joint Probability Distribution - II](#)

[Lecture 54 - Joint Probability Distribution - III](#)

[Lecture 55 - Correlation and Regression - I](#)

[Lecture 56 - Correlation and Regression - II](#)

[Lecture 57 - Testing of Hypotheses - I](#)

[Lecture 58 - Testing of Hypotheses - II](#)

[Lecture 59 - Testing of Hypotheses - III](#)

[Lecture 60 - Application to Queuing Theory and Reliability Theory](#)

Lecture 1 - Symbolic Representation of Statements - I

Lecture 2 - Symbolic Representation of Statements - II

Lecture 3 - Tautologies and Contradictions

Lecture 4 - Predicates and Quantifiers - I

Lecture 5 - Predicates and Quantifiers - II

Lecture 6 - Validity of Arguments

Lecture 7 - Language and Grammars - I

Lecture 8 - Language and Grammars - II

Lecture 9 - Language and Grammars - III

Lecture 10 - Finite- State Machines

Lecture 11 - Partially Ordered Sets - I

Lecture 12 - Partially Ordered Sets - II

Lecture 13 - Partially Ordered Sets - III

Lecture 14 - Lattices - I

Lecture 15 - Lattices - II

Lecture 16 - Lattices - III

Lecture 17 - Lattices - IV

Lecture 18 - Lattices - V

Lecture 19 - Boolean Algebra - I

Lecture 20 - Boolean Algebra - II

Lecture 21 - Boolean Algebra - III

Lecture 22 - Boolean Algebra - IV

Lecture 23 - Logic Gates

Lecture 24 - Karnaugh Map - I

Lecture 25 - Karnaugh Map - II

Lecture 26 - Various type of Graphs - I

Lecture 27 - Various types of Graphs - II

Lecture 28 - Paths and Connectivity

Lecture 29 - Subgraphs and Traversable Multigraphs

Lecture 30 - Undirected and Directed Graphs

Lecture 31 - Eulerian and Hamiltonian Graphs

[Lecture 32 - Planar Graphs](#)

[Lecture 33 - Representation of Graphs](#)

[Lecture 34 - Isomorphic and Homeomorphic Graphs](#)

[Lecture 35 - Kuratowski's Theorem](#)

[Lecture 36 - Dual of a Graph](#)

[Lecture 37 - Coloring of Graphs - I](#)

[Lecture 38 - Coloring of Graphs - II](#)

[Lecture 39 - Tree - I](#)

[Lecture 40 - Tree - II](#)

[Lecture 41 - Graphical Method - I](#)

[Lecture 42 - Graphical Method - II](#)

[Lecture 43 - General Linear Programming Problem](#)

[Lecture 44 - Simplex Method - I](#)

[Lecture 45 - Simplex Method - II](#)

[Lecture 46 - Big - M Method - I](#)

[Lecture 47 - Big - M Method - II \(Special Cases\)](#)

[Lecture 48 - Two Phase Method - I](#)

[Lecture 49 - Two Phase method - II](#)

[Lecture 50 - Duality - I](#)

[Lecture 51 - Duality - II](#)

[Lecture 52 - Dual Simplex Method](#)

[Lecture 53 - Transportation Problem - I](#)

[Lecture 54 - Transportation Problem - II](#)

[Lecture 55 - Assignment Problem - I](#)

[Lecture 56 - Assignment Problem - II](#)

Lecture 1 - Introduction to OR Models

Lecture 2 - More OR Models

Lecture 3 - Graphical Method for LPP

Lecture 4 - Convex sets

Lecture 5 - Simplex Method

Lecture 6 - Big M Method

Lecture 7 - Two Phase

Lecture 8 - Multiple solutions of LPP

Lecture 9 - Unbounded solution of LPP

Lecture 10 - Infeasible solution of LPP

Lecture 11 - Revised Simplex Method

Lecture 12 - Case studies and Exercises - I

Lecture 13 - Case studies and Exercises - II

Lecture 14 - Case studies and Exercises - III

Lecture 15 - Primal Dual Construction

Lecture 16 - Weak Duality Theorem

Lecture 17 - More Duality Theorems

Lecture 18 - Primal-Dual relationship of solutions

Lecture 19 - Dual Simplex Method

Lecture 20 - Sensitivity Analysis - I

Lecture 21 - Sensitivity Analysis - II

Lecture 22 - Case studies and Exercises - I

Lecture 23 - Case studies and Exercises - II

Lecture 24 - Integer Programming

Lecture 25 - Goal Programming

Lecture 26 - Multi-Objective Programming

Lecture 27 - Dynamic Programming

Lecture 28 - Transportation Problem

Lecture 29 - Assignment Problem

Lecture 30 - Case studies and Exercises

Lecture 31 - Processing n Jobs on Two Machines

[Lecture 32 - Processing n Jobs through Three Machines](#)

[Lecture 33 - Processing two jobs through m machines](#)

[Lecture 34 - Processing n jobs through m machines](#)

[Lecture 35 - Case studies and Exercises](#)

[Lecture 36 - Two Person Zero-Sum Game](#)

[Lecture 37 - Theorems of Game Theory](#)

[Lecture 38 - Solution of Mixed Strategy Games](#)

[Lecture 39 - Linear Programming method for solving games](#)

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- Lecture 1 - Vectors in Machine Learning
- Lecture 2 - Basics of Matrix Algebra
- Lecture 3 - Vector Space: Definition and Examples
- Lecture 4 - Vector Subspace: Examples and Properties
- Lecture 5 - Basis and Dimension
- Lecture 6 - Linear Transformations
- Lecture 7 - Norms and Spaces
- Lecture 8 - Orthogonal Complement and Projection Mapping
- Lecture 9 - Eigenvalues and Eigenvectors
- Lecture 10 - Special matrices and Properties
- Lecture 11 - Spectral Decomposition
- Lecture 12 - Singular Value Decomposition
- Lecture 13 - SVD: Properties and Applications
- Lecture 14 - Low Rank Approximations
- Lecture 15 - Python Implementation of SVD and Low - rank Approximation
- Lecture 16 - Principal Component Analysis - I
- Lecture 17 - PCA: Derivation and Examples
- Lecture 18 - Python Implementation of PCA
- Lecture 19 - Linear Discriminant Analysis
- Lecture 20 - Python Implementation of LDA
- Lecture 21 - Least Square Approximation and Minimum Normed Solution
- Lecture 22 - Linear and Multiple Regression - I
- Lecture 23 - Linear and Multiple Regression - II
- Lecture 24 - Logistic Regression - I
- Lecture 25 - Logistic Regression - II
- Lecture 26 - Classification Metrics
- Lecture 27 - Gram Schmidt Process
- Lecture 28 - Polar Decomposition
- Lecture 29 - Minimal Polynomial and Jordan Canonical Form - I
- Lecture 30 - Minimal Polynomial and Jordan Canonical Form - II
- Lecture 31 - Basic Concepts of Calculus - I



Lecture 32 - Basic Concepts of Calculus - II  
Lecture 33 - Basic Concepts of Calculus - III  
Lecture 34 - Basic Concepts of Calculus - IV  
Lecture 35 - Basic Concepts of Calculus - V  
Lecture 36 - Calculus in Python  
Lecture 37 - Convex Sets and Functions  
Lecture 38 - Properties of convex functions - I  
Lecture 39 - Properties of Convex functions - II  
Lecture 40 - Introduction to Optimization  
Lecture 41 - Unconstrained Optimization  
Lecture 42 - Constrained Optimization - I  
Lecture 43 - Constrained Optimization - II  
Lecture 44 - Steepest Descent method  
Lecture 45 - Newton's and Penalty function method  
Lecture 46 - Optimization using Python  
Lecture 47 - Operations on Sets  
Lecture 48 - Review on Probability  
Lecture 49 - Bayes' theorem and Random variables  
Lecture 50 - Expectation and Variance  
Lecture 51 - Discrete probability distributions  
Lecture 52 - Continuous probability distributions  
Lecture 53 - Joint probability distribution and covariance  
Lecture 54 - Introduction to SVM  
Lecture 55 - Error Minimizing LPP  
Lecture 56 - Concepts of Duality  
Lecture 57 - Hard Margin classifier  
Lecture 58 - Soft margin classifier  
Lecture 59 - SVM using Python - I  
Lecture 60 - SVM using Python - II

Lecture 1 - System of Linear Equations

Lecture 2 - Elementary Row Operations

Lecture 3 - Row-Reduced Echelon Form and its Applications

Lecture 4 - Vector Spaces - I

Lecture 5 - Vector Spaces - II

Lecture 6 - Basis and Dimensions - I

Lecture 7 - Basis and Dimensions - II

Lecture 8 - Change of Ordered Basis in F. D. V. S.

Lecture 9 - Row Space of a Matrix

Lecture 10 - Computations concerning Subspaces

Lecture 11 - Linear Transformations

Lecture 12 - Concept of Rank

Lecture 13 - Algebra of Linear Transformations - I

Lecture 14 - Algebra of Linear Transformations - II

Lecture 15 - Algebra of Linear Transformations - III

Lecture 16 - Matrix Representation of Linear Transformations - I

Lecture 17 - Matrix Representation of Linear Transformations - II

Lecture 18 - Linear Functional - I

Lecture 19 - Linear Functional - II

Lecture 20 - Linear Functional - III

Lecture 21 - Linear Functional and Transpose of L.T. - I

Lecture 22 - Linear Functional and Transpose of L.T. - II

Lecture 23 - Eigenvalue and Eigenvector of Linear Operator - I

Lecture 24 - Eigenvalue and Eigenvector of Linear Operator - II

Lecture 25 - Eigenvalue and Eigenvector of Diagonalizable L.O.

Lecture 26 - Annihilating Polynomial of Linear Operator

Lecture 27 - Cayley-Hamilton Theorem and Its Applications - I

Lecture 28 - Cayley-Hamilton Theorem and its Applications - II

Lecture 29 - Invariant Subspaces - I

Lecture 30 - Invariant Subspaces - II

Lecture 31 - Application of Invariant Subspaces - I

- Lecture 32 - Application of Invariant Subspaces - II
- Lecture 33 - Direct Sum Decompositions - I
- Lecture 34 - Direct Sum Decompositions - II
- Lecture 35 - Invariant Direct Sums - I
- Lecture 36 - Invariant Direct Sums - II
- Lecture 37 - Decomposition of space and Operator - I
- Lecture 38 - Decomposition of Space and Operator - II
- Lecture 39 - Applications of Primary Decomposition Theorem - I
- Lecture 40 - Applications of Primary Decomposition Theorem - II
- Lecture 41 - Applications of Primary Decomposition Theorem - III
- Lecture 42 - Inner Products - I
- Lecture 43 - Inner Products - II
- Lecture 44 - Inner Product Spaces - I
- Lecture 45 - Inner Product Spaces - II
- Lecture 46 - Best Approximation in I.P.S.
- Lecture 47 - Orthogonal Projection in I.P.S.
- Lecture 48 - Linear Functionals and Adjoints - I
- Lecture 49 - Linear Functionals and Adjoints - II
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- Lecture 51 - Linear Functionals and Adjoints - IV
- Lecture 52 - Isomorphism in Inner Product Spaces
- Lecture 53 - Unitary Operators - I
- Lecture 54 - Unitary Operators - II
- Lecture 55 - Application of Unitary O. and Initiation of Normal Operator
- Lecture 56 - Normal Operator - I
- Lecture 57 - Normal Operator - II
- Lecture 58 - Normal Operator and It's Spectral Resolution
- Lecture 59 - Singular Value Decomposition of a Matrix
- Lecture 60 - Forms on Inner product Spaces

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Lecture 2 - Prologue - Part 2

Lecture 3 - Prologue - Part 3

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- Lecture 61 - Initial Excitation in Adaptive Control - Part 1
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- Lecture 6 - Windowing and Clipping
- Lecture 7 - Clipping of Polygons
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- Lecture 9 - 3D Transformations and Projection
- Lecture 10 - Perspective Projections
- Lecture 11 - Projections and Hidden Surface Removal
- Lecture 12 - Hidden Surface Removal
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- Lecture 15 - Finite Element Method : An Introduction
- Lecture 16 - Galerkin's Approach
- Lecture 17 - Galerkin's Method : 1D Finite Element Method
- Lecture 18 - 1D Finite Element Problems
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- Lecture 20 - FE Problems : Solving for Q
- Lecture 21 - 1D - FE Problems : Galerkin's Approach
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- Lecture 27 - 3D - Tetrahedral and 2D - Quadrilateral Element
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- Lecture 29 - Modeling of Curves
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**NPTEL : Project and Production Management (Mechanical Engineering)**

**Co-ordinators : Prof. Arun Kanda**

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Lecture 2 - Project Management: An Overview

Lecture 3 - Project Identification and Screening

Lecture 4 - Project Appraisal - Part I

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Lecture 6 - Project Selection

Lecture 7 - Project Representation

Lecture 8 - Consistency and Redundancy in Project Networks

Lecture 9 - Basic scheduling with A-O-A Networks

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Lecture 11 - Project Scheduling with Probabilistic Activity

Lecture 12 - Linear Time-Cost Tradeoffs in Projects

Lecture 13 - Project Crashing with Multiple Objectives

Lecture 14 - Resource Profiles and Leveling

Lecture 15 - Limited Resource Allocation

Lecture 16 - Project Monitoring and Control with PERT/Cost

Lecture 17 - Team Building and Leadership in Projects

Lecture 18 - Organizational and Behavioral Issues

Lecture 19 - Computers in Project Management

Lecture 20 - Project Completion and Review

Lecture 21 - Life Cycle of a Production System

Lecture 22 - Role of Models in Production Management

Lecture 23 - Financial Evaluation of capital Decisions

Lecture 24 - Decision Trees and Risk Evaluation

Lecture 25 - Introducing New Products & Services

Lecture 26 - Economic Evaluation of New Products & Services

Lecture 27 - Product Mix Decisions

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Lecture 29 - Issues in Location of Facilities

Lecture 30 - Mathematical Models for Facility Location

Lecture 31 - Layout planning

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[Lecture 33 - Product Layouts and Assembly Line Balancing](#)

[Lecture 34 - Forecasting](#)

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[Lecture 36 - Aggregate Production Planning: Basic Concepts](#)

[Lecture 37 - Modelling Approaches](#)

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Lecture 2 - Design Considerations

Lecture 3 - Basic Concepts Psychrometry and Air-Conditioning

Lecture 4 - Refrigerants

Lecture 5 - Refrigerant Properties and Applications

Lecture 6 - Refrigeration Cycle and Components

Lecture 7 - Compressor Selection

Lecture 8 - Expansion Devices

Lecture 9 - Condensers and Evaporators

Lecture 10 - Types of Heat Exchangers and Air Conditioning Systems

Lecture 11 - Selection of Air Conditioning Systems for Hostels

Lecture 12 - Case Study on a Railway Air Conditioning System

Lecture 13 - Vibration and noise issues in railway AC systems

Lecture 14 - New product launch process

Lecture 15 - Case study on a telecom cooling system and Emerging technologies

Lecture 1 - Thermodynamic Concepts: Applications of thermodynamics

Lecture 2 - Thermodynamic Concepts: System definition, Heat, Work and Mass Flow

Lecture 3 - Thermodynamic Concepts: Questions and Answers

Lecture 4 - Thermodynamic Concepts: Properties, State and Equilibrium

Lecture 5 - Thermodynamic Concepts: Process, Cycles and Applications

Lecture 6 - Thermodynamic Concepts: Steady state, Reversible and Irreversible processes

Lecture 7 - Thermodynamic Concepts: Causes of irreversibility

Lecture 8 - Thermodynamic Concepts: Thermal reservoirs

Lecture 9 - Thermodynamic Concepts: Pressure and temperature

Lecture 10 - Thermodynamic Concepts: Revision and Summary

Lecture 11 - Laws Of Thermodynamics: Mass flow rate, Conservation of mass, Flow work

Lecture 12 - Laws Of Thermodynamics: Zeroth Law

Lecture 13 - Laws Of Thermodynamics: First Laws Of Thermodynamics, 1st law for Control Mass, Internal Energy, enthalpy

Lecture 14 - Laws Of Thermodynamics: 1st law for Control Volume

Lecture 15 - Laws Of Thermodynamics: Revision, Cycles, Second Law statements, Clausius inequality

Lecture 16 - Laws Of Thermodynamics: Introduction to Carnot Cycle

Lecture 17 - Laws Of Thermodynamics: Entropy, Entropy change for a system

Lecture 18 - Laws Of Thermodynamics: Thermodynamics relations, Bernoulli's equation

Lecture 19 - Laws Of Thermodynamics: Devices, Cycles

Lecture 20 - Properties of a Pure Substance: Thermodynamic behaviour of a pure substance

Lecture 21 - Properties of a Pure Substance: Saturated states, Subcooled liquid, Superheated vapour

Lecture 22 - Properties of a Pure Substance: Vapour pressure curve, Reference state

Lecture 23 - Properties of a Pure Substance: Saturated states

Lecture 24 - Properties of a Pure Substance: p-h diagram

Lecture 25 - Properties of a Pure Substance: T-s diagram, h-s diagram

Lecture 26 - Properties of a Pure Substance: Critical state, Compressibility factor

Lecture 27 - Properties of a Pure Substance: Ideal gas behaviour, Equations of state, Specific heat

Lecture 28 - Properties of a Pure Substance: Ideal gas processes

Lecture 29 - Properties of a Pure Substance: Gibbs energy, Helmholtz function, Property relations

Lecture 30 - Properties of a Pure Substance: Process analysis, Summary

Lecture 31 - Laws of Thermodynamics: Carnot Cycle Realization



Lecture 32 - Applications, Problem Solving: Devices, Schematic/Flow Diagrams

Lecture 33 - Applications, Problem Solving: Positive Displacement Devices

Lecture 34 - Applications, Problem Solving: Heat Exchangers

Lecture 35 - Applications, Problem Solving: Compressors, Fans and Blowers, Pumps

Lecture 36 - Applications, Problem Solving: Turbines

Lecture 37 - Applications, Problem Solving: Nozzle, Diffuser, Expansion Valve, Pipe/duct flow

Lecture 38 - Applications, Problem Solving: De-Superheater, Deaerator, Separation

Lecture 39 - Applications, Problem Solving: Unsteady processes, Filling, Evacuation

Lecture 40 - Applications, Problem Solving: Realization of Carnot cycle, Practical cycles, Air-standard cycles

Lecture 41 - Applications, Problem Solving: Materials, Compressible flow

Lecture 42 - Applications, Problem Solving: Otto cycle, Diesel cycle

Lecture 43 - Applications, Problem Solving: Closed system

Lecture 44 - Applications, Problem Solving: Open System

Lecture 45 - Properties of Ideal Gas Mixtures: Introduction to mixtures properties

Lecture 46 - Properties of Ideal Gas Mixtures: Equation of state, Conservation equations

Lecture 47 - Gas-Vapour Mixtures: Psychrometry, Moist air Properties,

Lecture 48 - Gas-Vapour Mixtures: Properties, Conservation of Mass and Energy

Lecture 49 - Gas-Vapour Mixtures: Psychrometric chart, Applications

Lecture 50 - Thermodynamics of Reacting systems: Introduction to reacting systems and combustion

Lecture 51 - Thermodynamics of Reacting systems: Flames, Stoichiometry

Lecture 52 - Thermodynamics of Reacting systems: Analysis of Closed and Open Systems, Enthalpy of Formation

Lecture 53 - Phase and Chemical Equilibrium: Introduction. Chemical equilibrium. Gibbs function

Lecture 54 - Phase and Chemical Equilibrium: Equilibrium constant. Phase equilibrium

- Lecture 1 - Mathematical Concepts: Working with Vectors and Tensors
- Lecture 2 - Traction Vector
- Lecture 3 - Stress Tensor and its Matrix Representation
- Lecture 4 - Transformation of Stress Matrix
- Lecture 5 - Stress Equilibrium Equations : Balance of Linear and Angular Momentum
- Lecture 6 - Balance of Angular Momentum (Continued...)
- Lecture 7 - Principal Planes and Principal stress components
- Lecture 8 - Maximizing the Shear Component of Traction
- Lecture 9 - Mohr's Circle
- Lecture 10 - Mohr's Circle (Continued...), Stress Invariants, Decomposition of the Stress Tensor
- Lecture 11 - Concept of Strain Tensor
- Lecture 12 - Longitudinal and Shear Strains
- Lecture 13 - Local Volumetric Strain and Local Infinitesimal Rotation
- Lecture 14 - Similarity in Properties of Stress and Strain Tensors
- Lecture 15 - Stress-Strain Relation
- Lecture 16 - Stress-Strain Relation for Isotropic Materials
- Lecture 17 - Linear Momentum Balance in Cylindrical Coordinate System
- Lecture 18 - Linear Momentum Balance in Cylindrical Coordinate System (Continued...)
- Lecture 19 - Strain Matrix Cylindrical Coordinate System
- Lecture 20 - Extension-Torsion-Inflation in a Hollow Cylinder
- Lecture 21 - Extension-Torsion-Inflation in a Hollow Cylinder (Continued...)
- Lecture 22 - Solving Problems Involving Torsion of Shafts
- Lecture 23 - Pure Bending of Rectangular Beams
- Lecture 24 - Bending of Beams (Continued...)
- Lecture 25 - Bending of Unsymmetrical Beams
- Lecture 26 - Concept of Shear Center
- Lecture 27 - Theory of Beams
- Lecture 28 - Theory of Beams (Continued...) and Beam Buckling
- Lecture 29 - Energy Methods
- Lecture 30 - Energy Methods (Continued...)
- Lecture 31 - Theories of Failure

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- Lecture 1 - Course Outline, Introduction
- Lecture 2 - Experimentation Processes and Applications Overview
- Lecture 3 - Developments in Uncertainty Analysis, Approach
- Lecture 4 - Errors, Their Causes and Classification
- Lecture 5 - Errors to Uncertainty via Statistics
- Lecture 6 - Sources of Errors, Uncertainty Definitions
- Lecture 7 - Experimentation - I
- Lecture 8 - Experimentation Stages / Phases I
- Lecture 9 - Experimentation Stages / Phases II
- Lecture 10 - Uncertainty Analysis Processes
- Lecture 11 - Instrument ans DAS
- Lecture 12 - Basic procedure - I
- Lecture 13 - Basic procedure - II
- Lecture 14 - Evaluating systematic uncertainties
- Lecture 15 - Worksheets for uncertainty in a measurement, Examples
- Lecture 16 - Examples of uncertainty in a measurement
- Lecture 17 - Methodologies, Multiple tests method
- Lecture 18 - Single test, Basics of taylor Series Method
- Lecture 19 - Sensitivity coefficient, Result uncertainty from TSM
- Lecture 20 - Result uncertainty TSM: Special cases
- Lecture 21 - Method selection, Worksheets for result uncertainty
- Lecture 22 - Examples for result uncertainty - 1
- Lecture 23 - Examples for result uncertainty - 2
- Lecture 24 - Regression Introduction
- Lecture 25 - Regression analysis - Linear, single variable
- Lecture 26 - Correlation, Related topics
- Lecture 27 - Reporting uncertainties
- Lecture 28 - Validation and verification aspects, Data archiving
- Lecture 29 - Course overview

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Lecture 2 - Examples of visualization - 1

Lecture 3 - Examples of visualization - 2

Lecture 4 - Visualization and drawing

Lecture 5 - Sketch to engineering drawing

Lecture 6 - Types of projections

Lecture 7 - Multiview projections

Lecture 8 - 1st and 3rd angle projections

Lecture 9 - Sketching

Lecture 10 - Visualization

Lecture 11 - Drawing sheet

Lecture 12 - Lines

Lecture 13 - Dimensioning

Lecture 14 - Projection of a point line and plane

Lecture 15 - Projection of simple objects

Lecture 16 - Example Projection of a solid

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Lecture 19 - Polygons Construction and Projections

Lecture 20 - Rotation of Solids

Lecture 21 - Example Rotation of Solids

Lecture 22 - Section views

Lecture 23 - Sectioning practices

Lecture 24 - Auxiliary views

Lecture 25 - Example Section View

Lecture 26 - Example Auxiliary View

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Lecture 28 - Construction of Isometric Drawings

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[Lecture 38 - Revolve Loft Pattern](#)

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[Lecture 47 - Example 9](#)

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Lecture 2 - Stream function, Orthogonality of streamlines and equipotential lines

Lecture 3 - Complex variables, Analyticity, Cauchy - Riemann equations, Complex potential, Complex velocity

Lecture 4 - Elementary flows : Uniform flow, Source and Sink, Free vortex

Lecture 5 - Flow in a bend, Flow around a sharp edge

Lecture 6 - Superposition of source and sink : doublet flow

Lecture 7 - Superposition of uniform flow and doublet

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Lecture 9 - Superposition of source and uniform flow

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Lecture 11 - Problem solving session - 2

Lecture 12 - Method of images, Forces on a body, Blasius theorem

Lecture 13 - Calculation of forces using derived flow field

Lecture 14 - Introduction to conformal transformation

Lecture 15 - Singularities and their transformations

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- Lecture 1 - Introduction to polymers
- Lecture 2 - Polymer structure
- Lecture 3 - Polymer classification
- Lecture 4 - Polymer length, packing and tacticity
- Lecture 5 - Glass transition temperature
- Lecture 6 - Temperature effects, glassy regime
- Lecture 7 - Viscoelastic, rubbery, viscous, decomposition
- Lecture 8 - Relaxation and creep tests
- Lecture 9 - Failure of polymers
- Lecture 10 - Heaviside, Dirac delta, Laplace
- Lecture 11 - Introduction to linear viscoelasticity
- Lecture 12 - Phenomenological models for linear viscoelasticity
- Lecture 13 - Maxwell model
- Lecture 14 - Kelvin model
- Lecture 15 - Three and four parameter models
- Lecture 16 - Generalized Maxwell and Kelvin models
- Lecture 17 - Boltzman superposition principle
- Lecture 18 - Alfrey's correspondence principle
- Lecture 19 - Analysis of viscoelastic bars
- Lecture 20 - Analysis of viscoelastic beams
- Lecture 21 - Dynamic mechanical analysis (DMA)
- Lecture 22 - Dynamic mechanical thermal analysis (DMTA)
- Lecture 23 - Time temperature superposition principle (TTSP)
- Lecture 24 - Plastic design consideration and practices
- Lecture 25 - What are composites?
- Lecture 26 - Composite materials and types
- Lecture 27 - Composite advantages and applications
- Lecture 28 - Fabrication and other aspects of composites
- Lecture 29 - 3D stress and strain components
- Lecture 30 - Symmetry in stress, strain and stiffness matrix
- Lecture 31 - Monoclinic, orthotropic and isotropic materials

- Lecture 32 - 3D stress strain relation for orthotropic material
- Lecture 33 - Plane stress: Specially orthotropic material
- Lecture 34 - Plane stress: Generally orthotropic material
- Lecture 35 - Lamina engineering constants
- Lecture 36 - Lamina hygrothermal effects
- Lecture 37 - Lamina fundamental strengths
- Lecture 38 - Lamina failure criteria
- Lecture 39 - Tsai-Hill and Hoffman failure criteria
- Lecture 40 - Micromechanics: Assumptions, RVE
- Lecture 41 - Micromechanics: Stiffness prediction
- Lecture 42 - Micromechanics: Stiffness and strength
- Lecture 43 - Macromechanics of laminate
- Lecture 44 - Classical laminate theory
- Lecture 45 - Classical laminate theory - II
- Lecture 46 - Symmetric laminates, orthotropic laminates
- Lecture 47 - Angle-ply, cross-ply and quasi-isotropic laminates
- Lecture 48 - Hygrothermal stresses in laminates
- Lecture 49 - Laminate failure
- Lecture 50 - Design practices with laminates
- Lecture 51 - Sandwich structures
- Lecture 52 - Composites testing
- Lecture 53 - Joining of composites

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Lecture 2 - Tribological Interfaces

Lecture 3 - Fundamentals of Friction and Wear

Lecture 4 - Adhesion, Abrasion, and Surface Fatigue Mechanisms

Lecture 5 - Wear Measurement Techniques

Lecture 6 - Principles of Lubrication, types of Lubricants and their properties

Lecture 7 - Lubrication regimes and film thickness calculations

Lecture 8 - Mixed Lubrication

Lecture 9 - Hydrodynamic Lubrication Theory

Lecture 10 - Design Considerations for Hydrodynamic Lubrication Systems

Lecture 11 - Elastohydrodynamic Lubrication

Lecture 12 - Solid Lubrication

Lecture 13 - Surface modification techniques for tribological applications

Lecture 14 - Thin film coatings and their tribological properties

Lecture 15 - Nanotribology

Lecture 16 - Tribocorrosion

Lecture 17 - Wear testing techniques and standards

Lecture 18 - Measurement and analysis of wear debris

Lecture 19 - Experimental Design and Statistical Analysis

Lecture 20 - Introduction to Data-Enabled Engineering

Lecture 21 - Data Collection and Preprocessing

Lecture 22 - Feature Extraction and Selection

Lecture 23 - Introduction to Machine Learning Algorithms

Lecture 24 - Regression and Classification Algorithms for Tribological Modeling

Lecture 25 - Deep Learning for Tribological Engineering

Lecture 26 - Data-Driven Models for Friction Prediction

Lecture 27 - Data-Driven Models for Wear Prediction

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Lecture 30 - Data-Driven Models for Tribocorrosion Prediction

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Lecture 1 - Introduction of Nonlinear systems

Lecture 2 - Review of Linear vibrating systems

Lecture 3 - Phenomena associated with Nonlinear systems

Lecture 4 - Commonly observed Phenomena in Nonlinear systems

Lecture 5 - Force and Moment based Approach

Lecture 6 - Energy based approach Extended Hamilton's principle and Lagrange Principle

Lecture 7 - Derivation of Equation of motion of nonlinear discrete system (More examples)

Lecture 8 - Derivation of Equation of motion of nonlinear continuous system - 1

Lecture 9 - Derivation of Equation of motion of nonlinear continuous system - 2

Lecture 10 - Ordering of nonlinear Equation of motion

Lecture 11 - Qualitative Analysis Straight forward expansion

Lecture 12 - Numerical method Straight forward expansion

Lecture 13 - Lindstedt Poincaré technique

Lecture 14 - Method of multiple scales

Lecture 15 - Method of Harmonic balance

Lecture 16 - Method of averaging

Lecture 17 - Generalized Method of averaging

Lecture 18 - Krylov-Bogoliubov-Mitropolski technique

Lecture 19 - Incremental harmonic balance method and Intrinsic multiple scale harmonic balance method

Lecture 20 - Modified Lindstedt Poincaré technique

Lecture 21 - Stability and Bifurcation of Fixed-point response - 1

Lecture 22 - Stability and Bifurcation of Fixed-point response - 2

Lecture 23 - Stability and Bifurcation of Fixed-point response - 3

Lecture 24 - Stability and Bifurcation of Fixed-point response - 4

Lecture 25 - Stability Analysis of Periodic response

Lecture 26 - Bifurcation of Periodic response And Introduction to quasi-periodic and Chaotic response

Lecture 27 - Quasi-Periodic and Chaotic response

Lecture 28 - Numerical methods to obtain roots of characteristic equation and time response

Lecture 29 - Numerical methods to obtain time response

Lecture 30 - Numerical methods to obtain frequency response

Lecture 31 - Free Vibration of Single degree of freedom Nonlinear systems with Cubic and quadratic nonlinearities

[Lecture 32 - Free Vibration of Single degree of freedom Nonlinear systems with Cubic and quadratic nonlinearities: effect of damping](#)

[Lecture 33 - Free Vibration of multi- degree of freedom Nonlinear systems with Cubic and quadratic nonlinearities](#)

[Lecture 34 - Forced nonlinear Vibration Single degree of freedom Nonlinear systems with Cubic nonlinearities:](#)

[Lecture 35 - Forced nonlinear Vibration Single and multi- degree of freedom Nonlinear systems](#)

[Lecture 36 - Nonlinear Forced-Vibration of Single and Multi Degree-of-Freedom System](#)

[Lecture 37 - Analysis of Multi- degree of freedom system](#)

[Lecture 38 - Nonlinear Vibration of Parametrically excited system: Axially loaded sandwich beam](#)

[Lecture 39 - Nonlinear Vibration of Parametrically excited system: Elastic and Magneto-elastic beam](#)

[Lecture 40 - Nonlinear Vibration of Parametrically excited system with internal resonance](#)

Lecture 1 - Introduction

Lecture 2 - A Brief History of Rotor Dynamics

Lecture 3 - The State of the Art of Rotor Dynamics

Lecture 4 - Simple Rotor Models with Rigid Bearings

Lecture 5 - Jeffcott Rotor Model

Lecture 6 - Variant of Jeffcott Rotor Model

Lecture 7 - Rigid Rotor Mounted on Simple Anisotropic Springs as Bearings

Lecture 8 - Rigid Rotor Mounted on Complex Anisotropic Bearings

Lecture 9 - Flexible Shaft with a Rigid Disc Mounted on Anisotropic Supports

Lecture 10 - Gyroscopic Effects : Synchronous whirl of a Rotor Systems with a thin Disc

Lecture 11 - Gyroscopic Effects : Synchronous and Asynchronous pure wobbling motions

Lecture 12 - Gyroscopic Effects : Asynchronous whirl of a Rotor system with a thin Disc

Lecture 13 - Gyroscopic Effects : Asynchronous whirl analysis with Dynamic Approach

Lecture 14 - Torsional Vibrations: Simple Rotor Systems

Lecture 15 - Three Disc Rotor System

Lecture 16 - Transfer Matrix Approach - Part I

Lecture 17 - Transfer Matrix Approach - Part II

Lecture 18 - Transfer Matrix Approach - Part III

Lecture 19 - Geared and Branched Systems

Lecture 20 - Continuous System and Finite Element Method

Lecture 21 - Finite Element Method

Lecture 22 - Finite Element Analysis

Lecture 23 - Finite Element Analysis - Part III

Lecture 24 - Influence Coefficient Method

Lecture 25 - Transfer Matrix Method - Part I

Lecture 26 - Transfer Matrix Method - Part II

Lecture 27 - Transfer Matrix Method - Part III

Lecture 28 - Continuous System Approach

Lecture 29 - Finite Element Method - Part I

Lecture 30 - Finite Element Method - Part II

Lecture 31 - Finite Element Method - Part III



[Lecture 32 - Instability in Rotor Systems: Bearings](#)

[Lecture 33 - Fluid-Film Bearings](#)

[Lecture 34 - Internal Damping & Asymmetrical Shaft](#)

[Lecture 35 - Steam Whirl and Seals](#)

[Lecture 36 - Subcritical Speed Whirl](#)

[Lecture 37 - Introduction to Rigid Rotor Balancing](#)

[Lecture 38 - Dynamic Balancing of Rotors: Rigid Rotor Balancing](#)

[Lecture 39 - Dynamic Balancing of Rotors:Flexible Rotor Model Balancing](#)

[Lecture 40 - Dynamic Balancing of Rotors:Influence Coefficient Method for Flexible Rotor](#)

[Lecture 41 - Common Faults & Vibration signatures](#)

[Lecture 42 - Condition Based Monitoring](#)

Lecture 1 - Fundamentals Of Engineering Mechanics

Lecture 2 - Equations of Equilibrium

Lecture 3 - Truss Analysis - Part 1

Lecture 4 - Truss Analysis - Part 2

Lecture 5 - Analysis of Frames Machines

Lecture 6 - Internal Forces

Lecture 7 - Internal Forces in Beams

Lecture 8 - Cables

Lecture 9 - Friction

Lecture 10 - Application of Friction - Part 1

Lecture 11 - Application of Friction - Part 2

Lecture 12 - Application of Friction - Part 3

Lecture 13 - Centroids Center of Mass

Lecture 14 - Centroids Area of Moments

Lecture 15 - Product of Inertia, Rotation of Axis and Principle Moments of Inertia

Lecture 16 - Principle Mass Moments of Inertia

Lecture 17 - Second Moment of Mass

Lecture 18 - Virtual Work of Ideal System

Lecture 19 - Principle of Virtual Work

Lecture 20 - Systems with Friction

Lecture 21 - Potential Energy

Lecture 22 - Stability of Equilibrium

Lecture 23 - Kinematics of a Particles

Lecture 24 - Kinematics of a Particle Moving on a Curve

Lecture 25 - Relative Motion

Lecture 26 - Plane Kinematics of Rigid Bodies

Lecture 27 - Kinematics of a Particle

Lecture 28 - Work and Energy

Lecture 29 - Impulse and Momentum

Lecture 30 - Direct and Oblique Impulse

Lecture 31 - Plane Kinetics of Rigid Bodies

[Lecture 32 - Kinetics of a Body](#)

[Lecture 33 - Method of Momentum and Analysis of Robot Manipulator](#)

[Lecture 34 - Kinematics in 3D](#)

[Lecture 35 - Kinetics in 3D](#)

[Lecture 36 - Free Vibration](#)

[Lecture 37 - Forced Vibration Damped Undamped](#)

[Lecture 38 - Vibration of Rigid Bodies - Part 1](#)

[Lecture 39 - Vibration of Rigid Bodies - Part 2](#)

[Lecture 40 - Some Problems of Vibration](#)

**NPTEL : Mechanical Vibrations (Mechanical Engineering)**

**Co-ordinators : Prof. S.K. Dwivedy, Prof. Rajiv Tiwari**

- Lecture 1 - Overview of the Course, Practical and Research Trends
- Lecture 2 - Harmonic and Periodic Motions, Vibration Terminology
- Lecture 3 - Vibration Model, Equation of Motion-Natural Frequency
- Lecture 4 - Energy Method, Principle of Virtual Work
- Lecture 5 - Viscously Damped Free Vibration Special Cases: Oscillatory
- Lecture 6 - Logarithmic Decrement Experimental Determination of Damping Coefficient Hysteresis Loop
- Lecture 7 - Coulomb Damping other Damping Models
- Lecture 8 - Forced Harmonic Vibration, Magnification Factor
- Lecture 9 - Laplace Transform, Superposition Theorem
- Lecture 10 - Rotor Unbalance and Whirling of Shaft, Transmissibility
- Lecture 11 - Support Motion, Vibration Isolation
- Lecture 12 - Sharpness of Resonance, Vibration Measuring Instruments
- Lecture 13 - Generalized and Principle Coordinates, Derivation of Equation of Motion
- Lecture 14 - Lagranges's Equation
- Lecture 15 - Coordinate Coupling
- Lecture 16 - Forced Harmonic Vibration
- Lecture 17 - Tuned Absorber, Determination of Mass Ratio
- Lecture 18 - Tuned and Damped Absorber, Untuned Viscous Damper
- Lecture 19 - Derivation of Equations of Motion, Influence Coefficient Method
- Lecture 20 - Properties of Vibrating Systems: Flexibility & Stiffness Matrices, Reciprocity Theorem
- Lecture 21 - Modal Analysis: Undamped
- Lecture 22 - Modal Analysis: Damped
- Lecture 23 - Simple Systems With One Two or Three Discs Geared System
- Lecture 24 - Multi-Degree of Freedom Systems-Transfer Matrix Method Branched Systems
- Lecture 25 - Derivation of Equations of Motion Part 1 - Newton
- Lecture 26 - Derivation of Equations of Motion Part 2 - Newton
- Lecture 27 - Vibration of Strings
- Lecture 28 - Longitudinal and Torsional Vibration of Rods
- Lecture 29 - Transverse Vibration of Beams, Equations of Motion and Boundary Conditions
- Lecture 30 - Transverse Vibration of Beams: Natural Frequencies and Mode Shapes
- Lecture 31 - Rayleigh's Energy Method

[Lecture 32 - Matrix Iteration Method](#)

[Lecture 33 - Durkerley, Rayleigh-Ritz and Galerkin Method](#)

[Lecture 34 - Finite Element Formulation for Rods, Gear Train and Branched System](#)

[Lecture 35 - Finite Element Formulation for Beams: Galerkin](#)

[Lecture 36 - Global Finite Element Assembly and Imposition of Boundary Conditions](#)

[Lecture 37 - Vibration Testing Equipments: Signal Measurements](#)

[Lecture 38 - Vibration Testing Equipments: Signal Analysis](#)

[Lecture 39 - Field Balancing of Rotors](#)

[Lecture 40 - Condition Monitoring](#)

Lecture 1 - Introduction to advanced machining processes

Lecture 2 - Ultrasonic machining - Part I

Lecture 3 - Ultrasonic machining - Part II

Lecture 4 - Abrasive jet machining

Lecture 5 - Water jet cutting and Abrasive water jet machining

Lecture 6 - Magnetic abrasive finishing

Lecture 7 - Abrasive Flow Finishing

Lecture 8 - Magnetorheological Finishing

Lecture 9 - Magnetorheological Abrasive Flow Finishing - Part I

Lecture 10 - Magnetorheological Abrasive Flow Finishing - Part II

Lecture 11 - Magnetorheological Abrasive Flow Finishing - Part III

Lecture 12 - Electric discharge machining (EDM)

Lecture 13 - Electric Discharge Grinding, Electric Discharge Diamond Grinding and Wire Electric Discharge Machining

Lecture 14 - Electrochemical Machining (ECM)

Lecture 15 - Electrochemical Grinding, Electrostream Drilling, Shaped Tube Electrolytic Machining

Lecture 16 - Plasma Arc Machining (PAM)

Lecture 17 - Electron Beam Machining (EBM) Edit Lesson

Lecture 18 - Laser Beam Machining (LBM)

Lecture 19 - Chemical Machining (ChM)

- Lecture 1 - Introduction of nuclear energy
- Lecture 2 - Binding energy and mass defect
- Lecture 3 - Radioactivity and radioactive decay
- Lecture 4 - Different types of nuclear transmutation
- Lecture 5 - Artificial radioactivity and neutron-nucleus interactions
- Lecture 6 - Energy and momentum conservation
- Lecture 7 - Fission and role of neutron energy
- Lecture 8 - Theory of elastic scattering
- Lecture 9 - Neutron multiplication factor
- Lecture 10 - Neutron diffusion theory
- Lecture 11 - Solution of one-group diffusion equation
- Lecture 12 - Simple reactor theory
- Lecture 13 - Nuclear fuel and simple energy consideration
- Lecture 14 - Axial temperature distribution and heat transfer coefficient
- Lecture 15 - Prompt and delayed neutrons
- Lecture 16 - Delayed neutron kinetics
- Lecture 17 - Different control mechanisms and various effects
- Lecture 18 - Classical reactor designs
- Lecture 19 - Evolution of reactors from Gen-I to Gen-IV
- Lecture 20 - The concept of breeding
- Lecture 21 - Fuel cycles and FBR
- Lecture 22 - Gen-IV FBR designs
- Lecture 23 - Hydrogen fusion reactions
- Lecture 24 - Coulomb barrier and other critical factors
- Lecture 25 - Radiation dose and gross biological effects
- Lecture 26 - Stochastic and deterministic effects of human cells
- Lecture 27 - Lessons from TMI and Chernobyl
- Lecture 28 - Defence-in-depth Philosophy
- Lecture 29 - Waste classification and Disposal of Mill Tailings
- Lecture 30 - Disposal methodologies for HLW and IMW

- Lecture 1 - Fundamentals of Welding and Joining - Part I
- Lecture 2 - Fundamentals of Welding and Joining - Part II
- Lecture 3 - Fundamentals of Welding and Joining - Part III
- Lecture 4 - Fundamentals of Welding and Joining - Part IV
- Lecture 5 - Fundamentals of Welding and Joining - Part V
- Lecture 6 - Laser and Electron Beam Welding - Part I
- Lecture 7 - Laser and Electron Beam Welding - Part II
- Lecture 8 - Solid State Welding Processes - Part I
- Lecture 9 - Solid State Welding Processes - Part II
- Lecture 10 - Solid State Welding Processes - Part III
- Lecture 11 - Computational Welding Mechanics - Part I
- Lecture 12 - Computational Welding Mechanics - Part II
- Lecture 13 - Computational Welding Mechanics - Part III
- Lecture 14 - Micro and Nano Joining Processes - Part I
- Lecture 15 - Micro and Nano Joining Processes - Part II
- Lecture 16 - Micro and Nano Joining Processes - Part III
- Lecture 17 - Welding Metallurgy - Part I
- Lecture 18 - Welding Metallurgy - Part II
- Lecture 19 - Welding Metallurgy - Part III
- Lecture 20 - Welding Metallurgy - Part IV
- Lecture 21 - Welding and Joining of Non-Metals - Part I
- Lecture 22 - Welding and Joining of Non-Metals - Part II
- Lecture 23 - Metal Transfer in Welding and Metal Printing



Lecture 1 - Introduction

Lecture 2 - Introduction and Importance of Machining

Lecture 3 - Principles of Machining or Metal Cutting

Lecture 4 - Cutting Tools

Lecture 5 - Forces in Machining

Lecture 6 - Tribology in Machining

Lecture 7 - Lubrication surface roughness in Machining

Lecture 8 - Machinability and Thermal Aspects

Lecture 9 - Tool Wear and Tool life - Part 1

Lecture 10 - Tool Wear and Tool life - Part 2

Lecture 11 - Tool Wear and Tool life - Part 3

Lecture 12 - Tool Materials and Coatings

Lecture 13 - Machining Fluids / Cutting Fluids and its Additives - Part 1

Lecture 14 - Machining Fluids / Cutting Fluids and its Additives - Part 2

Lecture 15 - Machining Fluids / Cutting Fluids and its Emissions

Lecture 16 - Eco Friendly Cutting Fluids - Part 1

Lecture 17 - Eco Friendly Cutting Fluids - Part 2

Lecture 18 - Rheology and Thermal Characterization of Machining / Cutting Fluids

Lecture 19 - Bio-degradation Studies of Machining / Cutting Fluids

Lecture 20 - Cutting Fluid Application in Machining Region

Lecture 21 - Practical Machining Processes - 1

Lecture 22 - Practical Machining Processes - 2

Lecture 23 - Introduction to Abrasive Processes - Grinding

Lecture 24 - Cutting fluids in Grinding Process

Lecture 25 - Unbonded Conventional Abrasive Processes

Lecture 26 - Advances in Metal Cutting\_Machining Processes

Lecture 27 - Advances in Metal Cutting\_Machining Processes - 2

Lecture 1 - Deformation of Metals

Lecture 2 - Mechanism of Plastic Deformation

Lecture 3 - Machining Processes: Single Edge Tool, Types of Chips

Lecture 4 - Tool Geometry: Single Point Cutting Tool Specifications

Lecture 5 - Tool Specifications, Conversion Of Tool Angles, Multi-Point Cutting Tools

Lecture 6 - Mechanics of Orthogonal Cutting, Force Relationships

Lecture 7 - Determination of Stress, Strain, and Strain Rate

Lecture 8 - Measurement of Shear Angle

Lecture 9 - Other Analysis for Force Relationships

Lecture 10 - Mechanics of Oblique Cutting

Lecture 11 - Measurement of Cutting Forces

Lecture 12 - Thermal Aspects Of Machining: Temperatures in Orthogonal Cutting

Lecture 13 - Tool Wear and Tool Life and Tool Life Equations

Lecture 14 - Economics in Machining

Lecture 15 - Practical Machining Operations: Turning And Shaping and Planning Operation

Lecture 16 - Practical Machining Operations: Milling And Drilling

Lecture 17 - Grinding of Metals and Mechanics of Grinding Process

Lecture 18 - Abrasive Machining and Finishing Operations

Lecture 19 - CNC Machines and CNC Programming

Lecture 20 - Introduction to Advanced Machining Processes

Lecture 1 - Introduction to hydraulic machines: classifications and operational principles

Lecture 2 - Euler equation for turbomachines: net head developed by the pump/turbines

Lecture 3 - Velocity triangles of pumps, effect of inlet swirl on pump operation

Lecture 4 - Velocity triangles of pumps, effect of inlet swirl on pump operation

Lecture 5 - Pump casings, Efficiencies and Problems - I

Lecture 6 - Pump casings, Efficiencies and Problems - II

Lecture 7 - Pump casings, Efficiencies and Problems - III

Lecture 8 - Axial flow pump, HQ curve, System Resistance Curve - I

Lecture 9 - Axial flow pump, HQ curve, System Resistance Curve - II

Lecture 10 - HQ Curve, System Resistance Curve - I

Lecture 11 - HQ Curve, System Resistance Curve - II

Lecture 12 - Introduction to Cavitation

Lecture 13 - Condition for Cavitation and NPSH

Lecture 14 - Net Positive Suction Head (NPSH)

Lecture 15 - Suction number and Introduction to off design condition

Lecture 16 - Cavitation: The effect of off-design Conditions

Lecture 17 - Cavitation: Preventive Measures

Lecture 18 - Cavitation: Preventive Measures, Effect on Pump Characteristic

Lecture 19 - Problems on Cavitation

Lecture 20 - Introduction to Slip : Stodola Slip Model

Lecture 21 - Departure from Euler theory

Lecture 22 - Slip Velocity - I

Lecture 23 - Slip Velocity - II

Lecture 24 - Problem on slip

Lecture 25 - Degree of reaction of pump

Lecture 26 - Degree of reaction and axial pump design

Lecture 27 - Testing of radial flow pump - I

Lecture 28 - Testing of radial flow pump - II

Lecture 29 - Problem on radial flow pump testing

Lecture 30 - Radial equilibrium of axial flow pump - I

Lecture 31 - Radial equilibrium of axial flow pump - II

- Lecture 32 - Pump operation: series and parallel connection
- Lecture 33 - Series and parallel operation of dissimilar pumps
- Lecture 34 - Pumping system design
- Lecture 35 - Design of parallel pumping system
- Lecture 36 - Numerical problem on pumps - I
- Lecture 37 - Numerical problem on pumps - II
- Lecture 38 - Numerical problem on pumps - III
- Lecture 39 - Working principle and Indicator diagram of PD pump
- Lecture 40 - Working principle and Indicator diagram of PD pump (Continued...)
- Lecture 41 - Modified indicator diagram and Head-Discharge curve
- Lecture 42 - Analysis and Head-Discharge curve of PD pump
- Lecture 43 - Analysis and efficiencies of PD pump
- Lecture 44 - Requirement of air chamber in PD pump
- Lecture 45 - Numerical problem on PD pump with air chamber
- Lecture 46 - Similarity and dimensional analysis of hydraulic machines
- Lecture 47 - Dimensional analysis of hydraulic machines: Buckingham's theorem
- Lecture 48 - Buckingham's theorem: Specific speed of hydraulic machines
- Lecture 49 - Turbine Classification and Operational principle of Pelton wheel
- Lecture 50 - Velocity Triangles and analysis
- Lecture 51 - Operational Principle of Reaction turbine
- Lecture 52 - Degree of Reaction and Introduction to axial flow turbine
- Lecture 53 - Kaplan Turbine: Operational Principle, Turbine efficiencies
- Lecture 54 - Draft Tube for Reaction Turbine and Cavitation
- Lecture 55 - Energy Balance and NPSH
- Lecture 56 - Thoma Cavitation Factor
- Lecture 57 - Reaction Turbine: Design aspects and Characteristic Curves
- Lecture 58 - Problems on Impulse and Reaction Turbines

- Lecture 1 - Introduction to Abrasive Machining and Finishing Processes
- Lecture 2 - Grinding Process
- Lecture 3 - Grinding Fluids and Its Additives
- Lecture 4 - Grinding Fluids and its Emissions
- Lecture 5 - Sustainable Grinding Process: Biodegradation of Grinding Fluids
- Lecture 6 - Sustainable Grinding Process: MQL in Grinding Process
- Lecture 7 - Honing Process
- Lecture 8 - Lapping Process
- Lecture 9 - Super Finishing and Sand Blasting
- Lecture 10 - Vibratory Bowl Finishing, Rotary Barrel Finishing or Tumbling
- Lecture 11 - Drag Finishing, Ice-bonded Abrasive Finishing, Pitch Polishing, Pad Polishing
- Lecture 12 - Introduction to Surface Texture in abrasive Process
- Lecture 13 - Representation of Surface Roughness
- Lecture 14 - Abrasive Jet Machining (AJM)
- Lecture 15 - Abrasive Water Jet Machining (AWJM)
- Lecture 16 - Ultrasonic Machining (USM)
- Lecture 17 - EDM, Wire-EDM, EDG, EDDG, AW-EDG
- Lecture 18 - Elastic Emission Machining
- Lecture 19 - PMEDM and ECD and ELID, ECH
- Lecture 20 - Abrasive Flow Finishing: Part 1
- Lecture 21 - Abrasive Flow Finishing: Part 2
- Lecture 22 - Magnetic Field Assisted Abrasive Finishing: MAF, MADe, MFP
- Lecture 23 - Magneto Rheological Finishing and BE-MRF
- Lecture 24 - Magnetic Field Assisted Abrasive Finishing: CNP, CMMRF, MRAFF, R-MRAFF
- Lecture 25 - Summary of the Course

Lecture 1 - Basic of Solid Mechanics

Lecture 2 - Energy Principles

Lecture 3 - Classification of Plate Theories and Some Basics

Lecture 4 - Tutorial: Transformation of Tensors

Lecture 5 - Governing Equation for Plate - 1

Lecture 6 - Governing Equation for Plate - 2

Lecture 7 - Tutorial: Reduced Stiffness and Plate Stiffness

Lecture 8 - Navier Solution + Levy solution

Lecture 9 - Levy Solution

Lecture 10 - Tutorial: Load Matrices Calculation

Lecture 11 - EKM and buckling of plates

Lecture 12 - 3D Solutions

Lecture 13 - Matlab Coding + ABAQUS

Lecture 14 - Tutorial: Levy Solutions

Lecture 1 - Introduction to measurement

Lecture 2 - Generalized measurement system and static characteristics

Lecture 3 - Uncertainties in measurement

Lecture 4 - Statistical treatment of random errors

Lecture 5 - System response to periodic inputs

Lecture 6 - Zeroth and first order systems

Lecture 7 - First and second order systems

Lecture 8 - Basics of digitization and number systems

Lecture 9 - Binary logic gates and binary codes

Lecture 10 - Analog-to-digital conversion

Lecture 11 - Digital-to-analog conversion

Lecture 12 - Electromagnetic indicators

Lecture 13 - Electronic amplifiers and filters

Lecture 14 - Resistive devices

Lecture 15 - Inductive, capacitive and optical devices

Lecture 16 - Piezoelectric and nozzle-flapper transducers

Lecture 17 - Resistive strain gages and associated circuitry

Lecture 18 - Strain gage rosettes and gage orientation

Lecture 19 - Elastic and strain gage load cells

Lecture 20 - Various load cells and dynamometers

Lecture 21 - Principles of manometry

Lecture 22 - Piezometer and elastic pressure transducer

Lecture 23 - Electric pressure transducer and high and low pressure measurement

Lecture 24 - Bernoulli's equation in obstruction meters

Lecture 25 - Obstruction meters and volume flowmeters

Lecture 26 - Mass flowmeters and velocity probes

Lecture 27 - Expansion-based devices

Lecture 28 - RTD, Thermistor and Thermocouple

Lecture 29 - Introduction to pyrometers

Lecture 30 - Basic seismic transducer

Lecture 31 - Vibro-, velo- and accelerometer

[Lecture 32 - Introduction to acoustic measurement](#)

[Lecture 33 - Radioactivity and its biological effects](#)



Lecture 1 - External and Internal combustion engines, Engine components, SI and CI engines

Lecture 2 - Four-stroke and Two-stroke engines, Comparison between SI and CI engines, and Four-stroke and Two-stroke engines

Lecture 3 - Classification of IC engines

Lecture 4 - Engine operating characteristics

Lecture 5 - Otto, Diesel and Dual cycles

Lecture 6 - Otto, Diesel and Dual cycles (Continued...)

Lecture 7 - Otto, Diesel and Dual cycles (Continued...)

Lecture 8 - Otto, Diesel and Dual cycles (Continued...)

Lecture 9 - Comparison between the cycles, Actual cycles and their analysis

Lecture 10 - Carburetor, Mixture requirements

Lecture 11 - Carburetor, Mixture requirements (Continued...)

Lecture 12 - Idling, cruising and power ranges

Lecture 13 - Idling, cruising and power ranges (Continued...)

Lecture 14 - Classification, types of nozzles, Ignition system, Battery and Magneto ignition systems

Lecture 15 - Classification, types of nozzles, Ignition system, Battery and Magneto ignition systems (Continued...)

Lecture 16 - Classification, types of nozzles, Ignition system, Battery and Magneto ignition systems (Continued...)

Lecture 17 - Engine friction, Lubrication systems, forces on piston

Lecture 18 - Lubricating oils, Thermochemistry and Fuels, Self-ignition

Lecture 19 - Octane and Cetane Numbers, Alternative Fuels - Methanol, Ethanol, hydrogen, Natural Gas

Lecture 20 - Octane and Cetane Numbers, Alternative Fuels - Methanol, Ethanol, hydrogen, Natural Gas (Continued...)

Lecture 21 - Combustion in SI and CI Engines, Pressure Crank Angle Diagram

Lecture 22 - Combustion in SI and CI Engines, Pressure Crank Angle Diagram (Continued...)

Lecture 23 - Combustion in SI and CI Engines, Pressure Crank Angle Diagram (Continued...)

Lecture 24 - SI engine injection system, Energy distribution, Engine temperatures, Heat transfer in combustion chambers

Lecture 25 - SI engine injection system, Energy distribution, Engine temperatures, Heat transfer in combustion chambers (Continued...)

Lecture 26 - CI engine injection systems, Air-cooled and liquid-cooled engines, Modern trends

Lecture 27 - CI engine injection systems, Air-cooled and liquid-cooled engines, Modern trends (Continued...)

Lecture 28 - CI engine injection systems, Air-cooled and liquid-cooled engines, Modern trends (Continued...)

Lecture 29 - Problems on IC engine

Lecture 30 - Turbomachines, Gas Turbine theory

Lecture 31 - Open Cycle Gas Turbine Power Plant, Twin Shaft Arrangement

Lecture 32 - Closed Cycle, Multi-Spool Arrangement, Steam Power Plant

Lecture 33 - Basic Thermodynamics

Lecture 34 - Brayton Cycle: Introduction and General Relationships

Lecture 35 - Brayton Cycle: Efficiency, Work Ratio and Optimum Work Output Condition

Lecture 36 - Brayton Cycle with Heat Exchanger/Reheater

Lecture 37 - Brayton Cycle with Intercooler

Lecture 38 - Real Brayton Cycle, Solved Example for Ideal Cycle

Lecture 39 - Solved Examples for Real Brayton Cycle

Lecture 40 - Introduction and Performance Parameters of Propulsion System

Lecture 41 - Basics of Various Aircraft Engine

Lecture 42 - Euler Turbomachinery Equation

Lecture 43 - Introduction and Flow Analysis of Centrifugal Compressors

Lecture 44 - Thermodynamics Analysis of Centrifugal Compressors

Lecture 45 - Axial Compressor: Basics, Velocity triangles, T-S diagram and Work Interaction

Lecture 46 - Axial Compressor: Different factors, Degree of Reaction and Free Vortex Condition

Lecture 47 - Complete Analysis of Axial Flow Gas Turbine

Lecture 48 - Solved Examples for Axial Compressors, Centrifugal Compressors and Turbine

Lecture 49 - Radial Flow Turbine, Solved Example of Free vortex Condition

Lecture 50 - Nozzles and Diffusers: Introduction, Intake efficiency, Nozzle efficiency

Lecture 1 - Introduction of welding

Lecture 2 - Classification of welding and joints

Lecture 3 - Parts of weld joint

Lecture 4 - Welding Symbol

Lecture 5 - welding power source - 1

Lecture 6 - Welding power source - 2

Lecture 7 - Welding Power sources characteristics - 1

Lecture 8 - Welding Power sources characteristics - 2

Lecture 9 - Physics of welding - 1

Lecture 10 - Physics of welding - 2

Lecture 11 - Physics of welding - 4 (Arc Stability and Arc Blow)

Lecture 12 - Physics of welding - 3

Lecture 13 - Physics of welding - 5 (Metal Transfer-1)

Lecture 14 - Physics of welding - 6 (Metal Transfer-2)

Lecture 15 - Physics of welding - 7 (Metal Transfer-3)

Lecture 16 - Physics of welding - 8 (Metal Transfer-4)

Lecture 17 - Physics of welding - 9 (Metal Transfer-5)

Lecture 18 - Physics of welding - 10 (Metalting Efficiency)

Lecture 19 - Oxy-Fuel Gas Welding

Lecture 20 - Shielded Metal Arc Welding

Lecture 21 - Gas Tungsten Arc Welding

Lecture 22 - Gas Metal Arc Welding

Lecture 23 - Submerged Arc Welding

Lecture 24 - Welding Defects and Inspection

Lecture 1 - Introduction to Polymer Assisted Abrasive Finishing Processes

Lecture 2 - Surface Integrity and Surface roughness representation - Part I

Lecture 3 - Surface Integrity and Surface roughness representation - Part II

Lecture 4 - Introduction to Grinding and Polymer assisted Grinding Wheels

Lecture 5 - Polymer medium for vibratory bowl finishing, Tumbling, Drag finishing

Lecture 6 - Polymer Pad and Chemo-mechanical Polishing

Lecture 7 - Elastic Emission Machining

Lecture 8 - Hydrodynamic Polishing, Elasto Abrasive Finishing

Lecture 9 - Abrasive Flow Machining and Finishing - Part I

Lecture 10 - Abrasive Flow Machining and Finishing - Part II

Lecture 11 - Advances in Abrasive Flow Finishing: DBGAFF, CFAAFM

Lecture 12 - Advances in Abrasive Flow Finishing: Spiral Polishing, R-AFF

Lecture 13 - AFF Processes: Magnetio AFF (MRAFF), UAA-AFF, EC-AFF

Lecture 14 - Finishing of Biomedical implants (Micro AFF: Micro holes, Micro slots, Bio Implants: Knee implants , Hip implants and Applications of one way, two way and orbital AFF)

Lecture 15 - Summary of the Course

- Lecture 1 - Materials and manufacturing Processes - 1
- Lecture 2 - Materials and manufacturing Processes - 2
- Lecture 3 - Physics based modeling approach at different scale
- Lecture 4 - Evaluation of properties and process modelling
- Lecture 5 - Thermofluid and electromagnetic analysis
- Lecture 6 - Solid-state deformation and residual stress - 1
- Lecture 7 - Solid-state deformation and residual stress - 2
- Lecture 8 - Melting, solidification and additive manufacturing
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- Lecture 10 - Force and velocity diagram - 2
- Lecture 11 - Heat transfer analysis
- Lecture 12 - Principle and mechanism at different processes - 1
- Lecture 13 - Principle and mechanism at different processes - 2
- Lecture 14 - Mechanics of bulk metal forming
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- Lecture 20 - Physics of welding and metal transfer
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- Lecture 22 - Heat transfer and material flow
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- Lecture 27 - Hybrid welding, residual stress and distortion
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- Lecture 4 - Concept of exergy and exergy destruction
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- Lecture 7 - Joule-Thomson coefficient and Clapeyron equation
- Lecture 8 - Liquid-vapor phase-change process
- Lecture 9 - Use of property tables
- Lecture 10 - Equations-of-state and Compressibility factor
- Lecture 11 - Ideal cycles for reciprocating engines
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- Lecture 13 - Stirling and Ericsson cycles
- Lecture 14 - Fuel-air cycle
- Lecture 15 - Numerical exercise on Fuel-air cycles
- Lecture 16 - Losses in actual cycle and valve-timing diagram
- Lecture 17 - Ideal Brayton cycle
- Lecture 18 - Intercooling and reheating in Brayton cycle
- Lecture 19 - Regeneration in Brayton cycle
- Lecture 20 - Ideal Rankine cycle
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- Lecture 22 - Regenerative Rankine cycle
- Lecture 23 - Binary vapor power cycle
- Lecture 24 - Combined gas-steam power plant
- Lecture 25 - Different arrangements in combined cycles
- Lecture 26 - Vapor compression refrigeration cycle
- Lecture 27 - SSS cycles and refrigerants
- Lecture 28 - Modifications in VCR systems
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- Lecture 30 - P-v-T behavior of gas mixtures
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Lecture 10 - Finite difference formulations of Elliptic Equations with boundary condition treatment

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Lecture 21 - Von Neumann stability analysis of different schemes for Parabolic equations

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Lecture 7 - Dimensional measurement Gauge blocks, The pneumatic displacement gauge

Lecture 8 - Dimensional measurement Gauge blocks, The pneumatic displacement gauge

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Lecture 10 - Mechanical pressure measurement devices, U-tube manometer, The inclined well type manometer

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Lecture 12 - The Mcleod gauge, The Pirani gauge, The Ionization gauge

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Lecture 27 - Transient response of thermal system, Thermocouple compensation, high speed flow

Lecture 28 - Transient response of thermal system, Thermocouple compensation, high speed flow (Continued...)

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- Lecture 2 - Functional with higher order derivatives; Variational statement
- Lecture 3 - Differential equation, Variational statement and Minimization problem; Rayleigh-Ritz method
- Lecture 4 - FEM steps: Explained with discrete linear springs; Gaussian Quadrature rule for integration
- Lecture 5 - Solving one Ordinary Differential Equation using Linear Finite Element
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- Lecture 7 - Bar Element: Elemental equation; Matlab Implementation with Example
- Lecture 8 - Bar Element: Postprocessing; Comparison with Analytical Solution; Bar with linear springs
- Lecture 9 - Truss Element: Elemental equation; Matlab Implementation with Example
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- Lecture 11 - Beam Element: Elemental equation; Matlab implementation with Example
- Lecture 12 - Beam Element: Matlab implementation for the example with Non-uniform distributed load
- Lecture 13 - Frame Element: Derivation of elemental equation in global reference frame
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- Lecture 15 - Generalization of Geometry data; Stiffness matrix, Load vector formation at element level
- Lecture 16 - Generalization of Assembly, Imposition of Boundary condition and Load information
- Lecture 17 - Indicial Notation: Summation convention, Kronecker delta, Permutation symbol
- Lecture 18 - Second order tensor; Gradient, Divergence, Curl and Laplacian in Indicial notation
- Lecture 19 - Gauss Divergence theorem and its application in Heat transfer and Structural analysis
- Lecture 20 - Derivation of weak form of 2D steady-state heat conduction problem
- Lecture 21 - Triangular element, calculating element stiffness and element force vector
- Lecture 22 - Numerical example, assembly, mapping
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- Lecture 25 - Development of a MATLAB code for solving 2D steady-state heat conduction problem
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- Lecture 31 - Solving eigenvalue problem in bar and beam, writing FEM code in MATLAB

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Lecture 1 - Application of convective heat transfer

Lecture 2 - Foundations of heat transfer

Lecture 3 - Derivation of energy equation

Lecture 4 - Derivation of boundary layer equation

Lecture 5 - Derivation of boundary layer energy equation

Lecture 6 - Blasius solution: similarity method

Lecture 7 - Pohlhausen solution: similarity method

Lecture 8 - Pohlhausen solution: heat transfer parameters

Lecture 9 - Falkner-Skan equation: Boundary layer flow over a wedge

Lecture 10 - Momentum integral equation for flat plate boundary layer

Lecture 11 - Laminar BL flow over flat plate: Uniform surface temperature

Lecture 12 - Laminar BL flow over flat plate: Uniform surface heat flux

Lecture 13 - Solution of example problems

Lecture 14 - Hydrodynamic and thermal regions

Lecture 15 - Energy balance in channel flow

Lecture 16 - Determination of heat transfer coefficient

Lecture 17 - Velocity profile in fully-developed channel flows

Lecture 18 - Thermally fully developed laminar slug flow with uniform wall heat flux condition

Lecture 19 - Hydrodynamically and thermally fully developed flow with uniform wall heat flux condition

Lecture 20 - Fully developed flow through parallel plate channel with uniform wall temperature

Lecture 21 - Fully developed flow through circular pipe with uniform wall temperature

Lecture 22 - Thermally developing flow through circular pipe with uniform wall heat flux

Lecture 23 - Thermally developing flow through circular pipe with uniform wall temperature

Lecture 24 - Heat transfer in plane Couette flow

Lecture 25 - Solutions of example problems

Lecture 26 - Introduction and scale analysis

Lecture 27 - Natural convection over a vertical plate: Similarity Solution

Lecture 28 - Natural convection over a vertical plate: Similarity solution of energy equation

Lecture 29 - Natural convection over a vertical plate: Integral solution

Lecture 30 - Natural convection over inclined plate and mixed convection

Lecture 31 - Natural convection inside enclosures

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[Lecture 41 - Laminar film condensation on a vertical plate](#)

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- Lecture 1 - Introduction to composite materials
- Lecture 2 - Basic terminology in Shell
- Lecture 3 - Derivation of fundamental theorem of surfaces
- Lecture 4 - Derivative of unit vectors and various theorems
- Lecture 5 - Classification of shells
- Lecture 6 - Derivation of strain-displacement relation
- Lecture 7 - Derivation of shell governing equations - 1
- Lecture 8 - Derivation of shell governing equations - 2
- Lecture 9 - Derivation of shell governing equations - 3
- Lecture 10 - Derivation of special cases
- Lecture 11 - Derivation of shell constitutive relations
- Lecture 12 - Solved examples on membrane theory and moment shell theory
- Lecture 13 - Shell of revolution problems
- Lecture 14 - Derivation of Navier solution for infinite shell panel
- Lecture 15 - Basics of MATLAB coding
- Lecture 16 - Derivation of Navier solution for finite shell panel
- Lecture 17 - ABAQUS Modelling
- Lecture 18 - Extended Kanatovich method for shell panel
- Lecture 19 - Free Vibration solution of shell panels under Navier and Levy supports - 1
- Lecture 20 - Free Vibration solution of shell panels under Navier and Levy supports - 2
- Lecture 21 - Basics of Buckling of shells
- Lecture 22 - Buckling of cylindrical shells
- Lecture 23 - Buckling of Levy-type cylindrical shells
- Lecture 24 - 3D Bending
- Lecture 25 - 3D Free vibration
- Lecture 26 - 3D Buckling
- Lecture 27 - Advanced Material
- Lecture 28 - Free vibration of a composite cylindrical shell

Lecture 1 - Properties, Modelling approaches, Process modelling and Optimization

Lecture 2 - Fusion welding - 1

Lecture 3 - Fusion welding - 2

Lecture 4 - Soldering, Brazing, Solid-state welding processes

Lecture 5 - Advanced welding processes

Lecture 6 - Advances in laser microwelding

Lecture 7 - Additive manufacturing processes

Lecture 8 - Elastic stress analysis - I

Lecture 9 - Elastic stress analysis - II and Potential energy method

Lecture 10 - Three-Dimensional element

Lecture 11 - Weighted residual method

Lecture 12 - Material nonlinearity - I

Lecture 13 - Material nonlinearity - II

Lecture 14 - Fluid flow and Natural coordinate system - I

Lecture 15 - Natural coordinate system in 3D and XFEM

Lecture 16 - Introduction to heat source model

Lecture 17 - Heat source models in welding - I

Lecture 18 - Heat source models in welding - II

Lecture 19 - Heat source model for Keyhole mode and solid state welding

Lecture 20 - Implementation of FEM in fusion welding processes

Lecture 21 - Implementation of FEM for fluid flow in fusion welding processes

Lecture 22 - FEM modeling of EBW and RSW

Lecture 23 - FEM modeling of FSW and hybrid FSW

Lecture 24 - Demonstration of thermal model development using commercial software

Lecture 25 - Fluid flow modeling in welding processes

Lecture 26 - Heat transfer and fluid flow analysis in quasi-steady state

Lecture 27 - Prediction of free surface profile

Lecture 28 - Principle stress, Hydrostatic and Deviatoric Components of Stress

Lecture 29 - Yield Function, Von Mises Yield Surface and Hardening rule

Lecture 30 - Material models, Residual stress and distortion

Lecture 31 - Phase transformation effect on Residual stress and distortion

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[Lecture 35 - Theoretical development of heat transfer model](#)

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Lecture 1 - Introduction to mechanical systems

Lecture 2 - Superposition rule, Commonly used nonlinear equations

Lecture 3 - Equilibrium points: potential function

Lecture 4 - Force and moment based Approach, Lagrange Principle

Lecture 5 - Extended Hamilton's principle

Lecture 6 - Use of scaling and book-keeping parameter for ordering

Lecture 7 - Numerical solution, Analytical solutions: Harmonic Balance method

Lecture 8 - Straight forward expansion

Lecture 9 - Lindstedt-Poincaré method

Lecture 10 - Method of Averaging

Lecture 11 - Method of multiple scales

Lecture 12 - Method of generalized Harmonic Balance method

Lecture 13 - Free vibration of undamped and damped SDOF systems with quadratic and cubic nonlinearity

Lecture 14 - Super and sub harmonic resonance conditions

Lecture 15 - Bifurcation analysis of fixed-point response

Lecture 16 - Nonlinear system with hard excitations

Lecture 17 - Super and sub harmonic resonance conditions

Lecture 18 - Bifurcation analysis of fixed-point response

Lecture 19 - Floquet theory, Hill's infinite determinant, Resonance in parametrically excited systems

Lecture 20 - Parametrically excited pneumatic artificial muscle

Lecture 21 - Parametric instability of sandwich plate

Lecture 22 - Analysis of periodic, quasi-periodic and chaotic systems

Lecture 23 - Stability and bifurcation analysis of periodic and quasi-periodic response

Lecture 24 - Analysis of chaotic system

Lecture 25 - Numerical methods for finding roots and solutions of ODE

Lecture 26 - Time response, phase portraits, frequency response

Lecture 27 - Poincaré section, FFT, Lyapunov exponent

Lecture 28 - Passive and active vibration absorber with displacement and acceleration feedback

Lecture 29 - Active vibration absorber with time delay acceleration feedback by HBM

Lecture 30 - Application of Active vibration absorber with combination feedback

Lecture 31 - Cantilever beam with tip mass for principal parametric resonance

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[Lecture 33 - Cantilever beam based piezoelectric based energy harvester](#)

[Lecture 34 - Nonlinear dynamics of turning operation with delay and internal resonance](#)

[Lecture 35 - Chatter in rolling mills and dynamic analysis of artificial pneumatic muscle](#)

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Lecture 1 - Introduction to Optimization

Lecture 2 - Introduction to Evolutionary Computation

Lecture 3 - Binary-Coded Genetic Algorithm (BGA)

Lecture 4 - Operators and Simulations of Binary-Coded Genetic Algorithm

Lecture 5 - Real-Coded Genetic Algorithm (RGA)

Lecture 6 - Operators and Simulations of Real-Coded Genetic Algorithm

Lecture 7 - Algorithmic Implementation of BGA and RGA

Lecture 8 - Particle Swarm Optimization (PSO)

Lecture 9 - Simulations and Algorithmic Implementation of Particle Swarm Optimization

Lecture 10 - Differential Evolution (DE)

Lecture 11 - Simulations and Algorithmic Implementation of Differential Evolution

Lecture 12 - Constrained Optimization: Introduction and Optimality

Lecture 13 - Penalty Function Methods for Evolutionary Computing Techniques

Lecture 14 - Evolutionary Computing Techniques: Separation of Objective Function and Constraints

Lecture 15 - Simulations of Constraint Handling Techniques - Part 1

Lecture 16 - Simulations of Constraint Handling Techniques - Part 2

Lecture 17 - Introduction to Multi-Objective Optimization - Part 1

Lecture 18 - Introduction to Multi-Objective Optimization - Part 2

Lecture 19 - Multi-Objective Optimization: Ranking and Diversity

Lecture 20 - Classical Multi-Objective Optimization Methods

Lecture 21 - Non-Dominated Genetic Algorithm: NSGA-II: Introduction

Lecture 22 - Non-Dominated Genetic Algorithm: NSGA-II: Simulations

Lecture 23 - Strength Pareto Evolutionary Algorithm: SPEA2: Introduction

Lecture 24 - Strength Pareto Evolutionary Algorithm: SPEA2: Simulations

Lecture 25 - Performance Assessment of Multi-Objective EC Techniques

Lecture 26 - Closure of EC for Single and Multi-Objective Optimization

Lecture 1 - Preliminary concepts

Lecture 2 - Fluid Kinematics

Lecture 3 - Derivation of incompressible Navier-Stokes equations

Lecture 4 - Initial and Boundary Conditions

Lecture 5 - Plane Couette Flow

Lecture 6 - Plane Poiseuille Flow

Lecture 7 - Plane Poiseuille Flow with Slip and Thin Film Flow

Lecture 8 - Combined Couette - Poiseuille Flow

Lecture 9 - Example Problems

Lecture 10 - Hagen - Poiseuille Flow

Lecture 11 - Thin Film Flow and Annular Flow

Lecture 12 - Steady Flow Between Rotating Cylinders

Lecture 13 - Flow near a plate suddenly set in motion

Lecture 14 - Flow due to an oscillating plate

Lecture 15 - Transient Plane Couette Flow

Lecture 16 - Transient Axisymmetric Poiseuille Flow

Lecture 17 - Flow Through Rectangular Duct

Lecture 18 - Flow Through Equilateral Triangular Duct

Lecture 19 - Flow Through Elliptical Duct

Lecture 20 - Example Problems

Lecture 21 - Creeping Flow Around a Sphere

Lecture 22 - Reynolds Equation for Lubrication

Lecture 23 - One-dimensional Slider Bearing

Lecture 24 - Journal Bearing and Piston-ring Lubrication

Lecture 25 - Derivation of Boundary Layer Equations

Lecture 26 - Blasius Flow Over A Flat Plate: Similarity Solution

Lecture 27 - Momentum Integral Equation For Flat Plate Boundary Layer

Lecture 28 - Falkner-Skan equation: Boundary layer flow over a wedge

Lecture 29 - Karman-Pohlhausen Method for Non-zero Pressure Gradient Flows

Lecture 30 - The Correlation Method by Thwaites

Lecture 31 - Separation of Boundary Layer

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[Lecture 33 - Two-dimensional Laminar Jet](#)

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[Lecture 36 - Derivation of Orr-Sommerfeld Equation](#)

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Lecture 2 - Flux Cored Arc Welding (FCAW)

Lecture 3 - Thermit Welding

Lecture 4 - Resistance Welding - Part 1 (Resistance Spot Welding)

Lecture 5 - Resistance Welding - Part 2 (Types of Resistance Welding)

Lecture 6 - Friction Welding

Lecture 7 - Friction Stir Welding - Part 1

Lecture 8 - Friction Stir Welding - Part 2

Lecture 9 - Soldering

Lecture 10 - Brazing

Lecture 11 - Residual Stress - Part 1

Lecture 12 - Residual Stress - Part 2

Lecture 13 - Influencing Factors and Control of Residual Stresses

Lecture 14 - Residual Stress Measurement - 1

Lecture 15 - Residual Stress Measurement - 2

Lecture 16 - Residual Stress Measurement by NDT

Lecture 17 - Welding Induced Distortion

Lecture 18 - Welding Induced Distortion (Control and Measurement)

Lecture 19 - Welding Induced Distortion (Measurement and Prediction)

Lecture 20 - Welded Joint Analysis

Lecture 21 - Welded Joints Analysis (Strength of Parallel and Transverse Fillet Welds)

Lecture 22 - Welded Joints Analysis (Analysis of Eccentrically Loaded Welded Joint)

Lecture 23 - Welded Joints Static Analysis (Analysis of Eccentrically Loaded Welded Joint - Part 1)

Lecture 24 - Welded Joints Static Analysis (Analysis of Eccentrically Loaded Welded Joint - Part 2)

Lecture 25 - Welded Joints Static Analysis (Welded Joint Subjected to Bending Moment)

Lecture 26 - Welded Joints Static Analysis (Welded Joint Subjected to Bending Moment - Part 1)

Lecture 27 - Welded Joints Static Analysis (Welded Joint Subjected to Bending Moment - Part 2)

- Lecture 1 - Introduction to Additive Manufacturing
- Lecture 2 - CAD Models for Additive Manufacturing
- Lecture 3 - Manipulation of STL Files
- Lecture 4 - Slicing Methods - Part A
- Lecture 5 - Slicing Methods - Part B
- Lecture 6 - Toolpath Planning
- Lecture 7 - Demonstration of CAD-CAM Packages
- Lecture 8 - Introduction to Liquid AM
- Lecture 9 - Stereolithography Apparatus: Fundamentals of Photopolymerization - Part 1
- Lecture 10 - Stereolithography Apparatus: Fundamentals of Photopolymerization - Part 2
- Lecture 11 - Stereolithography Apparatus: Sub-systems - Part 1
- Lecture 12 - Stereolithography Apparatus: Sub-systems - Part 2
- Lecture 13 - Other Liquid AM Processes - 1
- Lecture 14 - Other Liquid AM Processes - 2
- Lecture 15 - Sheet Additive Manufacturing - Part 1
- Lecture 16 - Sheet Additive Manufacturing - Part 2
- Lecture 17 - Wire Additive Manufacturing
- Lecture 18 - Fused Deposition Modeling
- Lecture 19 - Metal Wire Additive Manufacturing
- Lecture 20 - Metal Inert Gas-Wire Arc Additive Manufacturing (MIG-WAAM) - Part 1
- Lecture 21 - Metal Inert Gas-Wire Arc Additive Manufacturing (MIG-WAAM) - Part 2
- Lecture 22 - Tungsten Inert Gas/Plasma-Wire Arc Additive Manufacturing (TIG/Plasma-WAAM)
- Lecture 23 - Electron beam-based Wire Beam Additive Manufacturing (WBAM)
- Lecture 24 - Laser Metal Wire Additive Manufacturing
- Lecture 25 - Powder-Feed Additive Manufacturing - Part 1
- Lecture 26 - Powder-Feed Additive Manufacturing - Part 2
- Lecture 27 - Process Modeling for Powder Feed Additive Manufacturing - Part 1
- Lecture 28 - Process Modeling for Powder Feed Additive Manufacturing - Part 2
- Lecture 29 - Laser Beam based Powder Bed Additive Manufacturing - Part 1
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- Lecture 31 - Electron Beam based Powder Bed Additive Manufacturing

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Lecture 1 - Thermodynamic Systems and Pure Substance

Lecture 2 - Heat and Work Transfer - First Law of Thermodynamics

Lecture 3 - Second Law of Thermodynamics

Lecture 4 - Entropy and Exergy

Lecture 5 - Introduction to Steam Power Plant

Lecture 6 - Thermodynamics aspects of Steam Power Plant-Efficiency and Work ration

Lecture 7 - Rankine Cycle and its analysis

Lecture 8 - Improvement in Rankine Cycle Efficiency: Superheating and Reheating

Lecture 9 - Improvement in Rankine Cycle Efficiency: Reheating and Regenerative Methods

Lecture 10 - Improvement in Rankine Cycle Efficiency: Regenerative Methods

Lecture 11 - Regenerative Cycles

Lecture 12 - Impulse Steam Turbine: Velocity Diagrams,Work Transfer,Blade Efficiency

Lecture 13 - Impulse Steam Turbine: Velocity Diagrams,Work Transfer,Blade Efficiency (Continued...)

Lecture 14 - Reaction Steam Turbine

Lecture 15 - Reaction Steam Turbine: Velocity Diagram, Work transfer, Blade Efficiency

Lecture 16 - Steam Nozzle: Analysis and Efficiency

Lecture 17 - Steam Nozzle: Analysis and Efficiency (Continued...)

Lecture 18 - Boilers and Condensers

Lecture 19 - Condensers and Second Law Analysis of Steam Power cycle

Lecture 20 - Exergy Analysis of a Steam Turbine

Lecture 21 - Numerical Problems: Steam Power Cycle

Lecture 22 - IC engine-Components, Nomenclature and Classifications

Lecture 23 - Basic Engine Cycle and Engine Kinematic Analysis

Lecture 24 - Engine Operating Characteristics

Lecture 25 - Thermodynamics Analysis of Air Standard Cycles

Lecture 26 - Valve Timing Diagram and Fuel-Air Cycle

Lecture 27 - Thermochemistry and Fuel Characteristics

Lecture 28 - Combustion Phenomena in Engines

Lecture 29 - Heat Transfer Analysis in Engines

Lecture 30 - Exergy Analysis and Engine Emission/Pollution

Lecture 31 - Gas Turbine Engine-Components and Thermal Circuit

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[Lecture 34 - Real Gas Turbine Performance Cycle](#)

[Lecture 35 - Aircraft Propulsion Cycle - I](#)

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[Lecture 37 - Vapour Compression Refrigeration System - I](#)

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[Lecture 41 - Air-Conditioning Processes](#)

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[Lecture 43 - Reciprocating Compressor - Analysis and Modelling](#)

[Lecture 44 - Multistage Compression - Analysis and Modelling](#)



- Lecture 1 - Composite Materials - Introduction
- Lecture 2 - Composite Materials - Classification
- Lecture 3 - Anisotropic Elasticity
- Lecture 4 - Orthotropic Materials
- Lecture 5 - Hooke's Law for 2D Lamina
- Lecture 6 - Engineering Constants for 2D Lamina
- Lecture 7 - Strength Failure Criteria - Part I
- Lecture 8 - Strength Failure Criteria - Part II
- Lecture 9 - Hygrothermal Behavior of Lamina
- Lecture 10 - Introduction and Terminologies
- Lecture 11 - Evaluation of Elastic Moduli
- Lecture 12 - Evaluation of Longitudinal Strength
- Lecture 13 - Evaluation of Transverse and Shear Strengths
- Lecture 14 - Evaluation of Hygrothermal Properties
- Lecture 15 - Elasticity Approach
- Lecture 16 - Experimental Evaluation
- Lecture 17 - Laminate - Introduction
- Lecture 18 - Classical Lamination Theory - Part I
- Lecture 19 - Classical Lamination Theory - Part II
- Lecture 20 - Response of Laminate - Significance of ABBD
- Lecture 21 - Special Classes of Laminates
- Lecture 22 - Engineering Constants of Laminates
- Lecture 23 - Hygrothermal Behaviour of Laminates
- Lecture 24 - Analysis of Laminates
- Lecture 25 - Failure of Laminates
- Lecture 26 - Failure Analysis under Combined Loading
- Lecture 27 - Design Example - I
- Lecture 28 - Design Example - II
- Lecture 29 - Interlaminar Stresses- Delamination
- Lecture 30 - Prediction of Delamination
- Lecture 31 - Transverse Deflection

Lecture 32 - Buckling and Free Vibration

- Lecture 1 - Lasers in Manufacturing: Importance and Applications
- Lecture 2 - Fundamentals of Laser Technology
- Lecture 3 - Laser System: Construction and Types
- Lecture 4 - Principle of Operation, Types of Laser Cutting, and Kerf Geometry
- Lecture 5 - Types of Lasers in Material Removal, Process and Performance Parameters
- Lecture 6 - A Case-study on Cutting a Circular Part using CO2 Laser Machine
- Lecture 7 - Mechanisms of Laser Welding - Part I
- Lecture 8 - Mechanisms of Laser Welding - Part II
- Lecture 9 - Effects of Process Parameters during Laser Welding and Study of Defects in Weld Beads
- Lecture 10 - A Case Study on Welding of Mild Steel Sheets using 2.5 kW CO2 Laser Machine
- Lecture 11 - Material Forming and Fundamentals of Laser Forming
- Lecture 12 - Mechanisms of Laser Forming
- Lecture 13 - Process Parameters and their Effects on the Performance of Laser Forming
- Lecture 14 - Surface Treatment and Application of Lasers
- Lecture 15 - Laser Surface Hardening
- Lecture 16 - Laser Surface Alloying
- Lecture 17 - Laser Cladding
- Lecture 18 - Additive Manufacturing Techniques
- Lecture 19 - Laser Scanning Stereolithography
- Lecture 20 - Selective Laser Sintering and Selective Laser Melting
- Lecture 21 - Process and Performance Parameters of Laser Based Additive Manufacturing Techniques
- Lecture 22 - Lasers in Manufacturing Automation
- Lecture 23 - CNC for Laser Based Manufacturing
- Lecture 24 - CAD for Laser Based Manufacturing
- Lecture 25 - Laser-assisted Material Forming
- Lecture 26 - Effect of Coatings, 3D Laser Forming and Micro-forming

- Lecture 1 - Temperature and Zeroth Law of Thermodynamics
- Lecture 2 - Work and Heat Transfer - First Law of Thermodynamics
- Lecture 3 - Heat Engines and Refrigerators/Heat Pump - Second Law of Thermodynamics
- Lecture 4 - Entropy Analysis - Part I
- Lecture 5 - Entropy Analysis - Part II
- Lecture 6 - Entropy Analysis - Part III
- Lecture 7 - Exergy Analysis - Part I
- Lecture 8 - Exergy Analysis - Part II
- Lecture 9 - Exergy Analysis - Part III
- Lecture 10 - Thermodynamic Functions and Maxwell's Equations
- Lecture 11 - Property Relations for Phase Change Processes
- Lecture 12 - Property Relations for Single Phase Systems
- Lecture 13 - Heat Capacity Equations and its Applications
- Lecture 14 - Joule - Thomson Coefficient and Liquefaction of Gases
- Lecture 15 - Ideal Gas and Real Gas
- Lecture 16 - Gas Mixtures and Multi-Component System
- Lecture 17 - Ideal Gas Mixture
- Lecture 18 - Mixing Analysis of Thermodynamic Systems
- Lecture 19 - Thermodynamic Considerations of Combustion
- Lecture 20 - Conservation of Energy for Reacting Systems
- Lecture 21 - Adiabatic Flame Temperature, Entropy and Gibbs Function for Reacting System
- Lecture 22 - Equilibrium Products of Combustion and Effective Energy Utilization
- Lecture 23 - Fundamentals of Chemical Reactions
- Lecture 24 - Reaction Mechanisms - Part I
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- Lecture 26 - Chemical and Thermal Analysis of Reacting Systems
- Lecture 27 - Simplified Conservation Equations for Reacting Flows
- Lecture 28 - Laminar Premixed Flame - Part I
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- Lecture 30 - Laminar Diffusion Flame
- Lecture 31 - Droplet Evaporation and Turbulent Flame

Lecture 32 - Engine Combustion and Pollution

- Lecture 1 - First law of Thermodynamics for control mass and control volume systems
- Lecture 2 - First law of Thermodynamics for control volume system (Flow system)
- Lecture 3 - Steady State Steady Flow Processes, combination of First and Second Laws
- Lecture 4 - Second Law of Thermodynamics: A Brief Review
- Lecture 5 - Combined First and Second Laws Applied to Processes
- Lecture 6 - Combined First and Second Laws: Flow and Non-Flow Processes
- Lecture 7 - Description of Steam Power Plant: Application of 1st and 2nd Laws to Different Processes
- Lecture 8 - Second Law Applied to Processes of Power Plant and Ideal Cycle of Power Plant
- Lecture 9 - Steam Power Plant: Thermodynamic aspects, Efficiency, Work ratio and Ideal Cycle
- Lecture 10 - Ideal Power Cycle and its Limitations, Introduction to Actual Power Cycle
- Lecture 11 - Limitations of Carnot Cycle, Simple Rankine Cycle and Analysis
- Lecture 12 - Analysis of Simple Rankine Cycle and its Design Modifications
- Lecture 13 - Reheat Cycle and Analysis
- Lecture 14 - Reheat Cycle and Analysis (Continued...)
- Lecture 15 - Regenerative Principle of Steam Power Cycles
- Lecture 16 - Analysis of Regenerative Steam Power Cycles
- Lecture 17 - Regenerative Steam Power Cycle with Closed Feed-Water Heater, Ideal Working Fluid
- Lecture 18 - Multi-fluid Cycle and Analysis
- Lecture 19 - Analysis of Multi-fluid Cycle; Second Law Analysis of Steam Power Cycle
- Lecture 20 - Problems of Steam Power Cycle
- Lecture 21 - Problems of Steam Power Cycle (Continued...)
- Lecture 22 - Types of Boiler, Different Cycles in Boiler Operation, Boiler attachment
- Lecture 23 - Cochran Boiler Operation, Boiler attachment
- Lecture 24 - Boiler Attachments
- Lecture 25 - Superheaters and their Arrangements, Steam Temperature Control
- Lecture 26 - Characteristics of Convective and Radiant Superheaters; Steam Temperature Control
- Lecture 27 - Problems on Boiler/Steam Generator
- Lecture 28 - Use of nozzles in steam power plant, flow analysis of steam in nozzle
- Lecture 29 - Flow analysis of steam in nozzle: Mass flow rate
- Lecture 30 - Mass flow rate of steam in nozzle, Critical Pressure Ratio
- Lecture 31 - Critical Pressure Ratio and its Physical Significance

- Lecture 32 - Nozzle efficiency and factors that affect the efficiency
- Lecture 33 - Factors that affect the efficiency, problem on flow nozzle
- Lecture 34 - Problem on flow nozzle
- Lecture 35 - Steam Turbines: types and analysis using velocity triangles
- Lecture 36 - Analysis of Impulse Steam Turbine
- Lecture 37 - Compounding of Steam Turbine
- Lecture 38 - Analysis of Reaction Steam Turbine
- Lecture 39 - Problems on Steam Turbine
- Lecture 40 - The Role of Condenser in Power Plant
- Lecture 41 - Cooling Tower: Types and Analysis
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- Lecture 43 - IC Engines, Classification, Different Parts, SI and CI Engines
- Lecture 44 - Comparison of 2-stroke and 4-stroke Engines
- Lecture 45 - Comparison of SI and CI Engines, Compression Ratio
- Lecture 46 - Introduction to Carburettor and Regimes of Engine Operation
- Lecture 47 - Regimes of Engine Operation and Simple Float Type Carburettor
- Lecture 48 - Simple Float Type Carburettor and its Analysis
- Lecture 49 - Mass Flow Rate of Fuel and limitations of Simple Float Type Carburettor
- Lecture 50 - Limitations of Simple Float Type Carburettor, Problem on Carburettion
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- Lecture 52 - Performance Analysis parameters of IC Engine
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- Lecture 54 - Alternative Fuels and Self Ignition Characteristics of Fuel: Octane Number, Cetane Number
- Lecture 55 - Thermodynamic Analysis of SI Engine
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- Lecture 62 - Gas Turbine Units and Thermodynamic Cycles
- Lecture 63 - Gas Compressor and Optimum Pressure Ratio
- Lecture 64 - Compressor Efficiency and Multistage Compression with Intercooling

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Lecture 2 - Tensile test, effect of properties, exercise problem

Lecture 3 - Sheet deformation processes

Lecture 4 - Sheet deformation processes (Continued...)

Lecture 5 - Sheet deformation processes (Continued...)

Lecture 6 - Sheet deformation in plane stress

Lecture 7 - Sheet deformation in plane stress (Continued...)

Lecture 8 - Stamping analyses

Lecture 9 - Load instability and tearing

Lecture 10 - Load instability and tearing

Lecture 11 - Formability testing of sheet metals

Lecture 12 - Sheet formability

Lecture 13 - Sheet formability (Continued...)

Lecture 14 - Bending of sheets

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Lecture 16 - Cup deep drawing

Lecture 17 - Deep drawing, redrawing, ironing of cup

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Lecture 21 - Demonstration of sheet forming experiments

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- Lecture 2 - Thermodynamics Concepts - Part II
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- Lecture 12 - Steam Nozzles - Part II
- Lecture 13 - Steam Generator
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- Lecture 19 - Feed Water Heaters
- Lecture 20 - Cooling Towers
- Lecture 21 - Fundamentals of Gas turbine systems
- Lecture 22 - Modifications of Brayton cycle
- Lecture 23 - Combined Power cycle
- Lecture 24 - Gas Turbines for Aircraft Propulsion
- Lecture 25 - Hydro-Power System - Part I
- Lecture 26 - Hydro-Power System - Part II
- Lecture 27 - Wind Energy - Part I
- Lecture 28 - Wind Energy - Part II
- Lecture 29 - Energy From Oceans - Part I
- Lecture 30 - Energy From Oceans - Part II
- Lecture 31 - Geothermal Energy

[Lecture 32 - Energy Storage - I](#)

[Lecture 33 - Energy Storage - II](#)

[Lecture 34 - Energy Storage - III](#)

Lecture 1 - Introduction to phase diagrams

Lecture 2 - Thermodynamic relations

Lecture 3 - Single component system and binary solutions

Lecture 4 - Regular solutions

Lecture 5 - Real solutions

Lecture 6 - Phase transformations

Lecture 7 - Practice problems (Module 1)

Lecture 8 - Introduction to homogenous nucleation process

Lecture 9 - Fundamental to heterogeneous nucleation

Lecture 10 - Growth of pure metal

Lecture 11 - Alloy solidification

Lecture 12 - Formation of different S/L interface

Lecture 13 - Solidification structures and segregation

Lecture 14 - Weld Metal Solidification and Microstructure - I

Lecture 15 - Weld Metal Solidification and Microstructure - II

Lecture 16 - Solidification of additive manufacturing - I

Lecture 17 - Solidification of additive manufacturing - II

Lecture 18 - Rate of solidification-sand casting

Lecture 19 - Rate of solidification-die casting

Lecture 20 - Riser design and solidification of pure metal

Lecture 21 - Zone melting and rapid solidification

Lecture 22 - Semisolid processing and other solidification techniques

Lecture 23 - Demonstration of the solidification process and numerical problems

**NPTEL : Acoustics (Mechanical Engineering)**

**Co-ordinators : Prof. Nachiketa Tiwari**

Lecture 1 - Intro, sound wave versus vibration, different types of waves, octave, music scales, sense of SPL

Lecture 2 - Review: Linearity, complex numbers, and spring mass system

Lecture 3 - Review: Poles and zeroes, phase and magnitude plots, transfer functions, Bode plots

Lecture 4 - Review: Transfer functions, and Bode plots

Lecture 5 - 1-D wave equation, and its solution

Lecture 6 - Solution for 1-D wave equation

Lecture 7 - Waveguides, transmission line equations, and standing waves

Lecture 8 - Waveguides, transmission line equations, and standing waves

Lecture 9 - Examples of 1-D waves in tubes, short tubes, Kundt's tube

Lecture 10 - Thermodynamic processes during sound transmission

Lecture 11 - Numerical examples

Lecture 12 - Sound transmission through walls

Lecture 13 - Sound transmission through walls

Lecture 14 - Leakage in walls, STC Ratings, Octave bands

Lecture 15 - Instantaneous power flow

Lecture 16 - Radial propagation of sound, monopoles, and dipoles

Lecture 17 - Radial propagation of sound, monopoles, and dipoles

Lecture 18 - Radial propagation of sound, monopoles, and dipoles

Lecture 19 - Numerical examples

Lecture 20 - Numerical examples

Lecture 21 - Directivity

Lecture 22 - Directivity

Lecture 23 - Directivity

Lecture 24 - Directivity

Lecture 25 - Generalized elements

Lecture 26 - Examples of electromechanical systems

Lecture 27 - Transformers, radiation impedance, and Helmholtz resonator

Lecture 28 - Radiation impedance

Lecture 29 - Radiation impedance

Lecture 30 - Models of electro-mechanical-acoustic systems

Lecture 31 - Solution for a loudspeaker model

[Lecture 32 - Microphones](#)

[Lecture 33 - Vibro-meter, seismometer, accelerometer, shaker table](#)

[Lecture 34 - Sound propagation in rooms, 1-D rooms, 2D rooms](#)

[Lecture 35 - Sound in 3-D rooms](#)

[Lecture 36 - Absorption coefficient, and irregular rooms](#)

[Lecture 37 - Room constant, and Sabine's coefficient](#)

[Lecture 38 - Design of a muffler](#)

[Lecture 39 - Noise in machines, basics of noise management](#)

[Lecture 1 - Advanced Machining Processes](#)

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[Lecture 10 \(same as 9\)](#)

[Lecture 11](#)

[Lecture 12 \(Lecture Missing\)](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

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Lecture 1 - Introduction

Lecture 2 - Basic Ideas of Applied Linear Algebra

Lecture 3 - Systems of Linear Equations

Lecture 4 - Square Non-Singular Systems

Lecture 5 - Ill-Conditioned and Ill-Posed Systems

Lecture 6 - The Algebraic Eigenvalue Problem

Lecture 7 - Canonical Forms, Symmetric Matrices

Lecture 8 - Methods of Plane Rotations

Lecture 9 - Householder Method, Tridiagonal Matrices

Lecture 10 - QR Decomposition, General Matrices

Lecture 11 - Singular Value Decomposition

Lecture 12 - Vector Space: Concepts

Lecture 13 - Multivariate Calculus

Lecture 14 - Vector Calculus in Geometry

Lecture 15 - Vector Calculus in Physics

Lecture 16 - Solution of Equations

Lecture 17 - Introduction to Optimization

Lecture 18 - Multivariate Optimization

Lecture 19 - Constrained Optimization: Optimality Criteria

Lecture 20 - Constrained Optimization: Further Issues

Lecture 21 - Interpolation

Lecture 22 - Numerical Integration

Lecture 23 - Numerical Solution of ODE's as IVP

Lecture 24 - Boundary Value Problems, Question of Stability in IVP Solution

Lecture 25 - Stiff Differential Equations, Existence and Uniqueness Theory

Lecture 26 - Theory of First Order ODE's

Lecture 27 - Linear Second Order ODE's

Lecture 28 - Methods of Linear ODE's

Lecture 29 - ODE Systems

Lecture 30 - Stability of Dynamic Systems

Lecture 31 - Series Solutions and Special Functions

[Lecture 32 - Sturm-Liouville Theory](#)

[Lecture 33 - Approximation Theory and Fourier Series](#)

[Lecture 34 - Fourier Integral to Fourier Transform, Minimax Approximation](#)

[Lecture 35 - Separation of Variables in PDE's, Hyperbolic Equations](#)

[Lecture 36 - Parabolic and Elliptic Equations, Membrane Equation](#)

[Lecture 37 - Analytic Functions](#)

[Lecture 38 - Integration of Complex Functions](#)

[Lecture 39 - Singularities and Residues](#)

[Lecture 40 - Calculus of Variations](#)

Lecture 1 - Rigid Body Motion - Part 1

Lecture 2 - Rigid Body Motion - Part 2

Lecture 3 - Dynamic Force Analysis of Mechanisms

Lecture 4 - Space Motion of Rigid Bodies

Lecture 5 - Inertia Tensor Angular Momentum

Lecture 6 - Euler's Equation of Motion

Lecture 7 - Gyroscopic Action in Machines

Lecture 8 - Unbalance in Machines

Lecture 9 - Rotary Balancing

Lecture 10 - Balancing Machines

Lecture 11 - Field Balancing of Rotors

Lecture 12 - Single-Cylinder Engine Balancing

Lecture 13 - Balancing of Single Slider Machines

Lecture 14 - In-Line Engine Balancing

Lecture 15 - V and Radial Engine Balancing

Lecture 16 - Turning Moment Diagram

Lecture 17 - Flywheel Analysis

Lecture 18 - Dynamics of Machines

Lecture 19 - Dynamics of Machines

Lecture 20 - Dynamics of Machines

Lecture 21 - Dynamics of Machines

Lecture 22 - Dynamics of Machines

Lecture 23 - Dynamics of Machines

Lecture 24 - Dynamics of Machines

Lecture 25 - Dynamics of Machines

Lecture 26 - Dynamics of Machines

Lecture 27 - Dynamics of Machines

Lecture 28 - Dynamics of Machines

Lecture 29 - Rotating Vector Approach

Lecture 30 - Equivalent viscous damping

Lecture 31 - Dynamics of Machines

[Lecture 32 - Systems with two degree of freedom](#)

[Lecture 33 - Tuned Vibration Absorber](#)

[Lecture 34 - Design of Vibration Absorbers](#)

[Lecture 35 - Flexibility Matrix Influence Coeff](#)

[Lecture 36 - Forced Vibration of multiple](#)

[Lecture 37 - Forced Vibration of Multiple degrees](#)

[Lecture 38 - Vibration of Continuous Systems](#)

[Lecture 39 - Vibration of Continuous Systems](#)

[Lecture 40 - Vibration of Beams](#)

[Lecture 41 - Rayleigh's method](#)

[Lecture 42 - Rayleigh-Ritz Method](#)

[Lecture 43 - Vibration Measurement](#)

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**NPTEL : Finite Element Method (Mechanical Engineering)**

**Co-ordinators : Prof. C.S. Upadhyay**

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**NPTEL : Kinematics of Machines (Mechanical Engineering)**

**Co-ordinators : Prof. Ashok K Mallik**

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[Lab session 1 - Advanced manufacturing process for micro sytem fabrication](#)

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[Lab session 5 - Vaccume Assisted Forming](#)

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Lecture 4 - Review Lecture 1,2,3

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Lecture 8 - Review Lecture 4,5,6

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Lecture 21 - Review Lecture 7 to 10

Lecture 22 - Review Lecture 11 to 13

Lecture 23 - Review Lecture 14 to 16

Lecture 24 - Lecture-20

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Lecture 26 - Lecture-22

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Lecture 30 - Review Lecture 17,18,19

Lecture 31 - Review Lecture 20,21,22

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Lecture 1 - Introduction to Quality Engineering

Lecture 2 - Quality Costs

Lecture 3 - Product Design

Lecture 4 - Design of Experiments

Lecture 5 - Applications of Quality Loss Function

Lecture 6 - Product Selection Strategies

Lecture 7 - Robust Design Approaches

Lecture 8 - Taguchi's Method

Lecture 9 - Failure mode and effects analysis

Lecture 10 - Problem Solving : Failure mode and effects analysis - 1

Lecture 11 - Problem solving : Failure mode and effects analysis - 2

Lecture 12 - Product quality improvement methods

Lecture 13 - Quality tools - Part 1

Lecture 14 - Quality Tools - Part 2

Lecture 15 - Different types of control charts

Lecture 16 - Mean, Variance and Standard deviation

Lecture 17 - X bar chart, R-chart

Lecture 18 - Plotting methods for control charts

Lecture 19 - Six Sigma - Part 1

Lecture 20 - Six Sigma - Part 2

Lecture 21 - Theory of probability

Lecture 22 - Determining the defective products using Probability

Lecture 23 - Sampling based on Permutations and Combinations

Lecture 24 - Binomial distribution

Lecture 25 - Poisson distribution

Lecture 26 - Poisson distribution

Lecture 27 - Normal Distribution

Lecture 28 - Overview of control charts and different types of distribution

Lecture 29 - Fundamental of Robotics and its applications in Automated Systems

Lecture 30 - Joint configuration systems of Robot

Lecture 1 - Introduction to Finite Element Analysis(FEA)

Lecture 2 - Introduction of FEA, Nodes, Elements and Shape Functions

Lecture 3 - Nodes, Elements and Shape Functions

Lecture 4 - Polynomials as Shape Functions, Weighted Residuals, Elements and Assembly Level Equations

Lecture 5 - Types of Errors in FEA, Overall FEA Process and Convergence

Lecture 6 - Strengths of FE Method, Continuity conditions at Interfaces

Lecture 7 - Key concepts and terminologies

Lecture 8 - Weighted integral statements

Lecture 9 - Integration by parts - Review

Lecture 10 - Gradient and Divergence Theorems-Part - I

Lecture 11 - Gradient and Divergence Theorems Part - II

Lecture 12 - Functionals

Lecture 13 - Variational Operator

Lecture 14 - Weighted Integral and Weak Formulation

Lecture 15 - Weak Formulation

Lecture 16 - Weak Formulation and Weighted Integral : Principle of minimum potential energy

Lecture 17 - Variational Methods : Rayleigh Ritz Method

Lecture 18 - Rayleigh Ritz Method

Lecture 19 - Method of Weighted Residuals

Lecture 20 - Different types of Weighted Residual Methods - Part I

Lecture 21 - Different types of Weighted Residual Methods - Part II

Lecture 22 - FEA formulation for 2nd order BVP - Part I

Lecture 23 - FEA formulation for 2nd order BVP - Part II

Lecture 24 - Element Level Equations

Lecture 25 - 2nd Order Boundary Value Problem

Lecture 26 - Assembly of element equations

Lecture 27 - Assembly of element equations and implementation of boundary conditions

Lecture 28 - Assembly process and the connectivity matrix

Lecture 29 - Radially Symmetric Problems

Lecture 30 - One dimensional heat transfer

Lecture 31 - 1D-Heat conduction with convective effects : examples

[Lecture 32 - Euler-Bernoulli beam](#)

[Lecture 33 - Interpolation functions for Euler-Bernoulli beam](#)

[Lecture 34 - Finite element equations for Euler-Bernoulli beam](#)

[Lecture 35 - Assembly equations for Euler-Bernoulli beam](#)

[Lecture 36 - Boundary conditions for Euler-Bernoulli beam](#)

[Lecture 37 - Shear deformable beams](#)

[Lecture 38 - Finite element formulation for shear deformable beams : Part - I](#)

[Lecture 39 - Finite element formulation for shear deformable beams : Part - II](#)

[Lecture 40 - Equal interpolation but reduced integration element](#)

[Lecture 41 - Eigenvalue problems](#)

[Lecture 42 - Eigenvalue problems : examples](#)

[Lecture 43 - Introduction to time dependent problems](#)

[Lecture 44 - Spatial approximation](#)

[Lecture 45 - Temporal approximation for parabolic problems : Part - I](#)

[Lecture 46 - Temporal approximation for parabolic problems : Part - II](#)

[Lecture 47 - Temporal approximation for hyperbolic problems](#)

[Lecture 48 - Explicit and implicit method, diagonalization of mass matrix, closure](#)

Lecture 1 - Introduction

Lecture 2 - Vibration versus Waves

Lecture 3 - Nature of Sound

Lecture 4 - The Decibel Scale

Lecture 5 - Some Key Terms

Lecture 6 - Adding Decibels

Lecture 7 - Modeling Sound Propagation

Lecture 8 - The Momentum Equation

Lecture 9 - The Continuity Equation and The Gas Law

Lecture 10 - 1-D Wave Equation

Lecture 11 - General Solution for 1-D Wave Equation

Lecture 12 - Complex Time Signal and Transfer Functions

Lecture 13 - Transmission line equations

Lecture 14 - Planar Waves in Closed Tubes

Lecture 15 - Planar Waves in 1-D Open Tubes

Lecture 16 - A Semi-Infinite Tube and Overall Summary

Lecture 17 - 1-D Tubes with Imperfect Terminations

Lecture 18 - Measuring Impedance Through Kundt's Apparatus

Lecture 19 - Classification of Microphones

Lecture 20 - Classification of Microphones - Continuation

Lecture 21 - Classification of Microphones by Application

Lecture 22 - Microphone Sensitivity

Lecture 23 - Microphone Sensitivity- Continuation

Lecture 24 - Selecting the Right Microphone

Lecture 25 - Fourier Series Expansion

Lecture 26 - Fourier Series Expansion - Continuation

Lecture 27 - Fourier Integral

Lecture 28 - Fourier Integral - Continuation

Lecture 29 - Fourier Transform

Lecture 30 - Fourier Transform - Continuation

Lecture 31 - Discrete Fourier Transform (DFT)



[Lecture 32 - Discrete Fourier Transform \(DFT\) - Continuation](#)

[Lecture 33 - DFT - Calculating Frequencies and Padding](#)

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[Lecture 35 - FFT and Inverse FFT](#)

[Lecture 36 - Considerations while deciding instrumentation](#)

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[Lecture 40 - Octave band analysis](#)

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[Lecture 43 - Short time Fourier transforms \(STFT\)](#)

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[Lecture 47 - STC, NRC and sound attenuation](#)

[Lecture 48 - Reverberant rooms](#)

- Lecture 1 - Introduction to Manufacturing Process Technology
- Lecture 2 - Structure of Matter (Bonding of Solids, Crystal Structures)
- Lecture 3 - Brief introduction of non-conventional machining processes
- Lecture 4 - Structure of matters (bonding of solids, crystal structures)
- Lecture 5 - Elastic and Plastic Deformation
- Lecture 6 - Crystal imperfection and dislocation
- Lecture 7 - Plastic Deformation
- Lecture 8 - Material Properties, Stress Strain Diagram for different types of materials
- Lecture 9 - Friction and Wear, Solid solutions
- Lecture 10 - Equilibrium Phase Diagram
- Lecture 11 - Iron-carbon equilibrium phase diagram
- Lecture 12 - Control of material properties (Alloying and heat treatment), Mechanical properties and Recrystallization
- Lecture 13 - Introduction To Casting Process
- Lecture 14 - Pattern and Mold Design
- Lecture 15 - Mold Making Procedures
- Lecture 16 - Fundamentals of Melting and Furnaces & Pouring and Gating Design
- Lecture 17 - Vertical and Bottom Gating Systems Edit Lesson
- Lecture 18 - Numerical Estimation To Find Mold Filling Time and Mold Design
- Lecture 19 - Effects of friction and velocity distribution in time of filling
- Lecture 20 - Numerical design of gating systems using frictional and bending losses
- Lecture 21 - Principle of cooling and solidification in single and multiphase systems
- Lecture 22 - Estimation of rate of solidification
- Lecture 23 - Principles of cooling and solidification of casting
- Lecture 24 - Modeling of Solidification Rates of Thin Casting in a Metal Mold
- Lecture 25 - Solidification with Predominant Interface Resistance
- Lecture 26 - Solidification with Constant Casting Surface Temperature
- Lecture 27 - Solidification of Casting with Predominant Resistance in Mold and Solidified Metal
- Lecture 28 - Solidification Time for Permanent Mold Casting
- Lecture 29 - Solidification with Constant Casting Surface
- Lecture 30 - Riser Design and Placement - Part 1
- Lecture 31 - Riser Design and Placement - Part 2

[Lecture 32 - Riser Design and Placement - Part 3](#)

[Lecture 33 - Introduction of Machining Processes](#)

[Lecture 34 - Review of Basic Machining Processes and the Mechanics of Chip Formation](#)

[Lecture 35 - Estimation of Cutting Ratio and Shear Angle](#)

[Lecture 36 - Merchant's Force Analysis](#)

[Lecture 37 - Merchant Theory \(Cutting Forces Analysis\)](#)

[Lecture 38 - Merchant Theory \(Force analysis\) Part-2](#)

[Lecture 39 - Lee Shaffer's Solution](#)

[Lecture 40 - Specific Energy Model for Cutting](#)

[Lecture 41 - Modeling of Heat Generation and Cutting Tool Temperature](#)

[Lecture 42 - Temperature in Cutting and Builtup Edge Formation](#)

[Lecture 43 - Metal Cutting Operation](#)

[Lecture 44 - Tool life and Tool wear](#)

[Lecture 45 - Economics of Machining](#)

[Lecture 46 - Joining Process](#)

[Lecture 47 - Principle of Solid State Welding](#)

[Lecture 48 - Numerical Design of Welding Power Sources in Arc Welding](#)

Lecture 1 - History and Evolution of Materials

Lecture 2 - Classification of Materials

Lecture 3 - Advanced and Exotic Materials

Lecture 4 - Mechanical Properties of Materials - I

Lecture 5 - Mechanical Properties of Materials - II

Lecture 6 - Mechanical Properties of Materials - III

Lecture 7 - Bonding between atoms

Lecture 8 - The Role of Crystal Structure - I

Lecture 9 - The Role of Crystal Structure - II

Lecture 10 - The Role of Crystal Structure - III

Lecture 11 - Metals - I (Ferrous alloys)

Lecture 12 - Metals - II (Non-Ferrous alloys)

Lecture 13 - Metals - III (Strengthening and Degradation)

Lecture 14 - Ceramics - I

Lecture 15 - Ceramics - II

Lecture 16 - Polymers : Introduction and Classification

Lecture 17 - Polymeric Structure

Lecture 18 - Effects of Glass transition temperature

Lecture 19 - Polymer Mechanical properties

Lecture 20 - Composites - I

Lecture 21 - Composites - II

Lecture 22 - Composites - III

Lecture 23 - Smart Materials - I (Introduction)

Lecture 24 - Smart Materials - II (Piezoelectricity)

Lecture 25 - Smart Materials - III (Magnetostriction)

Lecture 26 - Smart Materials - IV (Smart Polymers)

Lecture 27 - Smart Materials - V (SMA)

Lecture 28 - Materials Selection in Engineering Design

Lecture 29 - Numerical: Cantilever beam (High stiffness and light weight)

Lecture 30 - Numerical: Cantilever beam (High strength and light weight)

Lecture 31 - Numerical: Connecting rod

[Lecture 32 - Numerical: Probe for scanning probe microscope](#)

[Lecture 33 - Optical Properties](#)

[Lecture 34 - Optical Fiber](#)

[Lecture 35 - Thermal Properties](#)

[Lecture 36 - Numerical: Material selection for Heat exchanger](#)

[Lecture 37 - Electric Properties - I](#)

[Lecture 38 - Electric Properties - II](#)

[Lecture 39 - Magnetic Properties](#)

[Lecture 40 - Laboratory demonstration](#)

Lecture 1 - Introduction to Advanced Machining Processes

Lecture 2 - Classification of Machining Processes

Lecture 3 - Silicon growth and Crystallography

Lecture 4 - Micro Fabrication Technology

Lecture 5 - Photolithography

Lecture 6 - Soft Lithography

Lecture 7 - Introduction to Wet Etching Techniques

Lecture 8 - Introduction to Dry Etching Techniques

Lecture 9 - Introduction of Additive Techniques

Lecture 10 - Introduction to Abrasive Jet Machining Process

Lecture 11 - Ultrasonic Machining Process

Lecture 12 - Determination of MRR of Ultrasonic Machining Process

Lecture 13 - Mechanics of Ultrasonic Machining (USM)

Lecture 14 - Effect of Process parameters of USM

Lecture 15 - Ultrasonic Machining Unit

Lecture 16 - Electrochemical Machining Processes (ECM)

Lecture 17 - Material Removal Rate of ECM

Lecture 18 - Electrode Double Layer

Lecture 19 - Material removal rate of an alloy in ECM

Lecture 20 - Kinematics and Dynamics of ECM

Lecture 21 - Temperature and Pressure rise during ECM

Lecture 22 - Determination of Electrolyte flow velocity in ECM

Lecture 23 - Effect of heat and Hydrogen bubble generation during ECM Process

Lecture 24 - Theoretical determination of Tool shape

Lecture 25 - Design for Electrolyte flow in ECM

Lecture 26 - Introductions of Electro-chemical Drilling Process

Lecture 27 - Introduction to Finishing Process

Lecture 28 - Electric Discharge Machining Process

Lecture 29 - EDM part-2

Lecture 30 - Effect of various process parameters on EDM process

Lecture 31 - Analysis of RC circuit for EDM

- [Lecture 32 - Electrodischarge machining system](#)
- [Lecture 33 - Effect of various parameters on EDM Process](#)
- [Lecture 34 - Tool Electrodes and Dielectric fluids and Electron Beam Machining](#)
- [Lecture 35 - Mechanics of Electron Beam Machining Process](#)
- [Lecture 36 - Functional Characteristics of EBM Process Edit Lesson](#)
- [Lecture 37 - Introduction of Laser Beam Machining Process](#)
- [Lecture 38 - Material removal rate of LBM](#)
- [Lecture 39 - Heat conduction and Temperature rise during LBM](#)
- [Lecture 40 - Modelling of LBM processes](#)
- [Lecture 41 - Metal forming Processes Edit Lesson](#)
- [Lecture 42 - Yield Criterion used in Metal Forming Processes Edit Lesson](#)
- [Lecture 43 - Concept of Principal stress, strain](#)
- [Lecture 44 - Trescas' Yield criteria and Rolling Process](#)
- [Lecture 45 - Rolling Processes - Part 1](#)
- [Lecture 46 - Rolling Processes - Part 2](#)
- [Lecture 47 - Additive Manufacturing Processes](#)
- [Lecture 48 - Fused Deposition Modeling Process](#)

Lecture 1 - Overview of the Course

Lecture 2 - Fundamental principles

Lecture 3 - Steps followed in FEA

Lecture 4 - Weak Formulation

Lecture 5 - Weak Formulation : Example Problem

Lecture 6 - Assembling element level equations

Lecture 7 - Errors in FEA Solution

Lecture 8 - Measures of Errors in FEA Solution

Lecture 9 - Convergence and Accuracy of Solution - Part I

Lecture 10 - Convergence and Accuracy of Solution - Part II

Lecture 11 - Convergence - Part I

Lecture 12 - Convergence - Part II

Lecture 13 - Numerical Integration Schemes - Part I

Lecture 14 - Numerical Integration Schemes - Part II

Lecture 15 - Approximations - Part I

Lecture 16 - Approximations - Part II

Lecture 17 - Approximations - Part III

Lecture 18 - Gauss Quadrature

Lecture 19 - Gaussian Quadrature review

Lecture 20 - Gaussian Quadrature - Part II

Lecture 21 - Gaussian Quadrature - Part III

Lecture 22 - Newton-Cotes Quadrature

Lecture 23 - Two dimensional FEM problem

Lecture 24 - Two dimensional one variable FEM problem

Lecture 25 - 2D Finite element problems with single variable (Model equation)

Lecture 26 - 2D Finite element problems with single variable (Weak formulation)

Lecture 27 - Elemental level 2D finite element equations

Lecture 28 - Interpolation functions for 2D finite element problems

Lecture 29 - Interpolation functions for linear triangular elements - Part I

Lecture 30 - Interpolation functions for linear triangular elements - Part II

Lecture 31 - Interpolation functions for Triangular and Rectangular elements



- Lecture 32 - Evaluation of Stiffness and Force matrices
- Lecture 33 - Stiffness and Force matrices for Triangular element
- Lecture 34 - Stiffness and Force matrices for Rectangular element
- Lecture 35 - Boundary elements for Finite element Equations
- Lecture 36 - Boundary integrals for Triangular element
- Lecture 37 - Assembly of 2-D finite elements - Part I
- Lecture 38 - Assembly of 2-D finite elements - Part II
- Lecture 39 - 2-D Heat transfer problems - Part I
- Lecture 40 - 2-D Heat transfer problems - Part II
- Lecture 41 - Numerical integration schemes for 2-D problems
- Lecture 42 - Jacobian and transformation matrix for 2-D problems
- Lecture 43 - Numerical Integration Schemes for 2-D Problems : Closure
- Lecture 44 - Post-processing
- Lecture 45 - Plane Elasticity Problems
- Lecture 46 - Plane Elasticity Problems : Development of Weak form
- Lecture 47 - Plane Elasticity Problems : Element level equations
- Lecture 48 - Plane Elasticity Problems : Closure

- Lecture 1 - Introduction to Vibration control
- Lecture 2 - Strategies and Steps in Vibration Control
- Lecture 3 - Strategies, Active control, Detuning and Decoupling
- Lecture 4 - Viscous damping model
- Lecture 5 - Coulomb and Hysteretic damping model
- Lecture 6 - Energy Dissipation in Structural Materials
- Lecture 7 - Material Selection Criterion against Damping
- Lecture 8 - Design for Enhanced Material Damping
- Lecture 9 - Linear Viscoelastic Materials and Models
- Lecture 10 - Maxwell and 3-Parameter Models
- Lecture 11 - Complex modulus and Applications of VEM
- Lecture 12 - Basics of Dynamic Vibration Absorber
- Lecture 13 - Modelling of Dynamic Vibration Absorber
- Lecture 14 - Proof mass Actuator
- Lecture 15 - Springs for Vibration Isolation
- Lecture 16 - Introduction to Active Vibration Control
- Lecture 17 - Basics of Classical Control System
- Lecture 18 - Basics of State Space Control
- Lecture 19 - Controllability and Observability of System
- Lecture 20 - Full State Feedback Control
- Lecture 21 - SMSS Laboratory Demonstration

Lecture 1 - Lesson 1 - Course Overview

Lecture 2 - Lesson 2 - Introduction

Lecture 3 - Lesson 3 - Nature Of Sound

Lecture 4 - Lesson 4 - The Decibel scale

Lecture 5 - Lesson 5 - Key Terms In Acoustics

Lecture 6 - Lesson 6 - Adding Decibels

Lecture 7 - Lesson 1 - Important Mathematical Concepts-Complex Algebra

Lecture 8 - Lesson 2 - Important Mathematical Concepts-Complex Time Signals

Lecture 9 - Lesson 3 - Important Mathematical Concepts-Transfer Function

Lecture 10 - Lesson 4 - Important Mathematical Concepts-Pole Zero Plot

Lecture 11 - Lesson 5 - Important Mathematical Concepts - Bode Plot For Simple Pole

Lecture 12 - Lesson 6 - Important Mathematical Concepts - Bode Plot For Simple Zero

Lecture 13 - Lesson 1 - Bode Plots (Magnitude) for Complex Transfer Functions

Lecture 14 - Lesson 2 - Momentum Equation for 1-D Sound Propagation

Lecture 15 - Lesson 3 - Continuity Equation for 1-D Sound Propagation

Lecture 16 - Lesson 4 - Gas Law for 1-D Sound Propagation

Lecture 17 - Lesson 5 - 1-D Wave Equation

Lecture 18 - Lesson 6 - Solution for 1-D Wave Equation

Lecture 19 - Lesson 1 - Waveguide

Lecture 20 - Lesson 2 - Transmission Line Equations - Part I

Lecture 21 - Lesson 3 - Transmission Line Equations - Part II

Lecture 22 - Lesson 4 - Transmission Line Equations - Part III

Lecture 23 - Lesson 5 - Transmission Line Equations - Part IV

Lecture 24 - Lesson 6 - Transmission Line Equations - Part V

Lecture 25 - Lesson 1 - Instantaneous Power

Lecture 26 - Lesson 2 - Instantaneous Power in a L-R Circuit

Lecture 27 - Lesson 3 - Power Factor, and Acoustic Power

Lecture 28 - Lesson 4 - Power Flow into an Infinitely Long Tube

Lecture 29 - Lesson 5 - Point Sources of Sound

Lecture 30 - Lesson 6 - Relations for Outward Travelling Spherical Acoustic Wave

Lecture 31 - Lesson 1 - Specific Acoustic Impedance for a Closed Tube

Lecture 32 - Lesson 2 - Specific Acoustic Impedance for an Open Tube and an Infinitely Long Tube

Lecture 33 - Lesson 3 - Specific Acoustic Impedance for a Tube with Imperfect Termination

Lecture 34 - Lesson 4 - Kundt's Tube

Lecture 35 - Lesson 5 - Volume Velocity

Lecture 36 - Lesson 6 - Comparison of Impedances for a Radially Propagating Wave and a Planar Wave

Lecture 37 - Lesson 1 - Interference of sound sources - Part I

Lecture 38 - Lesson 2 - Interference of sound sources - Part II

Lecture 39 - Lesson 3 - Interference of sound sources - Part III

Lecture 40 - Lesson 4 - Interference of sound sources - Part IV

Lecture 41 - Lesson 5 - Directivity

Lecture 42 - Lesson 6 - Complex power, pressure and velocity for a spherical source

Lecture 43 - Lesson 1 - Noise reduction - Mass Attenuation Method

Lecture 44 - Lesson 2 - Noise Reduction - Pressure Ratio

Lecture 45 - Lesson 3 - Noise Reduction - Velocity of Wall

Lecture 46 - Lesson 4 - 3 Media Problem - Introduction

Lecture 47 - Lesson 5 - 3 Media Problem - Apply Boundary Conditions

Lecture 48 - Lesson 6 - 3 Media Problem - Special cases

Lecture 49 - Lesson 1 - Mufflers

Lecture 50 - Lesson 2 - Designing of Reactive Mufflers

Lecture 51 - Lesson 3 - Designing of Dissipative Mufflers

Lecture 52 - Lesson 4 - Time and Frequency Domain Representation of a Signal

Lecture 53 - Lesson 5 - Fourier Series

Lecture 54 - Lesson 6 - Fourier Series

Lecture 55 - Lesson 1 - Fourier Transform

Lecture 56 - Lesson 2 - Fourier Transform

Lecture 57 - Lesson 3 - Fourier Transform

Lecture 58 - Lesson 4 - Discrete Fourier Transform (DFT)

Lecture 59 - Lesson 5 - Discrete Fourier Transform (DFT)

Lecture 60 - Lesson 6 - Discrete Fourier Transform (DFT)

Lecture 61 - Lesson 1 - Measuring Sound Signals

Lecture 62 - Lesson 2 - Microphones

Lecture 63 - Lesson 3 - Microphones

Lecture 64 - Lesson 4 - Weighting

[Lecture 65 - Lesson 5 - Loudness](#)

[Lecture 66 - Lesson 6 - Loudness](#)

[Lecture 67 - Lesson 1 - Octave Band Analysis - Part I](#)

[Lecture 68 - Lesson 2 - Octave Band Analysis - Part II](#)

[Lecture 69 - Lesson 3 - Octave Band Analysis - Part III](#)

[Lecture 70 - Lesson 4 - Reverberation Time](#)

[Lecture 71 - Lesson 5 - Calculation of Reverberation Time and Sound Transmission Class \(STC\)](#)

[Lecture 72 - Lesson 6 - Noise Reduction Coefficient \(NRC\)](#)

Lecture 1 - Recap - I

Lecture 2 - Recap - II

Lecture 3 - Recap - III

Lecture 4 - Determination of Phase Diagram (Experimentally) - I

Lecture 5 - Determination of Phase Diagram (Experimentally) - II

Lecture 6 - Determination of Phase Diagram (Thermodynamically)

Lecture 7 - Effect of pressure on phase transformation temperature and concept of equilibrium between condensed and vapor phase

Lecture 8 - Effect of different parameters on heat treatment and concept of saturation vapor pressure with examples

Lecture 9 - Title: Formation of ideal solid or liquid solution and (G-X) diagrams for ideal solutions (Part-I)

Lecture 10 - G-X diagrams (Part- II) and concept of chemical potential (Micro Sign) from G-X diagrams.

Lecture 11 - Concept of common tangent for equilibrium between two phases

Lecture 12 - Expressions for equilibrium of two phases - I

Lecture 13 - Expressions for equilibrium of two phases - II

Lecture 14 - Expressions for equilibrium of two phases - III

Lecture 15 - Determining nucleation of phases using G-X plot

Lecture 16 -  $\hat{H}^G$  for nucleation and overall transformation, concepts of solid state transformation including precipitation and Quasi-Chemical Model (QCM)

Lecture 17 - Introduction to real solutions and expression of  $\hat{H}^H_{mix}$  based on the Quasi-Chemical Model (QCM)

Lecture 18 - Expression for  $\hat{H}^H_{mix}$  as a function of interaction energy and mole fraction, based on the QCM - Part I

Lecture 19 - Expression for  $\hat{H}^H_{mix}$  as a function of interaction energy and mole fraction, based on the QCM - Part II

Lecture 20 - Graphical representation of  $\hat{H}^G_{mix}$ ,  $\hat{H}^H_{mix}$ , and  $-T\hat{S}^S_{mix}$  for real solutions and evolution of eutectic phase diagram from the G-X plots

Lecture 21 - Effect of  $\hat{H}^H_{mix}$  on determination of phase diagrams (same crystal structure)

Lecture 22 - Effect of  $\hat{H}^H_{mix}$  on determination of phase diagrams (Continued...)

Lecture 23 - Importance of phase diagrams

Lecture 24 - Effect of heat treatment on microstructure evolution in steel - I

Lecture 25 - Effect of heat treatment on microstructure evolution in steel - II

Lecture 26 - Recap of homogeneous and heterogeneous nucleation for solid to solid transformation

Lecture 27 - Nucleation rate and its dependence on T (temp. of interest),  $\hat{H}^H_T$ ,  $\hat{H}^G_v$  and  $\hat{H}^G^*$  and, introduction to growth kinetics

Lecture 28 - Growth kinetics (Continued...)

Lecture 29 - Growth rate variation with undercooling and kinetics of overall phase transformation

Lecture 30 - Implication of Avrami's equation with example on excel spreadsheet

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Lecture 31 - Experimental verification of Avrami Equation

Lecture 32 - Linear regression (least squares) method to find the value of n and k in Avrami equation

Lecture 33 - In this lecture, method to determine the goodness of fit has been explained. Procedure to estimate the values of n and k from experimental data have also been discussed.

Lecture 34 - Stereology and quantitative metallography - I

Lecture 35 - Stereology and quantitative metallography - II

Lecture 36 - Grain size measurements methods

Lecture 37 - Statistical tools for analysis and reporting of obtained data with examples

Lecture 38 - Evolution of TTT and CCT diagram from f vs. t plots

Lecture 39 - TTT, CCT continue and hardenability of steel

Lecture 40 - Importance of heat treatment practices in real life (with examples)

Lecture 1 - Brief Introduction

Lecture 2 - Define Phase, Equilibrium

Lecture 3 - Free Energy, Stability of Phases

Lecture 4 - Gibbs Free Energy of Binary Solution

Lecture 5 - Ideal Solution and Chemical Potential

Lecture 6 - Thermodynamics of solid solutions

Lecture 7 - G vs X curves

Lecture 8 - Solid solutions: Types

Lecture 9 - Heterogeneous phase equilibria

Lecture 10 - G vs X curves for eutectic system

Lecture 11 - G-X plot for peritectic system

Lecture 12 - Effect of temperature of solid solubility, Influence of interfaces on Equilibrium

Lecture 13 - Introduction of Diffusion

Lecture 14 - Mechanism of Diffusion, Fick's I law

Lecture 15 - Fick's II law

Lecture 16 - Fick's II law (Continued...), Diffusion and Temperature

Lecture 17 - Interfacial Free Energy, Solid/Vapor Interface

Lecture 18 - Boundaries in single phase solids

Lecture 19 - High angle grain boundaries, Equilibrium in poly-crystalline materials, Interphase interfaces in solids

Lecture 20 - Interphase interfaces in solids (Continued...)

Lecture 21 - CSL Boundaries

Lecture 22 - Types of Nucleations

Lecture 23 - Homogeneous Nucleation

Lecture 24 - Homogeneous Nucleation (Continued...)

Lecture 25 - Heterogeneous Nucleation

Lecture 26 - Heterogeneous nucleation (Continued...)

Lecture 27 - Growth

Lecture 28 - Atomic mechanism of growth

Lecture 29 - Dendritic Solidification

Lecture 30 - Growth rate for dendrite formation

Lecture 31 - Alloy solidification



- [Lecture 32 - Alloy solidification \(Continued...\)](#)
- [Lecture 33 - Eutectic: Solidification](#)
- [Lecture 34 - Eutectic: solidification \(Continued...\)](#)
- [Lecture 35 - Solidification of casting / ingot](#)
- [Lecture 36 - Precipitation hardenable alloy](#)
- [Lecture 37 - Precipitation age- hardening alloy \(Continued...\)](#)
- [Lecture 38 - Age hardening alloy](#)
- [Lecture 39 - Eutectoid transformation](#)
- [Lecture 40 - Eutectoid transformation \(Continued....\)](#)
- [Lecture 41 - Eutectoid transformation in steel \(Continued...\)](#)
- [Lecture 42 - Martensite](#)
- [Lecture 43 - Martensite \(Continued...\)](#)
- [Lecture 44 - Martensite \(Continued...\) and TTT curves](#)
- [Lecture 45 - TTT diagram](#)
- [Lecture 46 - Recovery, Recrystallization and Grain growth](#)
- [Lecture 47 - Recovery](#)
- [Lecture 48 - Recrystallization](#)
- [Lecture 49 - Recrystallization \(Continued...\)](#)
- [Lecture 50 - Introduction to spinodal decomposition](#)

Lecture 1 - Introduction to Composites

Lecture 2 - Matrices

Lecture 3 - Fiber reinforcements

Lecture 4 - Fiber reinforcements (Continued...)

Lecture 5 - Composites properties

Lecture 6 - Composites testing

Lecture 7 - Selection of material

Lecture 8 - Selection of material (Continued...)

Lecture 9 - Design for Manufacturing

Lecture 10 - Design for Manufacturing (Continued...)

Lecture 11 - Composite Manufacturing Processes

Lecture 12 - Filament winding Processes

Lecture 13 - Resin transfer moulding

Lecture 14 - Pultrusion

Lecture 15 - Compression Moulding Process

Lecture 16 - Vacuum Impregnation Methods

Lecture 17 - Stacking of Composites

Lecture 18 - Thermoplastic Composites Manufacturing Processes - Part 1

Lecture 19 - Thermoplastic Composites Manufacturing Processes - Part 2 (Continued...)

Lecture 20 - Non-destructive testing methods for composite materials

Lecture 21 - Metal Matrix Composites

Lecture 22 - Metal Matrix Composites applications (Continued...)

Lecture 23 - Processing of Metal Matrix Composites - Part 1

Lecture 24 - Processing of Metal Matrix Composites - Part 2

Lecture 25 - Ceramic Matrix Composites

Lecture 26 - Fabrication of Ceramic Matrix Composites (CMCs)

Lecture 27 - Carbon - Carbon Composites

Lecture 28 - Polymer Matrix and Nano Composites

Lecture 29 - Machining of Composites

Lecture 30 - Repair of Composites

Lecture 31 - Manufacturing Processes: Selection and Considerations



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[Lecture 30 - Work Systems](#)

[Lecture 31 - Measures of Productivity](#)

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[Lecture 33 - Work Study](#)

[Lecture 34 - Motion and time study](#)

[Lecture 35 - Motion Study](#)

[Lecture 36 - Flow Diagram](#)

[Lecture 37 - Time Study](#)

[Lecture 38 - Manual Work System](#)

[Lecture 39 - Worker Machine Systems](#)

[Lecture 40 - Industrial accidents](#)

[Lecture 41 - Human Errors](#)

[Lecture 42 - Workers compensation laws](#)

[Lecture 43 - Organisation Ergonomics - Part 1](#)

[Lecture 44 - Organisation Ergonomics - Part 2](#)

[Lecture 45 - Job Satisfaction](#)

[Lecture 46 - Worker behavior](#)

[Lecture 47 - Job ranking Techniques](#)

[Lecture 48 - Waging System](#)

[Lecture 49 - Biomechanics - 1](#)

[Lecture 50 - Biomechanics - 2](#)

[Lecture 51 - Applications of Biomechanics](#)

[Lecture 52 - Problem solving - 1](#)

[Lecture 53 - Problem solving - 2](#)

[Lecture 54 - Problem solving - 3](#)

Lecture 1 - Basics of Production

Lecture 2 - Basics of Production (Continued...)

Lecture 3 - Sustainability and Manufacturing

Lecture 4 - Introduction to Simulation

Lecture 5 - Introduction to Simulation (Continued...)

Lecture 6 - Basic Statistical Concepts for Sustainable Manufacturing Analysis

Lecture 7 - Basic Statistical Concepts for Sustainable Manufacturing Analysis (Continued...)

Lecture 8 - Life Cycle Assessment

Lecture 9 - Life Cycle Assessment Elements

Lecture 10 - Life Cycle Assessment Procedure

Lecture 11 - Life Cycle Assessment (Continued...)

Lecture 12 - Sustainability Framework

Lecture 13 - Basic Modeling Concepts for Factory Simulation

Lecture 14 - Basic Modeling Concepts for Factory Simulation (Continued...)

Lecture 15 - Green Manufacturing Modelling: Metrics for Green Manufacturing

Lecture 16 - Green Manufacturing Modelling (Continued...) Indices for Green Manufacturing

Lecture 17 - Green Manufacturing Modelling (Continued...) Developing Green Manufacturing System

Lecture 18 - Productivity and Sustainability

Lecture 19 - Productivity and Sustainability (Continued...)

Lecture 20 - Green Manufacturing Techniques

Lecture 21 - Green Manufacturing Techniques (Continued...)

Lecture 22 - Renewable Sources of Energy

Lecture 23 - Renewable Sources of Energy (Continued...)

Lecture 24 - Renewable energy in India and Industrial Symbiosis

Lecture 25 - Demonstration of Various Instruments Used for Green Machining

Lecture 26 - Laboratory demonstration

Lecture 27 - Developing a Smart Factory

Lecture 28 - Demonstration on PLM Software

Lecture 29 - Developing a Smart Factory (Continued...)

Lecture 30 - Sustainability and Green Manufacturing System

Lecture 1 - Course Overview

Lecture 2 - Introduction

Lecture 3 - Nature Of Sound

Lecture 4 - Beats

Lecture 5 - The Decibel Scale

Lecture 6 - Key Terms in Acoustics

Lecture 7 - Decibel Scale - Part 1

Lecture 8 - Decibel Scale - Part 2

Lecture 9 - Decibel Scale - Part 3

Lecture 10 - Complex Numbers

Lecture 11 - Complex Time Function

Lecture 12 - Linear Systems

Lecture 13 - Transfer Functions

Lecture 14 - Introduction to One Dimensional Wave Equation

Lecture 15 - The Momentum Equation

Lecture 16 - The Continuity Equation and The Gas Law

Lecture 17 - One Dimensional Wave Equation

Lecture 18 - Solution for One Dimensional Wave Equation

Lecture 19 - Transmission Line Equations

Lecture 20 - One Dimensional Example Problems

Lecture 21 - Impedance

Lecture 22 - Pressure Wave Travels in a Closed Tube

Lecture 23 - Standing Wave Formation in a Closed Tube With Rigid Termination

Lecture 24 - Pressure Wave Travels in an Open Tube

Lecture 25 - 1-D sound wave propagation: Kundt's tube - I

Lecture 26 - 1-D sound wave propagation: Kundt's tube - II

Lecture 27 - Radially propagating sound waves in spherical coordinate system - I

Lecture 28 - Radially propagating sound waves in spherical coordinate system - II

Lecture 29 - Complex impedance for radially propagating sound waves in spherical coordinate system

Lecture 30 - Volume velocity - I

Lecture 31 - Interference of 1-D spherically propagating sound waves - I

- Lecture 32 - Interference of 1-D spherically propagating sound waves - II
- Lecture 33 - Noise sources and introduction to microphones
- Lecture 34 - Classification of microphones - I
- Lecture 35 - Classification of microphones - II
- Lecture 36 - Classification of microphones - III
- Lecture 37 - Microphone Parameters
- Lecture 38 - Understanding microphone specifications
- Lecture 39 - Noise Source: Terminology
- Lecture 40 - Noise Source: Sound Attenuation
- Lecture 41 - Noise Source: Sound Pressure Level due to a noise source located outdoors
- Lecture 42 - Noise Source: Role of reflecting surfaces
- Lecture 43 - Noise Source: Sound Pressure Level due to a noise source located indoors - Part I
- Lecture 44 - Noise Source: Sound Pressure Level due to a noise source located indoors - Part II
- Lecture 45 - Measuring Sound Power Level - Understanding standard octave bands
- Lecture 46 - Measuring Sound Power Level - Fan noise - Part I
- Lecture 47 - Measuring Sound Power Level - Fan noise - Part II
- Lecture 48 - Measuring Sound Power Level - Fan noise - Part III
- Lecture 49 - Weighting
- Lecture 50 - Noise coming from Motors
- Lecture 51 - Noise coming from Motors and Pumps
- Lecture 52 - Noise coming from Pump and Motor Working Simultaneously
- Lecture 53 - Noise coming from Compressors
- Lecture 54 - Example problems regarding Noise coming from Compressor
- Lecture 55 - Noise Spread Mechanisms
- Lecture 56 - Reverberation time
- Lecture 57 - Reverberation time example problem
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Lecture 1 - Introduction to Machining

Lecture 2 - Mechanism of plastic deformation

Lecture 3 - Basic machining parameters, Cutting Tools and Types of Machining

Lecture 4 - Types of Chips, Tool nomenclature and tool angles

Lecture 5 - Tool Nomenclature in Normal Rake System and conversion of angles

Lecture 6 - Selection of Tool angles

Lecture 7 - Forces in machining, Merchant's Circle Diagram

Lecture 8 - Stress, Strain and Strain Rate and Shear Plane Angle

Lecture 9 - Numerical Examples; Lee and Shaffer's model

Lecture 10 - Friction in metal cutting: Zorev's Friction Model

Lecture 11 - Practical Machining Operations

Lecture 12 - Slab Milling; Measurement of Cutting Forces

Lecture 13 - Dynamometers; Tool Wear and Tool Life

Lecture 14 - Factors affecting tool life; Abrasive Machining Processes

Lecture 15 - Mechanics of Grinding Process

Lecture 16 - Chip length and specific energy in Grinding

Lecture 17 - Grinding wheel wear; Oblique Cutting

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Lecture 1 - Introduction to Cognitive Robotics (Private)

Lecture 2 - Smart Materials - I (Private)

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Lecture 5 - Architecture of the Brain

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Lecture 7 - Nerve Cells

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Lecture 14 - Child Robot Interaction

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- Lecture 2 - Robot Joints and Work Volume
- Lecture 3 - Spatial transformations
- Lecture 4 - Homogenous Transformtions
- Lecture 5 - Practice Problems with MATLAB in Rotation matrices
- Lecture 6 - Kinematics: Derivation of Link Transformations
- Lecture 7 - Problem Solving DH Parameters
- Lecture 8 - Forward Kinematics
- Lecture 9 - Inverse Kinematics
- Lecture 10 - Problems in Kinematics
- Lecture 11 - Inverse Kinematics of PUMA Robot
- Lecture 12 - Jacobian and Singularity
- Lecture 13 - Velocity and Static Forces
- Lecture 14 - Dynamics - Lagrangian Euler
- Lecture 15 - Newton Euler Dynamics
- Lecture 16 - Trajectory Planning
- Lecture 17 - Inverse Dynamics using MATLAB
- Lecture 18 - Sensors
- Lecture 19 - Actuators and Basic Control System
- Lecture 20 - Block Diagram Reduction and Position Regulator
- Lecture 21 - Control of a single joint
- Lecture 22 - Non Linear Control of Manipulators
- Lecture 23 - Force Control
- Lecture 24 - Manipulator Mechanism Design
- Lecture 25 - Industrial Robots and Applications
- Lecture 26 - Specifications and Programming
- Lecture 27 - VAL programming
- Lecture 28 - Experiment With PUMA Robot Using VAL- II

Lecture 1 - Introduction to Acoustic Wave Propagation

Lecture 2 - D'Alembert's solution and 1-D Continuity equation

Lecture 3 - Muffler Acoustics-Application to Automotive Exhaust Noise Control

Lecture 4 - Linearization of governing equations, and Development of 1-D Acoustic wave and Helmholtz equation

Lecture 5 - Solution of 1-D Helmholtz equation: Propagation in 1-D ducts/pipes

Lecture 6 - 1-D Acoustic Wave Equation in Ducts Carrying Uniform Mean Flow: Derivation

Lecture 7 - 1-D Acoustic Wave Equation in Ducts Carrying Uniform Mean Flow: Solution

Lecture 8 - 3-D Acoustic Wave Equation in Rectangular and Circular Waveguides: Derivation, Modal Solution and Concept of Cut-on Frequency

Lecture 9 - Sound Pressure Level, Intensity Level and Sound Power Level

Lecture 10 - Acoustic Impedance and Reflection Coefficient

Lecture 11 - Lumped System Analysis: Inertance and Compliance

Lecture 12 - Lumped Analysis of a Uniform Pipe Closed/Open at an End, Concept of End Correction

Lecture 13 - Helmholtz Resonator, Electro-Acoustic Analogy and Layout of a typical engine exhaust system

Lecture 14 - Muffler Performance Measures: Insertion Loss

Lecture 15 - Muffler Performance Measures: Transmission Loss and Level Difference

Lecture 16 - Lumped Analysis of a Tube, Simple Area Discontinuity and Transfer Matrices

Lecture 17 - Sudden area Discontinuity (Continued...)

Lecture 18 - Simple Expansion Chamber Analysis Using Transfer Matrix Method

Lecture 19 - Transmission Loss (TL) Graph for a Simple Expansion Muffler (MATLAB)

Lecture 20 - Extended-Inlet and Extended-Outlet Muffler Analysis

Lecture 21 - Extended-Inlet and Extended-Outlet Muffler Analysis (Continued...)

Lecture 22 - TL Analysis of Extended-Inlet and Extended-Outlet Muffler (MATLAB)

Lecture 23 - TL Analysis of Side-Inlet and Side-Outlet Muffler Using Transfer Matrix Method

Lecture 24 - Wave Propagation in Gradually Varying Area Ducts: Webster's Horn Equation

Lecture 25 - Webster's Horn Equation (Continued...) and Exponential Ducts

Lecture 26 - Solution of Webster's Horn Equation for Conical Ducts

Lecture 27 - TL analysis for Conical Muffler Configurations (MATLAB)

Lecture 28 - Segmentation Approach for Analysing Gradually Varying Area Ducts (MATLAB)

Lecture 29 - Acoustic Intensity (Energy Flux) in a Pipe with Mean Flow, and Transmission Loss Expression

Lecture 30 - Aeroacoustic State Variables Transfer Matrix for a Tubular Element (Uniform Pipe)

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Lecture 31 - Transfer Matrix for Extended-Inlet and Outlet Element and Use of Perforated Elements in Commercial Mufflers

Lecture 32 - Two-interacting Duct Configurations: Development of Equations and Concentric Tube Resonators

Lecture 33 - Concentric Tube Resonator: Partially Perforated Pipe or Airway (MATLAB)

Lecture 34 - Review of Perforate Impedance Expressions

Lecture 35 - MATLAB Demonstration for Fully and Partially Perforated CTR

Lecture 36 - Cross-Flow elements: Setting-up the Equations

Lecture 37 - Cross-Flow elements: MATLAB Demonstration for Simple Configurations

Lecture 38 - Plug Mufflers, Three-pass Perforated Element Muffler (Commercial Configurations) - MATLAB

Lecture 39 - Multiply-Connected Mufflers: HQ Tubes

Lecture 40 - TL Analysis of HQ Tubes (MATLAB): Network Analysis and Analytical Formula

Lecture 41 - Transmission Loss in terms of Scattering and Impedance Matrix Parameters

Lecture 42 - Rectangular Chamber Muffler: Characterization and TL Analysis using 3-D Piston-driven Model

Lecture 43 - Circular Chambers: Characterization and TL Analysis Using 3-D Piston-driven Model

Lecture 44 - Analytical Mode-Matching for Extended-Inlet and Outlet Muffler: Setting-up of the Equations

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Lecture 46 - Dissipative Mufflers (Lined Circular duct) - A Brief Discussion

Lecture 47 - Summary of the Topics Covered in This Course, Topics to be Covered in a Future Course

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Lecture 1 - Casting: Introduction to Casting

Lecture 2 - Various aspects of Casting

Lecture 3 - Patterns and Moulds

Lecture 4 - Sand Mould and Gating System

Lecture 5 - Gating System Design

Lecture 6 - Aspiration Effects and Riser Design

Lecture 7 - Solidification of Metals and Alloys

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Lecture 9 - Steps in Sand Casting Processes

Lecture 10 - Expendable Mould Casting Processes

Lecture 11 - Permanent Mould Casting

Lecture 12 - Various Casting Processes and Cost Analysis

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Lecture 15 - Characteristic Features of Welding Processes

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Lecture 19 - Shielded metal arc welding, MIG and TIG Welding

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Lecture 2 - Finite Difference Method - Basic Idea of Discretization

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Lecture 26 - Mathematical Approaches to Turbulent Flows (Modeling on the basis of RANS)

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- Lecture 5 - Metal Machining-2: Mechanism of plastic deformation
- Lecture 6 - Metal Machining-3: Types of Chips, Tool nomenclature and tool angles
- Lecture 7 - Metal Machining-4: Selection of Tool angles, Forces in machining
- Lecture 8 - Metal Machining-5: Merchant's Circle Diagram
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- Lecture 17 - Machining-14: Economics of Machining
- Lecture 18 - Non-Traditional Machining-1: Introduction; Classification
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- Lecture 5 - Euler Equation for Turbomachinery
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Lecture 1 - Introduction to Advanced Manufacturing Processes

Lecture 2 - Ultrasonic Machining

Lecture 3

Lecture 4

Lecture 5 - Abrasive Jet Machining

Lecture 6 - Adrasive Jet Micro-Machining and Mask Materials for AJMM

Lecture 7 - Electro-Chemical Machining

Lecture 8 - Electrochemical Machining - I

Lecture 9 - Electrochemical Machining - II

Lecture 10 - Electrochemical Machining - III

Lecture 11 - Electrochemical Machining - IV

Lecture 12 - Electrochemical Machining - V

Lecture 13 - Electrochemical Machining - VI

Lecture 14 - Electrochemical Machining - VII

Lecture 15 - Electrochemical Machining - VIII

Lecture 16 - Machining Applications

Lecture 17 - Electric Discharge Machining - I

Lecture 18 - Electric Discharge Machining - II

Lecture 19 - Electric Discharge Machining - III

Lecture 20 - Electric Discharge Machining - IV

Lecture 21 - Electric Discharge Machining - IV and Electron Beam Machining - I

Lecture 22 - Electron Beam Machining - II

Lecture 23 - Laser Beam Machining - I

Lecture 24 - Laser Beam Machining - II

Lecture 25 - Silicon and Processing of Silicon - I

Lecture 26 - Silicon and Processing of Silicon - II

Lecture 27 - Polymer Processing

Lecture 28 - Advanced Finishing Processes

Lecture 29 - Lab Session-I: Water Abrasive Jet Machining Process

Lecture 30 - Lab Session-II: Electro-discharge Machining Process - I

Lecture 31 - Lab Session-III: Electro-discharge Machining Process - II

[Lecture 32 - Lab Session-IV: Laser Beam Machining](#)

[Lecture 33 - Lab Session-V: Photolithography](#)

Lecture 1 - Introduction to Computational Fluid Dynamics and Principles of Conservation

Lecture 2 - Conservation of Mass and Momentum: Continuity and Navier Stokes Equation

Lecture 3 - Navier Stokes Equation (Continued.)

Lecture 4 - Energy Equation and General Structure of Conservation Equations

Lecture 5 - Classification of Partial Differential Equations and Physical Behaviour

Lecture 6 - Classification of Partial Differential Equations and Physical Behaviour (Continued.)

Lecture 7 - Approximate Solutions of Differential Equations: Error Minimization Principles

Lecture 8 - Approximate Solutions of Differential Equations: Variational Principles and Weighted Residual Approach

Lecture 9 - Weighted Residual Approach and Introduction to Discretization

Lecture 10 - Fundamentals of Discretization: Finite Element Method

Lecture 11 - Fundamentals of Discretization: Finite Difference and Finite Volume Method

Lecture 12 - Fundamentals of Discretization: Finite Volume Method (Continued.)

Lecture 13 - Finite Volume Method: Some Conceptual Basics and Illustrations through 1-D Steady State Diffusion Problems

Lecture 14 - Finite Volume Method: Boundary Condition Implementation and Discretization of Unsteady State Problems

Lecture 15 - Finite Volume Method: Discretization of Unsteady State Problems

Lecture 16 - Important Consequences of Discretization of Unsteady State Problems

Lecture 17 - Important Consequences of Discretization of Time Dependent Diffusion Type Problems (Continued.) and Stability Analysis

Lecture 18 - Discretization of Hyperbolic Equations: Stability Analysis

Lecture 19 - PART 1 : Stability of Second Order Hyperbolic Equations PART 2 : Mid-Semester Assessment Review (Questions and Answers)

Lecture 20 - PART 1: Mid-Semester Assessment Review (Questions and Answers) (Continued.) PART 2: Finite Volume Discretization of 2-D Unsteady State Diffusion Type

Lecture 21 - Solution of Systems of Linear Algebraic Equations

Lecture 22 - Solution of Systems of Linear Algebraic Equations: Elimination Methods

Lecture 23 - Solution of Systems of Linear Algebraic Equations: Elimination Methods (Continued.)

Lecture 24 - Elimination Methods: Error Analysis

Lecture 25 - Iterative Methods for Numerical Solution of Systems of Linear Algebraic Equations

Lecture 26 - Iterative Methods for Numerical Solution of Systems of Linear Algebraic Equations (Continued.)

Lecture 27 - Iterative Methods: Further Examples

Lecture 28 - PART 1: Combination of Iteration & Elimination Techniques PART 2: Introduction to Gradient Search Methods

Lecture 29 - Gradient Search Methods (Continued.)

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[Lecture 30 - Discretization of Convection-Diffusion Equations: A Finite Volume Approach](#)

[Lecture 31 - Discretization of Convection-Diffusion Equations: A Finite Volume Approach \(Continued.\)](#)

[Lecture 32 - Discretization of Convection- Diffusion Equations: A Finite Volume Approach \(Continued.\)](#)

[Lecture 33 - Discretization of Convection -Diffusion Equations: A Finite Volume Approach \(Continued.\)](#)

[Lecture 34 - Discretization of Convection-Diffusion Equations: A Finite Volume Approach \( Continued.\)](#)

[Lecture 35 - Discretization of Navier Stokes Equations](#)

[Lecture 36 - Discretization of Navier Stokes Equations \( Continued.\)](#)

[Lecture 37 - Discretization of Navier Stokes Equations \( Continued. \)](#)

[Lecture 38 - PART 1 : Discretization of Navier Stokes Equations \(Continued.\) PART 2 : Fundamentals of Unstructured Grid Formulation](#)

[Lecture 39 - Unstructured Grid Formulation \(Continued.\)](#)

[Lecture 40 - What is there in implementing a CFD Code](#)

[Lecture 41 - Introduction to Turbulence Modeling](#)

[Lecture 42 - Introduction to Turbulence Modeling \(Continued.\)](#)

[Lecture 43 - End Semester Questions Review](#)



Lecture 1 - What is Hydraulic and Pneumatic System

Lecture 2 - Basic Components, Symbols and Circuits

Lecture 3 - Incompressible Fluids - Some Fundamental Properties

Lecture 4 - Incompressible Fluid Flow related to Fluid Drive

Lecture 5 - Capillary Fluid (incompressible) Flow and Hydrodynamic Lubrication

Lecture 6 - Basis for Calculating Hydraulic Systems

Lecture 7 - Different types of Valves - Features and Operations - I

Lecture 8 - Hydraulic Valves (General) Different types of Valves - Features and Operations - II

Lecture 9 - Hydraulic Circuits and Valves

Lecture 10 - Hydraulic Servomechanism and Servo and Proportional Control Valves

Lecture 11 - Basic Spool Valve Design Analysis

Lecture 12 - General Control Valve Analysis

Lecture 13 - Critical Centre Spool Valve Analysis

Lecture 14 - Critical Centre Spool Valve Analysis - Stroking Forces

Lecture 15 - Proportional Solenoid Pilot Operated Two Stage Pressure Relief Valve

Lecture 16 - Proportional Solenoid Pilot Operated Two Stage Pressure Relief Valve (Continued...)

Lecture 17 - Introduction to Positive Displacement Hydrostatic Units (Hydraulic Pumps and Motors)

Lecture 18 - Basic features of some Hydraulic Pumps and Motors

Lecture 19 - Analysis of an axial - Piston Swash Plate type Hydrostatic Pump (Discharge Flow Characteristics)

Lecture 20 - Analysis of an axial - Piston Swash Plate type Hydrostatic Pump (Estimation of Torque on Drive Shaft and Swash Plate)

Lecture 21 - Analysis of an Axial - Piston Swash Plate type Hydrostatic unit (Pressure Ripple and Swash Plate Torque)

Lecture 22 - Design Analysis of Gear Pumps - I

Lecture 23 - Design Analysis of Gear Pumps - II

Lecture 24 - Basic Concept of Hydrostatic Transmission (HST) System

Lecture 25 - Selection of HST units and components

Lecture 26 - Regenerative Circuits

Lecture 27 - Introduction to Fluid Logic

Lecture 28 - Basic Devices, Symbols and Circuits

Lecture 29 - Logic Circuits

Lecture 30 - Design Analysis of ORBIT Motor - I : Basic Design and Feature

Lecture 31 - Design Analysis of ORBIT Motor - II : Geometric Volume Displacement

[Lecture 32 - Design Analysis of ORBIT Motor - III : Output torque and stress, Deformation, Gap at Contacts](#)

[Lecture 33 - Application and Selection of Accumulators - Part I](#)

[Lecture 34 - Application and Selection of Accumulators - Part II](#)

[Lecture 35 - Hydraulic Circuits in Industrial Applications](#)

[Lecture 36 - Air preparation - Compressor and Accessories](#)

[Lecture 37 - Pneumatic Circuits](#)

[Lecture 38 - Analysis of Three - Way \(Spool and Flapper Nozzle Valve\)](#)

[Lecture 39 - Analysis of Flapper Nozzle Valves](#)

[Lecture 40 - Flow Force Compensation and Spool Design \(Electro - hydraulic valves\)](#)

[Lecture 41 - Premier and Guide to Oil - hydraulic fluids ; and Introduction to Fluid Power Symbols](#)

[Lecture 42 - Symbols in Oil Hydraulics](#)

[Lecture 43 - Appendices Tutorial on Basic Calculation on HST System and Hydraulic Fluids](#)

Lecture 1 - Introduction

Lecture 2 - Principles of Maintenance

Lecture 3 - Failure Modes Effects and Criticality Analysis

Lecture 4 - Fault Diagnostics and Prognostics

Lecture 5 - Basics of Machinery Vibration

Lecture 6 - Engineering Applications of Vibration

Lecture 7 - Rotordynamics

Lecture 8 - Time Domain Signal Analysis

Lecture 9 - Frequency Domain Signal Analysis

Lecture 10 - Computer Aided Data Acquisition

Lecture 11 - FFT Analysis

Lecture 12 - Modulation and Sidebands

Lecture 13 - Envelope Analysis

Lecture 14 - Cepstrum Analysis

Lecture 15 - Order Analysis

Lecture 16 - Basics of Instrumentation

Lecture 17 - Sensors and Transducers

Lecture 18 - Data Recording and Transmission

Lecture 19 - Vibration Transducers

Lecture 20 - Vibration Monitoring

Lecture 21 - Basics of Noise and Noise Monitoring

Lecture 22 - Numericals in Noise Vibration and Data Acquisition

Lecture 23 - Unbalance Detection

Lecture 24 - Field Balancing

Lecture 25 - Misalignment Detection

Lecture 26 - Cracked Shaft Detection

Lecture 27 - Looseness and Rub Detection

Lecture 28 - Ball and Journal Bearings

Lecture 29 - Gear Fault Detection

Lecture 30 - Fans, Blowers and Compressors

Lecture 31 - Pumps and Turbines

[Lecture 32 - Contaminant Analysis](#)

[Lecture 33 - Oil Analysis](#)

[Lecture 34 - Fault Detection in Motors and Transformers](#)

[Lecture 35 - Motor Current Signature Analysis](#)

[Lecture 36 - Thermography](#)

[Lecture 37 - Ultrasonics](#)

[Lecture 38 - Acoustic Emission and Eddy Current Testing](#)

[Lecture 39 - Radiography, Dye Penetrant Test and Visual Inspection](#)

[Lecture 40 - Case Studies](#)

**NPTEL : Solar Energy Technology (Mechanical Engineering)**

**Co-ordinators : Prof. V.V. Satyamurty**

Lecture 1 - Energy and Dependence on External Sources and Sun, Physical Descriptions and Reactions

Lecture 2 - Sun - Earth Geometry

Lecture 3 - Terminology Extra - Terrestrial Radiation Terrestrial Radiation

Lecture 4 - Measuring Instruments

Lecture 5 - Estimation of Solar Radiation or Details

Lecture 6 - Radiation Processing - Long Term

Lecture 7 - Evaluation of the Apparent Sunrise and Sunset Angles

Lecture 8 - Estimation of Daily/Monthly Average daily Tilt Factor Under Terrestrial Conditions

Lecture 9 - Solar Collector Basics

Lecture 10 - Transmission - Absorptance Product

Lecture 11 - Daily (Or Monthly Average Daily) Transmittance - Absorptance Product Analytical Evaluation

Lecture 12 - Theory of Flat Plate Collectors - Liquid Based (A)

Lecture 13 - Theory of Flat Plate Collectors - Liquid Based (B)

Lecture 14 - Theory of Flat Plate Collectors - Liquid Based (C)

Lecture 15 - Mean temperature and Heat Capacity Effects

Lecture 16 - Theory of Air Based Solar Flat Plate Collectors

Lecture 17 - Theory of Air Based Solar Flat Plate Collectors (Continued.)

Lecture 18 - Other Collector Geometries

Lecture 19 - Concentrating Collectors

Lecture 20 - Concentrating Collectors (Continued.)

Lecture 21 - Concentrating Collectors (Continued.)

Lecture 22 - Compound Parabolic Collectors

Lecture 23 - Exercise - I

Lecture 24 - Exercise - I (Continued.)

Lecture 25 - Device and System Performance

Lecture 26 - Long Term Solar Energy System Performance

Lecture 27 - Exercise - I (Continued.)

Lecture 28 - Long Term Solar Energy System Performance Simplified Design Methods

Lecture 29 - Long Term Solar Energy System Performance Simplified Design Methods (Continued.)

Lecture 30 - Monthly Average Daily Utilizability

Lecture 31 - The  $\bar{\phi}$  - f chart method (Continued.)

[Lecture 32 - The  \$\phi\$ \(bar\) - f chart method Tank Losses and Finite Heat Exchanger](#)

[Lecture 33 - Exercise - 2](#)

[Lecture 34 - Exercise - 2 \(Continued.\)](#)

[Lecture 35 - Exercise - 2 \(Continued.\)](#)

[Lecture 36 - Economic Analysis](#)

[Lecture 37 - Life Cycle Savings : The P1 and P2 Method](#)

[Lecture 38 - Passive Devices](#)

[Lecture 39 - Passive Architecture, Overhangs and Wing Walls](#)

[Lecture 40 - Passive Architecture, Overhangs and Wing Walls \(Continued.\)](#)

[Lecture 41 - Summary](#)

[Lecture 42 - Summary \(Continued.\)](#)

[Lecture 43 - Summary \(Continued.\)](#)

Lecture 1 - Introduction

Lecture 2 - CVD Reaction

Lecture 3 - Adhesion of Surface Coating

Lecture 4 - CVD System

Lecture 5 - CDV of Tic

Lecture 6 - Chemical Vapour Deposition of Nitride Coating

Lecture 7 - Chemical Vapour Deposition of Carbo-Nitride Coating

Lecture 8 - Chemical Vapour Deposition of Chromium

Lecture 9 - Chemical Vapour Deposition of Aluminium Oxide

Lecture 10 - Chemical Vapour Deposition of Diamond

Lecture 11 - Vacuum Evaporation Deposition

Lecture 12 - Reactive Evaporation Deposition

Lecture 13 - Cathodic Arc Evaporation Deposition

Lecture 14 - Sputtering

Lecture 15 - Magnetron Sputtering

Lecture 16 - Unbalanced Magnetron Sputtering

Lecture 17 - Radio frequency and pulsed DC sputtering

Lecture 18 - Sputter Deposition of Nitride Coating

Lecture 19 - Sputter Deposition of Molybdenum Di Sulphide Coating

Lecture 20 - Influence of Architecture of Sputter Deposited Molybdenum Di Sulphide Coating

Lecture 21 - Electro Plating, Anodizing and Electro-Less Plating

Lecture 22 - Coating of Monolayer Abrasive Grain by Electro Plating

Lecture 23 - Mechanism of Wetting

Lecture 24 - Coating on Ceramics by Wetting

Lecture 25 - Coating of Monolayer Abrasive Grain by Wetting

Lecture 26 - Coating on Abrasive Grain

Lecture 27 - Combustion Spray Process

Lecture 28 - Plasma Spray Process

Lecture 29 - Mechanical, Chemical and Ion-Assisted Method

Lecture 30 - Combustion Spray Process

Lecture 31 - Production of Low Vacuum

[Lecture 32 - Production of High Vacuum](#)

[Lecture 33 - Measurement of Low Pressure and Gas Flow in Coating Deposition System](#)

[Lecture 34 - Physical Characterization](#)

[Lecture 35 - Assessment of Coating Hardness](#)

[Lecture 36 - Assessment of Friction and Wear of Coating](#)

[Lecture 37 - Assessment of Surface Roughness and Thickness of Coating](#)

[Lecture 38 - Assessment of Adhesion of Coating](#)

[Lecture 39 - Performance Evaluation of TiN Coated Tool](#)

[Lecture 40 - Performance Evaluation of HFCVD Diamond Coated Tool](#)



- Lecture 1 - Transverse Vibrations of Strings - I
- Lecture 2 - Transverse Vibrations of Strings - II
- Lecture 3 - Axial and Torsional Vibrations of Bars
- Lecture 4 - Variational Formulation - I
- Lecture 5 - Variational Formulation - II
- Lecture 6 - Modal Analysis - I
- Lecture 7 - Modal Analysis - II
- Lecture 8 - Properties of the Eigenvalue Problem
- Lecture 9 - Modal Analysis: Approximate Methods - I
- Lecture 10 - Modal Analysis: Approximate Methods - II
- Lecture 11 - The Initial Value Problem
- Lecture 12 - Forced Vibration Analysis - I
- Lecture 13 - Forced Vibration Analysis - II
- Lecture 14 - Forced Vibration Analysis - III
- Lecture 15 - Damping in Structures
- Lecture 16 - Axially Translating Strings
- Lecture 17 - d' Alembert's Solution - I
- Lecture 18 - d' Alembert's Solution - II
- Lecture 19 - Harmonic Waves and Energetics of Wave Motion
- Lecture 20 - Scattering of Waves
- Lecture 21 - Applications of Wave Solution - I
- Lecture 22 - Applications of Wave Solution - II
- Lecture 23 - Beam Models - I
- Lecture 24 - Beam Models - II
- Lecture 25 - Modal Analysis of Beams
- Lecture 26 - Applications of Modal Solution
- Lecture 27 - Approximate Methods
- Lecture 28 - Topic in Beam Vibration - I
- Lecture 29 - Topic in Beam Vibration - II
- Lecture 30 - Wave Propagation in Beams
- Lecture 31 - Dynamics of Curved Beams

[Lecture 32 - Vibrations of Rings and Arches](#)

[Lecture 33 - Dynamics of Membranes](#)

[Lecture 34 - Vibrations of Rectangular Membrane](#)

[Lecture 35 - Vibrations of Circular Membrane](#)

[Lecture 36 - Special Problems in Membrane Vibrations](#)

[Lecture 37 - Dynamics of Plates](#)

[Lecture 38 - Vibrations of Rectangular Plates](#)

[Lecture 39 - Vibrations of Circular Plates](#)

[Lecture 40 - Special Problems in Plate Vibrations](#)

- Lecture 1 - Introduction and Fundamental Concepts
- Lecture 2 - Zeroth Law and Fundamental Concepts
- Lecture 3 - Different Kind of Energy and First Law - I
- Lecture 4 - First Law - II
- Lecture 5 - First Law - III
- Lecture 6 - Second Law and Its Corollaries - I
- Lecture 7 - Second Law and Its Corollaries - II
- Lecture 8 - Second Law and Its Corollaries - III
- Lecture 9 - Second Law and Its Corollaries - IV
- Lecture 10 - Second Law and Available Energy - I
- Lecture 11 - Second Law and Available Energy - II
- Lecture 12 - Second Law and Available Energy - III
- Lecture 13 - Thermodynamic Property Relations - I
- Lecture 14 - Thermodynamic Property Relations - II
- Lecture 15 - Joule-Kelvin Expansion: Properties of Pure Substances
- Lecture 16 - Properties of Pure Substances - I
- Lecture 17 - Properties of Pure Substances - II
- Lecture 18 - Properties of Pure Substances: Ideal Gases
- Lecture 19 - Properties of Ideal Gases
- Lecture 20 - Vapors Power Cycle - I
- Lecture 21 - Vapor Power Cycle - II
- Lecture 22 - Vapor Power Cycle - III
- Lecture 23 - Vapor Power Cycle - IV
- Lecture 24 - Gas Power Cycle - I
- Lecture 25 - Gas Power Cycle - II
- Lecture 26 - Gas Power Cycle - III
- Lecture 27 - Thermodynamics of Reacting System - I
- Lecture 28 - Thermodynamics of Reacting System - II
- Lecture 29 - Thermodynamics of Reacting System - III
- Lecture 30 - Thermodynamics of Multi Component System - I
- Lecture 31 - Thermodynamics of Multi Component System - II



Lecture 1 - Design Philosophy

Lecture 2 - Design And Manufacturing

Lecture 3 - Engineering Materials

Lecture 4 - Engineering Materials

Lecture 5 - Simple Stresses In Machine Elements

Lecture 6 - Simple Stresses In Machine Elements

Lecture 7 - Compound Stresses In Machine Elements

Lecture 8 - Design For Strength

Lecture 9 - Design for Strength

Lecture 10 - Design For Strength

Lecture 11 - Design for Strength

Lecture 12 - Design for Strength

Lecture 13 - Design of Fasteners - I

Lecture 14 - Design of Fasteners - II

Lecture 15 - Design Of Keys and Splines

Lecture 16 - Threaded Fasteners

Lecture 17 - Design Of Threaded Fasteners

Lecture 18 - Power Screws

Lecture 19 - Design Of Power Screws

Lecture 20 - Shaft Coupling - I

Lecture 21 - Shaft Coupling - II

Lecture 22 - Rivet Joints

Lecture 23 - Design of Welded Joints - I

Lecture 24 - Design of Welded Joints - II

Lecture 25 - Design of Joints With Eccentric Loading

Lecture 26 - Design of Joints With Variable Loading

Lecture 27 - Design of Springs

Lecture 28 - Design Of Springs

Lecture 29 - Design Of Springs

Lecture 30 - Belt Drives

Lecture 31 - Belt Drives

[Lecture 32 - Belt Drives](#)

[Lecture 33 - Design for Strength](#)

[Lecture 34 - Design of Shafts](#)

[Lecture 35 - Design of Machine Elements - I \(V & W\)](#)

[Lecture 36 - Design of Machine Elements - II \(V & W\)](#)

[Lecture 37 - Design of Cylinders & Pressure Vessels - II](#)

[Lecture 38 - Design of Cylinders & Pressure Vessels - III](#)

[Lecture 39 - Design of Brakes - I](#)

[Lecture 40 - Design of Brakes - II](#)

Lecture 1 - Instructional Objectives - I (Manufacturing Process II)

Lecture 2 - Instructional Objectives - II

Lecture 3 - On Tool Geometry

Lecture 4 - Interrelations Among The Tool Angles

Lecture 5 - Mechanism of Chip Formation

Lecture 6 - Orthogonal and Oblique Cutting

Lecture 7 - Use of Chip Breaker in Machining

Lecture 8 - Machining Forces

Lecture 9 - Analytical and Experimental

Lecture 10 - Dynamometers for Measuring Cutting Forces

Lecture 11 - CTCEAC

Lecture 12 - CCTCFA

Lecture 13 - Concept of Machinability and its Improvement

Lecture 14 - Tool Life

Lecture 15 - Conventional Cutting Tool Maths

Lecture 16 - Advanced Tool Materials

Lecture 17 - Kinematics System of Centre Lathe

Lecture 18 - General Purpose Machine Tool Drills

Lecture 19 - Kinematic Systems and Operations

Lecture 20 - Configuration and Kinematic System

Lecture 21 - Mounting of jobs and Cutting Tools in Machine

Lecture 22 - Mounting of jobs and Cutting Tools in Machine

Lecture 23 - Construction, Operation and Tool Layout

Lecture 24 - Use of Attachments In Machine Tools

Lecture 25 - Forces Developing and Acting In Machine Tools

Lecture 26 - Estimation of Machining Time

Lecture 27 - Broaching - Principle Systems and Applications

Lecture 28 - Grinding Principle and Application

Lecture 29 - Abrasive Processes

Lecture 30 - Abrasive Processes (Grinding)

Lecture 31 - Super finishing Processes

[Lecture 32 - Production of Screw Threads](#)

[Lecture 33 - Gear Manufacturing](#)

[Lecture 34 - Jigs and Fixtures For Machine Shops](#)

[Lecture 35 - Design and Applications of Jigs and Fixtures](#)

[Lecture 36 - Non Traditional Manufacturing](#)

[Lecture 37 - Ultrasonic Machining](#)

[Lecture 38 - Water Jet Machining and Abrasive Water Jet](#)

[Lecture 39 - Electro - Chemical Machining](#)

[Lecture 40 - Electro - Discharge Machining](#)

[Lecture 41 - EBM and LBM](#)



**NPTEL : Refrigeration and Air Conditioning (Mechanical Engineering)**

**Co-ordinators : Prof. M. Ramgopal, Prof. R.C. Arora**

- Lecture 1 - History of Refrigeration
- Lecture 2 - Refrigerant Compressors & Development
- Lecture 3 - Applications of RTAC
- Lecture 4 - Review of Fundamentals Thermodynamics - I
- Lecture 5 - Review of Fundamentals
- Lecture 6 - Fundamentals of Fluid Flow
- Lecture 7 - Fundamentals of Heat Transfer
- Lecture 8 - Methods of Producing low Temperatures
- Lecture 9 - Air Cycle Refrigeration Systems
- Lecture 10 - Vapour Compression Refrigeration Systems
- Lecture 11 - Vapour Compression Refrigeration Systems (Continued...)
- Lecture 12 - Vapour Compression Refrigeration Systems (Continued...)
- Lecture 13 - Vapour Compression Refrigeration Systems (Continued...)
- Lecture 14 - Vapour Absorption Refrigeration Systems
- Lecture 15 - Vapour Absorption Refrigeration System
- Lecture 16 - Vapour Absorption Refrigeration Systems (Continued...)
- Lecture 17 - Vapour Absorption Refrigeration Systems (Continued...)
- Lecture 18 - Worked Out Examples - I
- Lecture 19 - Worked Out Examples - II
- Lecture 20 - Refrigeration System Components : Compressor
- Lecture 21 - Refrigeration System Components : Compressor (Continued...)
- Lecture 22 - Refrigeration System Components : Compressor (Continued...)
- Lecture 23 - Refrigeration System Components : Compressor (Continued...)
- Lecture 24 - Refrigeration System Components : Compressor (Continued...)
- Lecture 25 - Refrigeration System Components : Compressor (Continued...)
- Lecture 26 - Refrigeration System Components : Condensers
- Lecture 27 - Refrigeration System Components : Condensers (Continued...)
- Lecture 28 - Refrigeration System Components : Evaporators
- Lecture 29 - Refrigeration System Components : Evaporators
- Lecture 30 - Refrigeration System Components : Expansion Devices
- Lecture 31 - Refrigeration System Components : Expansion Devices

- [Lecture 32 - Analysis of Complete Vapour Compression System](#)
- [Lecture 33 - Refrigerants](#)
- [Lecture 34 - Psychrometry](#)
- [Lecture 35 - Psychrometric Processes](#)
- [Lecture 36 - Inside Design Condition Thermal Comfort](#)
- [Lecture 37 - Psychrometry of Air Conditioning Systems](#)
- [Lecture 38 - Air Conditioning Systems](#)
- [Lecture 39 - Cooling and Heating Load Calculation : Solar Radiation](#)
- [Lecture 40 - Cooling and Heating Load Calculations](#)
- [Lecture 41 - Cooling and Heating Load Calculations \(Continued...\)](#)
- [Lecture 42 - Cooling and Heating Load Calculations \(Continued...\)](#)
- [Lecture 43 - Selection of Air Conditioning Systems](#)
- [Lecture 44 - Transmission and Distribution of Air](#)
- [Lecture 45 - Transmission and Distribution of Air \(Continued..\)](#)
- [Lecture 46 - Space Air Distribution](#)

**NPTEL : Fluid Mechanics (Mechanical Engineering)**

**Co-ordinators : Prof. S.K. Som**

- Lecture 1 - Introduction and Fundamental Concepts - Part I
- Lecture 2 - Introduction and Fundamental Concepts - Part II
- Lecture 3 - Introduction and Fundamental Concepts - Part III
- Lecture 4 - Fluid Statics - Part I
- Lecture 5 - Fluid Statics - Part II
- Lecture 6 - Fluid Statics - Part III
- Lecture 7 - Fluid Statics - Part IV
- Lecture 8 - Fluid Statics - Part V
- Lecture 9 - Fluid Statics - Part VI
- Lecture 10 - Kinematics of Fluid - Part I
- Lecture 11 - Kinematics of Fluid - Part II
- Lecture 12 - Kinematics of Fluid - Part III
- Lecture 13 - Conservation Equations in Fluid Flow - Part I
- Lecture 14 - Conservation Equations in Fluid Flow - Part II
- Lecture 15 - Conservation Equations in Fluid Flow - Part III
- Lecture 16 - Conservation Equations in Fluid Flow - Part IV
- Lecture 17 - Conservation Equations in Fluid Flow - Part V
- Lecture 18 - Conservation Equations in Fluid Flow - Part VI
- Lecture 19 - Conservation Equations in Fluid Flow - Part VII
- Lecture 20 - Conservation Equations in Fluid Flow - Part VIII
- Lecture 21 - Conservation Equations in Fluid Flow - Part IX
- Lecture 22 - Fluid Flow Applications - Part I
- Lecture 23 - Fluid Flow Applications - Part II
- Lecture 24 - Fluid Flow Applications - Part III
- Lecture 25 - Fluid Flow Applications - Part IV
- Lecture 26 - Fluid Flow Applications - Part V
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- Lecture 28 - Fluid Flow Applications - Part VII
- Lecture 29 - Incompressible Viscous Flows - Part I
- Lecture 30 - Incompressible Viscous Flows - Part II
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[Lecture 46 - Introduction to Laminar Boundary Layer - Part I](#)

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- Lecture 2 - Energy Transfer in Fluid Machines Part - I
- Lecture 3 - Energy Transfer in Fluid Machines Part - II
- Lecture 4 - Energy Transfer - impulse and Reaction Machines, efficiencies of Fluid Machines
- Lecture 5 - Principles of Similarity in Fluid Machines
- Lecture 6 - Concept of specific speed and introduction to Impulse Hydraulic Turbine
- Lecture 7 - Analysis of force on the Bucket of Pelton wheel and Power Generation
- Lecture 8 - Specific speed, Governing and Limitation of a Pelton Turbine
- Lecture 9 - Introduction to reaction Type of Hydraulic Turbine - A Francis Turbine
- Lecture 10 - Analysis of Force on Francis Runner and Power Generation
- Lecture 11 - Axial Flow Machine and Draft Tube
- Lecture 12 - Governing of Reaction Turbine
- Lecture 13 - Introduction to Rotodynamic Pumps
- Lecture 14 - Flow and Energy Transfer in a Centrifugal Pump
- Lecture 15 - Characteristics of a Centrifugal Pump
- Lecture 16 - Matching of Pump and System Characteristics
- Lecture 17 - Diffuser and Cavitation
- Lecture 18 - Axial Flow Pump
- Lecture 19 - Reciprocating Pump - Part I
- Lecture 20 - Reciprocating Pump - Part II
- Lecture 21 - Centrifugal Compressor - Part I
- Lecture 22 - Centrifugal Compressor - Part II
- Lecture 23 - Centrifugal Compressor - Part III
- Lecture 24 - Axial Flow Compressor - Part I
- Lecture 25 - Axial Flow Compressor - Part II
- Lecture 26 - Introduction to Compressible Flow - Part I
- Lecture 27 - Introduction to Compressible Flow - Part II
- Lecture 28 - Thermodynamic Relations and Speed of Sound
- Lecture 29 - Disturbance propagation, Stagnation and Sonic Properties
- Lecture 30 - Effects of Area Variation on Properties in an Isentropic Flow
- Lecture 31 - Choking in a Converging Nozzle

[Lecture 32 - Isentropic Flow through Convergent - Divergent Duct](#)

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[Lecture 36 - Normal Shock - Part IV](#)

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[Lecture 4 - Viscosity](#)

[Lecture 5 - Viscosity \(Continued...\)](#)

[Lecture 6 - Viscosity \(Continued...\) and Surface Tension](#)

[Lecture 7 - Surface Tension \(Continued...\) and Fluid Statics](#)

[Lecture 8 - Fluid Statics \(Continued...\)](#)

[Lecture 9 - Fluid Statics \(Continued...\)](#)

[Lecture 10 - Fluid Statics \(Continued...\) and Fluid Under Rigid Body Motion](#)

[Lecture 11 - Fluid Kinematics](#)

[Lecture 12 - Fluid Kinematics \(Continued...\)](#)

[Lecture 13 - Fluid Kinematics \(Continued...\)](#)

[Lecture 14 - Fluid Kinematics \(Continued...\)](#)

[Lecture 15 - Fluid Kinematics \(Continued...\)](#)

[Lecture 16 - Dynamics of Inviscid Flows](#)

[Lecture 17 - Dynamics of Inviscid Flows \(Continued...\)](#)

[Lecture 18 - Dynamics of Inviscid Flows \(Continued...\)](#)

[Lecture 19 - Dynamics of Inviscid Flows \(Continued...\)](#)

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[Lecture 21 - Integral Forms of Control Volume Conservation Equations \(Reynolds Transport Theorem\)](#)

[Lecture 22 - Integral Forms of Control Volume Conservation Equations \(Reynolds Transport Theorem\) \(Continued...\)](#)

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[Lecture 25 - Integral Forms of Control Volume Conservation Equations \(Reynolds Transport Theorem\) \(Continued...\)](#)

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[Lecture 27 - Integral Forms of Control Volume Conservation Equations \(Reynolds Transport Theorem\) \(Continued...\)](#)

[Lecture 28 - Dynamics of Viscous Flows : Navier Stokes Equation](#)

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[Lecture 30 - Some Exact Solutions of Navier Stokes Equation](#)

[Lecture 31 - Some Exact Solutions of Navier Stokes Equation \(Continued...\)](#)

- [Lecture 32 - Some Exact Solutions of Navier Stokes Equation \(Continued...\)](#)
- [Lecture 33 - Introduction to Turbulence](#)
- [Lecture 34 - Introduction to Turbulence \(Continued...\)](#)
- [Lecture 35 - Introduction to Turbulence \(Continued...\)](#)
- [Lecture 36 - Introduction to Turbulence \(Continued...\)](#)
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- [Lecture 39 - Boundary Layer Theory \(Continued...\)](#)
- [Lecture 40 - Boundary Layer Theory \(Continued...\) and Flow Past Immersed Bodies](#)
- [Lecture 41 - Flow past Immersed Bodies \(Continued...\)](#)
- [Lecture 42 - Potential Flow Past Immersed Bodies](#)
- [Lecture 43 - Potential Flow \(Continued...\) and Flow Past Immersed Bodies of Special Shapes](#)
- [Lecture 44 - Flow Past Immersed Bodies \(Continued...\) and Sports Ball Aerodynamics](#)
- [Lecture 45 - Pipe Flow](#)
- [Lecture 46 - Pipe Flow \(Continued...\)](#)
- [Lecture 47 - Pipe Flow \(Continued...\)](#)
- [Lecture 48 - Principles of Similarity and Dimensional Analysis](#)
- [Lecture 49 - Introduction to Fluid Machines](#)
- [Lecture 50 - Introduction to Fluid Machines \(Continued...\)](#)
- [Lecture 51 - Introduction to Fluid Machines \(Continued...\)](#)
- [Lecture 52 - Introduction to Fluid Machines \(Continued...\)](#)
- [Lecture 53 - Introduction to Fluid Machines \(Continued...\)](#)
- [Lecture 54 - Compressible Flows](#)
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- [Lecture 57 - Compressible Flows \(Continued...\)](#)
- [Lecture 58 - Compressible Flows \(Continued...\)](#)



**NPTEL : Micro fluidics (Mechanical Engineering)**

**Co-ordinators : Prof. S. Chakraborty**

Lecture 1 - Introduction to Microfluidics

Lecture 2 - Microfluidics: Some Application Examples

Lecture 3 - Microfluidics: Some More Application Examples

Lecture 4 - Equations of Conservation

Lecture 5 - Navier Stokes Equation

Lecture 6 - Navier Stokes Equation (Continued...)

Lecture 7 - Energy Equation

Lecture 8 - Energy Equation (Continued...) and Species Conservation Equation

Lecture 9 - Pressure-driven Microflows

Lecture 10 - Pressure-driven Microflows (Continued...)

Lecture 11 - Pressure-driven Microflows (Continued...)

Lecture 12 - Pressure-driven Microflows (Continued...)

Lecture 13 - Pressure -driven Microflows (Continued...)

Lecture 14 - Some Examples of Unsteady Flows

Lecture 15 - Some Examples of Unsteady Flows (Continued...)

Lecture 16 - Some Examples of Unsteady Flows (Continued...)

Lecture 17 - Stokes Drag on a Sphere

Lecture 18 - Stokes Drag on a Sphere (Continued...) and Introduction to Lubrication Theory

Lecture 19 - Lubrication Theory (Continued...)

Lecture 20 - Lubrication Theory (Continued...)

Lecture 21 - Boundary Condition in Fluid Mechanics: Slip or No-slip?

Lecture 22 - Boundary Condition in Fluid Mechanics: Slip or No-slip? (Continued...)

Lecture 23 - Surface Tension Driven Flows

Lecture 24 - Surface Tension Driven Flows (Continued...)

Lecture 25 - Surface Tension Driven Flows (Continued...)

Lecture 26 - Surface Tension Driven Flows (Continued...)

Lecture 27 - Surface Tension Driven Flows (Continued...) and Modulating Surface Tension

Lecture 28 - Modulating Surface Tension (Continued...)

Lecture 29 - Thin Film Dynamics

Lecture 30 - Thin Film Dynamics (Continued...)

Lecture 31 - Thin Film Dynamics (Continued...)

[Lecture 32 - Thin Film Dynamics \(Continued...\)](#)

[Lecture 33 - Lab on a CD](#)

[Lecture 34 - Lab on a CD \(Continued...\)](#)

[Lecture 35 - Introduction to Microfabrication](#)

[Lecture 36 - Electrokinetics](#)

[Lecture 37 - Electrokinetics \(Continued...\)](#)

[Lecture 38 - Electrokinetics \(Continued...\)](#)

[Lecture 39 - Electrokinetics \(Continued...\)](#)

[Lecture 40 - Electrokinetics \(Continued...\)](#)

[Lecture 41 - Electrokinetics \(Continued...\)](#)

[Lecture 42 - Dispersion](#)

[Lecture 43 - Introduction to Nanofluidics](#)

[Lecture 44 - Introduction to Nanofluidics \(Continued...\) and Molecular Dynamics Simulations](#)

[Lecture 45 - Introduction to Molecular Dynamics Simulations \(Continued...\)](#)

[Lecture 46 - Biomicrofluidics](#)

[Lecture 47 - Biomicrofluidics \(Continued...\)](#)

[Lecture 48 - Nanofluidic Energy Conversion](#)

Lecture 1 - Introduction and Fundamental Concepts - I

Lecture 2 - Introduction and Fundamental Concepts - II

Lecture 3 - Heat Conduction Equation

Lecture 4 - Heat Conduction Equation and Different Types of Boundary Conditions

Lecture 5 - 1D Steady State Heat Conduction In Plane Wall Without Generation of Thermal Energy

Lecture 6 - 1D Steady State Heat Conduction In Plane Wall With Generation of Thermal Energy

Lecture 7 - Problems on 1D Steady State Heat Conduction In Plane Wall

Lecture 8 - 1D Steady State Heat Conduction In Cylindrical Geometry

Lecture 9 - 1D Steady State Heat Conduction In Cylindrical Geometry (Continued...)

Lecture 10 - 1D Steady State Heat Conduction in Spherical Geometry

Lecture 11 - Heat Transfer from Extended Surfaces (Fins)

Lecture 12 - Heat Transfer from Extended Surfaces (Continued...)

Lecture 13 - Two-dimensional Steady State Heat Conduction

Lecture 14 - Unsteady State Heat Conduction

Lecture 15 - Unsteady State Heat Conduction (Continued...)

Lecture 16 - One Dimensional Unsteady State Heat Conduction - I

Lecture 17 - One Dimensional Unsteady State Heat Conduction - II

Lecture 18 - Introduction to Convection

Lecture 19 - Convection - I

Lecture 20 - Review of Fluid Mechanics - I

Lecture 21 - Review of Fluid Mechanics - II

Lecture 22 - Review of Fluid Mechanics - III

Lecture 23 - Review of Fluid Mechanics - IV

Lecture 24 - Review of Fluid Mechanics - V

Lecture 25 - Review of Fluid Mechanics - VI

Lecture 26 - Review of Fluid Mechanics - VIII

Lecture 27 - Energy Equation - I

Lecture 28 - Energy Equation - II and Thermal Boundary Layer - I

Lecture 29 - Thermal Boundary Layer - II

Lecture 30 - Integral Method for Thermal BL Analysis

Lecture 31 - Internal Forced Convection - I

[Lecture 32 - Internal Forced Convection - II](#)

[Lecture 33 - Internal Forced Convection - III](#)

[Lecture 34 - Internal Forced Convection - IV](#)

[Lecture 35 - Free Convection - I \(Natural Convection\)](#)

[Lecture 36 - Free Convection - II \(Natural Convection\)](#)

[Lecture 37 - Boiling and Condensation - I](#)

[Lecture 38 - Boiling and Condensation - II](#)

[Lecture 39 - Heat Exchanger - I](#)

[Lecture 40 - Heat Exchanger - II](#)

[Lecture 41 - Heat Exchanger - II \(Continued...\)](#)

- Lecture 1 - Transverse Vibrations of Strings - I
- Lecture 2 - Transverse Vibrations of Strings - II
- Lecture 3 - Axial and Torsional Vibrations of Bars
- Lecture 4 - Variational Formulation - I
- Lecture 5 - Variational Formulation - II
- Lecture 6 - Modal Analysis - I
- Lecture 7 - Modal Analysis - II
- Lecture 8 - Properties of the Eigenvalue Problem
- Lecture 9 - Modal Analysis: Approximate Methods - I
- Lecture 10 - Modal Analysis: Approximate Methods - II
- Lecture 11 - The Initial Value Problem
- Lecture 12 - Forced Vibration Analysis - I
- Lecture 13 - Forced Vibration Analysis - II
- Lecture 14 - Forced Vibration Analysis - III
- Lecture 15 - Damping in Structures - I
- Lecture 16 - Damping in Structures - II
- Lecture 17 - Beam Models - I
- Lecture 18 - Beam Models - II
- Lecture 19 - Modal Analysis of Beams
- Lecture 20 - Application of Modal Solution
- Lecture 21 - Approximate Methods
- Lecture 22 - Topics in Beam Vibrations - I
- Lecture 23 - Topics in Beam Vibrations - II
- Lecture 24 - Dynamics of Curved Beams
- Lecture 25 - Vibrations of Rings and Arches - I
- Lecture 26 - Vibrations of Rings and Arches - II
- Lecture 27 - Dynamics of Membranes
- Lecture 28 - Vibrations of Rectangular Membranes
- Lecture 29 - Vibrations of Circular Membranes - I
- Lecture 30 - Vibrations of Circular Membranes - II
- Lecture 31 - Dynamics of Plates

[Lecture 32 - Vibrations of Rectangular Plates](#)

[Lecture 33 - Vibrations of Circular Plates](#)

[Lecture 34 - Special Problems in Plate Vibrations - I](#)

[Lecture 35 - Special Problems in Plate Vibrations - II](#)

Lecture 1 - Definition of Fluid Machines and Energy Transfer in Fluid Machines - Part I

Lecture 2 - Energy Transfer in Fluid Machines - Part II

Lecture 3 - Impulse and Reaction Machines: Introductory Concepts

Lecture 4 - Principles of Similarity in Fluid Machine

Lecture 5 - Concept of Specific Speed

Lecture 6 - Basic Principles, Analysis of Force and Power Generation - Part I

Lecture 7 - Basic Principles, Analysis of Force and Power Generation - Part II

Lecture 8 - Specific Speed Governing and Limitations of Impulse Turbine

Lecture 9 - Tutorial - I

Lecture 10 - Tutorial - II

Lecture 11 - Introduction and Analysis of Force on Francis Turbine (Radial Flow) - Part I

Lecture 12 - Analysis of Force (Part-II) and Power Generation

Lecture 13 - Draft Tube

Lecture 14 - Tutorial - III

Lecture 15 - Tutorial - IV

Lecture 16 - Axial Flow Turbine

Lecture 17 - Governing of Reaction Turbine

Lecture 18 - Introduction to Rotodynamic Pumps

Lecture 19 - Flow and Energy Transfer to Centrifugal Pumps

Lecture 20 - Tutorial - V

Lecture 21 - Characteristics of a Centrifugal Pump

Lecture 22 - Matching of Pump and System Characteristics

Lecture 23 - Diffuser and Cavitation

Lecture 24 - Tutorial - VI

Lecture 25 - Tutorial - VIII

Lecture 26 - Axial Flow Pump

Lecture 27 - Reciprocating Pump - Part I

Lecture 28 - Reciprocating Pump - Part II

Lecture 29 - Tutorial - VIII

Lecture 30 - Basic Principles and Energy Transfer in Centrifugal Compressor - Part I

Lecture 31 - Basic Principles and Energy Transfer in Centrifugal Compressor - Part II

[Lecture 32 - Basic Principles and Energy Transfer in Centrifugal Compressor - Part III](#)

[Lecture 33 - Basic Principles and Energy Transfer in Centrifugal Compressor - Part IV and Losses in Centrifugal Compressors](#)

[Lecture 34 - Performance Characteristics of Centrifugal Compressors - Part I](#)

[Lecture 35 - Performance Characteristics of Centrifugal Compressors - Part II](#)

[Lecture 36 - Basic Principles and Energy Transfer in Axial Flow Compressor - Part I](#)

[Lecture 37 - Basic Principles and Energy Transfer in Axial Flow Compressor - Part II](#)

[Lecture 38 - Fans and Blowers - Part I](#)

[Lecture 39 - Fans and Blowers - Part II](#)



Lecture 1 - Introduction to computer control – role of computers in automation

Lecture 2 - Introduction (Continued...) - binary logic and logic gates

Lecture 3 - Classification of Computer numerical control (CNC) – Point to point and continuous control

Lecture 4 - Classification (Continued...) - Closed loop and open loop control

Lecture 5 - Tutorial involving simple calculations on different aspects of CNC controls

Lecture 6 - Questions, MCQ Discussions on Motors, Encoders, Decoders and Programming Practice

Lecture 7 - Stepper motors, Permanent magnet DC motors

Lecture 8 - Binary circuits and decoders

Lecture 9 - Tachogenerator, printed circuit motors, Encoders

Lecture 10 - Programming Practice - I

Lecture 11 - Programming Practice - II

Lecture 12 - Computer Aided Offline Programming

Lecture 13 - Interpolators - Linear

Lecture 14 - Interpolators - Curvilinear

Lecture 15 - Questions on Programming and Interpolation

Lecture 16 - 3-D Machining - Basic Concepts

Lecture 17 - Curved Surface Geometry

Lecture 18 - Cutter Path Generation for Curved Surfaces

Lecture 19 - Cutter Path Generation (Concluding Part) and Current Status - CNC Machining and Related Processes

Lecture 20 - Questions and Discussions on Curved Surface Machining

**NPTEL : NOC:Non Traditional Abrasive Machining Processes - Ultrasonic, Abrasive Jet and Abrasive Water Jet Machining  
(Mechanical Engineering)**

**Co-ordinators : Prof. Asimava Roy Choudhury**

Lecture 1 - Non-traditional abrasive machining : Ultrasonic, Abrasive jet and abrasive water jet machining

Lecture 2 - Ultrasonic Machining

Lecture 3 - Ultrasonic Machining (Continued...)

Lecture 4 - Ultrasonic Machining - Free Impacts and Problem Solving

Lecture 5 - Ultrasonic Machining - Problems and MCQs

Lecture 6 - USM - Horn Design

Lecture 7 - USM - Horn Design (Continued...)

Lecture 8 - Ultrasonic Machining - Feed Mechanism, Head design and other aspects

Lecture 9 - Ultrasonic Machining - Effects of Various Inputs on the Output

Lecture 10 - Ultrasonic Machining - Numerical and MCQs

Lecture 11 - A JM (Abrasive jet machining)

Lecture 12

Lecture 13 - A JM - Numerical problems

Lecture 14 - A JM - Process Parameters and Response Characteristics take - home assignment discussing

Lecture 15 - A JM - MCQs

Lecture 16

Lecture 17 - AWJM - Equipment

Lecture 18 - AWJM - Numerical Problems

Lecture 19 - AWJM - Application Equipment Details

Lecture 20 - AWJM - MCQs

- Lecture 1 - Lagrangian and Eulerian Approach, Types of fluid flow
- Lecture 2 - Streamlines, Streakline and Pathline
- Lecture 3 - Acceleration of fluid flow
- Lecture 4 - Deformation and Conservation of mass of fluid a element
- Lecture 5 - Angular deformation of a fluid element, vorticity and streamfunction and velocity potential
- Lecture 6 - Euler's equation
- Lecture 7 - Bernoulli's Equation - Part I
- Lecture 8 - Bernoulli's Equation - Part II
- Lecture 9 - Reynolds Transport Theorem (RTT)
- Lecture 10 - Application of Conservation of Mass
- Lecture 11 - Application of RTT: Conservation of Linear Momentum
- Lecture 12 - Application of RTT in Accelerating Reference Frames
- Lecture 13 - Navier's Equation of Motion
- Lecture 14 - Derivation of Navier-Stokes Equation
- Lecture 15 - Derivation of Navier-Stokes Equation (Continued...)
- Lecture 16 - Derivation of Navier-Stokes Equation (Continued...)
- Lecture 17 - Fully developed flow between two parallel plates
- Lecture 18 - Force on a surface immersed in fluid - Part III, Stability of solid bodies in fluid - Part I
- Lecture 19 - Couette flow
- Lecture 20 - Flow with interfaces
- Lecture 21 - Thin film flow on an inclined plane and Hagen-Poiseuille flow
- Lecture 22 - Hagen-Poiseuille flow (Continued...)
- Lecture 23 - Flow between two rotating cylinders
- Lecture 24 - Stokes 1st problem
- Lecture 25 - Stokes 2nd problem
- Lecture 26 - Introduction to turbulence: basic concepts
- Lecture 27 - Eddies
- Lecture 28 - Eddies (Continued...) and Vortex shredding
- Lecture 29 - Statistical description of turbulent flows
- Lecture 30 - Reynolds stress
- Lecture 31 - Reynolds averaged Navier Stokes equation (RANS)

- Lecture 32 - Bernoulli's equation - Part I
- Lecture 33 - Bernoulli's equation - Part II
- Lecture 34 - Bernoulli's equation - Part III
- Lecture 35 - Euler's equation in streamline coordinates
- Lecture 36 - Flow over a flat plate: Blasius equation
- Lecture 37 - Momentum integral method for boundary layer analysis
- Lecture 38 - Approximate solution of the momentum integral equation
- Lecture 39 - Displacement and Momentum thickness
- Lecture 40 - Illustrative examples
- Lecture 41 - Boundary layer separation
- Lecture 42 - Resultant force on a body immersed in a fluid under motion
- Lecture 43 - Potential flow
- Lecture 44 - Examples of Potential flow
- Lecture 45 - Some more examples of Potential flows, Lift and Drag force
- Lecture 46 - Applications of lift and drag force
- Lecture 47 - Some examples of flow past immersed bodies
- Lecture 48 - Sports Ball aerodynamics
- Lecture 49 - Introduction to compressible flows
- Lecture 50 - Significance of Mach number
- Lecture 51 - Navier-Stokes equation - Part I
- Lecture 52 - Navier-Stokes equation - Part II
- Lecture 53 - Navier-Stokes equation - Part III
- Lecture 54 - Navier-Stokes equation - Part IV
- Lecture 55 - Pipe Flow - Part I
- Lecture 56 - Pipe Flow - Part II
- Lecture 57 - Pipe Flow - Part III
- Lecture 58 - Pipe Flow - Part IV
- Lecture 59 - Principle of Similarity and Dynamical Analysis - Part I
- Lecture 60 - Principle of Similarity and Dynamical Analysis - Part II

Lecture 1 - Introduction

Lecture 2 - Simple Gear Calculations

Lecture 3 - Gear Geometry

Lecture 4 - Helical Gear Problems

Lecture 5 - Numerical Problem MCQ

Lecture 6 - Numerical Problem Milling of Helical Gears

Lecture 7 - Simple and Compound Indexing

Lecture 8 - Differential Indexing

Lecture 9 - Helical Gear Cutting on Milling Machine

Lecture 10 - Numerical Problems on Gear Milling

Lecture 11 - Gear Shaping - I

Lecture 12 - Gear Shaping - II

Lecture 13 - Gear Shaping - III

Lecture 14 - Gear Shaping - IV

Lecture 15 - Gear Hobbing - I

Lecture 16 - Gear Hobbing - II

Lecture 17 - Gear Hobbing - III

Lecture 18 - Gear Hobbing - IV

Lecture 19 - Gear Hobbing - V

Lecture 20 - Gear Hobbing - VI

- Lecture 1 - Introduction, Definition of System, Properties and State of a System
- Lecture 2 - Properties of pure substances
- Lecture 3 - Properties of pure substances (Continued...)
- Lecture 4 - Heat and Work
- Lecture 5 - Tutorial 1: Properties of pure substances, heat and work
- Lecture 6 - Zeroth Law of Thermodynamics
- Lecture 7 - First law of thermodynamics for closed systems - Part I
- Lecture 8 - First law of thermodynamics for closed systems - Part II, some examples
- Lecture 9 - Tutorial 2: First law of thermodynamics for closed systems
- Lecture 10 - First law of thermodynamics for open systems
- Lecture 11 - Tutorial 3: First law of thermodynamics for open systems
- Lecture 12 - Second law and its corollaries - Part I
- Lecture 13 - Second law and its corollaries - Part II
- Lecture 14 - Second law and its corollaries - Part III
- Lecture 15 - Definition of entropy and entropy change in closed systems
- Lecture 16 - Entropy change in closed systems (Continued...)
- Lecture 17 - Tutorial 4: Entropy
- Lecture 18 - Entropy and its transport
- Lecture 19 - Tutorial 5: Entropy and its transport
- Lecture 20 - Introduction to Third Law
- Lecture 21 - Review of learning concepts

Lecture 1 - Introduction to waste heat recovery

Lecture 2 - Introduction to waste heat recovery (Continued...)

Lecture 3 - Introduction to waste heat recovery (Continued...)

Lecture 4 - Introduction to waste heat recovery (Continued...)

Lecture 5 - Thermodynamic principles of waste heat recovery

Lecture 6 - Thermodynamic principles of waste heat recovery (Continued...)

Lecture 7 - Thermodynamic principles of waste heat recovery (Continued...)

Lecture 8 - Thermodynamic principles of waste heat recovery (Continued...)

Lecture 9 - Reversible Cycles

Lecture 10 - Reversible Cycles (Continued...)

Lecture 11 - Entropy

Lecture 12 - Entropy (Continued...)

Lecture 13 - Entropy (Continued...), Exergy

Lecture 14 - Exergy, Second Law efficiency

Lecture 15 - Second Law efficiency (Continued...)

Lecture 16 - Recapitulation of common power cycles

Lecture 17 - Recapitulation of common power cycles (Continued...)

Lecture 18 - Recapitulation of common power cycles (Continued...)

Lecture 19 - Recapitulation of common power cycles (Continued...)

Lecture 20 - Recapitulation of common power cycles (Continued...)

Lecture 21 - Recapitulation of common power cycles (Continued...)

Lecture 22 - Gas Turbine cycle

Lecture 23 - Combined cycle

Lecture 24 - Combined cycle (Continued...)

Lecture 25 - Combined Cycle (Continued...)

Lecture 26 - Heat recovery steam generator

Lecture 27 - Thermodynamic cycles for low temperature application

Lecture 28 - Thermodynamic cycles for low temperature application (Continued...), Cogeneration

Lecture 29 - Heat Exchanger

Lecture 30 - Heat Exchanger (Continued...)

Lecture 31 - Heat Exchanger (Continued...)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37 - Heat Pipe - Part I](#)

[Lecture 38 - Heat Pipe - Part II](#)

[Lecture 39 - Heat Pipe - Part III](#)

[Lecture 40 - Direct Conversion - Introduction to TEG](#)

[Lecture 41 - Thermoelectric Generators - Functioning and Applications](#)

[Lecture 42 - TEG - performance analysis](#)

[Lecture 43 - TEG - performance optimization](#)

[Lecture 44 - Direct Conversion - Magneto Hydro dynamics \(MHD\)](#)

[Lecture 45 - Direct Conversion - Thermo-Ionic generation](#)

[Lecture 46 - Direct Conversion - Thermo Photo Voltaic generation \(TPV\)](#)

[Lecture 47 - Heat Pumps - I](#)

[Lecture 48 - Heat Pumps - II](#)

[Lecture 49 - Heat Pumps - III](#)

[Lecture 50 - Waste Heat Recovery from Incinerator Plants](#)

[Lecture 51 - Energy Storage Systems - I](#)

[Lecture 52 - Energy Storage Systems - II](#)

[Lecture 53 - Energy Storage Systems - III](#)

[Lecture 54 - Energy Storage Systems - IV](#)

[Lecture 55 - Energy Storage Systems - V](#)

[Lecture 56 - Energy Storage Systems - VI](#)

[Lecture 57](#)

[Lecture 58](#)

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[Lecture 62](#)

[Lecture 63](#)

[Lecture 64](#)



[Lecture 65](#)

[Lecture 66](#)

[Lecture 67](#)

[Lecture 68 - Corrigendum](#)

[Lecture 1 - Introduction](#)

[Lecture 2 - Introduction \(Continued...\)](#)

[Lecture 3 - Introduction \(Continued...\)](#)

[Lecture 4 - Introduction \(Continued...\)](#)

[Lecture 5 - Introduction \(Continued...\)](#)

[Lecture 6 - Introduction \(Continued...\)](#)

[Lecture 7 - Scaling Laws](#)

[Lecture 8 - Scaling laws \(Continued...\)](#)

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# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

**NPTEL : NOC:Elements of Metal Cutting, Machine tools, Gear Cutting and CNC Machining (Mechanical Engineering)**

**Co-ordinators : Prof. Asimava Roy Choudhury**

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**Co-ordinators : Prof. K. Ramamurthi**

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Lecture 17 - Performance Prediction Analysis

Lecture 18 - Dissociation of Products of Combustion

Lecture 19 - Shifting Equilibrium and Frozen Flow in Nozzles

Lecture 20 - Factors Influencing Choice of Chemical Propellants

Lecture 21 - Low Energy Liquid Propellants and Hybrid Propellants

Lecture 22 - Introduction to Solid Propellant Rockets

Lecture 23 - Burn Rate of Solid Propellants and Equilibrium Pressure in Solid Propellant Rockets

Lecture 24 - Design Aspects of Solid Propellant Rockets

Lecture 25 - Burning Surface Area of Solid Propellant Grains

Lecture 26 - Ignition of Solid Propellant Rockets

Lecture 27 - Review of Solid Propellant Rockets

Lecture 28 - Feed Systems for Liquid Propellant Rockets

Lecture 29 - Feed System Cycles for Pump Fed Liquid Propellant Rockets

Lecture 30 - Analysis of Gas Generator and Staged Combustion Cycles and Introduction to Injectors

Lecture 31 - Injectors, Cooling of Chamber and Mixture Ratio Distribution

[Lecture 32 - Efficiencies due to Mixture Ratio Distribution and Incomplete Vaporization](#)

[Lecture 33 - Pumps and Turbines; Propellant Feed System at Zero  \$\alpha\$  Conditions](#)

[Lecture 34 - Review of Liquid Bi-propellant Rockets and Introduction to Mono-propellant Rockets](#)

[Lecture 35 - Introduction to Hybrid Rockets and a Simple Illustration of Combustion Instability in Liquid Propellant Rockets](#)

[Lecture 36 - Combustion Instability in Solid Propellant and Liquid Propellant Rockets - Bulk and Wave Modes](#)

[Lecture 37 - Wave modes of Oscillation](#)

[Lecture 38 - Mechanisms Causing Instabilities and Strategies for Avoiding Combustion Instability](#)

[Lecture 39 - Electric and Magnetic Fields and the Electrostatic Thruster](#)

[Lecture 40 - Electrical Thrusters](#)

[Lecture 41 - Advances in Rocket Propulsion](#)

[Lecture 1 - Advanced Finite Elements Analysis](#)

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[Lecture 25 - Advanced Finite Elements Analysis](#)

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[Lecture 27 - Advanced Finite Elements Analysis](#)

[Lecture 28 - Advanced Finite Elements Analysis](#)

[Lecture 29 - Advanced Finite Elements Analysis](#)

[Lecture 30 - Advanced Finite Elements Analysis](#)

Lecture 1 - Introduction and Linear Programming

Lecture 2 - Revised Simplex Algorithm

Lecture 3 - Simplex Method for Bounded Variables

Lecture 4 - One Dimensional Cutting Stock Problem

Lecture 5 - One Dimensional Cutting Stock Problem (Continued.)

Lecture 6 - Dantzig-Wolfe Decomposition Algorithm

Lecture 7 - Dantzig-Wolfe Decomposition Algorithm Primal-Dual Algorithm

Lecture 8 - Primal-Dual Algorithm

Lecture 9 - Goal Programming-Formulations

Lecture 10 - Goal Programming Solutions Complexity of Simplex Algorithm

Lecture 11 - Complexity of Simplex Algorithm (Continued.) Integer Programming

Lecture 12 - Integer Programming-Formulations

Lecture 13 - Solving Zero-One Problems

Lecture 14 - Solving Zero-One Problems (Continued.)

Lecture 15 - Branch And Bond Algorithm For Integer Programming

Lecture 16 - Cutting Plane Algorithm

Lecture 17 - All Integer Primal Algorithm

Lecture 18 - All Integer Dual Algorithm

Lecture 19 - Network Models

Lecture 20 - Shortest Path Problem

Lecture 21 - Successive Shortest Path Problem

Lecture 22 - Maximum Flow Problem

Lecture 23 - Minimum Cost Flow Problem

Lecture 24 - Traveling Salesman Problem (TSP)

Lecture 25 - Branch and Bound Algorithms for TSP

Lecture 26 - Heuristics for TSP

Lecture 27 - Heuristics for TSP (Continued.)

Lecture 28 - Chinese Postman Problem

Lecture 29 - Vehicle Routeing Problem

Lecture 30 - Queueing Models

Lecture 31 - Single Server Queueing Models

[Lecture 32 - Multiple Server Queueing Models](#)

[Lecture 33 - Game Theory](#)

[Lecture 34 - Critical Path Method](#)

[Lecture 35 - Quadratic Programming](#)

[Lecture 36 - Integer Programming \(Continued.\)](#)

[Lecture 37 - All Integer Dual Algorithm](#)

[Lecture 38 - Mixed Integer Linear Programming](#)

[Lecture 39 - Benders Partitioning Algorithm](#)



Lecture 1 - Introduction to Linear Programming Formulations

Lecture 2 - Linear Programming Formulations (Continued...)

Lecture 3 - Linear Programming Solutions- Graphical Methods

Lecture 4 - Linear Programming Solutions - Simplex Algorithm

Lecture 5 - Simplex Algorithm-Minimization Problems

Lecture 6 - Simplex Algorithm - Initialization and Iteration

Lecture 7 - Simplex Algorithm - Termination

Lecture 8 - Introduction to Duality

Lecture 9 - Primal Dual Relationships, Duality Theorems

Lecture 10 - Dual Variables and the Simplex Tables

Lecture 11 - Simplex Algorithm in Matrix Form Introduction to Sensitivity Analysis

Lecture 12 - Sensitivity Analysis Transportation Problem (Introduction)

Lecture 13 - Transportation Problem, Methods for Initial Basic Feasible Solutions

Lecture 14 - Transportation Problem-Optimal Solutions

Lecture 15 - Transportation Problem - Other Issues

Lecture 16 - Assignment Problem - Hungarian Algorithm

Lecture 17 - Assignment Problem - Other Issues Introduction to Dynamic Programming

Lecture 18 - Dynamic Programming - Examples Involving Discrete Variables

Lecture 19 - Dynamic Programming - Continuous Variables

Lecture 20 - Dynamic Programming - Examples to Solve Linear & Integer Programming Problems

Lecture 21 - Inventory Models - Deterministic Models

Lecture 22 - Inventory Models - Discount Models, Constrained Inventory Problems, Lagrangean Multipliers, Conclusions

**NPTEL : Introduction to Finite Element Method (Mechanical Engineering)**

**Co-ordinators : Dr. R. Krishnakumar**

Lecture 1 - Introduction to Finite Element Method

Lecture 2 - Introduction to Finite Element Method

Lecture 3 - Introduction to Finite Element Method

Lecture 4 - Introduction to Finite Element Method

Lecture 5 - Introduction to Finite Element Method

Lecture 6 - Introduction to Finite Element Method

Lecture 7 - Introduction to Finite Element Method

Lecture 8 - Introduction to Finite Element Method

Lecture 9 - Introduction to Finite Element Method

Lecture 10 - Introduction to Finite Element Method

Lecture 11 - Introduction to Finite Element Method

Lecture 12 - Introduction to Finite Element Method

Lecture 13 - Introduction to Finite Element Method

Lecture 14 - Introduction to Finite Element Method

Lecture 15 - Introduction to Finite Element Method

Lecture 16 - Introduction to Finite Element Method

Lecture 17 - Introduction to Finite Element Method

Lecture 18 - Introduction to Finite Element Method

Lecture 19 - Introduction to Finite Element Method

Lecture 20 - Introduction to Finite Element Method

Lecture 21 - Introduction to Finite Element Method

Lecture 22 - Introduction to Finite Element Method

Lecture 23 - Introduction to Finite Element Method

Lecture 24 - Introduction to Finite Element Method

Lecture 25 - Introduction to Finite Element Method

Lecture 26 - Introduction to Finite Element Method

Lecture 27 - Introduction to Finite Element Method

Lecture 28 - Introduction to Finite Element Method

Lecture 29 - Introduction to Finite Element Method

Lecture 30 - Introduction to Finite Element Method

Lecture 31 - Introduction to Finite Element Method

[Lecture 32 - Introduction to Finite Element Method](#)

[Lecture 33 - Introduction to Finite Element Method](#)

Lecture 1 - Introduction to the Study of Mechanical Measurement

Lecture 2 - Errors in Measurement

Lecture 3 - Errors in Measurement (Continued...)

Lecture 4 - Propagation of Errors

Lecture 5 - Regression Analysis

Lecture 6 - Regression Analysis (Continued...)

Lecture 7 - Design of Experiments

Lecture 8 - Design of Experiments (Continued...)

Lecture 9 - Temperature Measurement

Lecture 10 - Overview of Thermometry

Lecture 11 - Thermoelectric Thermometry

Lecture 12 - Thermoelectric Thermometry (Continued...)

Lecture 13 - Measurement of Temperature Under Various Conditions

Lecture 14 - Errors in Temperature Measurement

Lecture 15 - Measurement of Transient Temperature and Resistance Thermometry

Lecture 16 - Resistance Thermometry (Continued...)

Lecture 17 - Resistance Thermometry (Continued...) and pyrometry

Lecture 18 - pyrometry (Continued...)

Lecture 19 - pyrometry (Continued...)

Lecture 20 - Pressure Measurement (Continued...)

Lecture 21 - Pressure Measurement (Continued...)

Lecture 22 - Pressure Measurement (Continued...)

Lecture 23 - Pressure Measurement (Continued...)

Lecture 24 - Transient Response of Pressure Transducers

Lecture 25 - Transient Response of Pressure Transducers

Lecture 26 - Measurement of High Vacuum

Lecture 27 - Measurement of Fluid Velocity

Lecture 28 - Hot Wire Anemometry and Laser Doppler Velocimetry

Lecture 29 - Laser Doppler Velocimetry and Ultrasonic Methods

Lecture 30 - Measurement of Heat Flux

Lecture 31 - Measurement of Heat Flux (Continued...)

- Lecture 32 - Transient Method of Heat Flux Measurement
- Lecture 33 - Measurement of Volume and Mass Flow Rate of Fluid
- Lecture 34 - Flow Measuring Devices
- Lecture 35 - Measurement of Stagnation and Bulk Mean Temperature
- Lecture 36 - Measurement of Thermo-Physical Properties
- Lecture 37 - Measurement of Thermal Conductivity
- Lecture 38 - Measurement of Heat Capacity and Heating Value
- Lecture 39 - Measurement of Viscosity
- Lecture 40 - Measurement of Viscosity (Continued...)
- Lecture 41 - Integrating Sphere and Measurement of Emissivity
- Lecture 42 - Measurements of Gas Composition
- Lecture 43 - Measurements of Gas Composition (Continued...)
- Lecture 44 - Measurements of Gas Composition and Smoke
- Lecture 45 - Measurement of Force
- Lecture 46 - Force Measurement
- Lecture 47 - Vibration and Acceleration Measurement
- Lecture 48 - Laser Doppler Accelerometer, Speed, Torque
- Lecture 49 - General Issues in Mechanical Measurement
- Lecture 50 - Case Studies

**NPTEL : Principles of Mechanical Measurements (Mechanical Engineering)**

**Co-ordinators : Prof. R. Raman**

[Lecture 1 - Principles Of Mechanical Measurements](#)

[Lecture 2 - Principles Of Mechanical Measurements](#)

[Lecture 3 - Principles Of Mechanical Measurements](#)

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[Lecture 8 - Principles Of Mechanical Measurements](#)

[Lecture 9 - Principles Of Mechanical Measurements](#)

[Lecture 10 - Principles of Mechanical Measurements](#)

[Lecture 11 - Principles Of Mechanical Measurements](#)

[Lecture 12 - Principles Of Mechanical Measurements](#)

[Lecture 13 - Principles Of Mechanical Measurements](#)

[Lecture 14 - Principles Of Mechanical Measurements](#)

[Lecture 15 - Principles Of Mechanical Measurements](#)

[Lecture 16 - Principles Of Mechanical Measurements](#)

[Lecture 17 - Principles Of Mechanical Measurements](#)

[Lecture 18 - Principles Of Mechanical Measurements](#)

[Lecture 19 - Principles Of Mechanical Measurements](#)

[Lecture 20 - Principles Of Mechanical Measurements](#)

[Lecture 21 - Principles Of Mechanical Measurements](#)

[Lecture 22 - Principles Of Mechanical Measurements](#)

[Lecture 23 - Principles Of Mechanical Measurements](#)

[Lecture 24 - Principles Of Mechanical Measurements](#)

[Lecture 25 - Principles Of Mechanical Measurements](#)

[Lecture 26 - Principles Of Mechanical Measurements](#)

**NPTEL : Spray Theory and Applications (Mechanical Engineering)**

**Co-ordinators : Prof. Mahesh Panchagnula, Dr. Paul E. Sojka**

- Lecture 1 - Introduction to sprays and their applications
- Lecture 2 - Spatial versus Temporal Sampling
- Lecture 3 - Spatial Vs Temporal Sampling example problem
- Lecture 4 - Steady vs unsteady spray
- Lecture 5 - Statistical measures on spray
- Lecture 6 - Discussion on pdf and moments
- Lecture 7 - Size velocity correlation
- Lecture 8 - Discussion on Interfacial tension
- Lecture 9 - Introduction to Atomizers and their design - 1
- Lecture 10 - Introduction to Atomizers and their design - 2
- Lecture 11 - Simple measurement techniques
- Lecture 12 - Selection of atomizers
- Lecture 13 - Spray measurement characteristics
- Lecture 14 - Spray measurements techniques
- Lecture 15 - Non-intrusive spray measurements techniques
- Lecture 16 - Non-intrusive spray measurements techniques
- Lecture 17 - Linear stability analysis “ Introduction
- Lecture 18 - Linear stability analysis- Kelvin-Helmholtz instability - 1
- Lecture 19 - Linear stability analysis- Kelvin-Helmholtz instability - 2
- Lecture 20 - Linear stability analysis- Kelvin-Helmholtz instability - 3
- Lecture 21 - Linear stability analysis procedure
- Lecture 22 - Linear stability analysis - Cylindrical jet instability - 1
- Lecture 23 - Linear stability analysis - Cylindrical jet instability - 2
- Lecture 24 - Linear stability analysis - Planar Liquid Sheet instability - 1
- Lecture 25 - Linear stability analysis - Planar Liquid Sheet instability - 2
- Lecture 26 - Design of pressure swirl atomizer - 1
- Lecture 27 - Design of pressure swirl atomizer - 2
- Lecture 28 - Design of pressure swirl atomizer - 3
- Lecture 29 - Design of pressure swirl atomizer - 4
- Lecture 30 - Secondary atomization-Dimensionless parameters
- Lecture 31 - Secondary atomization-Modes of breakup - 1

[Lecture 32 - Secondary atomization-Modes of breakup - 2](#)

[Lecture 33 - Multiphase modelling](#)

[Lecture 34 - Multiphase modelling](#)

[Lecture 35 - Multiphase flow modelling basics](#)

[Lecture 36 - Multiphase modelling " Selection of model - 1](#)

[Lecture 37 - Multiphase modelling " Selection of model - 2](#)

[Lecture 38 - Multiphase modelling - Governing equations](#)

[Lecture 39 - Droplet evaporation](#)

[Lecture 40 - Droplet combustion](#)

[Lecture 41 - Spray combustion](#)



Lecture 1 - Importance of Thermal Radiation

Lecture 2 - Blackbody definition

Lecture 3 - Solid angle, spectral radiation intensity

Lecture 4 - Radiation pressure and radiation energy density

Lecture 5 - Relationship between  $\rho_{\lambda}$  and  $\rho_T$  and Candidate blackbody distribution functions

Lecture 6 - Candidate blackbody distribution functions (Continued...)

Lecture 7 - Planck's blackbody radiation distribution function

Lecture 8 - Planck's distribution and Wien's displacement law

Lecture 9 - Universal blackbody function

Lecture 10 - Emissivity

Lecture 11 - Emissivity (Continued...)

Lecture 12 - Emissivity (Continued...)

Lecture 13 - Kirchoff law, Absorptivity

Lecture 14 - Kirchoff law, Absorptivity (Continued...)

Lecture 15 - Problems on emissivity, absorptivity

Lecture 16 - Reflectivity

Lecture 17 - Transmissivity

Lecture 18 - Problems on reflectivity and transmissivity

Lecture 19 - Radiation heat transfer between surfaces

Lecture 20 - View factor

Lecture 21 - View factor (Continued...)

Lecture 22 - View factor (Continued...)

Lecture 23 - Enclosure analysis

Lecture 24 - Enclosure analysis (Continued...)

Lecture 25 - Enclosure analysis - Gray surface

Lecture 26 - Enclosure analysis - Non gray surfaces

Lecture 27 - Radiation in participating media

Lecture 28 - Solution to the RTE

Lecture 29 - Concept of mean beam length

Lecture 30 - Enclosure analysis in the presence of absorbing / emitting gas

Lecture 31 - Emissivities and absorptivities of Gas mixtures

[Lecture 32 - Conduction - Introduction](#)

[Lecture 33 - Conduction - Energy equation](#)

[Lecture 34 - Conduction - 1D, steady state](#)

[Lecture 35 - Conduction - 1D, heat generation](#)

[Lecture 36 - Fin heat transfer - I](#)

[Lecture 37 - Fin heat transfer - II](#)

[Lecture 38 - Conduction - Cylindrical and Spherical geometries](#)

[Lecture 39 - Transient conduction](#)

[Lecture 40 - Transient conduction \(Continued...\)](#)

[Lecture 41 - Two dimensional steady state conduction](#)

[Lecture 42 - Analytical solution for Laplace equation](#)

[Lecture 43 - Numerical methods in conduction](#)

[Lecture 44 - Numerical methods in conduction \(Continued...\)](#)

[Lecture 45 - Conduction with change of phase](#)

[Lecture 46 - Conduction with change of phase \(Continued...\)](#)

Lecture 1 - Introduction

Lecture 2 - Introduction / Fundamental Ideas

Lecture 3 - Fundamental Ideas

Lecture 4 - Fundamental Ideas

Lecture 5 - Fundamental Ideas / Normal Shock Waves

Lecture 6 - Normal Shock Waves

Lecture 7 - Normal Shock Waves / Rayleigh Flow

Lecture 8 - Rayleigh Flow

Lecture 9 - Rayleigh Flow

Lecture 10 - Rayleigh Flow / Fanno Flow

Lecture 11 - Fanno Flow

Lecture 12 - Fanno Flow

Lecture 13 - Fanno Flow / Quasi One Dimensional Flows

Lecture 14 - Quasi One Dimensional Flows

Lecture 15 - Quasi One Dimensional Flows

Lecture 16 - Quasi One Dimensional Flows

Lecture 17 - Quasi One Dimensional Flows

Lecture 18 - Quasi One Dimensional Flows

Lecture 19 - Quasi One Dimensional Flows

Lecture 20 - Oblique Shock Waves

Lecture 21 - Oblique Shock Waves

Lecture 22 - Oblique Shock Waves

Lecture 23 - Oblique Shock Waves / Prandtl Meyer Waves

Lecture 24 - Prandtl Meyer Waves

Lecture 25 - Prandtl Meyer Waves

Lecture 26 - Propulsion - an Introduction

Lecture 27 - Components of the Gas Turbine Engine

Lecture 28 - Components of the Gas Turbine Engine

Lecture 29 - Components of the Gas Turbine Engine

Lecture 30 - Components of the Gas Turbine Engine

Lecture 31 - Components of the Gas Turbine Engine / Thermodynamic Analysis of the Engine

[Lecture 32 - Thermodynamic Analysis of the Engine](#)

[Lecture 33 - Thermodynamic Analysis of the Engine](#)

[Lecture 34 - Calculations for Thrust and Fuel Consumption](#)

[Lecture 35 - Calculations for Thrust and Fuel Consumption](#)

[Lecture 36 - Calculations for Thrust and Fuel Consumption / Emerging Trends](#)

[Lecture 37 - Emerging Trends / Ramjets](#)

[Lecture 38 - Ramjets](#)

[Lecture 39 - Ramjets / Scramjets](#)

[Lecture 40 - Scramjets](#)

Lecture 1 - Introduction and Scaling

Lecture 2 - Scaling

Lecture 3 - Micro-scale fluid mechanics

Lecture 4 - Micro-scale fluid mechanics (Continued...)

Lecture 5 - Micro-scale fluid mechanics (Continued...)

Lecture 6 - Micro-scale fluid mechanics (Continued...)

Lecture 7 - Micro-scale fluid mechanics (Continued...)

Lecture 8 - Micro-scale fluid mechanics (Continued...)

Lecture 9 - Micro-scale fluid mechanics (Continued...)

Lecture 10 - Micro-scale fluid mechanics (Continued...)

Lecture 11 - Capillary Flows

Lecture 12 - Capillary Flows (Continued...)

Lecture 13 - Capillary Flows and Electrokinetics

Lecture 14 - Electrokinetics

Lecture 15 - Electrokinetics (Continued...)

Lecture 16 - Electrokinetics (Continued...)

Lecture 17 - Electrokinetics (Continued...)

Lecture 18 - Electrokinetics (Continued...)

Lecture 19 - Electrokinetics (Continued...)

Lecture 20 - Electrokinetics and Magnetophoresis

Lecture 21 - Microfabrication Techniques

Lecture 22 - Microfabrication Techniques (Continued...)

Lecture 23 - Microfabrication Techniques (Continued...)

Lecture 24 - Microfabrication Techniques (Continued...)

Lecture 25 - Microfabrication Techniques (Continued...)

Lecture 26 - Microfabrication Techniques (Continued...)

Lecture 27 - Microfabrication Techniques (Continued...)

Lecture 28 - Microfabrication Techniques (Continued...)

Lecture 29 - Micropump

Lecture 30 - Micropump (Continued...)

Lecture 31 - Microvalve

[Lecture 32 - Microvalve \(Continued...\)](#)

[Lecture 33 - Microvalve \(Continued...\)](#)

[Lecture 34 - Micro Flow Sensor and Micro mixers](#)

[Lecture 35 - Micro mixers](#)

[Lecture 36 - Micro mixers \(Continued...\)](#)

[Lecture 37 - Micro droplets](#)

[Lecture 38 - Micro reactors \(Continued...\)](#)

[Lecture 39 - Micro needles and Microparticle separation](#)

[Lecture 40 - Few applications of microfluidics](#)

[Lecture 41 - Lab Demo](#)

Lecture 1 - Introduction to convective heat transfer - Part 1

Lecture 2 - Introduction to convective heat transfer - Part 2

Lecture 3 - Continuity Equation

Lecture 4 - Momentum and Energy Equations

Lecture 5 - Energy Equation

Lecture 6 - Reynolds Transport Theorem

Lecture 7 - Entropy Generation and streamfunction-vorticity formulation

Lecture 8 - Couette flow - Part 1

Lecture 9 - Couette flow - Part 2

Lecture 10 - Couette flow - Part 3

Lecture 11 - Boundary layer approximation

Lecture 12 - Laminar External flow past flat plate (Blasius Similarity Solution)

Lecture 13 - Numerical solution to the Blasius equation and similarity solution to heat transfer

Lecture 14 - Pohlhausen similarity solution and flows including pressure gradient (Falkner-Skan)

Lecture 15 - Falkner skan solutions for heat transfer

Lecture 16 - Similarity solution for flow and heat transfer with transpiration at walls

Lecture 17 - Thermal boundary layer in high speed flows

Lecture 18 - Approximate(Integral) methods for laminar external flow and heat transfer

Lecture 19 - Integral method for laminar external thermal boundary layer over isothermal surface

Lecture 20 - Integral method for flows with pressure gradient (von Karman-Pohlhausen method)

Lecture 21 - Integral method with pressure gradient: heat transfer

Lecture 22 - Heat transfer across a circular cylinder: Walz approximation

Lecture 23 - Duhamel's method for varying surface temperature

Lecture 24 - Laminar External heat transfer with non uniform surface temperature

Lecture 25 - Laminar internal forced convection - fundamentals

Lecture 26 - Hydrodynamically and thermally fully developed internal laminar flows

Lecture 27 - Fully developed laminar internal flow and heat transfer

Lecture 28 - Shooting method for fully developed heat transfer and thermal entry length problem

Lecture 29 - Thermal entry length problem with plug velocity profile: Graetz problem

Lecture 30 - Extended Graetz problem for parabolic velocity profile

Lecture 31 - Extended Graetz problem

[Lecture 32 - Extended Graetz problem with wall flux boundary condition](#)

[Lecture 33 - Approximate method for laminar internal flows](#)

[Lecture 34 - Integral method for thermal entry length problem](#)

[Lecture 35 - Introduction to Natural Convection Heat Transfer](#)

[Lecture 36 - Similarity Solution in Natural Convection for Vertical isothermal Plate - Part 1](#)

[Lecture 37 - Similarity Solution in Natural Convection for Vertical isothermal Plate - Part 2](#)

[Lecture 38 - Similarity Solution in Natural Convection for Vertical isoflux Plate](#)

[Lecture 39 - Approximate Method in Natural Convection Heat Transfer](#)

[Lecture 40 - Natural Convection in Other Configurations](#)

[Lecture 41 - Turbulent Convective Heat Transfer : RANS Equations - Part 1](#)

[Lecture 42 - Turbulent Convective Heat Transfer : RANS Equations - Part 2](#)

[Lecture 43 - Analogies in Turbulent Convective Heat Transfer - Part 1](#)

[Lecture 44 - Analogies in Turbulent Convective Heat Transfer - Part 2](#)



Lecture 1 - Loud Bang and Disruption

Lecture 2 - Blast Wave in an Explosion: Predictions from Dimensional Considerations

Lecture 3 - Typical Examples of Explosions and Classification

Lecture 4 - Shock Hugoniot and Rayleigh Line

Lecture 5 - Properties behind a Constant Velocity Shock

Lecture 6 - Blast waves: Concentration of Mass at the Front, Snow Plow Approximation, Energy conservation in a Blast wave

Lecture 7 - Blast waves: Decay of a strong Blast wave, Explosion Length, Sach's Scaling, Over pressure, Cranz Hopkinson Scaling law of Overpressure

Lecture 8 - Blast Waves: Overpressure and Impulse in the Near and Far Field, Examples, Introduction to Impulse

Lecture 9 - Blast Waves: Non-dimensional Impulse, Cranz -Hopkinson Scaling, Missiles, Fragments and Shrapnel, Craters, Examples

Lecture 10 - Blast Waves: Interaction with Objects, Reflection and Transmission of Blast Waves, Impedance

Lecture 11 - Blast Waves: Amplification of Reflected Blast Waves; Role of Impedance, Spalling, Damage to Organs containing Air, Mushroom Cloud in an Explosion, Examples

Lecture 12 - Blast Waves: Damage from Blast Waves, Examples, Multiple Spikes in an Impulse, Iso-damage Curve on an Overpressure- Impulse Diagram, Complex Structures

Lecture 13 - Energy Release in a Chemical Reaction: Moles, Internal Chemical Energy, Standard Heats of Formation

Lecture 14 - Energy Release: Stoichiometry, Equivalence Ratio and Heat Release in Fuel Rich and Oxidizer Rich Compounds

Lecture 15 - Energy Release: Examples of Energy Release Calculations, Higher and Lower Calorific Values, Internal Energy of Formation

Lecture 16 - Rate of Energy Release: Concentration, Activation Energy, Energy Release Profile

Lecture 17 - Thermal Theory of Explosion

Lecture 18 - Thermal Theory

Lecture 19 - Role of Chain Carriers in an Explosion

Lecture 20 - Combustion - I

Lecture 21 - Combustion - II

Lecture 22 - Case Histories of Explosions involving Volatile Liquids

Lecture 23 - Detonation

Lecture 24 - Structure of Detonations

Lecture 25 - Realizable States in a Detonation

Lecture 26 - One Dimensional Model of Detonation

Lecture 27 - Case Histories of Explosions involving Detonation or Quasi-Detonation

Lecture 28 - Explosions in Confined and Unconfined Geometries

Lecture 29 - Dust Explosions - I

[Lecture 30 - Dust Explosions - II](#)

[Lecture 31 - Physical Explosions](#)

[Lecture 32 - Rupture of Cryogenic Storage Vessels and Pressure Vessels](#)

[Lecture 33 - Condensed Phased Explosives Based on Hydrocarbons](#)

[Lecture 34 - Condensed Phase Explosives and their Properties](#)

[Lecture 35 - TNT Equivalence and Yield of an Explosion](#)

[Lecture 36 - Atmospheric Dispersion](#)

[Lecture 37 - Modeling Atmospheric Dispersion](#)

[Lecture 38 - Explosions Involving Atmospheric Dispersion](#)

[Lecture 39 - Quantification of Damages in an Explosion](#)

[Lecture 40 - Risk Analysis for an Explosion](#)

Lecture 1 - Introduction to Metrology

Lecture 2 - Metrology terminologies

Lecture 3 - Measurement errors

Lecture 4 - Linear measuring instruments  $\hat{A}$ - 1 (Angle plate, steel rule, spring calipers)

Lecture 5 - Linear measuring instruments  $\hat{A}$ - 2 (Combination set, Vernier calipers)

Lecture 6 - Linear measuring instruments  $\hat{A}$ - 3 (Height gauge, Micrometers  $\hat{A}$ - 1)

Lecture 7 - Linear measuring instruments  $\hat{A}$ - 4 (Micrometers  $\hat{A}$ - 2, Bore gauge)

Lecture 8 - Linear measuring instruments  $\hat{A}$ - 5 (Dial indicators, thickness gauges, depth gauges)

Lecture 9 - Manufacturing tolerances and fits

Lecture 10 - Terminologies of limits fits and tolerances

Lecture 11 - Numerical problems on fit and tolerances

Lecture 12 - Selection of fits, Geometrical tolerances

Lecture 13 - Positional tolerances

Lecture 14 - Limit gauging - 1

Lecture 15 - Limit gauging - 2

Lecture 16 - Design of limit gauges

Lecture 17 - Measurement of straightness, flatness and squareness

Lecture 18 - Perpendicularity measurement

Lecture 19 - Basics of surface roughness

Lecture 20 - Surface finish parameters

Lecture 21 - Stylus type surface finish measuring instruments

Lecture 22 - Non-contact type surface finish measuring instruments

Lecture 23 - Screw thread production and terminology

Lecture 24 - Measurement of screw thread elements

Lecture 25 - Introduction to gears

Lecture 26 - Measurement of gear elements

Lecture 27 - Angle measurement - 1

Lecture 28 - Angle measurement - 2

Lecture 29 - Radius measurement, Contact angle measurement

Lecture 30 - Basics of interferometry

Lecture 31 - Interferometers

- Lecture 32 - Introduction to comparators, Mechanical comparators
- Lecture 33 - Electrical and electronic comparators, Optical comparators
- Lecture 34 - Pneumatic comparators
- Lecture 35 - Geometrical tests on lathe
- Lecture 36 - Geometrical tests on pillar type drilling machine
- Lecture 37 - Universal measuring machine (UMM) and Coordinate measuring machine (CMM)
- Lecture 38 - CMM probes and CMM software
- Lecture 39 - Feature measurement using CMM, Laser vision
- Lecture 40 - In-process gauging and control
- Lecture 41 - Stage position metrology
- Lecture 42 - Micro and Nano stages, Nano technology instrumentation
- Lecture 43 - Optical system design
- Lecture 44 - Complex opto- mechanical assemblies, Metrology testing and certification services

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- Lecture 5 - Example 2 - Rigid Body Systems
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- Lecture 12 - Beams - Example 1
- Lecture 13 - Beams - BMD and SFD
- Lecture 14 - Beams - Loading, Shear and Bending Moment Relations
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- Lecture 16 - Friction - Solving Problems
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- Lecture 21 - Rotational Motion (Example 1)
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- Lecture 23 - Dynamics (Introduction)
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Lecture 6 - Concepts of BL displacement thickness ( $\delta^*$ ) and BL momentum thickness ( $\delta^2$ )

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Lecture 8 - Control Volume approach to derive expressions for  $\delta^2$  over a flat plate

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Lecture 10 - Concept of friction drag

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Lecture 22 - Similarity Solutions to the BL Equations (other than flat plate) - I

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Lecture 26 - Description of the Numerical Code to Solve the BL Equations (other than flat plate)

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Lecture 9 - Discussion on stagnation

Lecture 10 - Velocity of sound

Lecture 11 - Discussion on velocity of sound and mach number

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- [Lecture 33 - Kinetics of Arm Swinging during Walking](#)
- [Lecture 34 - Inverse Dynamics Analysis](#)
- [Lecture 35 - Biomechanics of Balance - Part I](#)
- [Lecture 36 - Biomechanics of Balance - Part II](#)
- [Lecture 37 - Biomechanics of Balance - Part III](#)
- [Lecture 38 - Human Gait](#)
- [Lecture 39 - Human Gait Terminologies](#)
- [Lecture 40 - Characteristics of Normal Gait - Part I](#)
- [Lecture 41 - Characteristics of Normal Gait - Part II](#)
- [Lecture 42 - Characteristics of Normal Gait - Part III](#)
- [Lecture 43 - Pathological Gait - Part I](#)
- [Lecture 44 - Pathological Gait - Part II](#)
- [Lecture 45 - Pathological Gait - Part III](#)
- [Lecture 46 - Introduction to Assistive Devices for Mobility](#)
- [Lecture 47 - Design Considerations: Prosthetic Foot](#)
- [Lecture 48 - Design Considerations: Prosthesis and Orthosis](#)
- [Lecture 49 - Design Considerations: Prosthetic Knee](#)
- [Lecture 50 - Journey of Standing Wheelchair Development](#)



Lecture 1 - Introduction to DfX

Lecture 2 - Introduction to Quality

Lecture 3 - Introduction to Robustness

Lecture 4 - Introduction to Six Sigma Concept

Lecture 5 - Recap and clarifications of basic concepts

Lecture 6 - Review of Six Sigma and Quality Loss Function (QLF)

Lecture 7 - Types of QLF and SN Ratio

Lecture 8 - Linking Quality and Robustness

Lecture 9 - Design for Six Sigma - Stages, Design of Experiments

Lecture 10 - Introduction To Design Of Experiments

Lecture 11 - Need for DoE and basic DoE methods

Lecture 12 - Factorial Design

Lecture 13 - Orthogonal Array- L4 and L8 example

Lecture 14 - Setting up an Orthogonal Array

Lecture 15 - Confounding OA and Resolution Table

Lecture 16 - Confounding Logic and Randomization of Experiments

Lecture 17 - Paper Helicopter Case Study - Part I

Lecture 18 - Paper Helicopter Case Study - Part II

Lecture 19 - Introduction To Injection Molding Process, Materials, Terminologies Related To Plastic Parts and Design Guidelines

Lecture 20 - Estimation of Mold Cost for Injection Molding (Dixon and Poli's Method)

Lecture 21 - Estimation of Mold Cost for Injection Molding (Dixon and Poli's Method) (Continued...)

Lecture 22 - Mold Cost Estimation - Tutorial

Lecture 23 - Design for Additive Manufacturing

Lecture 24 - Demo

Lecture 25 - Introduction to Sustainable Development and Sustainability Indicators - Part 1

Lecture 26 - Introduction to Sustainable Development and Sustainability Indicators - Part 2

Lecture 27 - Introduction to design process

Lecture 28 - Accounting for manufacturability and assembly in design - An overview

Lecture 29 - DfMA in product design

Lecture 30 - General design guidelines for manual assembly

Lecture 31 - Systematic DFA methodology

[Lecture 32 - Alpha symmetry, Beta symmetry](#)

[Lecture 33 - Quantification of part size and thickness](#)

[Lecture 34 - Systematic DFA Case study - controller assembly](#)

[Lecture 35 - DFA examples and discussion](#)

[Lecture 36 - Xerox Producibility Index \(XPI\)](#)

[Lecture 37 - High Speed and Robotic Assembly](#)

[Lecture 38 - Sheet Metal Working](#)

[Lecture 39 - Overview of DoE Workflow](#)

[Lecture 40 - DFA Software](#)

[Lecture 41 - DFM Software and Case Studies](#)

Lecture 1 - Overview and Motivation of Course

Lecture 2 - Basic Optimization Problem Formulation

Lecture 3 - Problem Formulation Example

Lecture 4 - Calculus related to Optimization

Lecture 5 - The big picture - Overview

Lecture 6 - Introduction to DOE - 1

Lecture 7 - Introduction to DOE - 2

Lecture 8 - Types of DOE - 1

Lecture 9 - Types of DOE - 2 and some examples

Lecture 10 - Introduction to surrogate modeling

Lecture 11 - Types of surrogate - Polynomial models

Lecture 12 - Radial basis function - 1

Lecture 13 - Radial basis function - 2

Lecture 14 - Kriging - 1

Lecture 15 - Kriging - 2

Lecture 16 - Metamodels for Safe and Efficient Automotive Structures

Lecture 17 - Exploration and Exploitation in Surrogates

Lecture 18 - Errors Based Exploration

Lecture 19 - Ensemble of Surrogates

Lecture 1 - Concept of Steel Quality

Lecture 2 - Typical Examples of Surface Defects

Lecture 3 - Origin of Common Quality Problems

Lecture 4 - Present Scenario on Quality Demands

Lecture 5 - Control of Residuals and Impact on Quality

Lecture 6 - Non-Metallic Inclusions

Lecture 7 - Evaluation of Residuals and Inclusions

Lecture 8 - Cleanliness Requirements for Different applications

Lecture 9 - Limitation of Primary Steelmaking and Importance of secondary Refining

Lecture 10 - Deoxidation

Lecture 11 - Prevention of Slag carryover

Lecture 12 - Desulphurisation

Lecture 13 - Degassing

Lecture 14 - Secondary Refining Processes

Lecture 15 - Injection of Calcium

Lecture 16 - Decarburisation

Lecture 17 - Cleanliness Measures in Ladle and Tundish

Lecture 18 - Cleanliness Measures in Mould

Lecture 19 - Different Routes and Temperature Control

Lecture 20 - Nature and Distribution of Entrapments in Casting

Lecture 21 - Sources of Exogenous Entrapments

Lecture 22 - Effect of Vertical vis-a-vis Curved Mould

Lecture 23 - Quality of Cast Product

Lecture 24 - Role of Concast Process, Caster Design and Steel Grade

Lecture 25 - Primary Cooling in Caster Mould

Lecture 26 - Heat Transfer in Mould

Lecture 27 - Cast Structure and Dendrite Size

Lecture 28 - Role of Mould Oscillation

Lecture 29 - Role of Chemistry - Part I

Lecture 30 - Role of Chemistry - Part II

Lecture 31 - Role of Segregation - Part I

[Lecture 32 - Role of Segregation - Part II](#)

[Lecture 33 - Deleterious Effect of Phosphorus](#)

[Lecture 34 - Strength of Solidifying Strand](#)

[Lecture 35 - Brittle Zone Near Solidus](#)

[Lecture 36 - Strength and Toughness of Solid Shell](#)

[Lecture 37 - Role of Chemistry on Solidification Behaviour](#)

[Lecture 38 - Sticking vis-a-vis Depression Behaviour](#)

[Lecture 39 - Role of Chemistry on Bulging or Depression Tendency - Part I](#)

[Lecture 40 - Role of Chemistry on Bulging or Depression Tendency - Part II](#)

[Lecture 41 - Effect of Cast Grain Size](#)

[Lecture 42 - Brittle Temperature Regions](#)

[Lecture 43 - Role of Secondary Cooling - Part 1](#)

[Lecture 44 - Role of Secondary Cooling - Part 2](#)

[Lecture 45 - Typical Cracks and Defects - Part I](#)

[Lecture 46 - Typical Cracks and Defects - Part II](#)

[Lecture 47 - Remedial Measures to Control Defects - Part I](#)

[Lecture 48 - Remedial Measures to Control Defects - Part II](#)

[Lecture 49 - Remedial Measures to Control Defects - Part III](#)

[Lecture 50 - Grade - Specific Casting Parameters - Part I](#)

[Lecture 51 - Grade - Specific Casting Parameters - Part II](#)

[Lecture 52 - Identification of Genesis of Quality Problems Through Metallographic Investigation - Part I](#)

[Lecture 53 - Identification of Genesis of Quality Problems Through Metallographic Investigation - Part II](#)

[Lecture 54 - Identification of Genesis of Quality Problems Through Metallographic Investigation - Part III](#)

[Lecture 55 - Some Examples of Quality Problems](#)

- Lecture 1 - Review of Kinematics Fundamentals-I
- Lecture 2 - Links, Pairs, Kinematic Chains; Planar Mobility Criterion
- Lecture 3 - Mobility of Mechanisms, Grubler's Criterion and Applications
- Lecture 4 - Inversions, Grashof Criterion, Kinematic equivalence
- Lecture 5 - Linkage Synthesis Classification, 2-position Motion Generation
- Lecture 6 - Driver dyad, Quick-return synthesis - I
- Lecture 7 - Quick-return synthesis - II, 3-position Motion Generation
- Lecture 8 - Specified fixed pivots, Path generation
- Lecture 9 - Function generation
- Lecture 10 - Function generation using relative poles
- Lecture 11 - Structural Error, and Chebyshev Spacing
- Lecture 12 - Chebyshev Spacing
- Lecture 13 - Analytical Linkage Synthesis-I: Vector Loop Closure, Freudenstein's method
- Lecture 14 - Analytical Linkage Synthesis-II: Bloch's method, Driver Dyad
- Lecture 15 - Four-bar Position Analysis, Dyad or Standard Form Synthesis
- Lecture 16 - Dyad Form Synthesis: Motion Generation
- Lecture 17 - Dyad Form Synthesis: Path and Function Generation
- Lecture 18 - Dyad Form Synthesis: Multi loop linkages
- Lecture 19 - Dyad Form Synthesis: Four Position Motion Generation
- Lecture 20 - Coupler Curves - I
- Lecture 21 - Coupler Curves - II, Fixed and Moving Centroids
- Lecture 22 - Coupler Curves - III, Symmetrical Coupler Curves
- Lecture 23 - Roberts-Chebyshev Theorem
- Lecture 24 - Cognates
- Lecture 25 - Velocity Analysis: Review of Velocity Polygons
- Lecture 26 - Velocity Analysis: Velocity Polygons (Continued...) and Instant Centres
- Lecture 27 - Velocity Analysis: Auxiliary Point Method
- Lecture 28 - Auxiliary Point Method: (Continued...)
- Lecture 29 - Velocity and Acceleration Analysis: Analytical Method
- Lecture 30 - Acceleration Analysis: Analytical Method (Continued...)
- Lecture 31 - Acceleration Analysis: Auxiliary Point Method

[Lecture 32 - Force Analysis of Mechanisms, Mechanical Advantage](#)

[Lecture 33 - Force Analysis of Mechanisms - II](#)

[Lecture 34 - Balancing of Mechanisms using Counterweights](#)

[Lecture 35 - Balancing of Mechanisms using Springs](#)

[Lecture 36 - Spatial Mechanisms](#)

[Lecture 37 - Introduction to the Kinematics of Spatial Mechanisms](#)

Lecture 1 - Introduction to Engineering Mechanics - I

Lecture 2 - Introduction to Engineering Mechanics - II

Lecture 3 - Force Systems - I

Lecture 4 - Force Systems - II

Lecture 5 - Equilibrium of Rigid bodies - I

Lecture 6 - Equilibrium of Rigid bodies - II

Lecture 7 - Trusses - I

Lecture 8 - Trusses - II

Lecture 9 - Trusses - III

Lecture 10 - Beams - I

Lecture 11 - Beams - II

Lecture 12 - Beams - III

Lecture 13 - Beams - IV

Lecture 14 - Virtual Work - I

Lecture 15 - Virtual Work - II

Lecture 16 - Energy Relations

Lecture 17 - Review Before Quiz - I

Lecture 18 - Friction - I

Lecture 19 - Friction - II

Lecture 20 - Friction - III

Lecture 21 - Particle Dynamics

Lecture 22 - Circular Motion

Lecture 23 - Absolute Motion

Lecture 24 - Relative Motion - I

Lecture 25 - Relative Motion - II

Lecture 26 - Relative Motion - III and Instantaneous Center

Lecture 27 - Rotating frame of reference I - Velocity

Lecture 28 - Rotating frame of reference II - Acceleration

Lecture 29 - Rotating frame of reference III - Choice of rotating frame of reference

Lecture 30 - RFR- IV Crank and slotted bar

Lecture 31 - RFR-V Understanding Coriolis Acceleration



[Lecture 32 - Kinetics - I](#)

[Lecture 33 - Kinetics - II](#)

[Lecture 34 - Kinetics - III](#)

[Lecture 35 - 3D Kinematics - I](#)

[Lecture 36 - 3D Kinematics - II](#)

[Lecture 37 - 3D Kinematics - III](#)

Lecture 1 - Introduction to the course

Lecture 2 - Some applications of MD simulations

Lecture 3 - Introduction to Bravais lattices and constructing simple crystals with MATLAB

Lecture 4 - Introduction to symmetry - 1

Lecture 5 - Symmetry Elements - 1

Lecture 6 - Symmetry elements - 2

Lecture 7 - Plane groups and their Hermann-Mauguin (HM) symbols

Lecture 8 - Glide reflection; Examples of writing point group symbols; Wyckoff positions

Lecture 9 - Generating 2D crystal with MATLAB using Bilbao crystallography website

Lecture 10 - Symmetry of space groups

Lecture 11 - Hermann mauguin symbols of space groups

Lecture 12 - Translational symmetry operators

Lecture 13 - The Space groups

Lecture 14 - Generation of crystals

Lecture 15 - Generation of monoclinic lattice

Lecture 16 - Introduction to Statistical Mechanics - 1

Lecture 17 - Introduction to Statistical Mechanics - 2

Lecture 18 - Introduction to Statistical Mechanics - 3

Lecture 19 - Statistical mechanics - 1

Lecture 20 - Statistical mechanics - 2

Lecture 21 - Basic introduction to mechanics

Lecture 22 - Introduction to phase space

Lecture 23 - Introduction to phase average and time average

Lecture 24 - Canonical ensemble; Partition function

Lecture 25 - Basic introduction to MD

Lecture 26 - Input script for LAMMPS - 1

Lecture 27 - Input script for LAMMPS - 2

Lecture 28 - Input script for LAMMPS - 3

Lecture 29 - Input script for LAMMPS - 4

Lecture 30 - LAMMPS exercises - 1

Lecture 31 - LAMMPS exercises - 2

[Lecture 32 - LAMMPS exercises - 3](#)

[Lecture 33 - LAMMPS exercises - 4](#)

[Lecture 34 - LAMMPS exercises - 5](#)

Lecture 1 - Introduction

Lecture 2 - Combustion processes in ICE and Gas turbine engines

Lecture 3 - Combustion in solid and liquid rocket motors

Lecture 4 - Equilibrium

Lecture 5 - Chemical kinetics, Equilibrium vs rate controlled

Lecture 6 - Demonstration of NASA-CEA

Lecture 7 - Premixed and diffusion flames: principal features and differences - Part I

Lecture 8 - Premixed and diffusion flames: principal features and differences - Part II

Lecture 9 - Quenching, flammability and other limit phenomena

Lecture 10 - Conservation equations

Lecture 11 - Integral Analysis of flame

Lecture 12 - Solid propellant combustion

Lecture 13 - Erosive burning

Lecture 14 - Instability in solid rockets

Lecture 15 - Analysis of p-t traces - Part II

Lecture 16 - Statistical representation of composite propellants in HeQu1D - geometry and thermochemistry

Lecture 17 - HeQu1D model - Parameter estimation

Lecture 18 - Effects of Al - extended HeQu1D model

Lecture 19 - Instability in solid rockets - II

Lecture 20 - Tutorial

Lecture 21 - Liquid propellant rockets - Part I

Lecture 22 - Liquid propellant rockets - Part II

Lecture 23 - Combustion in liquid rockets

Lecture 24 - Instabilities in liquid rockets and gas turbine after burners

Lecture 25 - CFD modeling aspects - Fundamentals

Lecture 26 - CFD modeling aspects - Modeling approaches

Lecture 27 - Effect of turbulence on flames

Lecture 28 - Scramjets - Part I

Lecture 29 - Scramjets - Part II

Lecture 30 - Summary - Premixed flames

Lecture 31 - Summary - Non-premixed flames

[Lecture 32 - Summary - Solid rocket propulsion](#)

[Lecture 33 - Additional Insights](#)

Lecture 1 - Introduction

Lecture 2 - Material Property Landscape

Lecture 3 - Crystal Structure-1 (Platonic Solids)

Lecture 4 - Crystal Structure-2 (Unit Cell, Lattice, Crystal)

Lecture 5 - Crystal Structure-3 (Bravais lattice, Symmetry in Crystals)

Lecture 6 - Crystal Structure-4 (Miller Indices for Crystallographic Points and Directions)

Lecture 7 - Crystal Structure-5 (Miller-Bravais Indices, Linear and Planar Density)

Lecture 8 - Crystal Structure-6 (Planar density, Close-Packed Structures, Stacking Faults)

Lecture 9 - Crystal Structure-7 (Single Crystal and Polycrystalline Materials)

Lecture 10 - Crystal Structure-8 (X-Ray Diffraction and Determination of Structure)

Lecture 11 - Defects in Crystalline Materials-1 (Types of Crystalline Defects)

Lecture 12 - Defects in Crystalline Materials-1 (Point Defects)

Lecture 13 - Defects in Crystalline Materials-1 (Equilibrium Concentration of Vacancies)

Lecture 14 - Defects in Crystalline Materials-1 (Theoretical Shear Strength)

Lecture 15 - Defects in Crystalline Materials-2 (Effect of Point Defects)

Lecture 16 - Defects in Crystalline Materials-2 (Point Defects and Solid Solutions)

Lecture 17 - Defects in Crystalline Materials-3 (Line Defects, Types of Dislocations and their Characteristics)

Lecture 18 - Defects in Crystalline Materials-4 (Slip Systems, Burger's Vector and Dislocation Motion)

Lecture 19 - Defects in Crystalline Materials-4 (Slip in Single Crystals and Resolved Shear Stress)

Lecture 20 - Defects in Crystalline Materials-5 (Different Stages of Slip in Single Crystalline Materials)

Lecture 21 - Defects in Crystalline Materials-5 (Geometry and Slip, Stress Field Around a Dislocation and Deformation Twinning)

Lecture 22 - Defects in Crystalline Materials-6 (Twinning, Interfacial Defects and Volume Defects)

Lecture 23 - Defects in Crystalline Materials-6 (Strengthening Mechanisms)

Lecture 24 - Defects in Crystalline Materials-7 (Plastic deformation in polycrystalline materials, Softening Mechanisms)

Lecture 25 - Mechanical Properties of Materials (Concept of Stress Tensor)

Lecture 26 - Mechanical Properties (Tension Test-Elastic Deformation)

Lecture 27 - Mechanical Properties (Tension Test - Plastic Deformation)

Lecture 28 - Mechanical Properties (Tension Test - Plastic Deformation)

Lecture 29 - Mechanical Properties (Hardness Test)

Lecture 30 - Static Failure Theories (Introduction, Definition of Failure)

Lecture 31 - Static Failure Theories (General form of failure theory, Stress tensor, Principal stress)

- Lecture 32 - Static Failure Theories (Distortion Energy Theory)
- Lecture 33 - Static Failure Theories (Maximum Shear Stress Theory)
- Lecture 34 - Static Failure Theories (Design Problems)
- Lecture 35 - Static Failure Theories (Failure of Brittle Materials)
- Lecture 36 - Static Failure Theories (Coulomb-Mohr and Modified Coulomb-Mohr)
- Lecture 37 - Static Failure Theories (Notches and Stress Concentration)
- Lecture 38 - Introduction to Fracture Mechanics, Griffith's Analysis of a Cracked Body
- Lecture 39 - Fracture Mechanics (Energy Release Rate)
- Lecture 40 - Fracture Mechanics (Crack Resistance, Stress Intensity Factor, Fracture Toughness)
- Lecture 41 - Fatigue Failure of Materials (Introduction, Historical Events, S-N Diagram)
- Lecture 42 - Fatigue Failure of Materials (S-N Diagram, Types of Time Varying Loads)
- Lecture 43 - Fatigue Failure of Materials (High Cycle Fatigue, Low Cycle Fatigue, Stress Ratio, Amplitude Ratio)
- Lecture 44 - Fatigue Failure of Materials (Rotating Beam Bending Test, Estimated S-N diagram)
- Lecture 45 - Fatigue Failure Theories (Fatigue strength correction factors)
- Lecture 46 - Problems on Fatigue Failure-1 (S-N diagram and Corrected endurance strength)
- Lecture 47 - Fatigue Failure of Materials (Features of Fatigue Failure; Factor of Safety in Life and Stress)
- Lecture 48 - Fatigue Failure of Materials (Effect of Mean Stress)
- Lecture 49 - Fatigue Failure of Materials (Multiaxial Fatigue and Variable Amplitude Loading)
- Lecture 50 - Fatigue Failure of Materials (Fatigue Stress Concentration Factor)
- Lecture 51 - Fatigue Failure of Materials (Fatigue Crack Growth, Paris' law)
- Lecture 52 - Problems on Fatigue Failure-2 (Effect of mean stress, Fatigue crack growth)
- Lecture 53 - Problems on Fatigue Failure-3 (Effect of Notch, Multiaxial Loading)
- Lecture 54 - Phase Diagrams (Introduction)
- Lecture 55 - Phase Diagrams (Language of Phase Diagrams, Types of Binary Phase Alloys)
- Lecture 56 - Phase Diagrams (Tie line, Lever Rule, Identification of compositions and weight fractions in two-phase regions)
- Lecture 57 - Phase Diagrams (Type I: Isomorphous Alloys, Microstructure evolution in Equilibrium and Non equilibrium cooling)
- Lecture 58 - Phase Diagrams (Congruent Melting Alloys, Type II Alloys, Eutectic Reaction)
- Lecture 59 - Phase Diagrams (Type III Alloys with Partial Solubility in Solid State)
- Lecture 60 - Phase Diagrams (Congruent melting alloys, Peritectic Reaction, Monotectic Reaction)
- Lecture 61 - Phase Diagrams (Allotropy, Eutectoid and Peritectoid Reactions)
- Lecture 62 - Phase Diagrams (Iron-Iron Carbide Phase Diagram)
- Lecture 63 - Kinetics of Phase Transformations (Homogeneous Nucleation)
- Lecture 64 - Kinetics of Phase Transformations (Heterogeneous Nucleation)

[Lecture 65 - Isothermal Transformation Diagram](#)

[Lecture 66 - Martensite Transformation, C-C-T Diagram](#)

[Lecture 67 - Heat Treatment of Steels \(Annealing and Normalizing\)](#)



Lecture 1 - Review of governing equations: Conservation of mass

Lecture 2 - Review of governing equations: Conservation of momentum

Lecture 3 - Review of governing equations: Conservation of energy

Lecture 4 - Review of governing equations: Navier-Stokes equations and energy equation

Lecture 5 - Review of governing equations: General scalar transport equation

Lecture 6 - Review of governing equations: classification of PDEs

Lecture 7 - Overview of Numerical Methods: Finite Difference Method

Lecture 8 - Overview of Numerical Methods: Finite Volume Method

Lecture 9 - Overview of Numerical Methods: Solution of linear algebraic equations

Lecture 10 - Finite Volume Method for Diffusion Equation: Discretization of 1D diffusion equation

Lecture 11 - Finite Volume Method for Diffusion Equation: Discretization of 2D diffusion equation

Lecture 12 - Finite Volume Method for Diffusion Equation: Boundary conditions for 2D diffusion equation

Lecture 13 - Finite Volume Method for Diffusion Equation: Discretization of 3D diffusion equation, mixed boundary conditions

Lecture 14 - Finite Volume Method for Diffusion Equation: Tri-Diagonal Matrix Algorithm

Lecture 15 - Finite Volume Method for Diffusion Equation: Linearization of source term, line-by-line TDMA

Lecture 16 - Finite Volume Method for Diffusion Equation: Problem solving using TDMA

Lecture 17 - Finite Volume Method for Diffusion Equation: Problem solving using line-by-line TDMA

Lecture 18 - Finite Volume Method for Diffusion Equation: Steady diffusion in polar and axisymmetric coordinates

Lecture 19 - Finite Volume Method for Diffusion Equation: Discretization of unsteady diffusion equation

Lecture 20 - Finite Volume Method for Diffusion Equation: Unsteady diffusion time-stepping schemes

Lecture 21 - Finite Volume Method for Diffusion Equation: Unsteady diffusion time-stepping schemes and Truncation errors of the FV schemes

Lecture 22 - Finite Volume Method for Diffusion Equation: Truncation errors and stability analysis

Lecture 23 - Finite Volume Method for Diffusion Equation: Stability analysis and steady diffusion in unstructured meshes.

Lecture 24 - Finite Volume Method for Diffusion Equation: Steady diffusion in unstructured meshes - Part 1

Lecture 25 - Finite Volume Method for Diffusion Equation: Steady diffusion in unstructured meshes - Part 2

Lecture 26 - Finite Volume Method for Diffusion Equation: Steady diffusion in unstructured meshes - Part 3

Lecture 27 - Finite Volume Method for Diffusion Equation: Steady diffusion in unstructured meshes - Part 4

Lecture 28 - Finite Volume Method for Diffusion Equation: Steady diffusion in unstructured meshes - Part 5

Lecture 29 - Finite Volume Method for Convection and Diffusion: Discretization of steady convection equation

Lecture 30 - Finite Volume Method for Convection and Diffusion: Discretization of steady convection equation

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[Lecture 31 - Finite Volume Method for Convection and Diffusion: Discretization of steady and unsteady convection equation](#)

[Lecture 32 - Finite Volume Method for Convection and Diffusion: Discretization of unsteady convection equation](#)

[Lecture 33 - Finite Volume Method for Convection and Diffusion: Discretization of convection-diffusion equation on unstructured mesh](#)

[Lecture 34 - Finite Volume Method for Convection-diffusion and fluid flow calculations](#)

[Lecture 35 - Finite Volume Method for Fluid Flow Calculations: The staggered grid approach](#)

[Lecture 36 - Finite Volume Method for Fluid Flow Calculations: SIMPLE algorithm - Part 1](#)

[Lecture 37 - Finite Volume Method for Fluid Flow Calculations: SIMPLE algorithm - Part 2](#)

[Lecture 38 - Finite Volume Method for Fluid Flow Calculations: SIMPLE algorithm - Part 3](#)

[Lecture 39 - Finite Volume Method for Fluid Flow Calculations: SIMPLE-Revised and SIMPLE-Corrected algorithm](#)

[Lecture 40 - Finite Volume Method for Fluid Flow Calculations: SIMPLE algorithm for Colocated mesh - Part 1](#)

[Lecture 41 - Finite Volume Method for Fluid Flow Calculations: SIMPLE algorithm for Colocated mesh - Part 2](#)

[Lecture 42 - Finite Volume Method for Fluid Flow Calculations: SIMPLE-Colocated algorithm for Unstructured mesh](#)

Lecture 1 - Introduction to Mobile Robots and Manipulators

Lecture 2 - Introduction to Locomotion and Types of Locomotion

Lecture 3 - Introduction to Mobile Robot Kinematics

Lecture 4 - Degree of Maneuverability and Types of Wheels

Lecture 5 - Kinematic Simulation of a Mobile Robot (Land-based)

Lecture 6 - Kinematic Simulation and Motion Animation of a Mobile Robot (Land-based)

Lecture 7 - A Generalized Wheel (Kinematic) Model

Lecture 8 - Examples related to the Generalized Wheel (Kinematic) Model

Lecture 9 - Holonomic and Non-holonomic Mobile Robots

Lecture 10 - Kinematic Simulation of Wheeled Mobile Robots - Part 1

Lecture 11 - Kinematic Simulation of Wheeled Mobile Robots - Part 2

Lecture 12 - Kinematic Simulation of Wheeled Mobile Robots - Part 3

Lecture 13 - Mobile Robot Dynamics - Part 1

Lecture 14 - Mobile Robot Dynamics - Part 2

Lecture 15 - Equation of Motion and Dynamic Simulation of a Mobile Robot

Lecture 16 - Dynamic Models of Wheeled Mobile Robots with Wheel Configurations

Lecture 17 - Kinematic and Dynamic Models of a Mobile base with Four-Independent Steerable Power Wheels

Lecture 18 - Sensing and Perception

Lecture 19 - Sensors and Sensing

Lecture 20 - Commonly used sensors - 1

Lecture 21 - Commonly used sensors - 2

Lecture 22 - Commonly used sensors - 3

Lecture 23 - Sensor Errors and Error modelling

Lecture 24 - Mobile Robot Localisation

Lecture 25 - Map based Localisation

Lecture 26 - Markov Localisation

Lecture 27 - Kalman Filter Localisation

Lecture 28 - SLAM

Lecture 29 - Mobile Robot Navigation

Lecture 30 - Path Planning: Graph Construction

Lecture 31 - Graph Search Methods

[Lecture 32 - Path Planning and Obstacle avoidance](#)

[Lecture 33 - Introduction to Motion Control of Mobile Robots - Part 1](#)

[Lecture 34 - Introduction to Motion Control of Mobile Robots - Part 2](#)

[Lecture 35 - Kinematic control of Land-based Mobile Robots](#)

[Lecture 36 - Simulation of Land-based Mobile Robots along with Kinematic Control - Part 1](#)

[Lecture 37 - Simulation of Land-based Mobile Robots along with Kinematic Control - Part 2](#)

[Lecture 38 - Simulation of Land-based Mobile Robots along with Kinematic Control - Part 3](#)

[Lecture 39 - Dynamic Control of Mobile Robots](#)

[Lecture 40 - Cascaded or Back-stepping Control of Mobile Robots](#)

[Lecture 41 - Modern Robotics and Challenges](#)

[Lecture 42 - Multiple Mobile Robotic Systems](#)

[Lecture 43 - Autonomous Mobile Robots and Mobile Manipulators](#)

[Lecture 44 - Legged and Hybrid Robots](#)

[Lecture 45 - Underwater and Aerial Robots](#)

[Lecture 46 - Healthcare Robots](#)

Lecture 1 - Fuel and their properties - Part 1

Lecture 2 - Fuel and their properties - Part 2 - Gaseous and Liquid fuels

Lecture 3 - Fuel and their properties - Part 3 - Liquid and Solid fuels

Lecture 4 - Review of basic thermodynamics of ideal gas mixtures - Part 1

Lecture 5 - Review of basic thermodynamics of ideal gas mixtures - Part 2

Lecture 6 - Stoichiometry - Part 1

Lecture 7 - Stoichiometry - Part 2 - Worked Examples

Lecture 8 - Stoichiometry - Part 3 - Worked Examples (Continued...)

Lecture 9 - First law and Second law of thermodynamics applied to combustion - Part 1 - Heat Calculation

Lecture 10 - First law and Second law of thermodynamics applied to combustion - Part 2 - Enthalpy Calculation

Lecture 11 - First law and Second law of thermodynamics applied to combustion - Part 3 - Calculation of flame temperature

Lecture 12 - First law and Second law of thermodynamics applied to combustion - Part 4 - Chemical equilibrium

Lecture 13 - First law and Second law of thermodynamics applied to combustion - Part 5 - Chemical equilibrium (Continued...)

Lecture 14 - First law and Second law of thermodynamics applied to combustion - Part 6 - Worked examples

Lecture 15 - First law and Second law of thermodynamics applied to combustion - Part 7 - Worked examples (Continued...)

Lecture 16 - Mass transfer basics - Part 1 - Fundamentals

Lecture 17 - Mass transfer basics - Part 2 - Calculation of diffusion velocity

Lecture 18 - Mass transfer basics - Part 3 - Steady evaporation (The Stefan Problem)

Lecture 19 - Mass transfer basics - Part 4 - Steady evaporation of liquid droplet and Worked examples

Lecture 20 - Fundamentals of combustion kinetics - Part 1 - Global and elementary reactions

Lecture 21 - Fundamentals of combustion kinetics - Part 2 - Reaction rates and equilibrium constant

Lecture 22 - Fundamentals of combustion kinetics - Part 3 - Steady state and partial equilibrium approximation

Lecture 23 - Fundamentals of combustion kinetics - Part 4 - Worked examples

Lecture 24 - Governing equations for reacting flow - Part 1 - Continuity, momentum and species conservation equations

Lecture 25 - Governing equations for reacting flow - Part 2 - The energy equation

Lecture 26 - Governing equations for reacting flow - Part 3 - Estimation of thermo-physical properties and control of combustion phenomena

Lecture 27 - Governing equations for reacting flow - Part 4 - Control of combustion phenomena and simplified chemically reacting system

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Lecture 17 - Numericals on Gear Pump, Tree Structure of Vane Pump

Lecture 18 - Vane Pump, Pumping theory, Construction and Operation of Unbalanced Vane Pump, Vane loading and solutions, Different Vanes

Lecture 19 - Variable Displacement Pressure Compensated Vane Pump, Balance Vane Pump, Kinematic Inversion of Vane pump and Numerical

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**Co-ordinators : Dr. D. B. Karunakar**

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Lecture 12 - Steps Involved in Making a Sand Casting

Lecture 13 - Design of Riser System - 1

Lecture 14 - Design of Riser System - 2

Lecture 15 - Design of Riser System - 3

Lecture 16 - Design of Riser System - 4

Lecture 17 - Design of Riser System - 5

Lecture 18 - Design of Gating System - 1

Lecture 19 - Design of Gating System - 2

Lecture 20 - Sand Casting Defects - 1

Lecture 21 - Sand Casting Defects - 2

Lecture 22 - Melting Furnaces and Practice

Lecture 23 - Treatment of Molten Metal

Lecture 24 - Fluidity of Molten Metal

Lecture 25 - Solidification

Lecture 26 - Cast Irons and Steels

Lecture 27 - Aluminum and Magnesium Cast Alloys

Lecture 28 - Copper, Zinc and Titanium Cast Alloys

Lecture 29 - Die Casting Process - I

Lecture 30 - Die Casting Process - II

Lecture 31 - Investment Casting Process - I

[Lecture 32 - Investment Casting Process - II](#)

[Lecture 33 - Continuous Casting Process](#)

[Lecture 34 - Centrifugal Casting Process](#)

[Lecture 35 - Evaporative Pattern Casting and Plaster Moulding](#)

[Lecture 36 - Vacuum Sealed Moulding and Squeeze Casting](#)

[Lecture 37 - Shakeout, Fettling and Finishing](#)

[Lecture 38 - Inspection, Testing and Quality Control](#)

[Lecture 39 - Design Consideration and Economics](#)

[Lecture 40 - Environment, Health and Safety Aspects](#)



Lecture 1 - Engineering Materials and Processing Techniques: Introduction

Lecture 2 - Properties of Non-Metals

Lecture 3 - Glass Structure and Properties

Lecture 4 - Glass Processing - I

Lecture 5 - Glass Processing - II

Lecture 6 - Ceramics - I

Lecture 7 - Ceramics - II

Lecture 8 - Ceramic Powder Preparation

Lecture 9 - Ceramic Powder Preparation – I

Lecture 10 - Processing of Ceramic Parts ? Pressing

Lecture 11 - Processing of Ceramic Parts – II

Lecture 12 - Ceramics: Secondary Processing

Lecture 13 - Thermoplastics and Thermosets

Lecture 14 - Processing of Plastics

Lecture 15 - Extrusion of Plastics

Lecture 16 - Transfer Molding and Compression Molding

Lecture 17 - Injection Molding

Lecture 18 - Thermoforming

Lecture 19 - Rotational Molding and Blow Molding

Lecture 20 - Composite Materials

Lecture 21 - Composite Materials: Classification and Applications

Lecture 22 - Processing of Polymer Matrix Composites

Lecture 23 - Hand Lay-up and Spray Lay-up

Lecture 24 - Pultrusion

Lecture 25 - Compression Molding

Lecture 26 - Filament Winding

Lecture 27 - Injection Molding-1

Lecture 28 - Pre-pregging and Sheet Molding Compounds

Lecture 29 - Resin Transfer Molding and Autoclave Molding

Lecture 30 - Ceramic Matrix Composites

Lecture 31 - Ceramic Matrix Composites: Fundamentals and Properties

[Lecture 32 - Powder Processing: Ceramic Matrix Composites](#)

[Lecture 33 - Chemical Vapour Infiltration](#)

[Lecture 34 - Ceramic Matrix Composites: Processing-1](#)

[Lecture 35 - Ceramic Matrix Composites: Post Processing](#)

[Lecture 36 - Drilling of Polymer Matrix Composites](#)

[Lecture 37 - Hole Making Techniques for Polymer Matrix Composites](#)

[Lecture 38 - Joining of Polymer Matrix Composites](#)

[Lecture 39 - Microwave Joining of Polymer Matrix Composites](#)

[Lecture 40 - Research Tools for Secondary Processing](#)

**NPTEL : Vibration control (Mechanical Engineering)**

**Co-ordinators : Dr. S. P. Harsha**

Lecture 1 - Basics of Vibrations for Simple Mechanical Systems

Lecture 2 - Introduction to Damping in Free and Force Vibrations

Lecture 3 - Free and Forced Vibrations of Two Degree of Systems

Lecture 4 - Multi Degree of Freedom Systems

Lecture 5 - Reduction at source - 1

Lecture 6 - Reduction at source - 2

Lecture 7 - Reduction at source - 3

Lecture 8 - Feedback Control System - 1

Lecture 9 - Shunt Damping

Lecture 10 - Vibration Isolation - 1

Lecture 11 - Vibration Isolation - 2

Lecture 12 - Vibration Isolation - 3

Lecture 13 - Source Classification

Lecture 14 - Self Excitation Vibration

Lecture 15 - Flow Induction Vibration

Lecture 16 - Field Balancing of Rigid / Flexible Rotors

Lecture 17 - Damping: Models and Measures - I

Lecture 18 - Damping: Models and Measures - II

Lecture 19 - Numerical Problems

Lecture 20 - Design Sensitivity - I

Lecture 21 - Design Specification

Lecture 22 - Design for Enhanced Material Damping

Lecture 23 - Basics of Passive Vibration Control

Lecture 24 - Design of Absorber

Lecture 25 - Shock Absorber

Lecture 26 - Isolators with Stiffness and Damping

Lecture 27 - Basics of Active Vibration Control

Lecture 28 - Piezoelectric Material - I

Lecture 29 - Piezoelectric Material - II: Applications

Lecture 30 - Piezoelectric Accelerometers

Lecture 31 - Electro-rheological (ER) Fluids

[Lecture 32 - Magneto-rheological \(MR\) Fluids](#)

[Lecture 33 - Magneto and Electrostrictive Materials](#)

[Lecture 34 - Shape Memory Alloy](#)

[Lecture 35 - Electro-Magnetics](#)

[Lecture 36 - Numerical Problems](#)

[Lecture 37 - Basics of Vibration Measurement System](#)

[Lecture 38 - Data Acquisition](#)

[Lecture 39 - Fourier Transformation](#)

[Lecture 40 - Filters](#)

- Lecture 1 - Introduction to Welding Engineering
- Lecture 2 - Classification of Welding Processes - I
- Lecture 3 - Classification of Welding Processes - II
- Lecture 4 - Sources of Heat and Protection of Weld pool
- Lecture 5 - Protection of Weld Pool
- Lecture 6 - Introduction
- Lecture 7 - Fundamentals of Arc Initiation
- Lecture 8 - Arc Maintenance & Arc Characteristics
- Lecture 9 - Arc Forces
- Lecture 10 - Arc Efficiency
- Lecture 11 - Melting Rate in Different Welding Processes
- Lecture 12 - Types of power sources and their characteristics - I
- Lecture 13 - Types of power sources and their characteristics - II
- Lecture 14 - SMAW - I
- Lecture 15 - SMAW - II
- Lecture 16 - GTAW - I
- Lecture 17 - GTAW - II
- Lecture 18 - PAW & SAW
- Lecture 19 - SAW
- Lecture 20 - GMAW
- Lecture 21 - Brazing, Soldering & Braze Welding
- Lecture 22 - Braze welding and Electroslag welding
- Lecture 23 - Weld Thermal Cycle
- Lecture 24 - Effect of WTC and Cooling rate in welding
- Lecture 25 - Cooling rate
- Lecture 26 - Peak temperature & Solidification rate
- Lecture 27 - Residual stress - I
- Lecture 28 - Residual stress - II
- Lecture 29 - Introduction
- Lecture 30 - Type of joints and welds
- Lecture 31 - Edge preparation

[Lecture 32 - Design for static and fatigue loading](#)

[Lecture 33 - Fatigue fracture of weld joints - I](#)

[Lecture 34 - Fatigue fracture of weld joints - II](#)

[Lecture 35 - Introduction-](#)

[Lecture 36 - DT & NDT](#)

[Lecture 37 - Understanding Weldability](#)

[Lecture 38 - Reactions in weldment](#)

[Lecture 39 - Weldability of Al alloys](#)

[Lecture 40 - Failure analysis and prevention](#)

Lecture 1 - Production Planning and Control

Lecture 2 - Product Design and Development

Lecture 3 - Statistical Process Control - Part I

Lecture 4 - Statistical Process Control - Part II

Lecture 5 - Statistical Process Control - Part III

Lecture 6 - Productivity

Lecture 7 - Factors Affecting the Productivity

Lecture 8 - Improving the Productivity Introduction to Work Study

Lecture 9 - Work Study Human Component and Method Study

Lecture 10 - Recording Techniques for Method Study - Part I

Lecture 11 - Recording Techniques for Method Study - Part II

Lecture 12 - Recording Techniques Critical Examination

Lecture 13 - Principles of Motion Economy

Lecture 14 - Work Measurement Time Study - Part I

Lecture 15 - Work Measurement Time Study - Part II

Lecture 16 - Performance Rating Allowances

Lecture 17 - Work Measurement: Work Sampling

Lecture 18 - PMT System Standard Data Method

Lecture 19 - Ergonomics

Lecture 20 - Metabolism and Organization at Work

Lecture 21 - Working Conditions Lights Vibrations

Lecture 22 - Materials Management - Part I

Lecture 23 - Materials Management - Part II

Lecture 24 - Materials Requirement Planning

Lecture 25 - Sales Forecasting - Part I

Lecture 26 - Sales Forecasting - Part II

Lecture 27 - Capacity Planning - Part I

Lecture 28 - Capacity Planning - Part II

Lecture 29 - Network Analysis - Part I

Lecture 30 - Network Analysis - Part II

Lecture 31 - Facility Design Part - Part I

[Lecture 32 - Facility Design Part - Part II](#)

[Lecture 33 - Facility Design Part - Part III](#)

[Lecture 34 - Facility Design Part - Part IV](#)

[Lecture 35 - Product Design Development](#)

[Lecture 36 - Materials Handling](#)

[Lecture 37 - Quality Concepts](#)

[Lecture 38 - Value Engineering](#)

[Lecture 39 - Reliability](#)

[Lecture 40 - Industrial Safety](#)



Lecture 1 - Powder Metallurgy - Part I

Lecture 2 - Powder Metallurgy - Part II

Lecture 3 - Powder Metallurgy - Part III

Lecture 4 - Metal Forming - Fundamentals

Lecture 5 - Forging

Lecture 6 - Swaging and Wire Drawing

Lecture 7 - Sheet Metal Operations - Part I

Lecture 8 - Sheet Metal Operations - Part II

Lecture 9 - Sheet Metal Operations - Part III

Lecture 10 - Sheet Metal Working - Presses

Lecture 11 - Sheet Metal Working - Equipment

Lecture 12 - High Energy Rate Forming Processes

Lecture 13 - Machining Fundamentals

Lecture 14 - Machining - Part I

Lecture 15 - Machining - Part II

Lecture 16 - Machining - Part III

Lecture 17 - Metal casting - Part I

Lecture 18 - Metal casting - Part II

Lecture 19 - Metal Casting - Part III

Lecture 20 - Metal Casting - Part IV

Lecture 21 - Metal Casting - Part V

Lecture 22 - Metal Casting - Part VI

Lecture 23 - Metal Casting - Part VII

Lecture 24 - Metal Casting - Part VIII

Lecture 25 - Metal Casting - Part IX

Lecture 26 - Metal Casting - Part X

Lecture 27 - Introduction

Lecture 28 - Welding Process Classification

Lecture 29 - Brazing Soldering Braze Welding

Lecture 30 - Arc Welding Power Source - Part I

Lecture 31 - Arc Welding Power Source - Part II

[Lecture 32 - Shielded Metal Arc Welding - Part I](#)

[Lecture 33 - Shielded Metal Arc Welding - Part II](#)

[Lecture 34 - Submerged Arc Welding](#)

[Lecture 35 - Gas Metal Arc Welding - Part I](#)

[Lecture 36 - Gas Metal Arc Welding - Part II](#)

[Lecture 37 - Tungsten Inert Gas Welding - Part I](#)

[Lecture 38 - Tungsten Inert Gas Welding - Part II](#)

[Lecture 39 - Resistance Welding Process](#)

[Lecture 40 - Reaction in Weld Region Welding Defects](#)

**NPTEL : Strength of Materials (Mechanical Engineering)**

**Co-ordinators : Dr. S.P. Harsha**

Lecture 1 - Solid Mechanics

Lecture 2 - Strength of Materials

Lecture 3 - Strength of Materials

Lecture 4 - Solid Mechanics

Lecture 5 - Strength of Materials

Lecture 6 - Strength of Materials

Lecture 7 - Strength of Materials

Lecture 8 - Strength of Materials

Lecture 9 - Strength of Materials

Lecture 10 - Strength of Materials

Lecture 11 - Strength of Materials

Lecture 12 - Strength of Materials

Lecture 13 - Strength of Materials

Lecture 14 - Strength of Materials

Lecture 15 - Strength of Materials

Lecture 16 - Strength of Materials

Lecture 17 - Strength of Materials

Lecture 18 - Strength of Materials

Lecture 19 - Strength of Materials

Lecture 20 - Strength of Materials

Lecture 21 - Strength of Materials

Lecture 22 - Strength of Materials

Lecture 23 - Strength of Materials

Lecture 24 - Strength of Materials

Lecture 25 - Strength of Materials

Lecture 26 - Strength of Materials

Lecture 27 - Strength of Materials

Lecture 28 - Strength of Materials

Lecture 29 - Strength of Materials

Lecture 30 - Strength of Materials

Lecture 31 - Strength of Materials

[Lecture 32 - Strength of Materials](#)

[Lecture 33 - Strength of Materials](#)

[Lecture 34 - Strength of Materials](#)

[Lecture 35 - Strength of Materials](#)

[Lecture 36 - Strength of Materials](#)

[Lecture 37 - Strength of Materials](#)

[Lecture 38 - Strength of Materials](#)

[Lecture 39 - Strength of Materials](#)

[Lecture 40 - Strength of Materials](#)

Lecture 1 - Introduction

Lecture 2 - Flow Regimes

Lecture 3 - Homogeneous Model

Lecture 4 - Drift Flux Model

Lecture 5 - Separated Flow Model

Lecture 6 - Dispersed Flow

Lecture 7 - Slug Flow

Lecture 8 - Annular Flow

Lecture 9 - Droplet Annular and Stratified Flow

Lecture 10 - Measurement of Void Fraction

Lecture 11 - Signal Analysis

Lecture 12 - Two Fluid and Population Balance Model

Lecture 13 - Interface Tracking

Lecture 14 - Lattice Boltzmann Method

Lecture 15 - Smoothed Particle Hydrodynamics

Lecture 16 - Molecular Perspective of Two Phase Flow

Lecture 17 - Boiling Heat Transfer

Lecture 18 - Condensation

Lecture 19 - Solid-Liquid Flow

Lecture 20 - Gas-Solid Flow

Lecture 1 - Recapitulation of Thermodynamics

Lecture 2 - Introduction to Refrigeration

Lecture 3 - Air Refrigeration Cycle

Lecture 4 - Aircraft Refrigeration Cycles - 1

Lecture 5 - Aircraft Refrigeration Cycles - 2

Lecture 6 - Aircraft Refrigeration Cycles - 3

Lecture 7 - Vapour Compression Cycle - 1

Lecture 8 - Vapour Compression Cycle - 2

Lecture 9 - P-h Charts

Lecture 10 - Actual Vapour Compression Cycle - 1

Lecture 11 - Actual Vapour Compression Cycle - 2

Lecture 12 - Compound Compression with Intercooling - 1

Lecture 13 - Compound Compression with Intercooling - 2

Lecture 14 - Multiple Evaporator and Cascade System

Lecture 15 - Problem Solving - 1

Lecture 16 - Refrigerants - 1

Lecture 17 - Refrigerants - 2

Lecture 18 - Vapour Absorption Systems - 1

Lecture 19 - Vapour Absorption Systems - 2

Lecture 20 - Vapour Absorption Systems - 3

Lecture 21 - Introduction to Air-conditioning

Lecture 22 - Properties of Moist Air

Lecture 23 - Psychrometric Chart

Lecture 24 - Psychrometric Processes - 1

Lecture 25 - Psychrometric Processes - 2

Lecture 26 - Psychrometric Processes - 3

Lecture 27 - Infiltration

Lecture 28 - Design Conditions

Lecture 29 - Cooling Load - 1

Lecture 30 - Cooling Load - 2

Lecture 31 - Cooling Load - 3

[Lecture 32 - Air Distribution System - 1](#)

[Lecture 33 - Air Distribution System - 2](#)

[Lecture 34 - Problem Solving - 2](#)

[Lecture 35 - Air-Conditioning Systems](#)

[Lecture 36 - Human Physiology](#)

[Lecture 37 - Thermal Comfort](#)

[Lecture 38 - Indoor Environmental Health - 1](#)

[Lecture 39 - Indoor Environmental Health - 2](#)

[Lecture 40 - Problem Solving - 3](#)

- Lecture 1 - Introduction to Engineering Economy, Physical and Economic Environment, Phases in Engg. process
- Lecture 2 - Some economic concepts, Value and utility, Interest and Interest rate, Time value of money
- Lecture 3 - Interest formulas: Simple and compound interest, Cash flow diagrams
- Lecture 4 - Interest formulas for discrete compounding and discrete payments: Single payment (CAF and PWF)
- Lecture 5 - Interest formulas for discrete compounding and discrete payments: Equal payment series (CAF, CRF and PWF)
- Lecture 6 - Problem solving on discrete compounding, discrete payment
- Lecture 7 - Interest formulas for Uniform gradient series
- Lecture 8 - Interest formulas for geometric gradient series
- Lecture 9 - Compounding frequency of Interest: Nominal and Effective interest rates
- Lecture 10 - Problem solving on frequency compounding of interest and gradient series factors
- Lecture 11 - Economic equivalence: Meaning and principles of equivalence
- Lecture 12 - Equivalence calculations involving cash flows
- Lecture 13 - Methods of comparison of alternatives: Present worth, Annual equivalent, Future worth, Internal rate of return
- Lecture 14 - comparison of alternatives: Capitalized equivalent amount, Capital recovery with return
- Lecture 15 - Problem solving on equivalence and comparison of alternatives
- Lecture 16 - Replacement analysis: Reason, Concept of defender and challenger
- Lecture 17 - Proper treatment of sunk cost in replacement
- Lecture 18 - Replacement because of improved efficiency, inadequacy, demand etc.
- Lecture 19 - Problem solving on replacement analysis
- Lecture 20 - Economic life of the asset
- Lecture 21 - Depreciation: Definition, Reasons, Types of property, Value time function and book value
- Lecture 22 - Basic depreciation methods:S-L method, Declining balance method
- Lecture 23 - Depreciation: Declining balance switching to S-L, SOYD Method
- Lecture 24 - Modified accelerated cost recovery system (MACRS) method of depreciation, Depletion
- Lecture 25 - Depreciation: Units of production method, Depletion
- Lecture 26 - Problem solving based on Depreciation and Depletion
- Lecture 27 - Elements of cost: types of cost
- Lecture 28 - Breakeven analysis, Effect of fixed and variable cost on BEP.
- Lecture 29 - Economic order quantity
- Lecture 30 - Problem solving based on Breakeven analysis and EOQ
- Lecture 31 - Cost estimation: Methods of cost estimation, Adjustment of data, Learning



[Lecture 32 - cost estimating relationships](#)

[Lecture 33 - Introduction to decision under risk Criteria for decision under risk](#)

[Lecture 34 - Expected value decision making under risk](#)

[Lecture 35 - Expected variance decision making under risk](#)

[Lecture 36 - Problem solving based on decision under risk](#)

[Lecture 37 - Income taxes: Principles and calculation of effective income tax rates](#)

[Lecture 38 - Effect of method of depreciation on income taxes](#)

[Lecture 39 - After tax economic analysis](#)

[Lecture 40 - Problem solving based on Income tax analysis](#)

Lecture 1 - Introduction

Lecture 2 - Balance of Total Energy

Lecture 3 - Different Forms of Thermal Energy Equation

Lecture 4 - Thermal Boundary Layer

Lecture 5 - Forced Convection : Low Prandtl Number over a Flat Plate

Lecture 6 - Forced Convection : High Prandtl Number over a Flat Plate

Lecture 7 - Forced Convection over a Flat Plate : Uniform Heat Flux

Lecture 8 - Natural Convection : Uniform Wall Temperature

Lecture 9 - Natural Convection : Uniform Heat Flux

Lecture 10 - Tutorial : Convection over Flat Plate

Lecture 11 - Forced Convection in Ducts

Lecture 12 - Thermally Developed Slug Flow in a Duct

Lecture 13 - Thermally and Hydrodynamically Developed Flow : Uniform Heat Flux

Lecture 14 - Thermally and Hydrodynamically Developed Flow : Uniform Wall Temperature

Lecture 15 - Thermal Entrance Region : Uniform Wall Temperature

Lecture 16 - Thermal Entrance Region : Uniform Heat Flux

Lecture 17 - Rayleigh Benard Convection

Lecture 18 - Heat Transfer with Phase Change

Lecture 19 - Mass Transfer

Lecture 20 - Tutorial : Convection inside Duct and Mass Transfer

Lecture 1 - Lesson 1 - Introduction

Lecture 2 - Lesson 2 - Addition of two harmonic motions and beat phenomenon

Lecture 3 - Lesson 3 - Fourier series and harmonic analysis

Lecture 4 - Lesson 4 - Vibration analysis procedure

Lecture 5 - Lesson 5 - Numerical problems

Lecture 6 - Lesson 1 - Undamped free vibration

Lecture 7 - Lesson 2 - Energy method

Lecture 8 - Lesson 3 - Damped free vibration

Lecture 9 - Lesson 4 - Viscous damped systems and logarithmic decrement

Lecture 10 - Lesson 5 - Coulomb damping

Lecture 11 - Lesson 1 - Harmonic excitations

Lecture 12 - Lesson 2 - Magnification factor and frequency response curve

Lecture 13 - Lesson 3 - Rotating unbalance

Lecture 14 - Lesson 4 - Excitation of the support

Lecture 15 - Lesson 5 - Energy input and dissipation by viscous damping

Lecture 16 - Lesson 1 - Coulomb damping and equivalent viscous damping

Lecture 17 - Lesson 2 - Structural damping and equivalent viscous damping

Lecture 18 - Lesson 3 - Vibration isolation and force transmissibility

Lecture 19 - Lesson 4 - Motion transmissibility

Lecture 20 - Lesson 5 - Numerical problems

Lecture 21 - Lesson 1 - Transducers and vibration pickup

Lecture 22 - Lesson 2 - Vibrometer

Lecture 23 - Lesson 3 - Accelerometer

Lecture 24 - Lesson 4 - Velocity pickup or Velometer

Lecture 25 - Lesson 5 - Phase distortion and frequency measurement

Lecture 26 - Lesson 1 - Undamped free vibration

Lecture 27 - Lesson 2 - Principal modes of vibration

Lecture 28 - Lesson 3 - Combined rectilinear and angular modes

Lecture 29 - Lesson 4 - Damped free vibration

Lecture 30 - Lesson 5 - Undamped forced vibration with harmonic excitation

Lecture 31 - Lesson 1 - Undamped dynamic vibration absorber

[Lecture 32 - Lesson 2 - Tuned absorber](#)

[Lecture 33 - Lesson 3 - Numerical problems](#)

[Lecture 34 - Lesson 4 - Damped dynamic vibration absorber](#)

[Lecture 35 - Lesson 5 - Optimally tuned vibration absorber](#)

[Lecture 36 - Lesson 1 - Undamped free vibration](#)

[Lecture 37 - Lesson 2 - Eigen values and eigen vectors](#)

[Lecture 38 - Lesson 3 - Flexibility influence coefficients](#)

[Lecture 39 - Lesson 4 - Stiffness influence coefficients](#)

[Lecture 40 - Lesson 5 - Static and dynamic coupling](#)

Lecture 1 - Introduction: Manufacturing and Joining

Lecture 2 - Fundamental mechanisms of Joining

Lecture 3 - Classification of Joining Processes

Lecture 4 - Heat Generation in Welding

Lecture 5 - Protection of Weld Metal

Lecture 6 - Principle of Fusion Welding Processes: Gas Welding

Lecture 7 - Fundamentals of Welding

Lecture 8 - Physics of Welding Arc

Lecture 9 - Shielded Metal Arc Welding

Lecture 10 - Gas Tungsten Arc Welding

Lecture 11 - Newer variants of Gas tungsten arc welding

Lecture 12 - Gas metal arc welding

Lecture 13 - Submerged arc welding

Lecture 14 - Electro-slag and Electro-gas welding

Lecture 15 - Laser beam welding

Lecture 16 - Brazing

Lecture 17 - Soldering and braze welding

Lecture 18 - Fundamentals of resistance welding

Lecture 19 - Resistance welding processes: spot and seam welding

Lecture 20 - Flash butt welding

Lecture 21 - Adhesive joining

Lecture 22 - Weld bonding

Lecture 23 - Solid state joining technologies: Fundamentals

Lecture 24 - Ultrasonic welding

Lecture 25 - Diffusion welding

Lecture 26 - Explosive welding

Lecture 27 - Magnetic pulse welding

Lecture 28 - Weld thermal cycle

Lecture 29 - Heat affected zone and weld thermal cycle - I

Lecture 30 - Heat affected zone and weld thermal cycle - II

Lecture 31 - Solidification of weld metal

- Lecture 32 - Metallurgical transformations in weld and heat affected zone of steels
- Lecture 33 - Residual Stresses in Weld Joints
- Lecture 34 - Solidification cracking and their control
- Lecture 35 - Cracking of Welded Joints II - Cold Cracks
- Lecture 36 - Understanding Weldability Introduction - I
- Lecture 37 - Understanding Weldability Introduction - II
- Lecture 38 - Metal Properties and Weldability - I
- Lecture 39 - Metal Properties and Weldability - II
- Lecture 40 - Weldability of Work Hardenable Metals
- Lecture 41 - Weldability of Work Hardenable and Precipitation Strengthened Metals
- Lecture 42 - Weldability of Precipitation Strengthened Metals
- Lecture 43 - Weldability of Metals Strengthened by Grain Refinement and Transformation Hardening
- Lecture 44 - Weldability of Transformation Hardening Metals
- Lecture 45 - Weldability of Metals - Combination of Strengthening Mechanisms
- Lecture 46 - Weldability Consideration
- Lecture 47 - Weldability of Carbon and Alloy Steel - I
- Lecture 48 - Weldability of Carbon and Alloy Steel - II
- Lecture 49 - Weldability of Carbon and Alloy Steel - III
- Lecture 50 - Weldability of Low Carbon Steel and Mild Steel
- Lecture 51 - Weldability of Medium Carbon Steel and High Carbon Steel
- Lecture 52 - Weldability of High Strength Low Alloy Steels
- Lecture 53 - Weldability of HTLA Steel - I
- Lecture 54 - Weldability of HTLA Steel - II
- Lecture 55 - Weldability of Cr-Mo Steel - I
- Lecture 56 - Weldability of Cr-Mo Steel - II
- Lecture 57 - Weldability of Pre-coated Steel - I
- Lecture 58 - Weldability of Pre-coated Steel - II
- Lecture 59 - Weldability of Stainless Steel - I
- Lecture 60 - Weldability of Stainless Steel - II

- Lecture 1 - Introduction to Modelling
- Lecture 2 - Examples of models
- Lecture 3 - Modeling of Dynamic Systems
- Lecture 4 - Introduction to Simulation
- Lecture 5 - MATLAB as a Simulation tool
- Lecture 6 - Bond graphs modelling
- Lecture 7 - Bond graph model and causality
- Lecture 8 - Generation of System Equations
- Lecture 9 - Methods of Drawing bond graph models - Mechanical Systems
- Lecture 10 - Methods of Drawing bond graph models - Electrical Systems
- Lecture 11 - Basic System Models - Mechanical Systems
- Lecture 12 - Basic System Models - Electrical Systems
- Lecture 13 - Basic System Models - Hydraulic Systems
- Lecture 14 - Basic System Models - Pneumatic Systems
- Lecture 15 - Basic System Models - Thermal Systems
- Lecture 16 - System Models : Linearity and Non Linearity in Systems
- Lecture 17 - System Model of Combined Rotary and Translatory Systems
- Lecture 18 - System Model of Electro Mechanical Systems
- Lecture 19 - System Model of Hydro Mechanical Systems
- Lecture 20 - System Models of Robots
- Lecture 21 - Dynamic response of the 1st order system
- Lecture 22 - Dynamic response of 2nd order system
- Lecture 23 - Performance measures for 2nd order system
- Lecture 24 - System Transfer functions
- Lecture 25 - Transfer Function of 1st and 2nd Order System
- Lecture 26 - Block Diagram Algebra
- Lecture 27 - Signal Flow Graphs
- Lecture 28 - State Variable Formulation
- Lecture 29 - Frequency Response
- Lecture 30 - Bode Plot
- Lecture 31 - Simulation using SIMULINK

[Lecture 32 - Simulation of simple and compound pendulums](#)

[Lecture 33 - Simulation of planar mechanisms](#)

[Lecture 34 - Simulation of wheeled mobile robots](#)

[Lecture 35 - Validation and Verification of Simulation Models](#)

[Lecture 36 - Parameter estimation methods](#)

[Lecture 37 - Parameter estimation examples](#)

[Lecture 38 - System identifications](#)

[Lecture 39 - Introduction to Optimization](#)

[Lecture 40 - Optimization with modeling of engineering problems](#)



Lecture 1 - Introduction to Casting Technology

Lecture 2 - Mechanism of solidification

Lecture 3 - Solidification of Pure Metals and Alloys

Lecture 4 - Freeze Wave Mechanism and Solidification Time

Lecture 5 - Problem Solving on Solidification

Lecture 6 - Technology of pattern making

Lecture 7 - Allowances in pattern making

Lecture 8 - Moulding sands and its ingredients

Lecture 9 - Testing of molding sands

Lecture 10 - Sand preparation for casting

Lecture 11 - Technology of mould making

Lecture 12 - Technology of core making

Lecture 13 - Special sand moulding process

Lecture 14 - Organic binders

Lecture 15 - Special moulding process

Lecture 16 - Introduction of gating design

Lecture 17 - Types of gate

Lecture 18 - Pouring time calculation

Lecture 19 - Aspiration effects in gating system

Lecture 20 - Problem solving on gating design

Lecture 21 - Solidification analysis

Lecture 22 - Riser design methods

Lecture 23 - Shape factor

Lecture 24 - Feeding and Chills effect

Lecture 25 - Problem related to riser design

Lecture 26 - Special casting process - 1

Lecture 27 - Special casting process - 2

Lecture 28 - Special casting process - 3

Lecture 29 - Technology of melting

Lecture 30 - Melting practices

Lecture 31 - Melting and Casting of cast metal

[Lecture 32 - Melting practice for gray iron](#)

[Lecture 33 - Melting practice for Malleable iron and S.G iron](#)

[Lecture 34 - Casting of steel and alloy steel](#)

[Lecture 35 - Casting practices for non-ferrous metals and alloys](#)

[Lecture 36 - Fettling of castings](#)

[Lecture 37 - Heat treatment of castings](#)

[Lecture 38 - Heat treatment practices for cast iron and non-ferrous metals and alloys](#)

[Lecture 39 - Casting defects](#)

[Lecture 40 - Diagnostics of casting defects](#)

Lecture 1 - Review of Thermodynamics

Lecture 2 - Rankine Cycle

Lecture 3 - Performance of Rankine Cycle

Lecture 4 - Binary vapour cycle and co-generation

Lecture 5 - Problem Solving (Rankine Cycle)

Lecture 6 - Steam Generators

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- Lecture 21 - Concept of stress and strain, Elastic and plastic behavior
- Lecture 22 - State of stress in two and three dimensions, Mohr's circle
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Lecture 39 - Rayleigh quotient for natural frequencies and mode shapes of elastic systems

Lecture 40 - Stability analysis and buckling using calculus of variations

Lecture 41 - Strongest (most stable) column

Lecture 42 - Dynamic compliance optimization

Lecture 43 - Electro-thermal-elastic structural optimization

Lecture 44 - Formulating the extremization problem starting from the differential equation, self-adjointness of the differential operator, and methods to deal with conservative and dissipative system

Lecture 1 - Overview

Lecture 2 - Spirit of compliant design

Lecture 3 - A glimpse of applications

Lecture 4 - Mobility and degrees of freedom in compliant mechanisms

Lecture 5 - Maxwell's rule and Grubler's formula

Lecture 6 - Using compatibility and force equilibrium matrices to identify degrees of freedom and states of self-stress in trusses

Lecture 7 - Empirical formula for flexure joints

Lecture 8 - Types of elastic pairs (flexures)

Lecture 9 - Linear finite element analysis of compliant mechanisms with beam elements

Lecture 10 - A compliant mechanism kit

Lecture 11 - Linear and nonlinear finite element analyses using continuum elements

Lecture 12 - Subtleties in finite element analysis: geometric nonlinearity and contact

Lecture 13 - Deformation of a cantilever under a tip-load, using elliptic integrals

Lecture 14 - Elliptic integrals and their use in elastica analysis

Lecture 15 - Frisch-Fay's approach to large deformation of beam

Lecture 16 - Burns-Crossley's kinematic model

Lecture 17 - Howell-Midha's elastic model

Lecture 18 - Putting together the pseudo rigid-body model

Lecture 19 - Modeling a partially compliant mechanism

Lecture 20 - Kinematic coefficients of a four-bar linkage with and without springs

Lecture 21 - Solving equations of PRB modeling and comparing with finite element analysis

Lecture 22 - Loop-closure equations for PRB models of compliant mechanisms

Lecture 23 - Burmester theory for compliant mechanisms

Lecture 24 - PRB-based Synthesis Examples

Lecture 25 - Structural optimization approach

Lecture 26 - Early works on design for compliance

Lecture 27 - Design for deflection of trusses

Lecture 28 - Design for deflection of beams and frames

Lecture 29 - Design of elastic continua for desired deflection

Lecture 30 - Continuum element-based topology optimization of compliant mechanisms

Lecture 31 - YinSyn; synthesis of nonlinear responses with compliant mechanisms

Lecture 32 - Five different formulations for compliant mechanism design and some benchmark problems

Lecture 33 - Distributed compliance

Lecture 34 - How to achieve distributed compliance

Lecture 35 - Shape optimization

Lecture 36 - Cam-flexure clamp-case-study

Lecture 37 - SL model for compliant mechanisms

Lecture 38 - Feasibility maps for compliant mechanisms

Lecture 39 - Selection of compliant mechanisms for given user-specifications

Lecture 40 - Two case-studies using feasibility maps technique

Lecture 41 - SML model for compliant mechanisms for dynamic response

Lecture 42 - Re-design of compliant mechanisms; Matlab and Java codes

Lecture 43 - Non-dimensional analysis of beams

Lecture 44 - Deformation index and slenderness ratio of compliant mechanisms

Lecture 45 - Kinetoelastostatic maps

Lecture 46 - Designing with kinetoelastic maps

Lecture 47 - Non-dimensionalization of stress, frequency, and other measures

Lecture 48 - Designing compliant suspensions using kinetoelastic maps

Lecture 49 - Instant centre method for designing compliant mechanisms

Lecture 50 - Stiffness and compliance ellipsoids

Lecture 51 - Building block method of designing compliant mechanisms

Lecture 52 - Comparative analysis of different methods for designing compliant mechanisms

Lecture 53 - Aspects of Mechanical advantage of compliant mechanisms

Lecture 54 - Mechanical advantage of rigid-body and compliant mechanisms

Lecture 55 - Bistability in elastic systems

Lecture 56 - Analysis of bistable arches

Lecture 57 - Compliant mechanisms with bistable arches

Lecture 58 - Static balancing and zero-free-length springs

Lecture 59 - Static balance of a compliant mechanism using a linkage

Lecture 60 - Static balancing method for compliant mechanisms

Lecture 61 - A catalogue of compliant mechanisms

Lecture 62 - Compliant suspension mechanism in microsystems (MEMS)

Lecture 63 - Micromechanical signal processors using compliant mechanisms

Lecture 64 - A few special concepts of compliant mechanisms

[Lecture 65 - Materials and prototyping of compliant mechanisms](#)

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[Lecture 68 - Miniature compliant mechanisms as cell-manipulation tools](#)

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[Lecture 70 - Compliant tissue cutting mechanism](#)

[Lecture 71 - A compliant pipe-crawling robots](#)

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Lecture 1 - Introduction to Multiphase

Lecture 2 - Thermodynamics of Multiphase systems

Lecture 3 - Thermodynamics of Interface - I

Lecture 4 - Thermodynamics of Interface - II

Lecture 5 - Interfacial phenomena key concepts - I

Lecture 6 - Interfacial phenomena key concepts - II

Lecture 7 - Interfacial heat and mass transfer - I - Interfacial mass, momentum and energy balance, Surface tension, WettingL07

Lecture 8 - Interfacial heat and mass transfer - II - Interfacial dynamics, Instabilities of the interface

Lecture 9 - Interfacial heat and mass transfer - III - Evaporation from thin films

Lecture 10 - Governing equations and interfacial conditions

Lecture 11 - Governing equations : Averaging techniques - I

Lecture 12 - Governing equations : Averaging techniques - II

Lecture 13 - Governing equations : Averaging techniques - III

Lecture 14 - Interface shapes

Lecture 15 - Transport processes at interface with key concepts - I

Lecture 16 - Transport processes at interface with key concepts - II

Lecture 17 - Interfacial transport

Lecture 18 - Interfacial transport including dynamic behavior

Lecture 19 - Interface behavior

Lecture 20 - Heat transfer and evaporation in droplets

Lecture 21 - Droplet vaporization models - I

Lecture 22 - Droplet vaporization models - II

Lecture 23 - Droplet vaporization dynamics - I

Lecture 24 - Droplet vaporization dynamics - II

Lecture 25 - Droplet liquid phase transport

Lecture 26 - Comprehensive droplet vaporization model and correlations - I

Lecture 27 - Comprehensive droplet vaporization model and correlations - II

Lecture 28 - Comparison of droplet vaporization models

Lecture 29 - Species transport in droplet

Lecture 30 - Heat transfer and transport processes in sessile droplets

Lecture 31 - Introduction to atomization



Lecture 32 - Atomization principles and governing parameters

Lecture 33 - Spray / droplet breakup models  $\hat{A}$ - I (TAB model)

Lecture 34 - Spray / droplet breakup models  $\hat{A}$ - II (WAVE model)

Lecture 35 - Droplet combustion - I

Lecture 36 - Droplet combustion - II

Lecture 37 - Regimes in spray combustion

Lecture 38 - Boiling - I

Lecture 39 - Boiling - II (Bubble dynamics)

Lecture 40 - Boiling - II (Bubble dynamics and critical heat flux)

- Lecture 1 - Introduction to convective heat transfer
- Lecture 2 - Governing equations I - Momentum Conservation
- Lecture 3 - Governing equations II - Energy Conservation
- Lecture 4 - Introduction to external forced convection
- Lecture 5 - Scaling Analysis - Momentum
- Lecture 6 - Scaling Analysis - Energy I
- Lecture 7 - Scaling Analysis - Energy II
- Lecture 8 - Similarity solution - Momentum
- Lecture 9 - Similarity solution - Energy
- Lecture 10 - Integral solutions - Momentum
- Lecture 11 - Integral solutions - Energy
- Lecture 12 - Suction and Blowing
- Lecture 13 - Falkner-Skan solution
- Lecture 14 - Arbitrary Wall temperature
- Lecture 15 - Internal forced convection - Developing flow
- Lecture 16 - Hydrodynamic fully developed flow
- Lecture 17 - Mean temperature in fully developed flow
- Lecture 18 - Uniform heat flux
- Lecture 19 - Uniform wall temperature
- Lecture 20 - Tube surrounded by isothermal flow
- Lecture 21 - Heat transfer to fully developed flow - I
- Lecture 22 - Heat transfer to fully developed flow - II
- Lecture 23 - Laminar slug flow
- Lecture 24 - Power law fluids
- Lecture 25 - Forced convection - Tutorial I
- Lecture 26 - Forced convection - Tutorial II
- Lecture 27 - Forced convection - Tutorial III
- Lecture 28 - Introduction to external natural convection
- Lecture 29 - Scaling analysis - I
- Lecture 30 - Scaling analysis - II
- Lecture 31 - Integral solution

- Lecture 32 - Similarity solution
- Lecture 33 - Uniform wall heat flux
- Lecture 34 - Thermal stratification
- Lecture 35 - Mixed convection
- Lecture 36 - Internal natural convection - Scaling analysis
- Lecture 37 - Heat transfer regimes
- Lecture 38 - Regime III
- Lecture 39 - Regime IV - Shallow enclosure limit - I
- Lecture 40 - Regime IV - Shallow enclosure limit - II
- Lecture 41 - Partially divided enclosures
- Lecture 42 - Inclined enclosures
- Lecture 43 - Natural convection - Tutorial I
- Lecture 44 - Natural convection - Tutorial II
- Lecture 45 - Introduction to Turbulence
- Lecture 46 - Reynolds-averaged Navier Stokes equation - I
- Lecture 47 - Reynolds-averaged Navier Stokes equation - II
- Lecture 48 - Turbulent boundary layer - Viscous sub layer
- Lecture 49 - Turbulent boundary layer - Fully turbulent sub layer
- Lecture 50 - Heat transfer in turbulent boundary layer
- Lecture 51 - Turbulent internal flow - I
- Lecture 52 - Turbulent internal flow - II
- Lecture 53 - Turbulent internal flow - III
- Lecture 54 -  $k-\epsilon$  model
- Lecture 55 - Turbulence - Tutorial
- Lecture 56 - Experimental techniques - Thermochromic liquid crystals
- Lecture 57 - Experimental techniques - IR thermography
- Lecture 58 - Droplet evaporation - Sessile I
- Lecture 59 - Droplet evaporation - Sessile II
- Lecture 60 - Droplet evaporation - Contact free

- Lecture 1 - Introduction to complex variables
- Lecture 2 - Cauchy Riemann Equations
- Lecture 3 - Analytic Functions
- Lecture 4 - Simple definitions
- Lecture 5 - Definition of sets, domains, theorem on antiderivative
- Lecture 6 - Cauchy Goursat Theorem
- Lecture 7 - Implications of Cauchy Goursat Theorem, Cauchy Integral Formula
- Lecture 8 - Implications of CIF, converse of CG theorem
- Lecture 9 - Examples in contour integrals, ratios of polynomials
- Lecture 10 - Contour integration of sinc function
- Lecture 11 - Method of path deformation
- Lecture 12 - Method of path deformation (Continued...)
- Lecture 13 - Infinite and finite branch cuts
- Lecture 14 - Finite Branch Cut
- Lecture 15 - Infinite branch cut example
- Lecture 16 - Contour integration: rectangular contour
- Lecture 17 - Finite square root branch cut
- Lecture 18 - Example on finite branch cut
- Lecture 19 - Pole on a branch cut
- Lecture 20 - L shaped branch cut
- Lecture 21 - L shaped branch cut continued
- Lecture 22 - Inverse Laplace Transform
- Lecture 23 - Inverse Laplace Transform (Continued...)
- Lecture 24 - Additional material or corrections to lectures
- Lecture 25 - Summary of the total course

Lecture 1 - Introduction

Lecture 2 - Deborah number

Lecture 3 - Response of Elastic solid

Lecture 4 - Response of Viscous fluid

Lecture 5 - Viscoelastic material

Lecture 6 - Creep and stress relaxation

Lecture 7 - Creep and stress relaxation functions

Lecture 8 - Linearity

Lecture 9 - Mechanical Analogues

Lecture 10 - Tutorial

Lecture 11 - Atoms and bonds

Lecture 12 - Interatomic bonds

Lecture 13 - Polymers

Lecture 14 - Polymers (Continued...)

Lecture 15 - Polymers (Continued...)

Lecture 16 - Freely jointed model

Lecture 17 - Constitutive equations

Lecture 18 - Constitutive equations (Continued...)

Lecture 19 - Constitutive equations (Continued...)

Lecture 20 - Viscoelastic effects

Lecture 21 - Lab Session

Lecture 22 - Polymer concentrations

Lecture 23 - Lagrangian and Eulerian perspectives

Lecture 24 - Maxwell model

Lecture 25 - Maxwell model (Continued...)

Lecture 26 - Kelvin-Meyer-Voigt model

Lecture 27 - Three parameter model

Lecture 28 - Three parameter model (Continued...)

Lecture 29 - Three parameter model (Continued...)

Lecture 30 - Jefferey's model

Lecture 31 - Two Maxwell model

[Lecture 32 - N-Maxwell model](#)

[Lecture 33 - N-Maxwell model \(Continued...\)](#)

[Lecture 34 - N-Kelvin Meyer Voigt model](#)

[Lecture 35 - Constitutive modelling](#)

[Lecture 36 - Objectivity](#)

[Lecture 37 - Objectivity](#)

[Lecture 38 - Sinusoidal oscillations](#)

[Lecture 39 - Sinusoidal oscillations \(Continued...\)](#)

[Lecture 40 - Sinusoidal oscillations \(Continued...\)](#)

[Lecture 41 - Summary](#)

[Lecture 42 - Tutorial](#)

[Lecture 43 - Tutorial \(Continued...\)](#)

Lecture 1 - Introduction, Types and Classification of Robots

Lecture 2 - Main Elements of a Robot

Lecture 3 - Modelling and Analysis of Robots

Lecture 4 - Mathematical Preliminaries, Homogeneous Transformations

Lecture 5 - Elements of robot - Joints, Elements of robots - Links

Lecture 6 - Examples of D-H parameters and Link transformation matrices

Lecture 7 - Introduction, Direct Kinematics of Serial Robots

Lecture 8 - Inverse Kinematics of Serial Robots

Lecture 9 - Inverse Kinematics of Serial Robots with  $n < 6$ , Inverse Kinematics of Serial Robots with  $n > 6$

Lecture 10 - Elimination Theory and Solution of Non-linear Equations, Inverse Kinematics of a General 6R Robot

Lecture 11 - Introduction, Loop-closure Equations

Lecture 12 - Direct Kinematics of Parallel Manipulators

Lecture 13 - Mobility of Parallel Manipulators

Lecture 14 - Inverse Kinematics of Parallel Manipulators

Lecture 15 - Direct Kinematics of Stewart Platform Manipulators

Lecture 16 - Sun tracking using 3-DOF parallel manipulator

Lecture 17 - Stewart-Gough platform-based force-torque sensor

Lecture 18 - Vibration isolation using a Stewart-Gough platform

Lecture 19 - Introduction, Linear and Angular Velocity of Links

Lecture 20 - Serial Manipulator Jacobian Matrix

Lecture 21 - Parallel Manipulator Jacobian Matrix

Lecture 22 - Singularities in Serial and Parallel Manipulators

Lecture 23 - Statics of Serial and Parallel Manipulators

Lecture 24 - Hyper-redundant robots

Lecture 25 - Redundancy resolution in human arm

Lecture 26 - Flexible robots

Lecture 27 - Introduction, Lagrangian formulation

Lecture 28 - Examples of Equations of Motion

Lecture 29 - Inverse Dynamics and Simulation of Equations of Motion

Lecture 30 - Recursive Formulations of Dynamics of Manipulators

Lecture 31 - Motion planning

[Lecture 32 - Control of a single link](#)

[Lecture 33 - Control of a multi-link serial manipulator](#)

[Lecture 34 - Control of a multi-link manipulator](#)

[Lecture 35 - Control of constrained and parallel manipulator, Cartesian control of serial manipulators](#)

[Lecture 36 - Force control of manipulators, Hybrid position/force control of manipulators](#)

[Lecture 37 - Advanced topics in non-linear control of manipulators](#)

[Lecture 38 - Wheeled Mobile Robots \(WMR\) on Flat Terrain](#)

[Lecture 39 - Wheeled Mobile Robots \(WMR\) on Uneven Terrain](#)

[Lecture 40 - Kinematics and Dynamics of WMR on Uneven Terrain](#)

[Lecture 41 - Over-Constrained Mechanism and Deployable Structures](#)

[Lecture 42 - Kinematic and Static Analysis](#)



- Lecture 1 - The longitudinal wave in vibrating spring
- Lecture 2 - Harmonically excited systems
- Lecture 3 - The concept of coincidence frequency
- Lecture 4 - A classical problem in sound-structure interaction
- Lecture 5 - Classical problem (Continued...)
- Lecture 6 - Uncoupled solution to the classical problem
- Lecture 7 - Uncoupled solution (Continued...).
- Lecture 8 - Introduction to the coupled problem.
- Lecture 9 - The coupled roots
- Lecture 10 - Physical meaning of terms
- Lecture 11 - Derivation of coupled roots using asymptotic method
- Lecture 12 - Coupled roots derivation (Continued...)
- Lecture 13 - Regions of heavy and light fluid loading
- Lecture 14 - Light and heavy fluid loading (Continued...)
- Lecture 15 - The coupled vibration field
- Lecture 16 - The coupled acoustic field and stationary phase
- Lecture 17 - The 2-D structural-acoustic waveguide
- Lecture 18 - The coupled partial differential equations
- Lecture 19 - Derivation of the coupled dispersion equation
- Lecture 20 - A schematic of coupled waves
- Lecture 21 - Derivation of coupled waves using asymptotic method
- Lecture 22 - Asymptotic method (Continued...) and Maple demo
- Lecture 23 - Physics of the coupled waves
- Lecture 24 - Critical points
- Lecture 25 - Heavy fluid loading
- Lecture 26 - Summary of the rectangular waveguide
- Lecture 27 - Impedance and mobility
- Lecture 28 - Derivation of acoustic and vibration response
- Lecture 29 - Derivation of vibro-acoustic response (Continued...)
- Lecture 30 - Derivation of vibro-acoustic response (Continued...)
- Lecture 31 - Numerical example

- Lecture 32 - Coupled resonance analysis using matrices
- Lecture 33 - Coupled resonance analysis (Continued...)
- Lecture 34 - Sound radiation from a baffled panel
- Lecture 35 - Derivation of pressure response.
- Lecture 36 - Radiation efficiency
- Lecture 37 - Physics of volume velocity cancellation
- Lecture 38 - Derivations in the frequency domain: 1-D
- Lecture 39 - Physics of the vibration spectrum in 2-D
- Lecture 40 - Modal character across the frequency range
- Lecture 41 - Simultaneous radiation from several modes
- Lecture 42 - Panel radiation model using monopoles
- Lecture 43 - Physics of panel radiation using monopole model
- Lecture 44 - Physics of panel radiation using monopole model (Continued...)
- Lecture 45 - Radiation resistance derivation from Maidanik's work (Continued...)
- Lecture 46 - Radiation resistance derivation from Maidanik's work (Continued...)
- Lecture 47 - Radiation resistance derivation from Maidanik's work (Continued...)
- Lecture 48 - Modal average radiation efficiency
- Lecture 49 - Modal average radiation efficiency (Continued...)
- Lecture 50 - Transmission of sound through a rigid panel with flexible mounts
- Lecture 51 - Frequency dependence of sound transmission
- Lecture 52 - Sound transmission through a flexible partition
- Lecture 53 - Transmission loss in different situations
- Lecture 54 - Cylindrical shell vibration
- Lecture 55 - Behavior of uncoupled shell waves
- Lecture 56 - Fluid waves in rigid-walled cylindrical shells
- Lecture 57 - Wave propagation characteristics in flexible cylindrical shells carrying fluid: Fullers paper
- Lecture 58 - Wave impedance of an infinite plate: fluid loading
- Lecture 59 - Fluid loading in a finite plate
- Lecture 60 - Summary of the entire course

Lecture 1 - Introduction to differential geometry

Lecture 2 - Properties of surfaces: First fundamental form

Lecture 3 - Properties of surfaces: Second fundamental form

Lecture 4 - Surfaces of revolution

Lecture 5 - Gauss Codazzi relations

Lecture 6 - Gauss Codazzi (Continued...)

Lecture 7 - Differential element length in a thin shell

Lecture 8 - Strain of a differential element

Lecture 9 - Explicit strain expressions

Lecture 10 - Love simplifications and inconsistencies Of the theory

Lecture 11 - Euler Bernoulli Beam equation using the Hamilton's Law

Lecture 12 - Euler Bernoulli Beam and Hamilton's Law (Continued...)

Lecture 13 - Beta definition, force and moment resultants

Lecture 14 - Hamilton's Law for a general shell

Lecture 15 - The Hamilton's law (Continued...)

Lecture 16 - Final Dynamical Equations and boundary conditions

Lecture 17 - Physics of each term in the dynamic equations

Lecture 18 - Physics of each term (Continued...)

Lecture 19 - The sixth equation of motion

Lecture 20 - The sixth equation of motion (Continued...)

Lecture 21 - Equations of motion for a rectangular plate using Hamilton's law

Lecture 22 - Equations of motion for a rectangular Plate (Continued...)

Lecture 23 - Rectangular plate boundary conditions

Lecture 24 - Rectangular plate equation using force balance

Lecture 25 - Modeshapes and resonances of a vibrating beam

Lecture 26 - Modeshapes and resonances of a vibrating Rectangular plate

Lecture 27 - Modeshapes and resonances of a vibrating Circular plate

Lecture 28 - Vibrating circular plate (Continued...)

Lecture 29 - Modeshapes and resonances of a vibrating Circular ring

Lecture 30 - Details of vibrating rings

Lecture 31 - Insights into vibrations of ring

- Lecture 32 - Cylindrical shell equations of motion using Force balance
- Lecture 33 - Cylindrical shell: Transverse equation of motion
- Lecture 34 - Orthogonality of modeshapes
- Lecture 35 - Orthogonality of Modes (Continued...)
- Lecture 36 - The Rayleigh Quotient
- Lecture 37 - Rayleigh Quotient Example: Simply-supported beam
- Lecture 38 - The Rayleigh Ritz method
- Lecture 39 - The Rayleigh Ritz method applied to a Complicated system
- Lecture 40 - The Lagrange Multiplier method
- Lecture 41 - The penalty method
- Lecture 42 - Orthogonal polynomials of RB Bhat
- Lecture 43 - Rayleigh Ritz paper by RB Bhat
- Lecture 44 - Numerical examples of the Rayleigh Ritz method
- Lecture 45 - Numerical examples of Rayleigh Ritz method And animations
- Lecture 46 - Rayleigh Ritz applied to curved structures
- Lecture 47 - Forced response of plates and shells
- Lecture 48 - Forced response (Continued...)
- Lecture 49 - Simply-supported plate response to various forces
- Lecture 50 - Simply-supported plate response to various Forces (Continued...)
- Lecture 51 - Simply-supported cylindrical shell response to a Point harmonic force
- Lecture 52 - Cylindrical shell response (Continued...)
- Lecture 53 - Cylindrical shell response (Continued...)
- Lecture 54 - Cylindrical shell response to a traveling load using Only transverse modes
- Lecture 55 - The Receptance method
- Lecture 56 - The receptance method (Continued...)
- Lecture 57 - Stiffening a cylindrical shell using rings
- Lecture 58 - Stiffening of a cylindrical shell (Continued...)
- Lecture 59 - Damping in structures
- Lecture 60 - Loss factor and Complex Young modulus

Lecture 1 - Introduction to Course

Lecture 2 - Position and Orientation of a Rigid Body

Lecture 3 - Homogenous Transformation

Lecture 4 - Linear and angular velocity of rigid body

Lecture 5 - Motion of Rigid Body and Particles

Lecture 6 - Introduction to multi-body systems

Lecture 7 - Joints, Degrees of Freedom and Constraints

Lecture 8 - Position, Velocity and Acceleration in Multi-body Systems

Lecture 9 - Mass and Inertia of a Rigid Body

Lecture 10 - External forces and moments

Lecture 11 - Angular momentum, Spinning tops and Gyroscopes

Lecture 12 - Free-body diagram and Equations of motion

Lecture 13 - Newton-Euler Formulation for Serial Chains

Lecture 14 - Lagrangian Formulation

Lecture 15 - Examples of Equations of Motion

Lecture 16 - Equations of Motion Using Computer Tools

Lecture 17 - Introduction and Examples of equations of motion

Lecture 18 - Inverse dynamics and Simulations of equations Of motion

Lecture 19 - Simulation using Computer Tools

Lecture 20 - Introduction and Goal of control

Lecture 21 - State Space Formulation

Lecture 22 - Solution of State Equations

Lecture 23 - Stability of Dynamical Systems

Lecture 24 - Controllability and Observability of Linear Systems

Lecture 25 - Examples of Controllability and Observability

Lecture 26 - Introduction to Classical Control

Lecture 27 - Root Locus

Lecture 28 - Frequency Domain Approach

Lecture 29 - PID Control

Lecture 30 - Root Locus based Controller Design

Lecture 31 - State Space Design



Lecture 1 - Introduction

Lecture 2 - Mathematical Preliminaries - I

Lecture 3 - Tensors and Deformations

Lecture 4 - Lagrangian and Eulerian Perspectives

Lecture 5 - Mathematical Preliminaries - II

Lecture 6 - Image Processing Preliminaries

Lecture 7 - Image Processing Operations

Lecture 8 - Light Matter Interaction - I

Lecture 9 - Lab Demo I: Optical Microscope

Lecture 10 - Optical System: Lenses

Lecture 11 - Lab Demo II: Lenses and Camera

Lecture 12 - Light Matter Interaction - II (Lab Demonstration)

Lecture 13 - Light Matter Interaction - II (Lab Demonstration)

Lecture 14 - Tracer Particles for Flow Visualisation

Lecture 15 - Particle Tracking Velocimetry

Lecture 16 - Particle Image Velocimetry - I

Lecture 17 - Particle Image Velocimetry - II

Lecture 18 - Particle Image Velocimetry - III

Lecture 19 - Particle Image Velocimetry - IV

Lecture 20 - Particle Image Velocimetry - V

Lecture 21 - Particle Image Velocimetry - VI

Lecture 22 - Schlieren and Shadowgraphy

Lecture 23 - Lab Demo III: PIV and Schlieren

Lecture 24 - Introduction to optical methods for solids

Lecture 25 - Basics of Digital Image Correlation

Lecture 26 - Iterative implementation of DIC

Lecture 27 - Example implementations

Lecture 28 - How is a DIC experiment set up ?

Lecture 29 - DIY(C)!

Lecture 30 - Introduction to Photoelasticity

Lecture 31 - Why do we see fringes ?

[Lecture 32 - How does light interact with matter ?](#)

[Lecture 33 - Origin of Birefringence](#)

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Lecture 1 - Introduction to Statistical Thermodynamics

Lecture 2 - Basic Probability Theory and Statistics

Lecture 3 - Important Probability Distributions

Lecture 4 - Combinatorial Analysis for Statistical Thermodynamics

Lecture 5 - Basic Concepts

Lecture 6 - Macrostates and Microstates

Lecture 7 - Bose Einstein and Fermi Dirac Statistics

Lecture 8 - Entropy and the equilibrium particle distribution

Lecture 9 - Operator Theory - 1

Lecture 10 - Stirling Approximation and Lagrange Multipliers

Lecture 11 - Equilibrium particle distribution

Lecture 12 - The Dilute Limit and Concept of Molecular Partition Function

Lecture 13 - The Molecular Partition Function and its relationship with Classical Thermodynamics

Lecture 14 - Historical Survey of Quantum Mechanics

Lecture 15 - Operator Theory - 2

Lecture 16 - Operator Theory - 3

Lecture 17 - Bohr Model for the Spectrum of Atomic Hydrogen

Lecture 18 - Heuristic Introduction to the Schrodinger Equation

Lecture 19 - The postulates of Quantum Mechanics

Lecture 20 - The Steady State Schrodinger Equation: Single Particle Analysis

Lecture 21 - Coordinate System - 1

Lecture 22 - Coordinate System - 2

Lecture 23 - Coordinate System - 3

Lecture 24 - The Steady State Schrodinger Equation: Multiparticle analysis

Lecture 25 - The Particle in a Box

Lecture 26 - The Uncertainty Principle

Lecture 27 - The Pauli Exclusion and the Correspondence Principle

Lecture 28 - Problem Solving - 1

Lecture 29 - Problem Solving - 2

Lecture 30 - The Internal Motion for a two particle system

Lecture 31 - The rotational and vibrational energy mode for a diatomic molecule

- Lecture 32 - Hermite polynomials as vibrational energy mode solution
- Lecture 33 - Equivalent two body model of atomic hydrogen
- Lecture 34 - The Electronic Energy Mode for Atomic Hydrogen
- Lecture 35 - Problem Solving - 3
- Lecture 36 - The four quantum numbers and multielectron systems
- Lecture 37 - Spectroscopic term symbols for multielectron atoms
- Lecture 38 - Electron energies for multielectron systems
- Lecture 39 - Combined energy modes for atoms and diatomic molecules
- Lecture 40 - Perturbation analysis of the Schrodinger Wave equation
- Lecture 41 - Selection rules
- Lecture 42 - The Rotational and vibrational spectroscopy
- Lecture 43 - Ro-vibrational spectroscopy (Simplex model)
- Lecture 44 - Rotation vibration coupling (Complex model)
- Lecture 45 - Ro-vibrational spectroscopy (Complex model)
- Lecture 46 - Ro-vibronic spectroscopy
- Lecture 47 - Working with Spectroscopic Schemes, Notations and Term Symbols
- Lecture 48 - From Particles to assembly - I
- Lecture 49 - From Particles to assembly - II
- Lecture 50 - Connecting Quantum Mechanics to Classical Mechanics
- Lecture 51 - The Equipartition principle and ideal gas
- Lecture 52 - Thermodynamic properties of ideal monoatomic and diatomic gas
- Lecture 53 - The zero of energy (rotational and vibrational)
- Lecture 54 - Specific heats, Internal energy through Vibrational and Ro-vibrational energy modes
- Lecture 55 - The Ro-vibrational partition function and Introduction to intersction of Radiationand Matter
- Lecture 56 - Absorption and Emission of Radiation
- Lecture 57 - The Rabi frequency and Beer's Law
- Lecture 58 - Insights into radiative spectral transitions
- Lecture 59 - Theory of Absorption Spectroscopy

- Lecture 1 - Module 1 : Lecture 1 - Solution models
- Lecture 2 - Module 1 : Lecture 2 - Summary of solution models
- Lecture 3 - Module 1 : Lecture 3 - G vs X diagrams
- Lecture 4 - Module 1 : Lecture 4 - Phase diagrams
- Lecture 5 - Module 1 : Lecture 5 - Bond breaking model
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- Lecture 7 - Module 1 : Tutorial 1
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- Lecture 13 - Module 2 : Lecture 7 - Diffusion and chemical potential
- Lecture 14 - Module 2 : Lecture 8 - Fick's law
- Lecture 15 - Module 2 : Lecture 9 - Failure of classical diffusion equation
- Lecture 16 - Module 2 : Lecture 10 - Some references
- Lecture 17 - Module 3 : Lecture 11 - Spinodal decomposition - some history
- Lecture 18 - Module 3 : Lecture 12 - Spinodal decomposition
- Lecture 19 - Module 3 : Lecture 13 - Stability
- Lecture 20 - Module 3 : Lecture 14 - Thermodynamic property : composition dependence
- Lecture 21 - Module 3 : Lecture 15 - Regions of stability
- Lecture 22 - Module 3 : Lecture 16 - Understanding spinodal region
- Lecture 23 - Module 2 : Tutorial 7
- Lecture 24 - Module 4 : Lecture 17 - Solution to classical diffusion equation
- Lecture 25 - Module 4 : Lecture 18 - Diffusion and mobility - I
- Lecture 26 - Module 4 : Lecture 19 - Diffusion and mobility - II
- Lecture 27 - Module 4 : Lecture 20 - Failure of classical diffusion equation
- Lecture 28 - Module 4 : Lecture 21 - Non-classical diffusion equation
- Lecture 29 - Module 5 : Lecture 22 - GNU Octave : Introduction
- Lecture 30 - Module 5 : Lecture 23 - GNU Octave : interactive mode

- Lecture 31 - Module 5 : Lecture 24 - GNU Octave : script mode
- Lecture 32 - Module 6 : Lecture 25 - Ideal solution using octave
- Lecture 33 - Module 6 : Lecture 26 - Regular solution using octave
- Lecture 34 - Module 6 : Lecture 27 - Constructing phase diagram
- Lecture 35 - Module 6 : Lecture 28 - Plotting spinodal
- Lecture 36 - Module 7 : Lecture 29 - Non-dimensionalisation of diffusion equation
- Lecture 37 - Module 7 : Lecture 30 - Diffusion and Fourier law of heat conduction
- Lecture 38 - Module 8 : Lecture 31 - Diffusion equation : Analytical solution - I
- Lecture 39 - Module 8 : Lecture 32 - Diffusion equation : Analytical solution - II
- Lecture 40 - Module 8 : Lecture 33 - Diffusion equation : Error function solution - I
- Lecture 41 - Module 8 : Lecture 34 - Diffusion equation: Error function solution - II
- Lecture 42 - Module 9 : Lecture 35 - Diffusion equation : finite difference method
- Lecture 43 - Module 9 : Lecture 36 - Diffusion equation : zero flux BC and explicit method
- Lecture 44 - Module 9 : Lecture 37 - Diffusion equation : zero flux BC and implicit method
- Lecture 45 - Module 9 : Lecture 38 - Diffusion equation : imposed concentration BC and explicit/implicit methods
- Lecture 46 - Module 10 : Lecture 39 - Periodic boundary conditions (PBC)
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- Lecture 48 - Module 10 : Lecture 41 - Spectral Techniques - I
- Lecture 49 - Module 10 : Lecture 42 - Spectral Techniques - II
- Lecture 50 - Module 10 : Lecture 43 - Implicit spectral method
- Lecture 51 - Module 11 : Lecture 44 - Scalars, vectors and tensors
- Lecture 52 - Module 11 : Lecture 45 - Coordinate transformation
- Lecture 53 - Module 11 : Lecture 46 - Transformation laws
- Lecture 54 - Module 11 : Lecture 47 - II rank tensors and Neumann principle
- Lecture 55 - Module 12 : Lecture 48 - Group theory
- Lecture 56 - Module 12 : Lecture 49 - Crystal: symmetry elements - I
- Lecture 57 - Module 12 : Lecture 50 - Crystal: symmetry elements - II
- Lecture 58 - Module 12 : Lecture 51 - Understanding Neumann's principle
- Lecture 59 - Module 12 : Lecture 52 - Representation quadric
- Lecture 60 - Module 13 : Lecture 53 - Variational calculus
- Lecture 61 - Module 13 : Lecture 54 - Optimization of functionals - I
- Lecture 62 - Module 13 : Lecture 55 - Optimization of functionals - II
- Lecture 63 - Module 13 : Lecture 56 - Variational derivative

Lecture 64 - Module 13 : Lecture 57 - Free energy functional

Lecture 65 - Module 14 : Lecture 58 - Derivation of Cahn-Hilliard (CH) equation - I

Lecture 66 - Module 14 : Lecture 59 - Derivation of Cahn-Hilliard (CH) equation - II

Lecture 67 - Module 14 : Lecture 60 - Free energy versus concentration curves

Lecture 68 - Module 14 : Lecture 61 - Diffusion equation versus CH

Lecture 69 - Module 15 : Lecture 62 - Numerical solution of CH: finite difference

Lecture 70 - Module 15 : Lecture 63 - Numerical solution of CH: spectral method

Lecture 71 - Module 16 : Lecture 64 - Interfacial energy in CH

Lecture 72 - Module 16 : Lecture 65 - CH: analytical solution

Lecture 73 - Module 16 : Lecture 66 - Interfacial energy in CH: analytical calculation

Lecture 74 - Module 16 : Lecture 67 - Interfacial energy: numerical versus analytical values

Lecture 75 - Module 17 : Lecture 68 - Order-disorder transition and Allen-Cahn equation

Lecture 76 - Module 17 : Lecture 69 - AC: numerical solution

Lecture 77 - Module 18 : Lecture 70 - Spinodal decomposition in 2D

Lecture 78 - Module 18 : Lecture 71 - Order-disorder transformation

Lecture 79 - Module 18 : Lecture 72 - Gibbs Thomson effect

Lecture 80 - Module 18 : Lecture 73 - Grain growth

Lecture 81 - Module 19 : Lecture 74 - Precipitate growth - I

Lecture 82 - Module 19 : Lecture 75 - Precipitate growth - II

Lecture 83 - Module 20 : Lecture 76 - Grain growth: Fan-Chen model - I

Lecture 84 - Module 20 : Lecture 77 - Grain growth: Fan-Chen model - II

Lecture 85 - Module 21 : Lecture 78 - Grain boundary grooving - I

Lecture 86 - Module 21 : Lecture 79 - Grain boundary grooving - II

Lecture 87 - Module 22 : Lecture 80 - Overview of phase field modelling

- Lecture 1 - Descriptive Statistics - I
- Lecture 2 - Descriptive Statistics - II
- Lecture 3 - Probability and Distribution
- Lecture 4 - Random variable and Expectation - I
- Lecture 5 - Random variable and Expectation - II
- Lecture 6 - Random variable and Expectation - III
- Lecture 7 - Random variable and Expectation - IV
- Lecture 8 - Module: Introduction to R
- Lecture 9 - R:Demos and getting help
- Lecture 10 - R as calculator and plotter: Diffusivity, scaled temperatures
- Lecture 11 - R as calculator and plotter: Diffraction, configurational entropy
- Lecture 12 - Data in tabular form: Properties of elements
- Lecture 13 - Tabular data in R: alternate methodology
- Lecture 14 - Dataframe in R: Properties of elements
- Lecture 15 - R libraries for plotting
- Lecture 16 - Importing and plotting data
- Lecture 17 - Property charts: Importing and plotting data
- Lecture 18 - Introduction to R: Summary of the module
- Lecture 19 - Descriptive statistics
- Lecture 20 - Presenting experimental results: Data on conductivity of ETP copper
- Lecture 21 - Property based reports, errors, significant digits
- Lecture 22 - Dealing with distributions: Grain size data
- Lecture 23 - Grain size data: Property and rank based reports
- Lecture 24 - Case study: Grain size in a two phase steel
- Lecture 25 - Grain size in a two phase steel: Descriptive statistics
- Lecture 26 - Presenting experimental results: data with error bars
- Lecture 27 - Errors and their propagation
- Lecture 28 - Fitting experimental data to distributions
- Lecture 29 - Combining uncertainties
- Lecture 30 - Summary:Descriptive statistics
- Lecture 31 - Special Random Variables - I

- Lecture 32 - Special Random Variables - II
- Lecture 33 - Special Random Variables - III
- Lecture 34 - Special Random Variables - IV
- Lecture 35 - Special Random Variables - V
- Lecture 36 - Probabilty Plots
- Lecture 37 - Probability distributions
- Lecture 38 - Properties of probability distributions
- Lecture 39 - Bernoulli trials and binomial distributions
- Lecture 40 - Atom probe technique and negative binomial distribution
- Lecture 41 - Atom probe and hypergeometric distribution
- Lecture 42 - Atom probe: analysis of error
- Lecture 43 - Nucleation and Poisson distribution
- Lecture 44 - Normal distribution
- Lecture 45 - Normal distribution and error function
- Lecture 46 - Probability scale
- Lecture 47 - Sampling Distribution - I
- Lecture 48 - Sampling Distribution - II
- Lecture 49 - Sampling Distribution - III
- Lecture 50 - Parameter Estimation - I
- Lecture 51 - Parameter Estimator - II
- Lecture 52 - Parameter Estimator - III
- Lecture 53 - Parameter Estimator - IV
- Lecture 54 - Bayesian Estimation
- Lecture 55 - Log normal distribution
- Lecture 56 - Lorentz/Cauchy distribution
- Lecture 57 - Lifetime and exponential distributions
- Lecture 58 - Distributions from statistical mechanics
- Lecture 59 - Uniform distribution and summary of probability distributions
- Lecture 60 - Data processing: Introduction
- Lecture 61 - Distribution function of a data series
- Lecture 62 - Estimating mean and mean-square-deviation of data
- Lecture 63 - Data with unequal weights
- Lecture 64 - Robust estimates

- Lecture 65 - From data to underlying distribution
- Lecture 66 - Bootstrap method
- Lecture 67 - Summary:Data processing
- Lecture 68 - Hypothesis Testing - I
- Lecture 69 - Hypothesis Testing - II
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- Lecture 71 - Hypothesis Testing - IV
- Lecture 72 - Hypothesis Testing - V
- Lecture 73 - Hypothesis Testing - VI
- Lecture 74 - Graphical handling of data
- Lecture 75 - Fitting and graphical handling of data: Introduction
- Lecture 76 - Data transformable to linear
- Lecture 77 - Data of known functional form
- Lecture 78 - Calibration,Fitting, Hypotheses testing
- Lecture 79 - Analysis of variance
- Lecture 80 - Summary:Fitting and graphical handling of data
- Lecture 81 - Regression Analysis - I
- Lecture 82 - Regression Analysis - II
- Lecture 83 - Regression Analysis - III
- Lecture 84 - Regression Analysis - IV
- Lecture 85 - Analysis of Variance - I
- Lecture 86 - Analysis of Variance - II
- Lecture 87 - Design of Experiment - I
- Lecture 88 - Design of Experiment - II
- Lecture 89 - Design of Experiment - III
- Lecture 90 - Design of Experiment - IV
- Lecture 91 - Summary of the course
- Lecture 92 - Case studies: Introduction
- Lecture 93 - Case study 1: Data smoothing - I
- Lecture 94 - Case study 1: Data smoothing - II
- Lecture 95 - Case study 2: Error analysis
- Lecture 96 - Case study 3: Calibration
- Lecture 97 - Case study 4: Design of experiment



[Lecture 98 - Case study 5: Hypothesis testing](#)

[Lecture 99 - Course summary](#)

Lecture 1 - Introduction to the course and corrosion implications

Lecture 2 - Can we predict if a metal corrodes? - Part I

Lecture 3 - Can we predict if a metal corrodes? - Part II

Lecture 4 - Can we calculate the rate of corrosion: Electrochemical kinetics - Tafel relation?

Lecture 5 - Can we calculate the rate of corrosion: Electrochemical kinetics - diffusion and mixed potential theory?

Lecture 6 - Can we calculate the corrosion rate of metals: Mixed potential theory and passivity?

Lecture 7 - Passivity (Continued...)

Lecture 8 - DC polarisation experiments and their relation to mixed potential theory/Evans diagram

Lecture 9 - Pourbaix diagram and electrochemical corrosion

Lecture 10 - Forms of corrosion: Uniform v/s localised corrosion

Lecture 11 - Forms of corrosion: Factors affecting uniform corrosion

Lecture 12 - Forms of corrosion: Preventive measures for uniform corrosion - Part I

Lecture 13 - Forms of corrosion: Preventive measures for uniform corrosion - Part II

Lecture 14 - Forms of corrosion: Galvanic or dissimilar metal corrosion - Part I

Lecture 15 - Forms of corrosion: Galvanic or dissimilar metal corrosion - Part II

Lecture 16 - Forms of corrosion: Galvanic or dissimilar metal corrosion - Part III

Lecture 17 - Forms of corrosion: Crevice corrosion - Part I

Lecture 18 - Forms of corrosion: Crevice corrosion - Part II

Lecture 19 - Forms of corrosion: Pitting corrosion - Part I

Lecture 20 - Forms of corrosion: Pitting corrosion - Part II

Lecture 21 - Forms of corrosion: Intergranular corrosion - Part I

Lecture 22 - Forms of corrosion: Intergranular corrosion - Part II

Lecture 23 - Forms of corrosion: Intergranular corrosion - Part III

Lecture 24 - Forms of corrosion: Intergranular corrosion - Part IV

Lecture 25 - Forms of corrosion: Selective leaching or dealloying

Lecture 26 - Forms of corrosion: Flow assisted corrosion and erosion corrosion - Part I

Lecture 27 - Forms of corrosion: Erosion corrosion - Part II

Lecture 28 - Forms of corrosion: Fretting corrosion

Lecture 29 - Forms of corrosion: Stress corrosion cracking - Part I

Lecture 30 - Forms of corrosion: Stress corrosion cracking - Part II

Lecture 31 - Forms of corrosion: Stress corrosion cracking - Part III

[Lecture 32 - Forms of corrosion: Hydrogen damage](#)

[Lecture 33 - Forms of corrosion: Microbial corrosion](#)

[Lecture 34 - Effective corrosion management](#)

- Lecture 1 - Introduction to the course and understanding corrosion
- Lecture 2 - External corrosion of pipelines
- Lecture 3 - Electrochemical principles
- Lecture 4 - Criteria
- Lecture 5 - Assessment of pipeline condition through surveys - Part I
- Lecture 6 - Assessment of pipeline condition through surveys - Part II
- Lecture 7 - Anode ground bed for cathodic protection
- Lecture 8 - Perspectives in storage tanks and off-shore structures
- Lecture 9 - Anodes
- Lecture 10 - Worked out examples
- Lecture 11 - Stray current corrosion and its control
- Lecture 12 - Coatings and rectifier selection
- Lecture 13 - Internal corrosion of oil and steel gas pipelines
- Lecture 14 - Anodic protection engineering

Lecture 1 - Introduction

Lecture 2 - Crystal geometry

Lecture 3 - Unit cell

Lecture 4 - Classification of lattices

Lecture 5 - Gaps in Bravais lattice list

Lecture 6 - Symmetry - I

Lecture 7 - Symmetry - II

Lecture 8 - Classification of lattices on the basis of symmetry

Lecture 9 - A symmetry based approach to Bravais lattices

Lecture 10 - Miller indices of directions

Lecture 11 - Miller indices for planes

Lecture 12 - Miller indices for plane and its normal in Cubic Crystal

Lecture 13 - Weiss Zone law and its applications

Lecture 14 - Inter-planar spacing

Lecture 15 - Bragg's Law

Lecture 16 - Close-packing of hard spheres

Lecture 17 - Hexagonal Close-Packed (HCP) structure

Lecture 18 - Lattice and motif of HCP crystals

Lecture 19 - c/a ratio of an ideal HCP crystal

Lecture 20 - ABCABC stacking of close-packed spheres

Lecture 21 - Voids in close-packed structures

Lecture 22 - Solid solutions - I

Lecture 23 - Solid solutions - II

Lecture 24 - Hume-Rothery rules

Lecture 25 - Ordered and disordered solid solutions

Lecture 26 - Graphene

Lecture 27 - Structure of graphite

Lecture 28 - Structure of diamond

Lecture 29 - Carbon nanotubes (CNT)

Lecture 30 - Buckminsterfullerene (C<sub>60</sub>)

Lecture 31 - Ionic solids

Lecture 32 - NaCl

Lecture 33 - CsCl

Lecture 34 - ZnS

Lecture 35 - BCC vs CsCl

Lecture 36 - Amorphous Solids

Lecture 37 - Polymers

Lecture 38 - Vinyl Polymers

Lecture 39 - Thermoplasts and Thermosets

Lecture 40 - Tacticity

Lecture 41 - Copolymers

Lecture 42 - Crystallinity in Polymers

Lecture 43 - Defects in Crystals

Lecture 44 - Vacancies

Lecture 45 - Edge dislocation: Half plane

Lecture 46 - Edge dislocation: Slip

Lecture 47 - Characteristic vectors of a dislocation

Lecture 48 - Edge, screw and mixed dislocations

Lecture 49 - Screw dislocations

Lecture 50 - Burgers circuit

Lecture 51 - Elastic energy of a dislocation line

Lecture 52 - Burgers vector: Shortest lattice translation

Lecture 53 - Burgers vector of a dislocation is constant along the line

Lecture 54 - Geometrical properties of a dislocations: Dislocation cannot end abruptly in a crystal: Free surface

Lecture 55 - Dislocation cannot end abruptly in a crystal: Grain boundaries

Lecture 56 - Dislocation cannot end abruptly in a crystal: Dislocation nodes

Lecture 57 - Dislocation cannot end abruptly in a crystal: Dislocation loop

Lecture 58 - Dislocation motion

Lecture 59 - 2D defects: Surfaces or interfaces

Lecture 60 - Free surface or external surface of the crystal

Lecture 61 - Stacking faults

Lecture 62 - Twin boundary

Lecture 63 - Grain boundary

Lecture 64 - Small angle symmetric tilt boundary

Lecture 65 - Ball bearing model

Lecture 66 - Phase diagrams: Introduction

Lecture 67 - Phases and components

Lecture 68 - Uses of phase diagrams

Lecture 69 - Phases present in the system

Lecture 70 - Composition of phases present in the system

Lecture 71 - Proportion of phases present in the system

Lecture 72 - Microstructure evolution during solidification in isomorphous systems

Lecture 73 - Eutectic system

Lecture 74 - Eutectic reaction

Lecture 75 - Eutectic, hypoeutectic and hypereutectic alloys

Lecture 76 - Gibbs's phase rule

Lecture 77 - Fe-C phase diagram

Lecture 78 - Eutectoid, hypoeutectoid and hypereutectoid steels

Lecture 79 - Microstructure of a hypoeutectoid steel

Lecture 80 - Microstructure of a hypereutectoid steel

Lecture 81 - Diffusion: Introduction

Lecture 82 - Fick's first law

Lecture 83 - Fick's second law

Lecture 84 - Error function solution of Fick's second law

Lecture 85 - Atomic mechanisms of diffusion

Lecture 86 - Substitutional diffusion revisited

Lecture 87 - Diffusion paths

Lecture 88 - Steady and unsteady state diffusion

Lecture 89 - Phase Transformation

Lecture 90 - Nucleation

Lecture 91 - Nucleation and capillary rise

Lecture 92 - Nucleation, growth and overall transformation

Lecture 93 - Time-temperature-transformation (TTT) diagram

Lecture 94 - Homogeneous and heterogeneous nucleation

Lecture 95 - Heat treatment of steels

Lecture 96 - TTT diagram of Eutectoid Steels

Lecture 97 - Quenching and martensite

- Lecture 98 - Austempering and bainite
- Lecture 99 - Tempering
- Lecture 100 - Residual stresses and Quench cracks
- Lecture 101 - Marquenching and martempering
- Lecture 102 - TTT diagram of hypoeutectoid and hypereutectoid steels
- Lecture 103 - TTT diagram of alloy steel
- Lecture 104 - hardenability of steels
- Lecture 105 - Glass Ceramics
- Lecture 106 - Tensile test
- Lecture 107 - Plastic deformation and crystal structure
- Lecture 108 - Shape change
- Lecture 109 - Slip
- Lecture 110 - Resolved shear stress
- Lecture 111 - CRSS
- Lecture 112 - Schmid's law
- Lecture 113 - CRSS:Theory vs experiment
- Lecture 114 - Why is experimental CRSS less than theoretical CRSS
- Lecture 115 - Strengthening mechanisms
- Lecture 116 - Dislocation density
- Lecture 117 - Frank-Read source
- Lecture 118 - strain hardening
- Lecture 119 - Dislocation interaction leading to strain hardening - I
- Lecture 120 - Dislocation interaction leading to strain hardening - II
- Lecture 121 - Solid solution hardening
- Lecture 122 - Grain size hardening
- Lecture 123 - Age hardening - I
- Lecture 124 - Age hardening - II
- Lecture 125 - Metastable precipitates
- Lecture 126 - Annealing of cold-worked metals
- Lecture 127 - Recovery
- Lecture 128 - Recrystallization
- Lecture 129 - Grain Growth
- Lecture 130 - True stress and true strain



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Lecture 2 - Structure and properties of materials - Part II

Lecture 3 - Elasticity Isotropic elasticity of materials; Anisotropic elasticity - Part I

Lecture 4 - Elasticity Isotropic elasticity of materials; Anisotropic elasticity - Part II

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Lecture 9 - Crystal Plasticity - I (Part A)

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Lecture 1 - Energy Resources and Environment

Lecture 2 - Characterization of Fuels: Concepts

Lecture 3 - Characterization of Fuels: Concepts

Lecture 4 - Production of Secondary Fuels : Carbonization

Lecture 5 - Materials Balance in Coke-making

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Lecture 9 - Principles of combustion: Concepts and illustrations

Lecture 10 - Principles of combustion: Concepts and illustrations

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Lecture 23 - Macroscopic Energy Balance: Applications to Design Head Meters, Stack and Blowers, Types of Flames

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Lecture 30 - Transport Phenomena in Furnaces: Convection and Radiation Heat Transfer, Role of Refractory

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[Lecture 35 - Miscellaneous Topics: Atmosphere in Furnaces](#)

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[Lecture 37 - Miscellaneous Topics: Pyrometry](#)

[Lecture 38 - Miscellaneous topics: Electric Resistance Heating](#)

[Lecture 39 - Furnace efficiency, Fuel Saving, Carbon Offset: Concepts and Exercises](#)

[Lecture 40 - Furnace efficiency, Fuel Saving, Carbon Offset: Concepts and Exercises](#)

**NPTEL : Introduction to Biomaterials (Metallurgy and Material Science)**

**Co-ordinators : Dr. Kantesh Balani, Dr. Birkamjit Basu**

Lecture 1 - Introduction to basic concepts of Biomaterials Science; Salient properties of important material classes; overview of body environment,

Lecture 2 - Manufacturing and properties of metals, ceramics, polymers and composites

Lecture 3 - Concept of biocompatibility, host response, structure-property of biological cell

Lecture 4 - Structure and properties of cells, protein and cellular adaptation process

Lecture 5 - Cell-I

Lecture 6 - Cell-II

Lecture 7 - Cell Migration and Cell Division and cell death

Lecture 8 - Cell Differentiation and Cell Death

Lecture 9 - Cell Apoptosis-I

Lecture 10 - Cell Apoptosis-II

Lecture 11 - Structure and properties of Protein; cell - material interaction

Lecture 12 - Assessment of biocompatibility of biomaterials

Lecture 13 - Biological testing (hemocompatibility, tribological testing)

Lecture 14 - Structure and properties of bone as well as in vivo testing and histocompatibility assessment

Lecture 15 - Important biometallic alloys

Lecture 16 - Ti Alloy

Lecture 17 - Co-Cr-Mo alloys

Lecture 18 - Bioceramics

Lecture 19 - Processing of Bioceramics

Lecture 20 - Ceramics, Bioceramics and Glasses

Lecture 21 - Sintering and mechanical properties of ceramics

Lecture 22 - Fracture and toughening of ceramic composites

Lecture 23 - Development of based bioceramic composites for hard tissue replacement

Lecture 24 - Alternative phosphate materials, based composites with bactericidal property and glass ceramics for dental restoration

Lecture 25 - Electrostatic Spraying of UHMWPE-HA-CNT composites

Lecture 26 - Thin Films and Coatings

Lecture 27 - Thermal Spray Coatings

Lecture 28 - Biocompatibility of plasma sprayed CNT reinforced Hydroxyapatite biocomposite coatings

Lecture 29 - Biocompatibility of Alumina and CNT reinforced Hydroxyapatite

Lecture 30 - Glass-ceramics for dental restoration applications

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Lecture 31 - Structure and properties of polymers

Lecture 32 - Biodegradable polymers (Importance)

Lecture 33 - Biodegradable polymers (Types)

Lecture 34 - Mechanisms of Bioerosion

Lecture 35 - External field and material interaction

Lecture 36 - Tissue Engineering and wound healing

Lecture 37 - Understanding Design Concepts of Bio-implants

Lecture 38 - Understanding Design Concepts of Dental-implants

Lecture 39 - Understanding Design Concepts of Orthopedic-implant

Lecture 1 - Introduction to Course

Lecture 2 - Measurement of Quantities

Lecture 3 - Exercises on Measurement of Quantities, Introduction to Stoichiometry

Lecture 4 - Stoichiometry Concept and Exercise

Lecture 5 - Exercise on Stoichiometry and Introduction to Thermochemistry

Lecture 6 - Thermochemistry

Lecture 7 - Exercise on Thermochemistry & Frequently Asked Questions

Lecture 8 - Errors in Measurements

Lecture 9 - Basics of Materials & Energy Balance

Lecture 10 - Introduction to Mineral Beneficiation

Lecture 11 - Materials Balance in Mineral Processing and Faq

Lecture 12 - Exercises in Mineral Processing

Lecture 13 - Calcination Concepts & Exercises

Lecture 14 - Pyromet Extraction Unit Processes

Lecture 15 - Predominance Area Diagram

Lecture 16 - Material Balance in Roasting; illustration

Lecture 17 - Heat Balance in Roasting illustration

Lecture 18 - Exercises on Roasting

Lecture 19 - Exercises on Roasting

Lecture 20 - Smelting Matte Smelting

Lecture 21 - Exercise-I Matte Smelting

Lecture 22 - Exercise-II Matte Smelting

Lecture 23 - Reduction Smelting

Lecture 24 - Lead Smelting Material Balance

Lecture 25 - Imperial Smelting Process

Lecture 26 - Introduction to Ironmaking

Lecture 27 - Coke Making

Lecture 28 - Ironmaking Fundamentals

Lecture 29 - Material & Heat Balance in Ironmaking - I

Lecture 30 - Material & Heat Balance in Ironmaking - II

Lecture 31 - RIST Diagram - I



[Lecture 32 - RIST Diagram - II](#)

[Lecture 33 - Concepts in Converting](#)

[Lecture 34 - Exercise in Converting](#)

[Lecture 35 - Additional Topics - I Melting in Cupola](#)

[Lecture 36 - Additional Topics - II Gasification](#)

[Lecture 37 - Additional Topics - III Material Balance in Gasification](#)

[Lecture 38 - Additional Topics - IV Industrial Furnaces](#)

[Lecture 39 - Energy Balance in Industrial Furnaces](#)

[Lecture 40 - Thoughts on Application of Energy Balance](#)

Lecture 1 - Conductivity of materials, Drude's theory and its failures

Lecture 2 - Free electron theory

Lecture 3 - Free electron theory

Lecture 4 - Crystal structure, Reciprocal lattice I

Lecture 5 - Reciprocal lattice II, Brillouin zone and Bragg's diffraction condition

Lecture 6 - Electrons in a crystal, Bloch's electron

Lecture 7 - Free electron band diagrams in an empty lattice

Lecture 8 - Effect of periodic potential, Origin of band-gap through Kronig-Penny model

Lecture 9 - Electron dynamics

Lecture 10 - Conduction in relation to band diagrams

Lecture 11 - Semiconductor E-k diagrams and their material properties

Lecture 12 - Equilibrium carrier statistics in semiconductors: density of states, fermi function and population density in bands

Lecture 13 - Equilibrium carrier statistics in semiconductors: qualitative examination of carrier densities in conduction and valence bands

Lecture 14 - Equilibrium carrier statistics in semiconductors: quantitative examination of carrier densities in intrinsic semiconductor

Lecture 15 - Doping in semiconductors

Lecture 16 - Equilibrium carrier statistics in semiconductors: complete ionization of dopant levels

Lecture 17 - Equilibrium carrier statistics in semiconductors: carrier freeze out

Lecture 18 - Semiconductor junctions in band-diagrams

Lecture 19 - Linear dielectric behavior

Lecture 20 - Non-linear dielectric behavior

Lecture 21 - Carrier recombination-generation - I: band-to-band transition

Lecture 22 - Carrier recombination-generation - II: Other mechanisms

Lecture 23 - R-G statistics via R-G centers

Lecture 24 - Optoelectronic materials and bandgap engineering

Lecture 25 - Optical properties of materials

Lecture 26 - Optical properties of single interfaces: Fresnel reflection coefficients

Lecture 27 - Optical Properties of two interfaces: thin film case

Lecture 28 - Drift

Lecture 29 - Diffusion

Lecture 30 - Continuity Equation

[Lecture 31 - Resistor and diode \(p-n junction\)](#)

[Lecture 32 - Fundamentals of p-n junction](#)

[Lecture 33 - Fundamentals of p-n junction \(Continued...\)](#)

[Lecture 34 - Solar cells](#)

[Lecture 35 - Microelectronics processing](#)

[Lecture 36 - MOS capacitor](#)

[Lecture 37 - Transistor](#)

[Lecture 38 - Organic Electronics](#)

[Lecture 39 - Organic Light Emitting Diodes](#)

[Lecture 40 - Organic Solar Cells and Organics Thin Film Transistors](#)

**NPTEL : Steel Making (Metallurgy and Material Science)**

**Co-ordinators : Prof. Satish Ch. Koria, Prof. Dipak Mazumdar**

[Lecture 1](#)

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Lecture 1 - Overview

Lecture 2 - Geometry of Crystals: Symmetry, Lattices

Lecture 3 - Geometry of Crystals: Symmetry, Lattices

Lecture 4 - Geometry of Crystals: Symmetry, Lattices

Lecture 5 - Geometry of Crystals: Symmetry, Lattices

Lecture 6 - Geometry of Crystals: Symmetry, Lattices

Lecture 7 - Geometry of Crystals: Symmetry, Lattices

Lecture 8 - Geometry of Crystals: Symmetry, Lattices

Lecture 9 - Geometry of Crystals: Symmetry, Lattices

Lecture 10 - Geometry of Crystals: Symmetry, Lattices

Lecture 11 - Geometry of Crystals: Symmetry, Lattices

Lecture 12 - Geometry of Crystals: Symmetry, Lattices (Continued...) and Miller Indices

Lecture 13 - Miller Indices

Lecture 14 - Miller Indices (Continued...) and Crystal Structures

Lecture 15 - Crystal Structures

Lecture 16 - Crystal Structures

Lecture 17 - Crystal Structures

Lecture 18 - Crystal Structures

Lecture 19 - Crystal Structures

Lecture 20 - Crystal Structures

Lecture 21 - Crystal Structures (Continued...) and Defects in Crystals

Lecture 22 - Defects in Crystals

Lecture 23 - Defects in Crystals

Lecture 24 - Defects in Crystals

Lecture 25 - Defects in Crystals

Lecture 26 - Defects in Crystals

Lecture 27 - Defects in Crystals

Lecture 28 - Defects in Crystals

Lecture 29 - Defects in Crystals

Lecture 30 - Diffusion in Solids

Lecture 31 - Diffusion in Solids

[Lecture 32 - Phase Diagrams](#)

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Lecture 1 - Introduction, Basic definition of corrosion

Lecture 2 - Forms of Degradation, Thermodynamics of corrosion

Lecture 3 - Thermodynamics of corrosion

Lecture 4 - Thermodynamics of corrosion

Lecture 5 - Thermodynamics of corrosion, Electrochemical series, Concentration cell

Lecture 6 - Reduction Potential series, Pourbaix diagram

Lecture 7 - Pourbaix diagram

Lecture 8 - Pourbaix diagram

Lecture 9 - Pourbaix diagram, Kinetics of corrosion

Lecture 10 - Kinetics of corrosion, Rate expression, Solved problems

Lecture 11 - Solved problems on the corrosion rate, Exchange current density

Lecture 12 - Exchange current density, Polarization, Activation Polarization, Tafel Equation

Lecture 13 - Activation Polarization, Concentration Polarization

Lecture 14 - Concentration Polarization, Mixed Potential Theory

Lecture 15 - Mixed Potential Theory, Explanation of corrosion events on the basis of Mixed potential theory, Galvanization

Lecture 16 - Explanation of corrosion events on the basis of Mixed potential theory, Effect of impurity, Effect of area factor

Lecture 17 - Explanation of corrosion events on the basis of Mixed potential theory, Effect of area factor, Concentration polarization, Passivation

Lecture 18 - Passivation and Mixed potential theory

Lecture 19 - Passivation and Mixed potential theory

Lecture 20 - Different corrosion protection mechanisms, electrochemical ways of protection, cathodic protection

Lecture 21 - Cathodic and anodic protection

Lecture 22 - Anodic protection, Forms of corrosion, Factors of corrosion

Lecture 23 - Forms of corrosion, Uniform Corrosion, Galvanic corrosion

Lecture 24 - Galvanic corrosion

Lecture 25 - Crevice corrosion

Lecture 26 - Crevice corrosion, Pitting corrosion

Lecture 27 - Pitting corrosion, Intergranular corrosion

Lecture 28 - Intergranular corrosion, Dealloying

Lecture 29 - Dealloying, Erosion corrosion

Lecture 30 - Erosion corrosion, Cavitation



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Lecture 31 - Cavitation, Fretting corrosion, corrosion cracking

Lecture 32 - Stress corrosion cracking: mechanisms (dissolution controlled)

Lecture 33 - Stress corrosion cracking: mechanisms (cleavage controlled), factors affecting SCC, hydrogen embrittlement, corrosion fatigue

Lecture 34 - Biologically influenced corrosion, liquid metal attack

Lecture 35 - Corrosion protection, change of materials, effect of design of component

Lecture 36 - Corrosion protection, change of environment, Inhibitors, coatings

Lecture 37 - Oxidation and hot corrosion, pitting Bedworth ratio, thermodynamics of oxidation

Lecture 38 - Thermodynamics of oxidation, Ellingham diagram, oxidation kinetics and laws

Lecture 39 - Oxide structure and Oxidation

Lecture 40 - Hot corrosion, corrosion testing and failure analysis, linear polarization

Lecture 41 - Degradation of composites, polymers and ceramics, corrosion and society

Lecture 1 - Introduction to the course

Lecture 2 - Heterogeneous equilibrium and Free energy Formalism

Lecture 3 - Concept of Chemical Potential

Lecture 4 - Phase Rule-I

Lecture 5 - Phase Rule-II and Single Component Equilibria

Lecture 6 - Single Component Phase Diagram

Lecture 7 - Binary Phase Diagram - Isomorphous Diagram

Lecture 8 - Binary Isomorphous System

Lecture 9 - Solidification of Isomorphous Alloys

Lecture 10 - Free Energy of Binary Isomorphous Phase Diagram

Lecture 11 - Phase Diagram of Binary Eutectic Systems Edit Lesson

Lecture 12 - Solidification of eutectic, hypo-eutectic and hyper-eutectic alloys & their morphologies - I

Lecture 13 - Solidification of eutectic, hypo-eutectic and hyper-eutectic alloys & their morphologies - II

Lecture 14 - Phase diagrams of binary eutectic two terminal solid solution

Lecture 15 - Phase diagrams of binary peritectic System - I

Lecture 16 - Phase diagrams of binary peritectic System - II

Lecture 17 - Phase diagrams of binary peritectic System with intermediate phases

Lecture 18 - Intermediate Phases

Lecture 19 - Introduction to Monotectic Phase Diagram

Lecture 20 - Microstructural Evolution of Monotectic Phase Diagram

Lecture 21 - Free Energy Composition diagrams for Monotectic systems and Syntactic phase diagram

Lecture 22 - Quasichemical theory - I

Lecture 23 - Quasichemical theory - II

Lecture 24 - Quasichemical theory Free energy formalism

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Lecture 27 - Eutectoid transformation in Iron-Carbon phase diagram

Lecture 28 - Austenite to pearlite transformation in Iron-Carbon phase diagram

Lecture 29 - Hypo-eutectoid steels

Lecture 30 - Pearlite Transformation

Lecture 31 - Martensite Transformation - I

- Lecture 32 - Martensite Transformation - II
- Lecture 33 - Tempering of Martensite
- Lecture 34 - Bainite Transformation
- Lecture 35 - TTT curves for Steel
- Lecture 36 - Cast Iron - I
- Lecture 37 - Cast Iron - II
- Lecture 38 - Ductile Iron and Nodular Iron
- Lecture 39 - Malleable Iron
- Lecture 40 - Alloyed Cast Iron
- Lecture 41 - Phase Diagram for different Solid State Reaction
- Lecture 42 - Phase Diagram of Ceramic
- Lecture 43 - Ternary Phase Diagram - I
- Lecture 44 - Ternary Phase Diagram - II
- Lecture 45 - Ternary Phase Diagram and Tie Line Construction - I
- Lecture 46 - Ternary Phase Diagram and Tie Line Construction - II
- Lecture 47 - Ternary Phase Diagram and Tie Line Construction - III
- Lecture 48 - Ternary Isomorphous Phase Diagram
- Lecture 49 - Ternary Three Phase Equilibria
- Lecture 50 - Three Phase Equilibria in Ternary Systems - I
- Lecture 51 - Three Phase Equilibria in Ternary Systems - II
- Lecture 52 - Solidification Behaviour of Ternary Alloy
- Lecture 53 - Three Phase Equilibria
- Lecture 54 - Ternary Four Phase Equilibria - I
- Lecture 55 - Ternary Four Phase Equilibria - II
- Lecture 56 - Solidification Behaviour of Ternary Eutectic Alloys
- Lecture 57 - Phase Diagram of Ternary Eutectic with Terminal Solid Solution
- Lecture 58 - Ternary Peritectic Reaction
- Lecture 59 - Quasi-peritectic Reaction
- Lecture 60 - Case Studies on Ternary Phase Diagrams - I
- Lecture 61 - Case Studies on Ternary Phase Diagrams - II

Lecture 1 - Introduction

Lecture 2 - Solidification (Casting)

Lecture 3 - Solidification (Welding)

Lecture 4 - Thermodynamics of Solidification

Lecture 5 - Kinetics of Solidification (Homogeneous)

Lecture 6 - Kinetics of Solidification (Heterogeneous)

Lecture 7 - Heat Flow

Lecture 8 - Heat Flow (Continued...)

Lecture 9 - Heat Flow (Insulating Mold Condition)

Lecture 10 - Heat Flow (Insulating Mold Condition) (Continued...)

Lecture 11 - Heat Flow (Interface Resistance Controlled Solidification)

Lecture 12 - Heat Flow (Effect of Superheat)

Lecture 13 - Heat Flow (Solidification of Alloys)

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Lecture 15 - Composition Variation (Continued...)

Lecture 16 - Complete and Limited Liquid Diffusion

Lecture 17 - Mixed Mode Solidification

Lecture 18 - Mixed Mode Solidification and Zone Refining

Lecture 19 - Zone Refining (Continued...)

Lecture 20 - Cellular Solidification of Single Phase Alloy

Lecture 21 - Cellular Solidification of Single Phase Alloy (Continued...)

Lecture 22 - Cellular Solidification of Single Phase Alloy (Continued...)

Lecture 23 - Plane Front Solidification of Multiphase Alloy

Lecture 24 - Plane Front Solidification of Multiphase Alloy (Continued...)

Lecture 25 - Fluid Flow Considerations

Lecture 26 - Introduction to Powder Processing

Lecture 27 - Introduction to Powder Processing (Continued...)

Lecture 28 - Powder characterization

Lecture 29 - Powder Characterization Techniques

Lecture 30 - Powder Characterization using Surface Area

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[Lecture 34 - Powder Manufacturing \(Continued...\)](#)

[Lecture 35 - Powder Consolidation](#)

[Lecture 36 - Powder Consolidation \(Continued...\)](#)

[Lecture 37 - Particle Packing](#)

[Lecture 38 - Powder Compaction](#)

[Lecture 39 - Powder Compaction \(Continued...\)](#)

[Lecture 40 - Sintering Theory](#)

Lecture 1 - Introduction to Heat Treatment and Importance of Material Tetrahedron

Lecture 2 - Case studies in reference to Material tetrahedron T/t information and processing

Lecture 3 - Few more case studies in reference to processing with T/t modification

Lecture 4 - Critical Definition and Phase Transformation Thermodynamics and Driving Force

Lecture 5 - Thermodynamics of Phase Transformation Driving force of Phase Transformation

Lecture 6 - Thermodynamics of Phase Transformation and Driving Force for Phase Transformation

Lecture 7 - Finding Value of Driving Force ( $\Delta G$ ) and Single Component (liquid-solid)

Lecture 8 - Finding Value of Driving Force ( $\Delta G$ ) and Nucleation Single Component (liquid-solid)

Lecture 9 - Nucleation Treatment Single Component (Solid-Liquid) - I

Lecture 10 - Nucleation Treatment Single Component (Solid-Liquid) - II

Lecture 11 - Solved Problem on Nucleation rate and How to determine the value of  $\gamma_{sl}$  Physical Concept & Interfacial Energy

Lecture 12 - How to determine the value of  $\gamma_{sl}$  (Physical Concept and Interfacial Energy)

Lecture 13 - Interfacial Energy - I

Lecture 14 - Interfacial Energy - II

Lecture 15 - Heterogeneous Nucleation - I

Lecture 16 - Heterogeneous Nucleation - II

Lecture 17 - Solid - Solid Transformation and Nucleation rate - I

Lecture 18 - Solid - Solid Transformation and Nucleation rate - II

Lecture 19 - Phase Diagram and G vs X plot - I

Lecture 20 - Phase Diagram and G vs X plot - II

Lecture 21 - Phase Diagram and G vs X plot - III

Lecture 22 - Introduction to Kinetics of Phase Transformation

Lecture 23 - Variation of  $\Delta G^*$  and  $r^*$  with Undercooling

Lecture 24 - Nucleation rate - I

Lecture 25 - Nucleation Rate - II

Lecture 26 - Critical Undercooling

Lecture 27 - Maximum nucleation rate for homogeneous nucleation

Lecture 28 - Maximum nucleation rate for heterogeneous nucleation

Lecture 29 - Nucleation kinetics in solid state

Lecture 30 - Interface controlled growth

Lecture 31 - Diffusion controlled growth

[Lecture 32 - Avrami Kinetics - I](#)

[Lecture 33 - Avrami Kinetics - II](#)

[Lecture 34 - Avrami Kinetics - III](#)

[Lecture 35 - Time-Temperature-Transformation \(TTT\) diagram](#)

[Lecture 36 - Diffusion in Solids - I](#)

[Lecture 37 - Diffusion in Solids - II](#)

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[Lecture 39 - Diffusion in Solids - IV](#)

[Lecture 40 - Applications of heat treatment](#)

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Lecture 2 - Continuum Mechanics

Lecture 3 - Stress Invariants

Lecture 4 - Strain Tensors and Mohr circle for strains

Lecture 5 - Yield Stress Criterion

Lecture 6 - Effective Stress and Strain

Lecture 7 - Work Hardening and Flow Behaviour

Lecture 8 - Effect of Strain Rate

Lecture 9 - Combined Effect of Strain, Strain Rate and Temperature

Lecture 10 - Effect of Temperature

Lecture 11 - Cold, Warm and Hot Working

Lecture 12 - Mechanics of Metal Working

Lecture 13 - Wire Drawing

Lecture 14 - Wire Drawing (Continued...)

Lecture 15 - Hodographs

Lecture 16 - Upper-Bound Analysis

Lecture 17 - Plane Strain Indentation

Lecture 18 - Strain Calculation Models and Friction

Lecture 19 - Types of Friction

Lecture 20 - Effect of Friction in Rolling

Lecture 21 - Vacuum Technology

Lecture 22 - Vacuum Technology (Continued...)

Lecture 23 - Thermal Evaporation

Lecture 24 - Thermal Evaporation (Continued...)

Lecture 25 - Thermal Evaporation (Continued...)

Lecture 26 - Plasma Physics

Lecture 27 - Plasma Physics (Continued...)

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Lecture 31 - Chemical Vapor Deposition



[Lecture 32 - Chemical Vapor Deposition \(Continued...\)](#)

[Lecture 33 - Chemical Vapor Deposition \(Continued...\)](#)

[Lecture 34 - Chemical Vapor Deposition \(Continued...\)](#)

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[Lecture 41 - Thin Film Characterization](#)

Lecture 1 - Material Evolution

Lecture 2 - Bonding in Materials

Lecture 3 - Correlation between bond and physical properties

Lecture 4 - Crystal Structure: Lattice and Basis

Lecture 5 - Unit Cell (Primitive and Non-primitive)

Lecture 6 - Crystal Systems and Bravais Lattices

Lecture 7 - Bravais Lattice and Symmetry in Crystals

Lecture 8 - Symmetry in Crystals

Lecture 9 - Symmetry and Correlation with the Bravais Lattice

Lecture 10 - Miller Indices (Planes and Directions)

Lecture 11 - Miller Indices - Part 2

Lecture 12 - Miller Indices - Part 3

Lecture 13 - Miller Indices and Weiss Zone Law

Lecture 14 - Structure of Metals and Alloys

Lecture 15 - Structure of Metals, Packing, Co-ordination and Interstices

Lecture 16 - Interstices, Solid Solutions and Alloys

Lecture 17 - Solid Solutions: Alloys

Lecture 18 - Solid Solutions: Alloy (Continued...)

Lecture 19 - Covalent Solids

Lecture 20 - Covalent Solids (Continued...) and Ionic Solids

Lecture 21 - Ionic Solids: Stability and Rules of Formation

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Lecture 23 - ionic Solids (Continued...) : Close Packing of anions

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Lecture 25 - Ionic Solids (Ceramics) : Remaining cubic and non-cubic structures

Lecture 26 - HCP based Structure

Lecture 27 - Structure of Non-crystalline Solids (glasses)

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Lecture 3 - Energy of Vacancy Formation

Lecture 4 - Vacancy Concentration Measurement Techniques

Lecture 5 - Self-interstitial Defects+Frenkel Defects

Lecture 6 - Schottky Defects+Extrinsic Defects

Lecture 7 - Interstitials in Iron

Lecture 8 - Defects Reaction+Kroger-Vink Notation

Lecture 9 - Defects Reaction and its Thermodynamics

Lecture 10 - Equilibrium Concentration using Defects Reaction

Lecture 11 - Examples on defect reaction

Lecture 12 - Diffusion (Interstitial Diffusion)

Lecture 13 - Non-steady state diffusion

Lecture 14 - Self-diffusion + Examples

Lecture 15 - Diffusion in substitutional alloys+Diffusion along defects

Lecture 16 - History of Dislocations

Lecture 17 - Volterra Model + Structure of Dislocations + Burger vectors

Lecture 18 - Characteristics of Dislocations

Lecture 19 - Mixed Dislocations + Dislocation Loops

Lecture 20 - Elastic Continuum Model + Strain field for screw dislocations

Lecture 21 - Stress and Strain Fields

Lecture 22 - Stress State around Edge Dislocations+Elastic Energy of Dislocations

Lecture 23 - Glide Forces on Dislocations+Line Tension on Dislocations

Lecture 24 - Climb Forces on Dislocations+Interaction Between Dislocations

Lecture 25 - Image Forces on Dislocations

Lecture 26 - Resistance to Dislocation Motion+Peierl Nebarro Valley

Lecture 27 - Slip System+Examples

Lecture 28 - Dislocations and Slips+Examples

Lecture 29 - Critical resolved Shear Stress+Examples (Continued...)

Lecture 30 - Glide+Kinks

Lecture 31 - Cross-slip+Climb

[Lecture 32 - Climb+Jogs](#)

[Lecture 33 - Examples on Jogs+Dislocation Intersection](#)

[Lecture 34 - Dislocation Intersection and step characteristics+Superjogs](#)

[Lecture 35 - Strain and strain-rate due to dislocation motion+Velocity of dislocations+Observation of dislocations](#)

[Lecture 36 - Observation of dislocation \(Continued...\) + Dislocation Dynamics](#)

[Lecture 37 - Dislocations in FCC+Partial dislocations](#)

[Lecture 38 - Partial dislocations \(Continued...\) +Stacking Fault](#)

[Lecture 39 - Thompson's Tetrahedron+Examples](#)

[Lecture 40 - Dislocations in BCC+Asymmetry of Slip](#)

- Lecture 1 - Introduction to corrosion - I
- Lecture 2 - Introduction to corrosion - II
- Lecture 3 - Types and forms of corrosion
- Lecture 4 - Uniform and Galvanic corrosion
- Lecture 5 - Crevice and Pitting corrosion
- Lecture 6 - Forms of corrosion: Explanation with Examples
- Lecture 7 - Electrochemical Nature of Corrosion and its Thermodynamics
- Lecture 8 - Thermodynamics aspects of corrosion - I
- Lecture 9 - Thermodynamics aspects of corrosion - II
- Lecture 10 - Thermodynamics aspects of corrosion - III
- Lecture 11 - Relation Between Free Energy and Equilibrium Constant
- Lecture 12 - Derivation of Nernst Equation
- Lecture 13 - Standard Reduction Potential Series for Pure Metals
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- Lecture 35 - Electric steel making
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- Lecture 40 - Ladle de-sulphurization, alloying, stainless steel making
- Lecture 41 - Inclusion and its control
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- Lecture 44 - IM: Cored wire injection: Industrial implications
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Lecture 3 - Characteristics of polymers and advanced polymeric materials

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Lecture 20 - Strengthening of materials, fatigue, and creep

Lecture 21 - Composite materials: Particle-reinforced composites, and fiber reinforced composites

Lecture 22 - Structural Composite

Lecture 23 - Dielectric and piezoelectric behavior

Lecture 24 - Ferroelectric Behaviour of Non-Metallic Materials and Ferroelectric thin film for Non-Volatile Memory Applications

Lecture 25 - Magnetic Properties : Origin of Magnetism, Para, Dia, Ferro, and Ferrimagnetism

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- Lecture 32 - Introduction to electrochemical methods; cyclic voltammetry and other related techniques
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- Lecture 40 - Fundamental of thin film growth, growth mechanism and kinetics
- Lecture 41 - Thin film growth techniques, thermal evaporation, CVD, sputtering, CSD
- Lecture 42 - Fundamentals and processing of conducting and semiconducting ceramic devices
- Lecture 43 - Processing of ceramics devices
- Lecture 44 - Organic electronic materials: conducting polymers, semi-conducting organic materials, applications
- Lecture 45 - Thermal analyses
- Lecture 46 - Introduction of spectroscopic technique : UV-VIS spectroscopy
- Lecture 47 - Infra-red and Raman spectroscopy
- Lecture 48 - Optical and scanning electron microscopy
- Lecture 49 - X-ray photoelectron spectroscopy
- Lecture 50 - Measurement of mechanical properties, fracture toughness, MOR, hardness
- Lecture 51 - Ferroelectric thin film: synthesis and characterization
- Lecture 52 - Thermal analysis techniques: Differential scanning calorimetry and thermogravimetry
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- Lecture 55 - Fundamentals of corrosion, corrosion of materials
- Lecture 56 - Oxidation, corrosion of ceramic materials, degradation of polymers: swelling and dissolution, bond rupture, weathering
- Lecture 57 - Ceramics in biology and medicine
- Lecture 58 - Design of Ceramics
- Lecture 59 - Finishing of Ceramics
- Lecture 60 - Fly-ash based glazed wall tiles: A case study

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Lecture 2 - Scanning Electron Microscopy

Lecture 3 - SEM and Its Capabilities

Lecture 4 - Main Components of SEM - Electron Guns

Lecture 5 - Main Components of SEM - Electron Guns and Electromagnetic Lenses

Lecture 6 - Electron Probe Diameter Verses Electron Probe Current

Lecture 7 - Electron Beam - Specimen Interaction

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Lecture 9 - BSE Detector and Sample Preparation for SEM

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Lecture 11 - How to Get a Good SEM Image

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Lecture 13 - Additional Capabilities of SEM (Continued...)

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Lecture 16 - Ions Versus Electrons as Source for Microscopy

Lecture 17 - Ions Source in HIM

Lecture 18 - GFIS Properties and Ion Optical Column

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Lecture 22 - Contrast Mechanism and Imaging Modes

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Lecture 24 - Creation and Modification of Materials by HIM

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- Lecture 2 - Image formation, resolution, magnification, depth of field and depth of focus
- Lecture 3 - Aberrations in microscopy: General concepts
- Lecture 4 - Introduction, types and image formation in Optical microscopy
- Lecture 5 - Components of optical microscope
- Lecture 6 - Bright field and Dark field modes
- Lecture 7 - Phase contrast optical microscopy
- Lecture 8 - Polarized light microscopy
- Lecture 9 - Differential interference contrast
- Lecture 10 - Fluorescence microscopy
- Lecture 11 - Basic components of electron microscope
- Lecture 12 - Basic components of electron microscope (Continued...)
- Lecture 13 - Basic components of electron microscope (Continued...)
- Lecture 14 - Electron-material interaction
- Lecture 15 - Electron-material interaction (Continued...)
- Lecture 16 - Electron-material interaction (Continued...) and Image formation and contrast generation
- Lecture 17 - Modes of TEM (BF and DF)
- Lecture 18 - Modes of TEM
- Lecture 19 - Modes of TEM (Continued...) and Electron diffraction in TEM
- Lecture 20 - Electron diffraction in TEM
- Lecture 21 - Electron diffraction in TEM (Continued...)
- Lecture 22 - Electron diffraction in TEM (Continued...)
- Lecture 23 - Electron diffraction in TEM (Continued...)
- Lecture 24 - Electron diffraction in TEM (Continued...)
- Lecture 25 - Application of Electron diffraction
- Lecture 26 - Signal generation in SEM
- Lecture 27 - Signal generation in SEM (Continued...)
- Lecture 28 - Signal generation in SEM (Continued...)
- Lecture 29 - Signal generation in SEM (Continued...)
- Lecture 30 - Signal generation in SEM (Continued...)
- Lecture 31 - Basic components of SEM

- Lecture 32 - Basic components of SEM (Continued...)
- Lecture 33 - Optics of SEM
- Lecture 34 - Optics of SEM (Continued...)
- Lecture 35 - Optics of SEM (Continued...) and analytical detectors
- Lecture 36 - Analytical detectors in SEM
- Lecture 37 - Analytical (WDS) detector and contrast formation in SEM
- Lecture 38 - Imaging in SEM
- Lecture 39 - Imaging in SEM (Continued...)
- Lecture 40 - Imaging in SEM (Continued...)
- Lecture 41 - Imaging in SEM and X-ray diffraction
- Lecture 42 - Continuous and characteristics X-ray spectrum
- Lecture 43 - Characteristics X-ray radiation
- Lecture 44 - Characteristics X-ray radiation (Continued...) and X-ray absorption
- Lecture 45 - X-ray absorption (Continued...)
- Lecture 46 - X-ray absorption and filters
- Lecture 47 - Intensity of diffracted beam
- Lecture 48 - Intensity of diffracted beam (Continued...)
- Lecture 49 - Intensity of diffracted beam (Continued...)
- Lecture 50 - Intensity of diffracted beam (Continued...)
- Lecture 51 - Intensity of diffracted beam (Continued...)
- Lecture 52 - Intensity of diffracted beam (Continued...)
- Lecture 53 - Intensity of diffracted beam (Continued...)
- Lecture 54 - Intensity of diffracted beam (Continued...)
- Lecture 55 - Intensity of diffracted beam (Continued...)
- Lecture 56 - Intensity of diffracted beam (Continued...) and X-ray diffraction profile and analysis
- Lecture 57 - X-ray diffraction profile and analysis
- Lecture 58 - X-ray diffraction profile and analysis (Continued...)
- Lecture 59 - X-ray diffraction profile and analysis (Continued...)
- Lecture 60 - Electron backscatter diffraction (EBSD)

Lecture 1 - Fundamentals of electrochemistry, definition of primary and secondary batteries

Lecture 2 - Primary batteries and Secondary batteries

Lecture 3 - Supercapacitors

Lecture 4 - Concepts of thermodynamics pertinent to electrochemical cells

Lecture 5 - Kinetics of electrochemical cells and structural characteristics of electrodes

Lecture 6 - Introduction to EMF, redox potential, Faraday law and Nernst's law

Lecture 7 - Terminology related to secondary battery : half-cell,full-cell, redox couple,positive

Lecture 8 - Measurements: Cyclic voltammetry, nominal voltage, capacity, rate performance

Lecture 9 - Impedance spectroscopy measurement and analyses

Lecture 10 - Measurement of rechargeable cell: Case study

Lecture 11 - History and categories of lithium batteries

Lecture 12 - Operational mechanisms for lithium batteries: Intercalation materials, alloys

Lecture 13 - Differences of voltage profiles between intercalation materials, alloys, and conversion

Lecture 14 - Properties of electrode materials (Case study: alloy as anode)

Lecture 15 - Properties of electrode materials (conversion type oxide as case study)

Lecture 16 - Positive electrodes: Lithiated transition metal oxides, lithiated iron oxyphosphates etc

Lecture 17 - Negative electrodes: Carbonaceous materials, lithium titanium oxides etc

Lecture 18 - Electrolyte :Liquid Electrolyte, Polymer Electrolyte

Lecture 19 - Current Collector, Conductive Agents, Separator and Other Accessories

Lecture 20 - Novel materials for lithium ion rechargeable cells

Lecture 21 - Principle of Operation of Commercial Cells : viz. C - NMC, C - NCA etc

Lecture 22 - Principle of operation of commercial cells

Lecture 23 - Major characteristics of commercial Li ion cells: Cell performance,degradation phenomena

Lecture 24 - Fabrication of Li ion cell: Cylindrical configuration

Lecture 25 - Fabrication of Li ion cell: Pouch and prismatic cell

Lecture 26 - Positive electrodes: Layered oxide, polyanionic compounds (phosphates, sulphates etc)

Lecture 27 - Negative electrodes: Carbonaceous materials, alloy based and other materials

Lecture 28 - Electrolytes: Roles and requirements, organic electrolyte, ionic liquid electrolyte

Lecture 29 - Performance of Na ion rechargeable cell

Lecture 30 - Future perspective of Na ion cells

Lecture 31 - Introduction to battery module, BMS, thermal management and pack design

- Lecture 32 - Degradation and safety issues of Li ion rechargeable cells
- Lecture 33 - Introduction to battery management system: BMS topologies, hardware, concept of active
- Lecture 34 - Introduction to thermal management: Active thermal management system, passive thermal
- Lecture 35 - Packaging of battery pack and battery testing: Material selection, sealing of enclosure
- Lecture 36 - Classification of supercapacitors: EDLC and pseudocapacitive type
- Lecture 37 - Pseudocapacitor
- Lecture 38 - Asymmetric supercapacitor and BATCAP: Battery supercapacitor hybrid electrochemical
- Lecture 39 - Electrolytes for supercapacitors: Aqueous/organic liquid electrolytes/ionic liquid
- Lecture 40 - Current collectors, separators etc. and their effect on performance
- Lecture 41 - Operational principles of aqueous and Li - O<sub>2</sub> batteries
- Lecture 42 - Electrolytes for Li - O<sub>2</sub> batteries
- Lecture 43 - Limitations of Li - Air batteries
- Lecture 44 - State of the art Li - Air batteries : Carbonaceous materials
- Lecture 45 - State of the art Li - Air batteries: Case study
- Lecture 46 - The element sulfur, principle of operation
- Lecture 47 - Advantages and disadvantages of Li - S batteries, positive electrodes
- Lecture 48 - Electrolyte and negative electrode for Li - S battery
- Lecture 49 - State of the art Li - S batteries : Case study - I
- Lecture 50 - State of the art Li - S batteries : Case study - II
- Lecture 51 - Global Geographic Distribution of Raw Lithium Resources
- Lecture 52 - Nature and geological origin of all potential lithium resources
- Lecture 53 - State of the art extraction techniques and known production reserves
- Lecture 54 - Recycling of lithium and other battery constituents from used battery
- Lecture 55 - Recycling of lithium and other battery constituents from used battery (Continued...)
- Lecture 56 - Lead Acid Batteries: Operational principles, main characteristics and applications
- Lecture 57 - Lead Acid Batteries: Operational principles, main characteristics and applications (Continued...)
- Lecture 58 - Ni-Cd and Ni-MeH Batteries: Operational principles, main characteristics and applications
- Lecture 59 - Redox flow battery vanadium redox battery,operational principle, and main characteristics
- Lecture 60 - Other Redox Flow Battery Technologies

Lecture 1 - Introduction

Lecture 2 - Texture and Anisotropy

Lecture 3 - Processing - Texture - Anisotropic Properties

Lecture 4 - Crystal Structure and Stereographic Projections

Lecture 5 - Utilization of Stereographic Projections

Lecture 6 - Diffraction and Bragg's Law

Lecture 7 - Structure Factor and Diffraction Extinction Criteria

Lecture 8 - Structure factor and diffraction extinction criteria (Continued...)

Lecture 9 - Pole figures

Lecture 10 - Pole figures (Continued...)

Lecture 11 - Inverse Pole Figures

Lecture 12 - Three Dimensional Texture Analysis

Lecture 13 - Euler Angles and ODFs

Lecture 14 - Euler Angles and ODFs (Continued...)

Lecture 15 - Euler Angles and ODFs (Continued...)

Lecture 16 - Euler Angles and ODFs (Continued...)

Lecture 17 - Symmetry Effects on Orientation Matrix

Lecture 18 - Euler Space and Orientation Matrices

Lecture 19 - Texture Fibre, Periodicity in Euler Space, Incomplete Pole Figures

Lecture 20 - Crystal Structures and Symmetry

Lecture 21 - Size of Euler Space in Relation to Crystal and Sample Symmetry

Lecture 22 - Macrotecture and Microtexture Measurements

Lecture 23 - Penetration Depth of X-ray, Neutron, e-1 and Basics of X-ray Generation

Lecture 24 - Characteristic X-ray, Absorption and Filters

Lecture 25 - Principles of pole figure measurements by X-ray diffraction

Lecture 26 - Texture Goniometer Components

Lecture 27 - Limitations and Errors in X-ray Texture Measurement and Corrections

Lecture 28 - Basics of Electron Microscopy - I

Lecture 29 - Basics of Electron Microscopy - II

Lecture 30 - Kikuchi Diffraction Pattern - I

Lecture 31 - Kikuchi Diffraction Pattern - II



- Lecture 32 - Quantitative Evaluation of Kikuchi Diffraction Pattern - I
- Lecture 33 - Quantitative evaluation of Kikuchi Diffraction Pattern - II
- Lecture 34 - Quantitative evaluation of Kikuchi Diffraction Pattern - III
- Lecture 35 - Analysis using the TSL-OIM software
- Lecture 36 - Analysis using the AZtec Crystal software
- Lecture 37 - Analysis using the ATEX software
- Lecture 38 - Introduction to solidification texture
- Lecture 39 - Solidification texture in Alloys
- Lecture 40 - Solidification texture in FCC, BCC, and HCP structures
- Lecture 41 - Phase Transformation Texture and Bain Strain
- Lecture 42 - Orientation Relationships between FCC and BCC / BCT
- Lecture 43 - Various Orientation Relationships and Variants
- Lecture 44 - Basic Mechanics of Polycrystal Plasticity
- Lecture 45 - Basic Mechanics of Polycrystal Plasticity (Continued...)
- Lecture 46 - A Metallurgist Point of View
- Lecture 47 - A Metallurgist Point of View (Continued...)
- Lecture 48 - Texture in FCC polycrystals
- Lecture 49 - Texture in BCC polycrystals - I
- Lecture 50 - Texture in BCC polycrystals - II
- Lecture 51 - Texture in HCP polycrystals - I
- Lecture 52 - Texture in HCP polycrystals - II
- Lecture 53 - Texture in HCP polycrystals - III
- Lecture 54 - Static recrystallization
- Lecture 55 - Dynamic recrystallization and recrystallization texture
- Lecture 56 - Dynamic recrystallization and grain refinement during hot large strain shear

- Lecture 1 - Classification of Mining and Bulk Solid Handling Systems
- Lecture 2 - Properties of bulk material vis-a-vis different bulk handling operations
- Lecture 3 - Fundamentals of BMH and Transport: Capacity and Productivity Concepts
- Lecture 4 - Bulk material handling in Processing plants: Crushing and Screening Flow Charts
- Lecture 5 - Introduction to Bulk Material Transport and Autonomous Vehicles
- Lecture 6 - Constructional Components: Trends of Developments
- Lecture 7 - Belt Conveyor Construction: Belting for Bulk Material Conveyor
- Lecture 8 - Idlers and Belt Cleaners
- Lecture 9 - Feeding and Discharging Devices
- Lecture 10 - Safety and Troubleshooting
- Lecture 11 - Size Selection and Power Calculation
- Lecture 12 - Principle of operations and applicability
- Lecture 13 - Basic Design Calculations
- Lecture 14 - Introduction to Pneumatic Conveying systems
- Lecture 15 - Design Calculations for Pneumatic Conveying
- Lecture 16 - Exercise with Basic Design Calculations
- Lecture 17 - Stackers and Reclaimers: Classification and Selection Criteria
- Lecture 18 - Stackers and Reclaimers: Comparison of Different Types
- Lecture 19 - Principles of Blending and Reclaiming
- Lecture 20 - Case studies of stacker and reclaimers application
- Lecture 21 - System Layout
- Lecture 22 - Introduction to Bin Bunker and Silo
- Lecture 23 - Introduction to Bunker
- Lecture 24 - Introduction to Silo
- Lecture 25 - Silo Failures and Maintenance
- Lecture 26 - Basics of Silo Design
- Lecture 27 - Feeder Selection and Design
- Lecture 28 - Crushers: Classification and selection
- Lecture 29 - Secondary Crushers
- Lecture 30 - Screen: Classification and Selection
- Lecture 31 - Monitoring and Maintenance of Processing Plant Equipment

Lecture 32 - Concentration and Separation

Lecture 33 - Fine Size Classification: Desliming and Cycloning

Lecture 34 - Froth Flotation Techniques, Magnetic Separation, Jigs and Thickeners

Lecture 35 - Jigs and Thickeners

Lecture 36 - Coal Washery Equipment and Practices

Lecture 37 - Classification and Selection

Lecture 38 - Crusher Selection and Application

Lecture 39 - Off-Highway trucks and Haul Roads - 1

Lecture 40 - Off-Highway trucks and Haul Roads - 2

Lecture 41 - Recent Developments in Truck Transportation

Lecture 42 - RopeCon Transportation

Lecture 43 - Aerial Ropeways: Introduction

Lecture 44 - Aerial Ropeways Calculation

Lecture 45 - Pipe Conveyor Belt: Enclosed Material Transport

Lecture 46 - Underground Mine Transport System

Lecture 47 - Rope Haulage for Underground Mine Transport

Lecture 48 - Main and Tail and Endless Rope Haulage

Lecture 49 - Pit Top and Pit Bottom Layout

Lecture 50 - Haulage calculation

Lecture 51 - Locomotive

Lecture 52 - Low Profile Dumper

Lecture 53 - Load Haul Dumper

Lecture 54 - Introduction to Cage and Skip Winding

Lecture 55 - Winding Calculations

Lecture 56 - Safety Aspects in Bulk Solid Handling and Transportation

Lecture 57 - Safety Aspects in Bulk Solid Handling and Transportation

Lecture 58 - Basic Introduction of Automatic Control

Lecture 59 - Automating Bulk Solids Processes

Lecture 60 - Online Monitoring

- Lecture 1 - Introduction to Materials and Environment
- Lecture 2 - Genesis of Materials Degradation
- Lecture 3 - Classification of degradation and Parameters Influencing it - Part I
- Lecture 4 - Parameters Influencing Degradation - Part II
- Lecture 5 - Engineering Solution to Combat Environmental Degradation of Materials
- Lecture 6 - Aqueous corrosion-thermodynamics of Wet Corrosion
- Lecture 7 - Aqueous corrosion-Classification - Part I
- Lecture 8 - Aqueous corrosion-Classification - Part II
- Lecture 9 - Classification of Aqueous corrosion - Part III
- Lecture 10 - Classification of Aqueous corrosion - Part IV
- Lecture 11 - Friction and Wear-Part - I
- Lecture 12 - Friction and Wear-Part - II
- Lecture 13 - Wear- Classification of wear - Part I
- Lecture 14 - Wear- Classification of wear - Part II
- Lecture 15 - Fatigue – Surface Dependent Property
- Lecture 16 - Failure Analysis - Part I
- Lecture 17 - Failure Analysis - Part II
- Lecture 18 - Characteristics of Failure - Part I
- Lecture 19 - Characteristics of Failure - Part II
- Lecture 20 - Characteristics of Failure - Part III
- Lecture 21 - Prevention
- Lecture 22 - Prevention of Chemical/Electrochemical Degradation
- Lecture 23 - Prevention of Chemical/Electrochemical Degradation (Continued...)
- Lecture 24 - Prevention of Chemical/Electrochemical Degradation (Continued...)
- Lecture 25 - Prevention of Mechanical Degradation
- Lecture 26 - Non Destructive Testing
- Lecture 27 - Mechanical and Electrochemical Testing - Part I
- Lecture 28 - Mechanical and Electrochemical Testing - Part II
- Lecture 29 - Mechanical and Electrochemical Testing - Part III
- Lecture 30 - Characterization
- Lecture 31 - Surface/Interface

- Lecture 32 - Scope, Classification and Objectives of Surface Engineering
- Lecture 33 - Shot Peening
- Lecture 34 - Grinding and Polishing
- Lecture 35 - Ultrasonic Peening and Laser Shock Peening
- Lecture 36 - Conventional Surface Hardening (Flame and induction)
- Lecture 37 - Pack Carburizing
- Lecture 38 - Fluidized Bed Carburizing
- Lecture 39 - Fused bath and Gas Nitriding
- Lecture 40 - Plasma Nitriding
- Lecture 41 - Diffusion Based Coatings - Solid State
- Lecture 42 - Chemical Conversion Coatings
- Lecture 43 - Electrodeposition
- Lecture 44 - Electrophoretic and Electroless deposition
- Lecture 45 - Galvanizing and Hot Dipping
- Lecture 46 - Thick Coatings by Weld Overlay and Cladding
- Lecture 47 - Introduction to thin film deposition
- Lecture 48 - Physical Vapor Deposition including Sputtering
- Lecture 49 - Chemical Vapor Deposition (CVD) and Composite Coating
- Lecture 50 - Chemical Vapor Deposition (CVD) and Composite Coating
- Lecture 51 - Spray Coating Techniques II - Plasma Spray and Cold Spray
- Lecture 52 - Ion Implantation
- Lecture 53 - Electron Beam Assisted Surface Engineering
- Lecture 54 - Laser Material Processing
- Lecture 55 - Laser Surface Engineering
- Lecture 56 - Laser Assisted Additive Manufacturing, LAM
- Lecture 57 - Strengthening Mechanisms in Surface Engineering
- Lecture 58 - Microstructural Characterization after Surface Engineering
- Lecture 59 - Compositional Characterization after Surface Engineering
- Lecture 60 - Summary of surface engineering and Conclusion

Lecture 1 - Modes of Fracture

Lecture 2 - Theoretical Strengths and Defects

Lecture 3 - Stress Concentration

Lecture 4 - Griffith Criterion

Lecture 5 - Griffith Criteria - Modification

Lecture 6 - Stress Intensity Factor

Lecture 7 - Fracture Toughness and Plane Stress-Plane Strain

Lecture 8 - Plastic Zone Size

Lecture 9 - Plane stress and plane strain fracture toughness

Lecture 10 - Plane stress and plane strain fracture toughness (Continued...)

Lecture 11 - Plane Strain Fracture Toughness Testing

Lecture 12 - Plane Strain-Plane Stress Fracture Toughness Testing

Lecture 13 - Plane Stress Fracture Toughness

Lecture 14 - Plane Stress fracture toughness-J integral

Lecture 15 - Experimental determination of JIC

Lecture 16 - J-integral and JIC

Lecture 17 - Impact Toughness

Lecture 18 - Impact Toughness (Continued...)

Lecture 19 - Impact Toughness (Continued...)

Lecture 20 - Impact Toughness (Continued...)

Lecture 21 - Impact Toughness (Continued...)

Lecture 22 - Fracture Toughness

Lecture 23 - Fracture Toughness (Continued...)

Lecture 24 - Fracture Toughness (Continued...)

Lecture 25 - Fracture Toughness (Continued...)

Lecture 26 - Fracture Toughness (Continued...)

Lecture 27 - Environment Assisted Fracture

Lecture 28 - Environment Assisted Fracture (Continued...)

Lecture 29 - Environment Assisted Fracture (Continued...)

Lecture 30 - Introduction to Fatigue

Lecture 31 - Stress Controlled Fatigue

- [Lecture 32 - Stress Controlled Fatigue \(Continued...\)](#)
- [Lecture 33 - Stress Controlled Fatigue \(Continued...\)](#)
- [Lecture 34 - Stress Controlled Fatigue \(Continued...\)](#)
- [Lecture 35 - Strain Controlled Fatigue \(Continued...\)](#)
- [Lecture 36 - Strain Controlled Fatigue \(Continued...\)](#)
- [Lecture 37 - Strain Controlled Fatigue \(Continued...\)](#)
- [Lecture 38 - Strain Controlled Fatigue \(Continued...\)](#)
- [Lecture 39 - Fatigue Crack Nucleation](#)
- [Lecture 40 - Notch Effect](#)
- [Lecture 41 - Crack in Fatigue](#)
- [Lecture 42 - Fatigue Crack Propagation](#)
- [Lecture 43 - Fatigue Crack Propagation \(Continued...\)](#)
- [Lecture 44 - Fatigue Crack Propagation \(Continued...\)](#)
- [Lecture 45 - Fatigue Crack Propagation \(Continued...\)](#)
- [Lecture 46 - Fatigue Crack Propagation \(Continued...\)](#)
- [Lecture 47 - Fatigue Crack Propagation \(Continued...\)](#)
- [Lecture 48 - Fatigue in Materials](#)
- [Lecture 49 - Fatigue in Materials \(Continued...\)](#)
- [Lecture 50 - Effect of Temperature on Fatigue](#)
- [Lecture 51 - Failure Analysis](#)
- [Lecture 52 - Failure Analysis \(Continued...\)](#)
- [Lecture 53 - Failure Analysis \(Continued...\)](#)
- [Lecture 54 - Failure Analysis - Case study - Titanic](#)
- [Lecture 55 - Failure Analysis - Case Study - ALK](#)
- [Lecture 56 - Failure Analysis - Case study - Point Pleasant Bridge](#)
- [Lecture 57 - Failure Analysis - Case Study - Rail Crash](#)
- [Lecture 58 - Failure Analysis - Case Study - Comet](#)
- [Lecture 59 - Failure Analysis - Case Study - Columbia](#)
- [Lecture 60 - Failure Analysis - Summary](#)

Lecture 1 - Introduction to closure concept

Lecture 2 - Mine Closure Objectives and Regulatory Aspects

Lecture 3 - Mining Footprint and Regulatory Aspects

Lecture 4 - Mine Closure Costs and Financing Approaches

Lecture 5 - Decommissioning of Mines

Lecture 6 - Demolition Techniques

Lecture 7 - Post Closure Liabilities and Activities

Lecture 8 - Post Closure Community Concerns and Sustainable Development Plans

Lecture 9 - Closure oriented Resource Development-Post Mining Land Uses

Lecture 10 - Post mining site monitoring

Lecture 11 - Planning inputs, tools and techniques

Lecture 12 - Tools and Techniques for Closure Plan Development and Procedures

Lecture 13 - Closure Plan Development Procedures

Lecture 14 - Monitoring, Review and Feedback of Closure Plan Implementation-Closure Criteria

Lecture 15 - Failure Mode and Effect Analysis Framework for Mine Closure Planning

Lecture 16 - Multiple Accounts Analysis (MAA) for Assessment of Closure Alternatives

Lecture 17 - Provisioning of capital

Lecture 18 - Closure costs and Rehabilitation Costs

Lecture 19 - Finance and Accounting: Closure cost estimate

Lecture 20 - Closure Economics and Audit

Lecture 21 - Application of Remote Sensing for Mine Closure-Introduction

Lecture 22 - Remote Sensing Sensors

Lecture 23 - Remote Sensing media and sensors

Lecture 24 - Image Processing and Data Interpretation

Lecture 25 - GIS for Mine Closure: Mapping and Geo-Spatial Data Analysis

Lecture 26 - Integration of phase operations

Lecture 27 - Integration of Interdepartmental work and phase operations - Part 1

Lecture 28 - Integration of Interdepartmental work and phase operations - Part 2

Lecture 29 - Risk Analysis Techniques and Management

Lecture 30 - Post Mine Closure Waste to Wealth Conversion

Lecture 31 - CSR and EMP Integration



Lecture 32 - Introduction to Asset Management

Lecture 33 - Principle of Asset Management and Decommissioning of Assets for Site Restoration

Lecture 34 - Brownfield Redevelopment and Value Addition to Assets

Lecture 35 - Landform Design and Post Mining Asset Creation

Lecture 36 - Concept of Sustainable Development and Mining industry

Lecture 37 - Sustainability Measurement and Reporting

Lecture 38 - Sustainability Measurement and Reporting (Continued...)

Lecture 39 - Sustainable Mineral Industry

Lecture 40 - Policy and Legislative Framework of Sustainability for SDG and Mine Closure

Lecture 41 - Communicating sustainability performance

Lecture 42 - Framework of Sustainability reporting

Lecture 43 - Sustainable accounting

Lecture 44 - Case studies on Sustainability initiatives in Mining Industry

Lecture 45 - Data Analytics for Sustainability management

Lecture 46 - Cleaner Production Based Closure Management

Lecture 47 - Regenerative environment design for sustainable Mine Closure

Lecture 48 - Reusable resource identification in post closure mine site

Lecture 49 - Optimization of Residual Value of Assets

Lecture 50 - Post Mining Site for Community wealth

Lecture 51 - Management of water resources

Lecture 52 - Soil Treatment and Revegetation

Lecture 53 - Bio-diversity: Post Land reclamation and plantation

Lecture 54 - Physical and Chemical Stability issues

Lecture 55 - Economic Utilization of Post Mining Structures and assets

Lecture 56 - Techniques for closing underground workings

Lecture 57 - Application of Industry 4.0 for Mine

Lecture 58 - Best mining practices for Sustainable mining - Case studies

Lecture 59 - Stability Monitoring and Enhancing tools

Lecture 60 - VR and AR Technology for Post Mining Mine site Visualization and Design

- Lecture 1 - Fundamental aspects of hybrid materials
- Lecture 2 - Materials selection basics for design with hybrid materials
- Lecture 3 - Classes of materials and material property charts
- Lecture 4 - Material property charts and concept of material indices
- Lecture 5 - Material property chart-indices and concept of hybridization
- Lecture 6 - Hybrid materials - Composite
- Lecture 7 - Cellular solids - Applications of metal foams
- Lecture 8 - Cellular solids - Applications of porous ceramics and polymer foams
- Lecture 9 - Basics of Composite Materials and Classification
- Lecture 10 - Composite Classification - Matrix and Reinforcement
- Lecture 11 - Fibers - Fundamentals, Glass fiber
- Lecture 12 - Fibers - Boron and Carbon Fibers
- Lecture 13 - Fibers - Aramid and Ceramic fibers, Alumina fiber
- Lecture 14 - Fibers - SiC fiber and Whiskers
- Lecture 15 - Metal matrix composites (MMCs) - Basic concept, Liquid state processing
- Lecture 16 - Metal matrix composites (MMCs) - Liquid and Solid state processing
- Lecture 17 - Ceramic Matrix Composites (CMCs) - Basic concept, Processing techniques
- Lecture 18 - Ceramic Matrix Composites (CMCs) - Processing techniques
- Lecture 19 - CMCs and PMCs - Processing and Application
- Lecture 20 - Fabrication of cellular ceramics
- Lecture 21 - Sintering of ceramics - Aspects and mechanisms
- Lecture 22 - Fabrication of cellular ceramics
- Lecture 23 - Processing of metal foams - Foaming techniques
- Lecture 24 - Processing of metal foams (Continued...)
- Lecture 25 - Processing of metal foams (Continued...)
- Lecture 26 - Polymer foams - Processing and properties
- Lecture 27 - Additive manufacturing - Definition and Prospects
- Lecture 28 - Cellular solids classification and Structure description
- Lecture 29 - Structure of cellular solids - Pore structure characterization
- Lecture 30 - Interfacial phenomena - Basic concept, Adhesion and Wettability
- Lecture 31 - Interfacial phenomena - Factors affecting wettability

- Lecture 32 - Interfacial phenomena - Interfacial bonding
- Lecture 33 - Interfacial phenomena - Interfacial strength measurement
- Lecture 34 - Interfacial phenomena - Case study - Al-MWCNT nanocomposite
- Lecture 35 - Interfacial phenomena - Case studies: MMCs and CMCs
- Lecture 36 - Interfacial phenomena - Case studies: MMCs and CMCs (Continued...)
- Lecture 37 - Mechanics of Composites - Unidirectional Lamina
- Lecture 38 - Mechanics: Fiber-reinforced composites - Transverse Loading
- Lecture 39 - Mechanics: Fiber-reinforced composites - Problem Solving
- Lecture 40 - Mechanics: Fiber-reinforced composites - Discontinuous fibers
- Lecture 41 - Mechanics of Composites - Discontinuous fibers
- Lecture 42 - Dependence of properties on pore structure
- Lecture 43 - Mechanics of cellular solids
- Lecture 44 - Mechanics of cellular solids (Continued...)
- Lecture 45 - Deformation behavior of honeycomb and foams
- Lecture 46 - Deformation behaviour of Foams
- Lecture 47 - Deformation behaviour of Foams (Continued...)
- Lecture 48 - Deformation behaviour of Foams (Continued...)
- Lecture 49 - Thermal properties of foams
- Lecture 50 - Other important properties of foams (Continued...)
- Lecture 51 - Advanced composites - MMCs
- Lecture 52 - Advanced composites - MMCs (Continued...)
- Lecture 53 - Advanced composites - CMCs
- Lecture 54 - Advanced composites - Advanced Processing Techniques
- Lecture 55 - Advanced composites - Advanced Processing Techniques (Continued...)
- Lecture 56 - Advanced composites - Advanced Processing Techniques (Continued...)
- Lecture 57 - Advanced composites - Application oriented advanced composites
- Lecture 58 - Microstructure and properties of natural cellular solid - wood
- Lecture 59 - Advanced hybrid material - Functionally graded composite materials (FGMs)
- Lecture 60 - Advanced hybrid material - Functionally graded composite materials (FGMs) (Continued...)

- Lecture 1 - Introduction, Classification and Uses of Metals
- Lecture 2 - Introduction, Classification and Uses of Metals (Continued...)
- Lecture 3 - Occurrence/Source of Metals
- Lecture 4 - Metal Extraction Process Overview
- Lecture 5 - Mineral Beneficiation: Overview and Mass Balances
- Lecture 6 - Crushing and Grinding (Comminution)
- Lecture 7 - Mineral Classification: Separation in Flowing Fluid
- Lecture 8 - Mineral Concentration by Froth Flotation
- Lecture 9 - Mineral Concentration by Froth Flotation
- Lecture 10 - Magnetic and Electric Separation/Concentration
- Lecture 11 - Sensor-based/Automatic Ore Sorting
- Lecture 12 - Solid-Liquid Separation
- Lecture 13 - Particle Size Estimation and Screening
- Lecture 14 - Fuels in Metallurgical Processes and Coal Characteristics
- Lecture 15 - Calorific Value and Caking Properties of Coal
- Lecture 16 - Coke: Making and Properties
- Lecture 17 - Combustion of Fuels
- Lecture 18 - Combustion: Mass and Heat Balance
- Lecture 19 - Combustion Heat Balance: Flame Temperature
- Lecture 20 - Combustion Heat Utilization in Furnace
- Lecture 21 - Heat Utilization in Furnace: Numerical Examples
- Lecture 22 - Classification of Furnaces
- Lecture 23 - Refractories for Furnace Linings
- Lecture 24 - Refractories: Testing and Production
- Lecture 25 - Agglomeration of Fines: Pelletization and Briquetting
- Lecture 26 - Agglomeration of Fines: Sintering
- Lecture 27 - Extraction of Metal from Sulfides: Roasting
- Lecture 28 - Roasting Reactors and Heat Balance
- Lecture 29 - Roasting: Predominance Area Diagram
- Lecture 30 - Roasting: Application of Predominance Area Diagram
- Lecture 31 - Reduction Smelting and Matte Smelting

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[Lecture 37 - Cu Extraction: Cyclone Flash Smelting and Numerical Examples](#)

[Lecture 38 - Cu Extraction: Conversion](#)

[Lecture 39 - Conversion of Nickel Sulphide and Numerical Examples](#)

[Lecture 40 - TSL Smelting, Continuous Conversion and Direct Cu-Production](#)

[Lecture 41 - Reduction Smelting: Lead Extraction](#)

[Lecture 42 - Reduction Smelting: Zinc Extraction and ISP](#)

[Lecture 43 - Extraction of Tin, Tungsten, Molybdenum and Numerical Examples](#)

[Lecture 44 - Extraction of Nb, V, Ferroalloys and Titania \(from Ilmenite\)](#)

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[Lecture 48 - Halide Metallurgy: Extraction of Ti, Zr, Hf, U, Si Purification](#)

[Lecture 49 - Purification of Bulk Metals: Chemical Refining](#)

[Lecture 50 - Chemical Refining: Purification of Lead](#)

[Lecture 51 - Chemical Refining of Zinc, Tin, Nickel, Ti \(Zr, Hf, Th\)](#)

[Lecture 52 - Physical Refining: Vacuum De-gassing, Zone Melting and Distillation](#)

[Lecture 53 - Hydrometallurgy: Unit Steps, Leaching Reagents and Methods](#)

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[Lecture 55 - Hydrometallurgy: Solution Purification and Metal Ion Reduction](#)

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Lecture 2 - Free energy, Stability, equilibrium in a unary system

Lecture 3 - Effect of Pressure on equilibrium transformations: Clausius Clapeyron equation, phase diagram for unary system

Lecture 4 - Free energy of solutions, free energy-composition diagrams

Lecture 5 - Solution models, chemical potential

Lecture 6 - Phase rule, free energy-composition diagrams and phase diagrams

Lecture 7 - Evolution of phase diagrams

Lecture 8 - Evolution of phase diagrams, miscibility gap

Lecture 9 - To concept, partition less solidification

Lecture 10 - To concept, partition less solidification (Continued...)

Lecture 11 - Eutectic solidification, glass formation

Lecture 12 - Kauzmann paradox, order of a transformation, glass forming ability

Lecture 13 - Eutectic solidification, coupled growth, heterogeneous nucleation

Lecture 14 - Peritectic solidification, metastable phase diagrams

Lecture 15 - Errors in drawing phase diagrams, Fe-C vs. Fe-Fe<sub>3</sub>C phase diagram

Lecture 16 - Free energy of undercooled liquid, shape of nucleus

Lecture 17 - Solid state phase transformations - Precipitation

Lecture 18 - Precipitation

Lecture 19 - Precipitation - quasicrystals

Lecture 20 - Precipitate coarsening, stability of a phase, spinodal decomposition

Lecture 21 - Spinodal decomposition

Lecture 22 - Eutectoid reaction

Lecture 23 - Eutectoid reaction (Continued...)

Lecture 24 - Bainitic transformation

Lecture 25 - Kinetics of eutectoid transformations

Lecture 26 - Martensitic Transformation

Lecture 27 - Martensitic transformation, order-disorder transformation

Lecture 28 - Miscibility gap in phase diagrams

Lecture 29 - Phase diagram calculations

Lecture 30 - Thermodynamics of heterogeneous systems

Lecture 31 - Thermodynamics of heterogeneous systems (Continued...)



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Lecture 3 - Depth of field, focus and field of view

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Lecture 5 - Optical microscope demo., Bright field imaging, opaque specimen illumination

Lecture 6 - Opaque stop microscopy, Phase contrast microscopy

Lecture 7 - Dark field microscopy, Polarization microscopy

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Lecture 9 - Sample preparation techniques for optical microscopy

Lecture 10A - Tutorial problems (Continuation...)

Lecture 10 - Tutorial problems

Lecture 11 - Introduction to scanning electron Microscopy

Lecture 12 - Lens aberrations, Object resolution, Image quality

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Lecture 14 - SEM and its mode of operation, Effect of aperture size, Working distance, condenser lens strength

Lecture 15 - SEM and its mode of operation- continuation, Relation between probe current and probe diameter, Summary

Lecture 16 - Factors affecting Interaction volume, Demonstration of SEM

Lecture 17 - Image formation and interpretation

Lecture 18 - Image formation and interpretation continued, EDS, WDS

Lecture 19 - Special contrast mechanisms, Monte Carlo simulations of Interaction volume

Lecture 20 - Electron channeling contrast imaging (ECCI), Electron back scattered diffraction (EBSD)-Theory & instrument demonstration

Lecture 21 - Tutorial Problems on SEM

Lecture 22 - Basics of X-ray emission from source, electron excitation and X-ray interaction with materials in general

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Lecture 24 - Bragg's Law Derivation

Lecture 25 - Diffraction relationship with reciprocal space

Lecture 26 - X-ray scattering

Lecture 27 - Factors affecting intensities of X-ray peaks

Lecture 28 - Factors affecting intensities of X-ray peaks- continuation

Lecture 29 - Effect of crystallite size and strain on intensity of X-rays



- Lecture 30 - Profile fit, Factors affecting peak broadening
- Lecture 31 - Indexing of diffraction pattern, Quantitative analysis
- Lecture 32 - Indexing, Quantitative analysis-continuation, Residual stress measurements
- Lecture 33 - XRD and Residual stress measurement- lab demonstration
- Lecture 34 - Introduction to Transmission Electron Microscopy (TEM)
- Lecture 35 - Fundamentals of Transmission Electron Microscopy (TEM)
- Lecture 36 - Basics of Diffraction-1
- Lecture 37 - Basics of Diffraction-2
- Lecture 38 - TEM imaging-1
- Lecture 39 - TEM imaging-2
- Lecture 40 - TEM instrument demonstration
- Lecture 41 - TEM sample preparation-1
- Lecture 42 - TEM sample preparation-2
- Lecture 43 - XRD Tutorial - 1
- Lecture 44 - XRD tutorial - 2
- Lecture 45 - TEM Tutorial - 1
- Lecture 46 - TEM Tutorial - 2
- Lecture 47 - Quantitative metallography - Tutorial 1
- Lecture 48 - Quantitative metallography - Tutorial 2
- Lecture 49 - Quantitative metallography - Tutorial 3
- Lecture 50 - Quantitative metallography - Tutorial 4
- Lecture 51 - Quantitative metallography - Tutorial 5
- Lecture 52 - Quantitative metallography - Tutorial 6
- Lecture 53 - Quantitative metallography - Tutorial 7

Lecture 1 - Introduction

Lecture 2 - Properties of Materials

Lecture 3 - Thermal Expansion

Lecture 4 - Measuring Electrical Conductivity: DC and AC

Lecture 5 - Free Electron Gas

Lecture 6 - The Ideal Gas

Lecture 7 - Drude Model: Electrical Conductivity

Lecture 8 - Drude Model: Thermal Conductivity

Lecture 9 - Drude Model: Successes and Limitations

Lecture 10 - Drude Model: Source of Shortcomings

Lecture 11 - Large Systems and Statistical Mechanics

Lecture 12 - Maxwell Boltzmann Statistics

Lecture 13 - Classical Particles and Quantum Particles

Lecture 14 - History of Quantum Mechanics - 1

Lecture 15 - History of Quantum Mechanics - 2

Lecture 16 - Introduction to Drude Sommerfeld model

Lecture 17 - Fermi-Dirac Statistics - Part 1

Lecture 18 - Fermi-Dirac Statistics - Part 2

Lecture 19 - Features of the Fermi Dirac Distribution Function

Lecture 20 - Maxwell-Boltzmann Distribution Vs Fermi-Dirac Distribution

Lecture 21 - Anisotropy and Periodic Potential in a Solid

Lecture 22 - Confinement and Quantization - Part 1

Lecture 23 - Confinement and Quantization - Part 2

Lecture 24 - Density of States

Lecture 25 - Fermi Energy, Fermi Surface, Fermi Temperature

Lecture 26 - Electronic Contribution to Specific Heat at Constant Volume

Lecture 27 - Reciprocal Space-1: Introduction to Reciprocal Space

Lecture 28 - Reciprocal Space-2: Condition for Diffraction

Lecture 29 - Reciprocal Space-3: Ewald sphere, Simple Cubic, FCC and BCC in Reciprocal Space

Lecture 30 - Wigner Seitz Cell and Introduction to Brillouin Zones

Lecture 31 - Brillouin Zones, Diffraction, and Allowed Energy Levels

[Lecture 32 - E Vs k, Brillouin Zones and the Origin of Bands](#)

[Lecture 33 - Calculating Allowed Energy Bands and Forbidden Band Gaps](#)

[Lecture 34 - Bands; Free Electron Approximation, Tight Binding Approximation](#)

[Lecture 35 - Semiconductors](#)

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[Lecture 37 - Electron Compounds; Phonons, Optoelectronic Materials](#)

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- Lecture 2 - Introduction to semiconductors
- Lecture 3 - Density of states and Fermi-Dirac statistics
- Lecture 4 - Assignment 1 - Bonding, DOS, and Fermi statistics
- Lecture 5 - Intrinsic semiconductors
- Lecture 6 - Intrinsic semiconductors - conductivity
- Lecture 7 - Assignment 2 - Intrinsic semiconductors
- Lecture 8 - Extrinsic semiconductors
- Lecture 9 - Extrinsic semiconductors - Fermi level
- Lecture 10 - Extrinsic semiconductors - conductivity
- Lecture 11 - Assignment 3 - Extrinsic semiconductors
- Lecture 12 - Metal-semiconductor junctions
- Lecture 13 - Assignment 4 - Metal-semiconductor junctions
- Lecture 14 - pn junctions in equilibrium
- Lecture 15 - pn junctions under bias
- Lecture 16 - pn junction breakdown and heterojunctions
- Lecture 17 - Assignment 5 - pn junctions
- Lecture 18 - Transistors
- Lecture 19 - MOSFETs
- Lecture 20 - Assignment 6 - transistors
- Lecture 21 - Optoelectronic devices: Introduction
- Lecture 22 - Optoelectronic devices: LEDs
- Lecture 23 - Optoelectronic devices: LASERS
- Lecture 24 - Optoelectronic devices: photodetector
- Lecture 25 - Optoelectronic devices: solar cells
- Lecture 26 - Assignment 7 - optical properties
- Lecture 27 - Assignment 8 - optoelectronic devices
- Lecture 28 - Semiconductor manufacturing: Introduction
- Lecture 29 - Si wafer manufacturing
- Lecture 30 - IC device manufacturing: overview
- Lecture 31 - Layering: thermal oxidation

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Lecture 11 - Tutorial problems (Continued...)

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Lecture 22 - Tutorial Problems on SEM

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Lecture 3 - Electron statistics in a solid

Lecture 4 - Worked numericals on week 1 lessons

Lecture 5 - Intrinsic semiconductors

Lecture 6 - Intrinsic semiconductors - conductivity

Lecture 7 - Optional - worked assignment on intrinsic semiconductors

Lecture 8 - Extrinsic semiconductors - Introduction

Lecture 9 - Extrinsic semiconductors - Fermi level

Lecture 10 - Extrinsic semiconductors - Mobility

Lecture 11 - Worked assignment on extrinsic semiconductors

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Lecture 20 - Worked assignment on transistors

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Lecture 22 - Light emitting diodes

Lecture 23 - Solid state semiconductor lasers

Lecture 24 - Optional - worked assignment on optical properties

Lecture 25 - Photodetectors

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Lecture 1 - Reciprocal space; Definition and Properties

Lecture 2 - Condition for Diffraction

Lecture 3 - Worked out examples

Lecture 4 - Ewald Sphere and lattices in reciprocal space

Lecture 5 - Wigner Sietz cells and Brillouin Zones

Lecture 6 - Worked out exmaples

Lecture 7 - Brillouin Zones, Diffraction and allowed energy levels

Lecture 8 - E Vs K, Brillouin zones and the Origin of Bands

Lecture 9 - Week 3 Worked out examples

Lecture 10 - Reciprocal space as Fourier transform of real lattice

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Lecture 3 - Heat sources - Part 1/2

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Lecture 11 - Fluid flow modelling - Part 1/2

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Lecture 13 - Solute transfer modelling - Part 1/2

Lecture 14 - Solute transfer modelling - Part 2/2

Lecture 15 - Solute segregation profile - Part 1/2

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Lecture 17 - Microstructure Formation in Fusion Welds

Lecture 18 - Numerical Solutions to Thermal Field and Fluid Flow in Welding - Part 1

Lecture 19 - Numerical Solutions to Thermal Field and Fluid Flow in Welding - Part 2

Lecture 20 - Dissimilar Welding

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Lecture 7 - Factors affecting intensities of X-ray peaks (Continued...)

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Lecture 7 - Magnetic particle testing - 2

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Lecture 26 - Acoustic Emission Testing - 1

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Lecture 3 - 2-D Lattice

Lecture 4 - 3-D Lattice - a

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Lecture 7 - 3-D Crystals

Lecture 8 - Types of Point Defects

Lecture 9 - Vacancy Concentration Determination - 1

Lecture 10 - Vacancy Concentration Determination - 2

Lecture 11 - Point Defect Interstitial

Lecture 12 - Transformation of co-ordinates

Lecture 13 - Tensor - 1

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Lecture 18 - Description of Dislocation - 2

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Lecture 28 - Dislocations in Ordered Alloys and Dislocation Dislocation Interaction

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Lecture 4 - Geometric Probability - Part 1

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Lecture 11 - Basic Stereological Parameters - Part 1

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Lecture 18 - Other Applications of the Disector

Lecture 19 - Stereology of Anisotropic Microstructures

Lecture 1 - Introduction to the course, Introduction to physical metallurgy of steels

Lecture 2 - Martensitic transformation, Introduction to modern automotive steels

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Lecture 4 - Introduction to advanced high strength steels

Lecture 5 - Introduction to Dual Phase Steel and TRIP Steel Heat Treatments

Lecture 6 - Thermal and Mechanical Processing of TRIP and Hot Forming Steels

Lecture 7 - Introduction to Welding Processes in Automotive Industries

Lecture 8 - Principles of Resistance Spot Welding (RSW)

Lecture 9 - Process Characteristics of Resistance Spot Welding - Part I

Lecture 10 - Process Characteristics of Resistance Spot Welding - Part II

Lecture 11 - Introduction to Laser Beam Welding - Part I

Lecture 12 - Introduction to Laser Beam Welding - Part II

Lecture 13 - Principles of Gas Metal Arc Welding - Part I

Lecture 14 - Principles of Gas Metal Arc Welding - Part II

Lecture 15 - Welding Metallurgy of Advanced High Strength Steels - Part I

Lecture 16 - Microstructural Evolution During Welding of Advanced High Strength Steels

Lecture 17 - Elemental Behaviour During Welding of Advanced High Strength Steels

Lecture 18 - Quantification of Microstructural Constituents in Automotive Steel Welds - Part I

Lecture 19 - Quantification of Microstructural Constituents in Automotive Steel Welds - Part II and Mechanical Properties

Lecture 20 - Methodologies to Improve the Weldability of Advanced High Strength Steels



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- Lecture 2 - Classification of welding processes and definition of welding arc
- Lecture 3 - Physics of welding arc - Part 1
- Lecture 4 - Physics of welding arc - Part 2
- Lecture 5 - Physics of welding arc - Part 3
- Lecture 6 - Physics of welding arc - Part 4
- Lecture 7 - Fundamentals of ionisation in welding arc
- Lecture 8 - Electrical conductivity of welding arc
- Lecture 9 - Electrical resistivity of welding arc
- Lecture 10 - Heat transfer inside the arc
- Lecture 11 - Arc ignition mechanisms Part - I
- Lecture 12 - Arc ignition mechanisms Part - II
- Lecture 13 - Principles of Gas Tungsten Arc Welding
- Lecture 14 - Shielding gases for arc welding
- Lecture 15 - Selection of shielding gases for engineering alloys
- Lecture 16 - Arc welding power sources - Part 1
- Lecture 17 - Arc welding power sources - Part 2
- Lecture 18 - Arc welding power sources - Part 3
- Lecture 19 - Variations in GTAW process
- Lecture 20 - Square wave, variable polarity, GTAW with filler, hot wire GTAW
- Lecture 21 - Dual gas GTAW and Plasma Welding processes
- Lecture 22 - Multi cathode GTAW and Activated GTAW
- Lecture 23 - Buried GTAW and Rate controlling parameters of GTAW
- Lecture 24 - Introduction to consumable welding processes
- Lecture 25 - Melting rate of consumable wires
- Lecture 26 - Physics of droplet transfer in consumable welding
- Lecture 27 - Modes of droplet transfer - Part 1
- Lecture 28 - Modes of droplet transfer - Part 2
- Lecture 29 - Modes of droplet transfer - Part 3
- Lecture 30 - Shielded Metal Arc Welding
- Lecture 31 - Flux cored arc welding - Introduction

- Lecture 32 - Electrode fluxes and process characteristics of flux cored arc welding
- Lecture 33 - Flux cored arc welding - Process characteristics
- Lecture 34 - Advances in gas metal arc welding - Pulsed GMAW
- Lecture 35 - Advances in gas metal arc welding - Controlled dip short circuiting processes
- Lecture 36 - Submerged arc welding
- Lecture 37 - Resistance welding - Fundamentals
- Lecture 38 - Resistance spot welding - Part 1
- Lecture 39 - Resistance spot welding - Part 2
- Lecture 40 - Resistance spot welding - Part 3
- Lecture 41 - Resistance spot welding - Part 4
- Lecture 42 - Variants in resistance welding - Part 1
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- Lecture 44 - Laser welding process - Introduction - Part 1
- Lecture 45 - Laser welding process - Part 2
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- Lecture 47 - Laser welding process - Part 4
- Lecture 48 - Electron beam welding process
- Lecture 49 - Other welding processes - Electroslag welding
- Lecture 50 - Magnetically Impelled Arc Butt (MIAB) welding
- Lecture 51 - Aluminothermic (thermit) welding
- Lecture 52 - Introduction to solid state welding processes - Friction welding
- Lecture 53 - Friction stir welding - Part 1
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- Lecture 55 - Other solid state welding processes
- Lecture 56 - Joining processes for Plastics - Part 1
- Lecture 57 - Joining processes for Plastics - Part 2
- Lecture 58 - Adhesive bonding of plastics
- Lecture 59 - Welding nomenclatures

Lecture 1 - Importance of studying creep

Lecture 2 - Basics of plastic deformation and characteristics of dislocations - Part 1

Lecture 3 - Basics of plastic deformation and characteristics of dislocations - Part 2

Lecture 4 - Basics of plastic deformation and characteristics of dislocations - Part 3

Lecture 5 - Creep and different factors that influence creep deformation - Part 1

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Lecture 7 - Creep and different factors that influence creep deformation - Part 3

Lecture 8 - Creep and different factors that influence creep deformation - Part 4

Lecture 9 - Creep and different factors that influence creep deformation - Part 5

Lecture 10 - Creep and different factors that influence creep deformation - Part 6

Lecture 11 - Mechanisms of Creep - Part 1

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Lecture 16 - Transitions in Creep Mechanisms and Creep Constitutive Equation

Lecture 17 - Deformation Mechanism Maps - Part 1

Lecture 18 - Deformation Mechanism Maps - Part 2

Lecture 19 - Modeling the Useful Creep Life of Materials/Components - Part 1

Lecture 20 - Modeling the Useful Creep Life of Materials/Components - Part 2

Lecture 21 - Modeling the Useful Creep Life of Materials/Components - Part 3

Lecture 22 - Creep Testing Methods - Part 1

Lecture 23 - Creep Testing Methods - Part 2

Lecture 24 - Improving Creep Resistance of Materials

- Lecture 1 - Nanotechnology Science and Applications - Introduction
- Lecture 2 - Nanotechnology : A Walk through History
- Lecture 3 - Discussion on Feynman's talk on Nanotechnology - Part I
- Lecture 4 - Discussion on Feynman's talk on Nanotechnology - Part II
- Lecture 5 - Impact of the nanoscale on thermodynamic considerations
- Lecture 6 - Phase Diagrams and Stable Phases
- Lecture 7 - Calorimetry
- Lecture 8 - Zirconia - ZrO<sub>2</sub>
- Lecture 9 - Experimentally Investigating the Hall-Petch relationship
- Lecture 10 - Impact of the Nanoscale on the Hall-Petch Relationship
- Lecture 11 - Impact of the nanoscale on Mechanical properties
- Lecture 12 - Superplasticity and the Nanoscale: Background
- Lecture 13 - Superplasticity and the Nanoscale: Experimental aspects
- Lecture 14 - Severe Plastic Deformation and the nanoscale: Experimental Utility
- Lecture 15 - An approach to prepare bulk nanostructures
- Lecture 16 - Nanosized Ferroelectrics
- Lecture 17 - Impact of the nanoscale on optical properties
- Lecture 18 - Experimental approach to study impact of the nanoscale on optical properties
- Lecture 19 - Impact of the nanoscale on optical properties: measurements
- Lecture 20 - Nanocomposites
- Lecture 21 - Effect of Nanoscale on Magnetic Properties: Potential use of biomaterials
- Lecture 22 - Effect of Nanostructure on Damping Properties
- Lecture 23 - Carbon
- Lecture 24 - Carbon Nanotubes
- Lecture 25 - Graphene, a 2D nanomaterials

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Lecture 2 - Powder Fabrication Methods: Mechanical Fabrication

Lecture 3 - Powder Fabrication Methods: Mechanical and Electrolytic Fabrication

Lecture 4 - Powder Fabrication Methods: Chemical Fabrication

Lecture 5 - Powder Fabrication Methods: Atomization

Lecture 6 - Gas atomization

Lecture 7 - Water Atomization

Lecture 8 - Centrifugal Atomization

Lecture 9 - Comparison of Atomization techniques

Lecture 10 - Nucleation and Growth

Lecture 11 - Thermodynamics and Kinetic of Solidification

Lecture 12 - Microstructure Control

Lecture 13 - Microstructure control: Effect of process parameters

Lecture 14 - Dendritic growth in pure metals

Lecture 15 - Dendritic growth in alloys

Lecture 16 - Crystalline and Amorphous structures

Lecture 17 - Crystalline vs Amorphous

Lecture 18 - T-T-T diagram: Formation of Amorphous solids

Lecture 19 - Effect of particle size on microstructure

Lecture 20 - Powder Characterization

Lecture 21 - Basis for particle size measurement

Lecture 22 - Measurement of particle size and size distribution

Lecture 23 - Particle size distribution

Lecture 24 - Dynamic Light Scattering - 1

Lecture 25 - Dynamic Light Scattering - 2

Lecture 26 - Particle size measurement - Other methods

Lecture 27 - Surface Area Analysis - 1

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- Lecture 32 - Powder mixing and blending
- Lecture 33 - Powder Lubrication and Coating
- Lecture 34 - Powder compaction - 1
- Lecture 35 - Powder compaction - 2
- Lecture 36 - Powder compaction - 3
- Lecture 37 - Cold Isostatic Pressing and; Powder Injection Molding
- Lecture 38 - Powder Injection Molding - 2
- Lecture 39 - Slurry Techniques
- Lecture 40 - Tape casting
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# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

**NPTEL : NOC:Designing Learner-Centric MOOCs (Multi-Disciplinary)**

**Co-ordinators : Prof.Sridhar Iyer, Prof.Sahana Murthy, Dr.Jayakrishnan M., Dr.Sameer Sahasrabudhe**

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**HTML Links for 1,14,300+ NPTEL Video Lectures, Created by LinuXpert Systems, Chennai**

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**Co-ordinators : Prof. Gouri Gargate**

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[Lecture 34 - Evaluation of Teaching Quality - A Research Proposal \(Continued...\)](#)

[Lecture 35 - Assessment and Evaluation - to Improve Teaching](#)

[Lecture 36 - Item Analysis - Theory and Practice](#)

[Lecture 37 - Learning Styles and Learning Approaches](#)

[Lecture 38 - Good Teaching Attributes and Characteristics](#)

[Lecture 39 - Teacher Effectiveness Research](#)

[Lecture 40 - Teacher Effectiveness Research \(Continued...\)](#)

[Lecture 41 - Teaching Learning Process using Outcome based Education](#)

**NPTEL : NOC:Introduction to Environmental Engineering and Science - Fundamental and Sustainability Concepts (Multi-Disciplinary)**

**Co-ordinators : Prof. Brajesh Kumar Dubey**

- Lecture 1 - Sustainability Concepts - Innovations and Challenges
- Lecture 2 - Sustainability Concepts - Innovations and Challenges
- Lecture 3 - Basics and Sustainability Concepts and Evolution
- Lecture 4 - Engineering for Sustainability
- Lecture 5 - Life Cycle Thinking and Circular Economy
- Lecture 6 - Mass Concentration Units
- Lecture 7 - Partial Pressure Units
- Lecture 8 - Other Types of Units
- Lecture 9 - Units (Continued...), Qualitative and Quantitative Measurements
- Lecture 10 - Quantative Measurements Basics
- Lecture 11 - Ecology
- Lecture 12 - Energy Flow and Ecological Concepts
- Lecture 13 - Population
- Lecture 14 - Population, Consumption and Biodiversity
- Lecture 15 - Environmental Chemistry
- Lecture 16 - Mass Balance and Reactor Systems
- Lecture 17 - Mass Balance in Continuous Reactor / Continuous Stirred Tank Reactor (CSTR) and Plug Flow Reactor
- Lecture 18 - Plug Flow Reactor and Energy Flow
- Lecture 19 - Energy Balance and Earth Overshot Day
- Lecture 20 - Mass Transport Processes
- Lecture 21 - Oxygen Demand in Environmental Systems
- Lecture 22 - BOD Examples, Oxygen Levels in Surface Waters, COD
- Lecture 23 - Environmental Health Basics and SDGs
- Lecture 24 - Field Applications
- Lecture 25 - Nutrient Cycle
- Lecture 26 - Environmental Risk
- Lecture 27 - Risk Assessment Steps and EIA Introduction
- Lecture 28 - Environmental Risk Assessments with Concepts of EIA and LCA
- Lecture 29 - Environmental Risk Assessments with Concepts of EIA and LCA (Continued...)
- Lecture 30 - Environmental Risk Assessments with Concepts of EIA and LCA (Continued...)

- Lecture 31 - Water Quantity
- Lecture 32 - Water Availability and Usage
- Lecture 33 - Population Forecasting
- Lecture 34 - Water Quality
- Lecture 35 - Water Quality (Continued...)
- Lecture 36 - Plain Sedimentation
- Lecture 37 - Coagulation
- Lecture 38 - Review of Sedimentation and Rapid Sand Filtration
- Lecture 39 - Disinfection and Water Supply
- Lecture 40 - Water Treatment Plant Visit
- Lecture 41 - Wastewater collection and characterization
- Lecture 42 - Sewerage System and Sewage Characteristics
- Lecture 43 - BOD Concepts and Preliminary Treatment of Wastewater
- Lecture 44 - Wastewater Treatment - I
- Lecture 45 - Activated Sludge Process and Sludge Disposal
- Lecture 46 - Introduction to Solid Waste Management
- Lecture 47 - Introduction to Solid Waste Management (Continued...)
- Lecture 48 - Components of Solid Waste Management
- Lecture 49 - Collection and Treatment
- Lecture 50 - Waste Disposal and Summary
- Lecture 51 - Basics of Air Pollution Issues - Global and Local
- Lecture 52 - Air Pollutants and Air Pollution Index
- Lecture 53 - Global Warming and Climate Change
- Lecture 54 - Air Pollution Models
- Lecture 55 - SDGs, Noise and Soil Pollution
- Lecture 56 - Present Issues and Few Case Studies
- Lecture 57 - Case Study - Solid Waste Management
- Lecture 58 - Case Study - Industrial Pollution and Disasters
- Lecture 59 - Case Study - Global Food Waste Initiatives
- Lecture 60 - Case Study - Global Food Waste and Resource Recovery

Lecture 1 - Introduction to Biophotonics - Part I

Lecture 2 - Introduction to Biophotonics - Part II

Lecture 3 - Introduction to Biophotonics - Part III

Lecture 4 - Nature of Light - Part I (As Wave)

Lecture 5 - Nature of Light - Part II (As Particle)

Lecture 6 - Fact of Matter - Part I

Lecture 7 - Fact of Matter - Part II

Lecture 8 - Basic of Light-Matter Interaction

Lecture 9 - Molecular Materials

Lecture 10 - Introduction to Fluorescence

Lecture 11 - The Cell

Lecture 12 - The Central Dogma

Lecture 13 - Genetic Code

Lecture 14 - Building Blocks

Lecture 15 - Remaining Topics

Lecture 16 - Light-Matter Interactions in Molecules (Basic of Spectroscopy)

Lecture 17 - Light-Matter Interactions in Molecules (Basic of Spectroscopy) (Continued...)

Lecture 18 - Interaction of Light with Cells

Lecture 19 - Interaction of Light with Tissues

Lecture 20 - Photoprocesses in Biopolymers

Lecture 21 - Laser Principles and Operation

Lecture 22 - Types of Lasers

Lecture 23 - Nonlinear Optical Processes

Lecture 24 - In Vivo Photoexcitation

Lecture 25 - Examples and Applications

Lecture 26 - Introduction

Lecture 27 - Microscopy Techniques

Lecture 28 - Near Field Microscopy and Optical Coherence Tomography

Lecture 29 - Fluorophores and Fluorescence Microscopy Techniques

Lecture 30 - The Future: AFM-IR

Lecture 31 - Biosensing Background



[Lecture 32 - Optical Fiber Sensors](#)

[Lecture 33 - Metamaterials](#)

[Lecture 34 - Metamaterials as Biosensors](#)

[Lecture 35 - Biosensing with Optical Nano-antennas](#)

[Lecture 36 - Introduction to Photodynamic Therapy \(PDT\)](#)

[Lecture 37 - Application of Photodynamic Therapy \(PDT\)](#)

[Lecture 38 - Light Irradiation for Photodynamic Therapy \(PDT\)](#)

[Lecture 39 - Real Life Examples of Photodynamic Therapy \(PDT\)](#)

[Lecture 40 - Future of PDT and Photothermal Therapy \(PTT\)](#)

[Lecture 41 - Laser Based Tissue Engineering](#)

[Lecture 42 - Laser Tissue Contouring: Dermatological Application](#)

[Lecture 43 - Laser Tissue Welding and Tissue Regeneration](#)

[Lecture 44 - Laser Tissue Contouring: Ophthalmic Application](#)

[Lecture 45 - Laser in Dentistry](#)

[Lecture 46 - Tools for Micromanipulation](#)

[Lecture 47 - The Optical/Laser Tweezer](#)

[Lecture 48 - Design of Optical Tweezers](#)

[Lecture 49 - Optical Scissors](#)

[Lecture 50 - Selected Examples of Application](#)

[Lecture 51 - Introduction to nanotechnology](#)

[Lecture 52 - Processes of Nanotechnology](#)

[Lecture 53 - Nano-Lithography: The Art of Small](#)

[Lecture 54 - Thin Film Deposition](#)

[Lecture 55 - Bionanophotonics Applications](#)

[Lecture 56 - Introduction to Optogenetics](#)

[Lecture 57 - Controlling the Brain with Light](#)

[Lecture 58 - Optical Neuroimaging and Tomography](#)

[Lecture 59 - Functional Near Infrared Spectroscopy \(fNIRS\) of the Brain](#)

[Lecture 60 - Summary and Revisiting Few topics](#)

- Lecture 1 - Introduction to Vacuum, Natural Vacuum
- Lecture 2 - History of Vacuum Technology
- Lecture 3 - Kinetic Theory of Gases, Physical Parameters of Vacuum and Regions of Vacuum
- Lecture 4 - Vacuum Process Applications - I
- Lecture 5 - Vacuum Process Applications - II
- Lecture 6 - Pumping Speed and Throughput Concepts
- Lecture 7 - Rotary Vacuum Pump
- Lecture 8 - Diffusion Pump
- Lecture 9 - Roots Vacuum Pump
- Lecture 10 - Rotary Piston Pump
- Lecture 11 - Liquid Ring Pump
- Lecture 12 - Steam Jet Ejector
- Lecture 13 - Diaphragm Pump
- Lecture 14 - Claw Pump
- Lecture 15 - Screw Pump
- Lecture 16 - Scroll Pump, Sorption Concepts and Pumps
- Lecture 17 - Ion Pumping-Sputter Ion Pump
- Lecture 18 - Turbomolecular Pump
- Lecture 19 - Cryopumps
- Lecture 20 - Selection Criteria of Vacuum Pumps
- Lecture 21 - Primary vs Secondary Gauges, U Tube/McLeod gauges (Primary)
- Lecture 22 - Bourdon/Capacitance Gauges (Mechanical Deflection)
- Lecture 23 - Thermo-couple/Pirani gauges (Thermal Conductivity)
- Lecture 24 - Spinning Rotor/Ionization/Bayard Alpert Gauges
- Lecture 25 - Penning/ Inverted Magnetron gauges, Gauge calibration
- Lecture 26 - Vacuum Materials (Metals, Glasses, Ceramics, Greases and Oils)
- Lecture 27 - Vacuum Components (Flanges, Couplings, Seals, Valves)
- Lecture 28 - Vacuum Chamber Design
- Lecture 29 - Fabrication Techniques for Vacuum Systems
- Lecture 30 - Testing of Vacuum Systems for Mechanical Failures, Gas Leaks and Outgassing
- Lecture 31 - Gas Flow at Low Pressures, Conductance and Effective Pumping Speed Concepts

- Lecture 32 - Conductance Calculations in Viscous Flow Region
- Lecture 33 - Molecular Flow
- Lecture 34 - Transition and Choked Flows
- Lecture 35 - Conductance and Pump Down Calculations in Vacuum Systems
- Lecture 36 - Design Aspects of Vacuum Systems for Different Applications - Part I
- Lecture 37 - Design Aspects of Vacuum Systems for Different Applications - Part II
- Lecture 38 - Design of a Vacuum Furnace for Metallurgical Processing
- Lecture 39 - Leak Detection in Vacuum Systems
- Lecture 40 - Magnetic Deflection Leak Detector and Quadrupole Residual Gas Analyzer
- Lecture 41 - Vacuum Processes in Chemical and Pharmaceutical Industries
- Lecture 42 - Vacuum for Food Processing
- Lecture 43 - Vacuum Technology in the Packaging Industry
- Lecture 44 - Vacuum in Wood Industry
- Lecture 45 - Vacuum Systems for Medical and Dental Applications
- Lecture 46 - Vacuum for Desalination of Sea Water and Treatment of Waste Water
- Lecture 47 - Vacuum Technology for Power Sector
- Lecture 48 - Vacuum Technology In Oil and Gas Industries
- Lecture 49 - Vacuum Technology in LNG industry
- Lecture 50 - Vacuum Technology for Cryogenic Applications
- Lecture 51 - Vacuum Technology in High Speed Transportation (Hyperloop and Maglev)
- Lecture 52 - Vacuum technology for Metallurgical applications
- Lecture 53 - Vacuum Technology for Analytical Instruments
- Lecture 54 - Vacuum based coating units for thin film deposition
- Lecture 55 - Vacuum for solar energy (Thermal and PV)
- Lecture 56 - Vacuum Technology for semiconductor chip manufacturing
- Lecture 57 - Vacuum Technology for Display Systems
- Lecture 58 - Vacuum Technology for Nuclear Applications - Part I
- Lecture 59 - Vacuum Technology for Nuclear Applications - Part II
- Lecture 60 - Vacuum technology for Space Applications

- Lecture 1 - Brief history of public health
- Lecture 2 - Scope and Evolution of Health Promotion and Education
- Lecture 3 - Ottawa Charter
- Lecture 4 - Principles of health promotion
- Lecture 5 - Settings and audiences for health promotion
- Lecture 6 - Concepts of Health Behavior
- Lecture 7 - Health Risk Behavior Vs Health Promotion Behavior
- Lecture 8 - Concepts of Health Communication - Part I
- Lecture 9 - Concepts of Health Communication - Part II
- Lecture 10 - Health Literacy
- Lecture 11 - Information Education and Communication (IEC)
- Lecture 12 - Behavior Change Communication (BCC) - Part I
- Lecture 13 - Behavior Change Communication (BCC) - Part II
- Lecture 14 - Social and Behavior Change Communication (SBCC) - Part I
- Lecture 15 - Social and Behavior Change Communication (SBCC) - Part II
- Lecture 16 - Need Assessment for Health Promotion
- Lecture 17 - Approaches for Health Promotion and Behavior Change
- Lecture 18 - Models of Individual Health Behavior
- Lecture 19 - Models of Inter-Personal Health Behaviour
- Lecture 20 - Community and Group Models of Health Behavior Change
- Lecture 21 - Planning HPE Intervention - Part I
- Lecture 22 - Planning HPE Intervention - Part II
- Lecture 23 - Implementing HPE Intervention - Part I
- Lecture 24 - Implementing HPE Intervention - Part II
- Lecture 25 - Monitoring HPE Intervention
- Lecture 26 - Principles of Designing Messages
- Lecture 27 - Processes and Approaches of Designing Messages - Part I
- Lecture 28 - Processes and Approaches of Designing Messages - Part II
- Lecture 29 - Overview of Pretesting
- Lecture 30 - Pretesting of Health Promotion and Education Tools
- Lecture 31 - Health Education Methods - Part I

[Lecture 32 - Health Education Methods - Part II](#)

[Lecture 33 - Health Education Material - Part I](#)

[Lecture 34 - Health Education Material - Part II](#)

[Lecture 35 - Technology-based approaches to health behavior change](#)

[Lecture 36 - Evaluation of Theory-based HPE Interventions - Part I](#)

[Lecture 37 - Evaluation of Theory-based HPE Interventions - Part II](#)

[Lecture 38 - Analyzing Health Behavior Change Data](#)

[Lecture 39 - RE-AIM Framework for Health Promotion Program Evaluation](#)

[Lecture 40 - Health Impact Assessment](#)

- Lecture 1 - Introduction to Neuroanatomy
- Lecture 2 - Cerebellum
- Lecture 3 - Basal Ganglia
- Lecture 4 - Thalamus and Hypothalamus
- Lecture 5 - Cerebral Cortex
- Lecture 6 - Synapse and Neurotransmitters - 1
- Lecture 7 - Synapse and Neurotransmitters - 2
- Lecture 8 - Limbic System
- Lecture 9 - Physiology of Emotions
- Lecture 10 - Reticular Formation
- Lecture 11 - Electrical activity of brain
- Lecture 12 - Descriptive Psychopathology
- Lecture 13 - Principles of Personality Development
- Lecture 14 - Schizophrenia
- Lecture 15 - Mood Disorders - 1
- Lecture 16 - Mood Disorders - 2
- Lecture 17 - Anxiety Disorders - I
- Lecture 18 - Anxiety Disorders - II
- Lecture 19 - Eating Disorders
- Lecture 20 - Physiology of sleep
- Lecture 21 - Sleep Disorders
- Lecture 22 - Learning and Memory - 1
- Lecture 23 - Learning and Memory - 2
- Lecture 24 - Neurocognitive Disorders - I
- Lecture 25 - Neurocognitive Disorders - II
- Lecture 26 - Substance - I
- Lecture 27 - Substance - II
- Lecture 28 - Physiology of sensations
- Lecture 29 - Psychosomatic Illness
- Lecture 30 - Emergency Psychiatry
- Lecture 31 - Child Psychiatry - I

[Lecture 32 - Child Psychiatry - II](#)

[Lecture 33 - Psychotherapy - I](#)

[Lecture 34 - Psychotherapy - II](#)

[Lecture 35 - Psychological Tests](#)

[Lecture 36 - Anti-psychotic drugs](#)

[Lecture 37 - Antidepressants](#)

[Lecture 38 - Mood Stabilizer](#)

[Lecture 39 - Anti-anxiety drugs](#)

[Lecture 40 - Forensic Psychiatry](#)

Lecture 1 - Introduction to Reliability Engineering

Lecture 2 - Introduction to Reliability Engineering

Lecture 3 - Introduction to Reliability Engineering

Lecture 4 - Probability Basics

Lecture 5 - Probability Basics (Continued...)

Lecture 6 - Constant Failure Rate Model - I

Lecture 7 - Constant Failure Rate Model - II

Lecture 8 - Constant Failure Rate Model - III

Lecture 9 - Two Parameter Exponential Distribution

Lecture 10 - Weibull Distribution (2 Parameter)

Lecture 11 - Burn-in Screening for Weibull

Lecture 12 - Weibull Distribution

Lecture 13 - Normal Distribution

Lecture 14 - Lognormal Distribution

Lecture 15 - System Reliability Modelling

Lecture 16 - System Reliability Modelling (Continued...)

Lecture 17 - System Reliability Modelling (Continued...)

Lecture 18 - System Reliability Modelling (Continued...)

Lecture 19 - System Reliability Modelling (Continued...)

Lecture 20 - System Reliability Modelling (Continued...)

Lecture 21 - Markov Analysis

Lecture 22 - Markov Analysis (Continued...)

Lecture 23 - Markov Analysis (Continued...)

Lecture 24 - Markov Analysis (Continued...)

Lecture 25 - Markov Analysis (Continued...)

Lecture 26 - Failure Data Analysis: Non-Parametric Approach

Lecture 27 - Failure Data Analysis: Non-Parametric Approach (Continued...)

Lecture 28 - Failure Data Analysis: Non-Parametric Approach (Continued...)

Lecture 29 - Failure Data Analysis: Non-Parametric Approach (Continued...)

Lecture 30 - Failure Data Analysis (Parametric)

Lecture 31 - Failure data analysis (Parametric) (Continued...)



[Lecture 32 - Failure data analysis \(Parametric\) \(Continued...\)](#)

[Lecture 33 - Goodness of fit](#)

[Lecture 34 - Goodness of Fit \(GoF\) Tests](#)

[Lecture 35 - Goodness of Fit \(GoF\) Tests \(Continued...\)](#)

[Lecture 36 - Maintainability and Availability](#)

[Lecture 37 - Maintainability and Availability \(Continued...\)](#)

[Lecture 38 - Maintainability and Availability \(Continued...\)](#)

[Lecture 39 - Maintainability and Availability \(Continued...\)](#)

[Lecture 40 - Summary of the course Introduction to Reliability Engineering](#)

Lecture 1 - Introduction

Lecture 2 - Biosensors and its Application

Lecture 3 - Translational Research and Nano Biosensing

Lecture 4 - Nanomaterials for Healthcare Biosensing

Lecture 5 - Signal Amplification for Ultrasensitive Biosensors

Lecture 6 - Signal Amplification for Ultrasensitive Biosensors (Continued...)

Lecture 7 - Signal Amplification for Ultrasensitive Biosensors (Continued...)

Lecture 8 - Signal Amplification for Ultrasensitive Biosensors (Continued...)

Lecture 9 - Different Measurement Techniques for Electrochemical Biosensors

Lecture 10 - Limit of Detection and Wash-Free Detection for Biosensors

Lecture 11 - Wash-Free Detection for Biosensors (Continued...)

Lecture 12 - Label-Free Detection for Biosensors

Lecture 13 - Label-free detection and Multiplex Biosensors

Lecture 14 - Multiplex Biosensors (Continued...)

Lecture 15 - Strategy for Electrochemical Detection and Tuning of Electrocatalytic Activities

Lecture 16 - Enhanced electrocatalytic activity for biosensors

Lecture 17 - Strategy for Electrochemical Detection and Tuning of Electrocatalytic Activities

Lecture 18 - Strategy for Electrochemical Detection and Tuning of Electrocatalytic Activities

Lecture 19 - Strategy for Electrochemical Detection and Tuning of Electrocatalytic Activities

Lecture 20 - Strategy for Electrochemical Detection and Tuning of Electrocatalytic Activities

Lecture 21 - Strategy for Electrochemical Detection and Tuning of Electrocatalytic Activities

Lecture 22 - Strategy for Electrochemical Detection and Tuning of Electrocatalytic Activities

Lecture 23 - Effect of pretreatment on PCB and biosensor development

Lecture 24 - Impact of surface Roughness of PCB and PCB for Glucose sensors

Lecture 25 - Tutorial on Biosensors Fabrication

Lecture 26 - Tutorial on Biosensors Fabrication (Continued...)

Lecture 27 - Tutorial on Biosensors Fabrication (Continued...)

Lecture 28 - Tutorial on Biosensors Fabrication (Continued...)

Lecture 29 - Tutorial on Biosensors Fabrication (Continued...)

Lecture 30 - Tutorial on Biosensors Fabrication (Continued...)

Lecture 31 - Self-Powered Biosensors

[Lecture 32 - Biosensors for Safety and Security](#)

[Lecture 33 - Research Proposal and Ethical Clearance](#)

[Lecture 34 - Special Chemistry for Biosensing](#)

[Lecture 35 - Tutorial - 2](#)

[Lecture 36 - Tutorial - 3](#)

[Lecture 37 - Tutorial - 4](#)

[Lecture 38 - Lab Demonstration - 1](#)

[Lecture 39 - Lab Demonstration - 2](#)

[Lecture 40 - Lab Demonstration - 3](#)

- Lecture 1 - Adolescent Health Statistics
- Lecture 2 - Introduction to Nutrition and Dietetics
- Lecture 3 - Role of Macronutrients
- Lecture 4 - Role of Micronutrients
- Lecture 5 - Basics of Adolescent Mental Health
- Lecture 6 - Physiological and Psychological changes during Adolescence
- Lecture 7 - Special Nutritional Requirements in Adolescents
- Lecture 8 - Malnutrition in Adolescents and their effects in Adult life
- Lecture 9 - Adolescent Immunization
- Lecture 10 - High risk behaviour in Adolescents
- Lecture 11 - Nutrition Care Process
- Lecture 12 - Dietary Counseling and Nutrition Planning
- Lecture 13 - Common Micronutrient Deficiency in Adolescents
- Lecture 14 - Eating Disorders in Adolescents
- Lecture 15 - National Initiatives related to Adolescents
- Lecture 16 - Behavior Modification for Weight Management
- Lecture 17 - Adolescents And Physical Activity
- Lecture 18 - Combating Special Situations
- Lecture 19 - Legislations for Adolescents
- Lecture 20 - Innovations for Holistic Well-being of Adolescents

- Lecture 1 - Basics of Health Promotion
- Lecture 2 - Basic Principles of Health Promotion
- Lecture 3 - The Health Promotion Research Process
- Lecture 4 - Process of Health Promotion Research: Integrity and Rigor
- Lecture 5 - Ethics in Health Promotion Research
- Lecture 6 - Health Behavior and Health Behavior Change
- Lecture 7 - Theory, Research and Behavior Change Techniques
- Lecture 8 - Intervention Mapping
- Lecture 9 - Ecological Models of Health Behavior
- Lecture 10 - Social Science Techniques
- Lecture 11 - Precede-Proceed Model
- Lecture 12 - Models of Individual Health Behavior - I
- Lecture 13 - Models of Individual Health Behavior - II
- Lecture 14 - Models of Interpersonal Health Behavior
- Lecture 15 - Community and Group Models of Health Behavior Change
- Lecture 16 - Research design and techniques
- Lecture 17 - Observational research designs
- Lecture 18 - Experimental Research Designs
- Lecture 19 - Experimental Research Designs: Issues and Challenges
- Lecture 20 - Measurements in Health promotion
- Lecture 21 - Qualitative methods in Health Promotion - Part I
- Lecture 22 - Qualitative Methods in Health Promotion - Part II
- Lecture 23 - Qualitative Methods in Health Promotion - Part III
- Lecture 24 - Qualitative Methods in Health Promotion - Part IV
- Lecture 25 - Qualitative Methods in Health Promotion - Part V
- Lecture 26 - Introduction to Mixed Methods Research
- Lecture 27 - The Convergent Design
- Lecture 28 - The Explanatory Sequential Design
- Lecture 29 - The Exploratory Sequential Design (Continued...)
- Lecture 30 - The Embedded Design
- Lecture 31 - Different study tools and their application in health promotion research

- Lecture 32 - Formulating an appropriate study tool (Quantitative data collection tools)
- Lecture 33 - Validity and reliability of study tools in quantitative research - Part I
- Lecture 34 - Validity and reliability of study tools in quantitative research - Part II
- Lecture 35 - Formulating an appropriate study tool(Qualitative data collection tools)
- Lecture 36 - Designing messages - Part I
- Lecture 37 - Designing messages - Part II
- Lecture 38 - Materials and Methods of Intervention Delivery - Part I
- Lecture 39 - Materials and Methods of Intervention Delivery - Part II
- Lecture 40 - Pretesting of an intervention tool
- Lecture 41 - BCC and SBCC - Part I
- Lecture 42 - BCC and SBCC - Part II
- Lecture 43 - BCC and SBCC - Part III
- Lecture 44 - BCC and SBCC - Part IV
- Lecture 45 - BCC and SBCC - Part V
- Lecture 46 - Community-Based Participatory Research in context to Health Promotion - Part I
- Lecture 47 - Community-Based Participatory Research in context to Health Promotion - Part II
- Lecture 48 - Community-Based Participatory Research in context to Health Promotion - Part III
- Lecture 49 - Community-Based Participatory Research in context to Health Promotion - Part IV
- Lecture 50 - Community-Based Participatory Research in context to Health Promotion - Part V
- Lecture 51 - Quantitative analytical methods - Part I
- Lecture 52 - Quantitative analytical methods - Part II
- Lecture 53 - Quantitative analytical methods - Part III
- Lecture 54 - Analysis of Qualitative data
- Lecture 55 - Analyzing Mixed Methods data
- Lecture 56 - Developing a research proposal in health promotion
- Lecture 57 - Report writing in health Promotion: An Overview
- Lecture 58 - Report writing: quantitative research in health promotion - Part I
- Lecture 59 - Report writing: quantitative research in health promotion - Part II
- Lecture 60 - Report Writing: Qualitative and Mixed Methods research

Lecture 1 - Introduction

Lecture 2 - Urban Heritage - Global Conventions and Declarations

Lecture 3 - Historical Urban Landscape (HUL) - Approach, Toolkit, and Actions

Lecture 4 - Urban Heritage - The Indian Context

Lecture 5 - SDG(s) 11(.4) - Transdisciplinary Possibilities, Pathways, and Actions

Lecture 6 - Historicizing lakes of Bangalore - social-ecological perspectives

Lecture 7 - Urban environmentalisms - lake-based and rights-based

Lecture 8 - Example 1: The Jakkur Lake

Lecture 9 - Example 2: The Puttenahalli Lake

Lecture 10 - Example 3: The Kaikondrahalli Lake

Lecture 11 - Kolkata's heritage - Applying the urban ecological heritage lens

Lecture 12 - Kolkata and EKW - conveying the co-evolutionary narrative

Lecture 13 - Living Systems infrastructure of Kolkata

Lecture 14 - Case study 1: The Nalban and Goltala Fisheries

Lecture 15 - Case study 2: Baro Chaynavi Cooperative

Lecture 16 - Case study 3: Jhagrashisha

Lecture 17 - EKW as heritage - Lessons from a Practical Empirical Implementation Project - I

Lecture 18 - EKW as heritage - Lessons from a Practical Empirical Implementation Project - I

Lecture 19 - Conclusions

Lecture 1 - Introduction

Lecture 2 - Experiment 1: Teaching of Serial Manipulator

Lecture 3 - Experimentation I

Lecture 4 - Experiment 1: Teaching of Serial Manipulator (Continued...)

Lecture 5 - Experiment 2: Control of Tracked Mobile Manipulator

Lecture 6 - Experimentation II

Lecture 7 - Experiment 2: Control of Tracked Mobile Manipulator (Continued...)

Lecture 8 - Experiment 3: Path and Gait Planning of Six-legged Robot

Lecture 9 - Experimentation III

Lecture 10 - Experiment 3: Path and Gait Planning of Six-legged Robot (Continued...)

Lecture 11 - Experiment 4: Navigation of Drone

Lecture 12 - Experimentation IV

Lecture 13 - Experimentation IV (Continued...)

Lecture 14 - Experiment 5: Path and Gait Planning of 25 dof NAO Humanoid Robot

Lecture 15 - Experimentation V

Lecture 16 - Experiment 5: Path and Gait Planning of 25 dof NAO Humanoid Robot (Continued...)

Lecture 17 - Current Trends in Robotics Research

Lecture 18 - Summary of the Course



- Lecture 1 - Interface between Medical Profession and Law
- Lecture 2 - Role of Medical practitioners in Justice Administration
- Lecture 3 - Dos and Don'ts of Doctors
- Lecture 4 - Dos and Don'ts for Legal Practitioners
- Lecture 5 - Knowledge exchange between Medical and Legal Practitioners
- Lecture 6 - Consent in Law
- Lecture 7 - Types of Consent in Medical Field
- Lecture 8 - Ethics in Medical Profession
- Lecture 9 - Importance of Documentation in Medical practice
- Lecture 10 - Legal Implications of Improper Documentation
- Lecture 11 - Legal Responsibilities of Medical Practitioners
- Lecture 12 - Medical Negligence and Legal Implications
- Lecture 13 - Legal Implications of Medical Malpractice
- Lecture 14 - Landmark Judgments on Medical Negligence
- Lecture 15 - Testimony of Doctors in Medical Negligence
- Lecture 16 - Healthcare Policy and Law
- Lecture 17 - Clinical Establishment Law
- Lecture 18 - Legal liability of Hospitals/Clinical Establishments
- Lecture 19 - Legal responsibility in Diagnostics
- Lecture 20 - Penalties for non-compliance
- Lecture 21 - Role of IPR in promoting medical innovation and technologies
- Lecture 22 - Health Policy formulation and Role of IPR
- Lecture 23 - Intellectual Property and Access to Medicine
- Lecture 24 - Neglected diseases and Role of IPR
- Lecture 25 - Patenting Therapeutic Practices and Techniques
- Lecture 26 - Duties of Doctor in Courts
- Lecture 27 - Evidence Law and Medical experts
- Lecture 28 - Admissibility of Forensic Evidence
- Lecture 29 - Various Legal procedures in Medical practice
- Lecture 30 - Collection, preservation and dispatch of Forensic Evidence
- Lecture 31 - Ethical insight into different aspects of Surrogacy practice

[Lecture 32 - Surrogacy Regulation in India](#)

[Lecture 33 - Assisted Reproductive Technology Regulation in India](#)

[Lecture 34 - Pre-Conception and Pre-Natal Diagnostic](#)

[Lecture 35 - Penalties for non-compliance](#)

[Lecture 36 - Ethical Issues in Organ Transplantation](#)

[Lecture 37 - Law governing organ transplantation](#)

[Lecture 38 - Comparative Law on Organ Transplantation](#)

[Lecture 39 - Medico-Legal Issues in Clinical Trials](#)

[Lecture 40 - Regulatory Law for Clinical Trials in India](#)

- Lecture 1 - Overview of Obstetrics
- Lecture 2 - Anatomy of Vulva or pudendum
- Lecture 3 - Anatomy of Vagina
- Lecture 4 - Anatomy of Cervix and Uterus
- Lecture 5 - Anatomy of Uterus
- Lecture 6 - Anatomy of fallopian tubes and ovary
- Lecture 7 - Anatomy of plvic floor and perineum
- Lecture 8 - Gametogenesis
- Lecture 9 - Fertilisation and Embryogenesis
- Lecture 10 - Implantation
- Lecture 11 - Placentation (normal and abnormal)
- Lecture 12 - Placentation (normal and abnormal) (Continued...)
- Lecture 13 - Umbilical cord and Fetal membranes - Part 1
- Lecture 14 - Umbilical cord and Fetal membranes - Part 2
- Lecture 15 - FETUS (physiology and circulation)
- Lecture 16 - Physiological changes in pregnancy - Part 1
- Lecture 17 - Physiological changes in pregnancy - Part 2
- Lecture 18 - Physiological changes in pregnancy - Part 3
- Lecture 19 - Hormones in pregnancy
- Lecture 20 - Hormones in pregnancy (Continued...)
- Lecture 21 - Diagnosis of pregnancy - 1
- Lecture 22 - Diagnosis of Pregnancy - 2
- Lecture 23 - Obstetrical Examination
- Lecture 24 - Obstetrical Examinationon antenatal mother (Clinical Study)
- Lecture 25 - Maternal Pelvis \$ Foetal Skill - Part 1
- Lecture 26 - Fetal Skull
- Lecture 27 - Pre-conceptional counselling and care
- Lecture 28 - Nutrition in Pregnancy
- Lecture 29 - Antenatal Care - Part 1
- Lecture 30 - Antenatal Care - Part 2
- Lecture 31 - Antenatal Care - Part 3

- Lecture 32 - Antenatal Assessment of Fetal Well-Being - Part 1
- Lecture 33 - Antenatal Assessment of Fetal Well-Being - Part 2
- Lecture 34 - Antenatal Assessment of Fetal Well-Being - Part 3
- Lecture 35 - Prenatal Screening and Diagnosis of aneuploidies
- Lecture 36 - Invasive and non-invasive Prenatal Diagnostic Test
- Lecture 37 - Invasive and non-invasive Prenatal Diagnostic Test (Continued...)
- Lecture 38 - Fetal Imaging and Amniotic Fluid Study
- Lecture 39 - Fetal Imaging and Amniotic Fluid Study
- Lecture 40 - Teratology, Teratogens and feto-toxic agents - Part 1
- Lecture 41 - Teratology, Teratogens and feto-toxic agents - Part 2
- Lecture 42 - Normal Labour - Stages and cause of onset
- Lecture 43 - Physiology of Labor
- Lecture 44 - Events of Normal Labour
- Lecture 45 - Mechanism of Normal Labour
- Lecture 46 - Mechanism of Normal Labour (Continued...)
- Lecture 47 - Clinical course of Labour
- Lecture 48 - Monitoring of Normal Labour - Part 1
- Lecture 49 - Monitoring of Normal Labour - Part 2
- Lecture 50 - Labour Analgesia
- Lecture 51 - Labour Analgesia (Continued...)
- Lecture 52 - Abnormal Labour
- Lecture 53 - Intrapartum Fetal Monitoring - Partogram
- Lecture 54 - Intrapartum Fetal Monitoring - Cardiotocography (CTG)
- Lecture 55 - Intrapartum Fetal Monitoring - Cardiotocography (CTG) (Continued...)
- Lecture 56 - Induction and Augmentation of Labour
- Lecture 57 - WHO Labour Guide
- Lecture 58 - Episiotomy
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- Lecture 60 - Obstetric anal sphincter injuries OASIS
- Lecture 61 - Lower Segment Caesarean Section
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- Lecture 4 - Data Collection
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- Lecture 13 - User-Based Approach
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- Lecture 21 - Introduction to content based recommender system: Foundations
- Lecture 22 - Feature Engineering - I
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Lecture 3 - Transcription (RNA Synthesis)

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Lecture 5 - Nucleic Acid Isolation and Detection Methods

Lecture 6 - PCR (Polymerase Chain Reaction) Fundamentals

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Lecture 17 - FISH (Fluorescence in situ Hybridization)

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Lecture 19 - Methods to study DNA-protein interaction - II

Lecture 20 - Epigenetics and DNA methylation analysis

Lecture 21 - DNA Sequencing - Part 1 - Maxam Gilbert Sequencing

Lecture 22 - DNA Sequencing - Part 2 - Sanger Sequencing

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Lecture 26 - Overview, Importance, Methods in Proteomics

Lecture 27 - Proteomic Techniques - High performance liquid chromatography (HPLC)

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- Lecture 32 - Label-based Protein Quantification Technologies - Part 2
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- Lecture 37 - Molecular Diagnostics in Antimicrobial Resistance Testing
- Lecture 38 - RNA Sequencing: Role in Infectious diseases - I
- Lecture 39 - RNA Sequencing: Role in Infectious diseases - II
- Lecture 40 - Point of Care (POC) diagnostics in Infectious diseases
- Lecture 41 - Molecular genetics in tumorogenesis
- Lecture 42 - Liquid biopsies in cancer detection
- Lecture 43 - Digital PCR in Cancer detection
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- Lecture 45 - Isothermal Nucleic Acid Amplification
- Lecture 46 - Genetic Testing and Inherited Disorders - Part 1
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- Lecture 48 - Prenatal diagnostics and NIPT
- Lecture 49 - Reproductive genetics and genetic counselling
- Lecture 50 - Genetic counselling and patient education
- Lecture 51 - Serial Analysis of Gene Expression
- Lecture 52 - Metabolomics in Molecular Diagnostics
- Lecture 53 - Immunoassay and Luminex Multiplex Assay
- Lecture 54 - Molecular diagnostics in Metabolic, Cardiovascular and Gastrointestinal disorders
- Lecture 55 - Molecular diagnostics in Endocrine, Neurodegenerative and Transplantation disorders
- Lecture 56 - Pharmacogenomics and Personalized Medicine
- Lecture 57 - Quality control (QC) in molecular diagnostics
- Lecture 58 - Ethical concerns in molecular diagnostics
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- Lecture 60 - Integration of Multiomics Data in Molecular Diagnostics

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Lecture 10 - Review of Action Potential and Neurotransmitters

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Lecture 12 - Disorders of Neuromuscular Junction

Lecture 13 - Skeletal Muscles - Part 1

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Lecture 20 - Motor Units - PIC and EMG

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Lecture 3 - Epidemiology of TB-Session - 2

Lecture 4 - Pathogenesis of TB-Session - 1

Lecture 5 - Pathogenesis of TB-Session - 2

Lecture 6 - Clinical manifestations of TB-Session - 1

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Lecture 9 - Bacteriological Diagnosis of Tuberculosis - Smear and Culture

Lecture 10 - Demonstration of processing of sputum specimen for culture for diagnosis of tuberculosis

Lecture 11 - Demonstration of sputum smear examination for diagnosis of tuberculosis

Lecture 12 - Demonstration of solid culture method for diagnosis of tuberculosis

Lecture 13 - Demonstration of liquid culture method for diagnosis of tuberculosis in sputum

Lecture 14 - Phenotypic drug susceptibility testing in Tuberculosis

Lecture 15 - Demonstration of drug susceptibility testing of first line anti-TB drugs by liquid culture

Lecture 16 - Molecular Diagnosis of Tuberculosis-Session - 1

Lecture 17 - Molecular Diagnosis of Tuberculosis-Session - 2

Lecture 18 - Demonstration of Xpert MTB-RIF assay for diagnosis of tuberculosis from sputum specimens

Lecture 19 - Demonstration of Line Probe Assay (LPA) (Direct detection of tuberculosis and resistance to isoniazid and rifampicin) in sputum

Lecture 20 - Radiology in diagnosis of Tuberculosis-Session - 1

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Lecture 22 - Radiology in diagnosis of Tuberculosis-Session - 3

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Lecture 24 - Approach to diagnosis of Pulmonary TB

Lecture 25 - Case Discussion-Approach to diagnosis of TB in a person with presumptive pulmonary TB

Lecture 26 - Case Discussion-Approach to diagnosis of pulmonary TB in a patient with negative sputum smear for AFB

Lecture 27 - Approach to diagnosis of Extra-pulmonary TB

Lecture 28 - Case Discussion-Approach to diagnosis of TB in a person with swelling in the neck

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Lecture 30 - Diagnosis of Childhood Tuberculosis-Session - 1

Lecture 31 - Diagnosis of Childhood Tuberculosis-Session - 2

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Lecture 33 - Case Discussion-Approach to diagnosis of TB in a child with presumptive pulmonary TB

Lecture 34 - Case Discussion-Approach to diagnosis of TB meningitis in a child

Lecture 35 - Drugs for treating Tuberculosis and Principles of Chemotherapy-Session - 1

Lecture 36 - Drugs for treating Tuberculosis and Principles of Chemotherapy-Session - 2

Lecture 37 - Treatment of Drug Sensitive Pulmonary Tuberculosis

Lecture 38 - Case discussion-Approach to treatment of drug sensitive TB

Lecture 39 - Management of drug resistant Tuberculosis-Session - 1

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Lecture 41 - Case discussion-Approach to treatment of Multi-drug resistant TB (MDR-TB)/ Extensively drug resistant TB (XDR-TB)

Lecture 42 - Management of Extra-pulmonary Tuberculosis-Session - 1

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Lecture 44 - Panel discussion-Practical difficulties in the management of Extra-pulmonary TB

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Lecture 46 - Management of patients with HIV-TB coinfection-Session - 2

Lecture 47 - Case discussion-Approach to management of HIV-TB

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Lecture 51 - Treatment of Pediatric Tuberculosis-Session - 2

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Lecture 54 - Case discussion-Approach to management of jaundice during anti-TB treatment

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Lecture 56 - Non-tuberculous Mycobacteria- Diagnosis and Clinical management-Session - 1

Lecture 57 - Non-tuberculous Mycobacteria - Diagnosis and Clinical Management Session - 2

Lecture 58 - Newer Anti-TB drugs and regimens-Session - 1

Lecture 59 - Newer Anti-TB drugs and regimens-Session - 2

Lecture 60 - Management of Latent TB Infection-Session - 1

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Lecture 62 - Airborne infection control in tuberculosis-Session - 1

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[Lecture 72 - Addressing Social Barriers in Tuberculosis Control-Session - 1](#)

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[Lecture 74 - Standards for TB Care in India-Session - 1](#)

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[Lecture 76 - Global Tuberculosis Control Strategies](#)

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Lecture 3 - Dams

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Lecture 5 - Adayar River

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Lecture 7 - Use And Throw Plastic

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Lecture 23 - Drinking Water Supply: Need and Challenges

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- Lecture 49 - Tutorial problem - Part 2
- Lecture 50 - Tutorial problem - Part 3
- Lecture 51 - Tutorial problems on two-phase systems (2 numbers)
- Lecture 52 - Tutorial problem (1 number)
- Lecture 53 - Rate equation of the first law of thermodynamics for a control mass and a control volume
- Lecture 54 - Energy equation for a steady-state, steady-flow process in selected engineering devices
- Lecture 55 - Tutorial problems (3 numbers)
- Lecture 56 - Tutorial problem - Part 1
- Lecture 57 - Tutorial problem - Part 2
- Lecture 58 - Quasi-static process revisited: Work against an external force
- Lecture 59 - Second law of thermodynamics: limitations of the first law of thermodynamics
- Lecture 60 - Second law of thermodynamics: direct and reverse heat engine
- Lecture 61 - Second law of thermodynamics: Kelvin-Planck and Clausius statements
- Lecture 62 - Second law of thermodynamics: reversible process
- Lecture 63 - Second law of thermodynamics: Carnot's cycle and theorems
- Lecture 64 - Second law of thermodynamics: absolute temperature scale

- Lecture 65 - Tutorial problems (2 numbers)
- Lecture 66 - Tutorial problem (1 number)
- Lecture 67 - Tutorial problem (1 number)
- Lecture 68 - Tutorial problem (2 numbers)
- Lecture 69 - Second law of thermodynamics: Clausius's inequality
- Lecture 70 - Entropy - Part 1
- Lecture 71 - Tutorial problem (1 number)
- Lecture 72 - Entropy - Part 2
- Lecture 73 - Entropy - Part 3
- Lecture 74 - Entropy - Part 4
- Lecture 75 - Tutorial problem (1 number)
- Lecture 76 - Tutorial problem (1 number)
- Lecture 77 - Tutorial problems (2 numbers)
- Lecture 78 - Entropy - Part 5
- Lecture 79 - Entropy - Part 6
- Lecture 80 - Entropy - Part 7
- Lecture 81 - Exergy - Part 1
- Lecture 82 - Exergy - Part 2
- Lecture 83 - Exergy - Part 3
- Lecture 84 - Thermodynamics cycles: Rankine cycle
- Lecture 85 - Tutorial problem (1 number)
- Lecture 86 - Thermodynamics cycles: Brayton cycle
- Lecture 87 - Tutorial problem (1 number)
- Lecture 88 - Thermodynamics cycles: vapor compression refrigeration cycle
- Lecture 89 - Tutorial problem (1 number)

Lecture 1 - Courses Overview

Lecture 2 - Medical device and in vitro diagnostics: Introduction and types of devices including combination devices

Lecture 3 - Medical Device Rules, 2017: Implications on medical devices

Lecture 4 - Classification of medical devices

Lecture 5 - Labelling of medical devices and in vitro diagnostics

Lecture 6 - Standards of medical device, quality assurance and testing

Lecture 7 - Regulatory requirements of biocompatibility of medical devices and ISO 10993

Lecture 8 - Clinical investigation of medical devices, regulation of investigational medical devices

Lecture 9 - Quality assurance and quality management system

Lecture 10 - How to obtain a licence to manufacture a medical device?

Lecture 11 - ISO 14971 (Medical devices: Application of risk management to medical devices)

Lecture 12 - Inspection of medical device and IVD establishments

Lecture 13 - Import and export of medical devices and IVDs

Lecture 14 - Medical device regulation: International practices

**NPTEL : NOC:Current Regulatory Requirements for Conducting Clinical Trials in India for Investigational New Drugs  
(Version 2.0) (Multi-Disciplinary)**

**Co-ordinators : Prof. Nandini K Kumar, Prof. Y. K. Gupta, Prof. D. K. Sable, Prof. Arun B. Ramteke, Prof. Rubina Bose, Prof. Sucheta Banerjee Kurundkar, Prof. Vishnu Rao**

Lecture 1 - Courses Overview

Lecture 2 - Overview of Indian regulatory system

Lecture 3 - Overview of Drugs and Cosmetics Act and Rules thereunder

Lecture 4 - Overview of New Drugs and Clinical Trials Rules, 2019

Lecture 5 - Pre-Clinical Data Requirements

Lecture 6 - Rules Governing Clinical Trials

Lecture 7 - Phases of clinical trial, forms, and fees

Lecture 8 - Regulatory pathway and data requirements for NDCT, 2019

Lecture 9 - BA/BE study and study centers: Legal provisions

Lecture 10 - Guidelines to conduct BA/BE studies

Lecture 11 - Ethics Committee registration and re-registration

Lecture 12 - Ethical Considerations

Lecture 13 - Good Clinical Practice

Lecture 14 - Requirements for import/manufacture of new drug/IND for conducting clinical trials in India

Lecture 15 - Requirements for import/manufacture of new drug/IND for sale/ distribution and unapproved new drug for patients

Lecture 16 - Important issues

Lecture 17 - Special concern

Lecture 18 - Clinical trial related guidelines (NDCT Rules)

Lecture 19 - Content of Proposed Clinical Trial Protocol

Lecture 20 - Content of a Clinical Trial Report

Lecture 21 - Post Marketing Assessment and Clinical Trial Compensation

Lecture 22 - Common observations during submission of CT/BA/BE protocol

Lecture 23 - Common observations during CT/BA/BE centre inspections

Lecture 24 - Drug development process: Overview

Lecture 25 - Salient feature of NDCT 2019 - what's new in NDCT?

Lecture 26 - Online Submission 23A: Sugam

Lecture 27 - Online Submission (CTRI)

Lecture 28 - Tables Given in NDCT 2019 and its Content

Lecture 1 - Course Background: Model Predictive Control

Lecture 2 - Course Outline

Lecture 3 - Additional MATLAB Video - Array Operations

Lecture 4 - Additional MATLAB Video - Array Operations

Lecture 5 - Recap: Linear Algebra

Lecture 6 - Recap: Differential and Difference Equations

Lecture 7 - Recap: Process Control Basics

Lecture 8 - Introduction to Model Predictive Control

Lecture 9 - MPC: Salient Features

Lecture 10 - MPC: Historical Perspective

Lecture 11 - Vectors and Matrices

Lecture 12 - Vector Spaces

Lecture 13 - Linear Operation

Lecture 14 - Null and Image Spaces

Lecture 15 - Eigenvalues and Eigenvectors

Lecture 16 - Eigenvalue Decomposition and Tutorial

Lecture 17 - Recap of Week-2

Lecture 18 - Model Classification

Lecture 19 - Discrete-Time Models Overview

Lecture 20 - Discrete-Time Models

Lecture 21 - Finite Impulse Response Models

Lecture 22 - Finite Step Response Models

Lecture 23 - Recap and Plan for Week-4

Lecture 24 - State Space and Step Response Models

Lecture 25 - Nonlinear Models and Model Linearization

Lecture 26 - Model Types and Model Conversion

Lecture 27 - Model Conversion - 2

Lecture 28 - Model Conversion: TF to SS

Lecture 29 - How to handle MIMO systems

Lecture 30 - Discretization of State-Space Models

Lecture 31 - Introduction to Dynamic Matrix Control (DMC)

Lecture 32 - The DMC Algorithm: Future Predictions

Lecture 33 - The DMC Algorithm: Objective and Constraints

Lecture 34 - The DMC Algorithm: Optimization

Lecture 35 - Coding for DMC Algorithm: Setup

Lecture 36 - Coding for DMC Algorithm: Populate Matrices

Lecture 37 - Recap of DMC Algorithm

Lecture 38 - Extensions of DMC Algorithm

Lecture 39 - LTI Models and Coordinate Transform

Lecture 40 - LTI Models: Stability

Lecture 41 - LTI Models: Controllability

Lecture 42 - LTI Models: Conditions for controllability

Lecture 43 - Tutorial by Arvind (Recap of Controllability)

Lecture 44 - LTI Models: Observability

Lecture 45 - Linear Control: Introduction

Lecture 46 - Pole Placement Controller

Lecture 47 - Linear Quadratic Regulator: Batch Solution

Lecture 48 - LQR: Dynamic Programming Solution

Lecture 49 - State Estimation: Introduction

Lecture 50 - Stochastic Processes and Random Variables

Lecture 51 - State Estimation: Pole Placement Observer

Lecture 52 - Kalman Filter: Terminology

Lecture 53 - Kalman Filter: Derivation

Lecture 54 - Recap of Modules 7-9

Lecture 55 - Recap and Plan for this week

Lecture 56 - Linear Quadratic Gaussian

Lecture 57 - LQG Derivation and Separation Principle

Lecture 58 - Setpoint Tracking in LQ Control

Lecture 59 - Disturbance Rejection in LQ Control

Lecture 60 - Disturbance Modeling for Estimation

Lecture 61 - Estimation with Disturbance Modeling

Lecture 62 - Recap and Plan for this week

Lecture 63 - State-Space MPC: Deterministic case

Lecture 64 - Extension to Measured Disturbances

[Lecture 65 - Offset-Free State Space MPC](#)

[Lecture 66 - Comparison of State-Space MPC with DMC](#)

[Lecture 67 - State-Space MPC: Disturbance Modeling](#)

[Lecture 68 - Disturbance Modeling: Background and Setup](#)

[Lecture 69 - Stochastic Output-Feedback State-Space MPC](#)

[Lecture 70 - Bonus Video: Disturbance Modeling for State Space MPC](#)

[Lecture 71 - Self-Guided Tutorial of MPC Toolbox](#)

[Lecture 72 - Help Session: Using MPC Toolbox](#)

[Lecture 73 - Recap of LQ Control and Linear MPC](#)

[Lecture 74 - Linear MPC - Key Features and Results](#)

[Lecture 75 - Practical Issues: Inferential Control](#)

[Lecture 76 - Practical Issues: Measurement Delay](#)

[Lecture 77 - Other Practical Issues](#)

[Lecture 78 - Some Classical Examples of MPC](#)



Lecture 1 - What is Science? - Part 1

Lecture 2 - What is Science? - Part 2

Lecture 3 - Subjective Thinking Versus Objective Thinking

Lecture 4 - Idealism Versus Materialism

Lecture 5 - Causality - Part 1

Lecture 6 - Causality - Part 2

Lecture 7 - Logical Reasoning: Inductive Logic

Lecture 8 - Logical Reasoning: Deductive Logic - Part 1

Lecture 9 - Logical Reasoning: Deductive Logic - Part 2

Lecture 10 - Logical Reasoning: Syllogistic Logic - Part 1

Lecture 11 - Logical Reasoning: Syllogistic Logic - Part 2

Lecture 12 - Logical Reasoning: Syllogism Logic, Truth and Validity

Lecture 13 - Historical Perspective: Emergence of Materialism and Idealism - Part 1

Lecture 14 - Historical Perspective: Emergence of Materialism and Idealism - Part 2

Lecture 15 - Historical Perspective:Renaissance to the Development of Mechanical Materialism - Part 1

Lecture 16 - Historical Perspective:Renaissance to the Development of Mechanical Materialism - Part 2

Lecture 17 - Historical Perspective: The Advent of Empiricism and the Idea of Evolution

Lecture 18 - Historical Perspective: Science in Ancient India

Lecture 19 - Historical Perspective: The Advent of Scientific Materialism - Part 1

Lecture 20 - Historical Perspective: The Advent of Scientific Materialism - Part 2

Lecture 21 - Historical Perspective: The Rise and Fall of Positivism - Part 1

Lecture 22 - Historical Perspective: The Rise and Fall of Positivism - Part 2

Lecture 23 - What Scientists Actually Do - Part 1

Lecture 24 - What Scientists Actually Do - Part 2

Lecture 25 - Falsifiability and Reproducibility - Part 1

Lecture 26 - Falsifiability and Reproducibility - Part 2

Lecture 27 - Proposing a Hypothesis - Part 1

Lecture 28 - Proposing a Hypothesis - Part 2

Lecture 29 - Elements of Scientific Measurement - Part 1

Lecture 30 - Elements of Scientific Measurement - Part 2

Lecture 31 - The Central Limit Theorem and its Applications - Part 1

- Lecture 32 - The Central Limit Theorem and its Applications - Part 2
- Lecture 33 - Error Bars and Confidence Interval - Part 1
- Lecture 34 - Error Bars and Confidence Interval - Part 2
- Lecture 35 - Measurement of a Proportion - Part 1
- Lecture 36 - Measurement of a Proportion - Part 2
- Lecture 37 - Examples of Proportion Measurement
- Lecture 38 - Box and Whisker Plot
- Lecture 39 - Propagation of Errors - Part 1
- Lecture 40 - Propagation of Errors - Part 2
- Lecture 41 - Issues in Hypothesis Testing - Part 1
- Lecture 42 - Issues in Hypothesis Testing - Part 2
- Lecture 43 - Statistical Methods in Hypothesis Testing: Z-Test and T-Test - Part 1
- Lecture 44 - Statistical Methods in Hypothesis Testing: Z-Test and T-Test - Part 2
- Lecture 45 - Hypothesis Testing: The Chi-Square Test - Part 1
- Lecture 46 - Hypothesis Testing: The Chi-Square Test - Part 2
- Lecture 47 - Hypothesis Testing: The Chi-Square Test - Part 3
- Lecture 48 - Hypothesis Testing: The Chi-Square Test - Part 4
- Lecture 49 - Theoretical Research: Functional Relationships from Experimental Data - Part 1
- Lecture 50 - Theoretical Research: Functional Relationships from Experimental Data - Part 2
- Lecture 51 - Theoretical Research: Mathematical Models of Physical Systems
- Lecture 52 - Order of Magnitude Calculations
- Lecture 53 - Theoretical Research: Modeling Using Dimensional Analysis - Part 1
- Lecture 54 - Theoretical Research: Modeling Using Dimensional Analysis - Part 2
- Lecture 55 - An Example of Mathematical Modeling
- Lecture 56 - Importance of Theory-Building in Science
- Lecture 57 - Scientific Writing: Journal Papers - Part 1
- Lecture 58 - Scientific Writing: Journal Papers - Part 2
- Lecture 59 - Scientific Writing: Journal Papers - Part 3
- Lecture 60 - Scientific Writing: Journal Papers - Part 4
- Lecture 61 - Scientific Writing: PhD Thesis
- Lecture 62 - Scientific Writing: Text Stylistics
- Lecture 63 - Presentation in Scientific Conferences - Part 1
- Lecture 64 - Presentation in Scientific Conferences - Part 2

[Lecture 65 - Writing Grant Proposals - Part 1](#)

[Lecture 66 - Writing Grant Proposals - Part 2](#)

[Lecture 67 - Ethical Conduct in Science: Aspects of Scientific Ethics](#)

[Lecture 68 - Ethical Conduct in Science: Research Misconduct](#)

[Lecture 69 - Ethical Conduct in Science: Ethics in Scientific Publication - Part 1](#)

[Lecture 70 - Ethical Conduct in Science: Ethics in Scientific Publication - Part 2](#)

[Lecture 71 - Ethical Conduct in Science: Cases of Scientific Misconduct - Part 1](#)

[Lecture 72 - Ethical Conduct in Science: Cases of Scientific Misconduct - Part 2](#)

Lecture 1 - Vasovagal Syncope

Lecture 2 - Vasovagal Syncope - Clinical Scenario

Lecture 3 - Postural Hypotension

Lecture 4 - Postural Hypotension - Clinical Scenario

Lecture 5 - Hyperventilation

Lecture 6 - Hyperventilation - Clinical Scenario

Lecture 7 - Asthma - Status Asthmaticus - Part 1

Lecture 8 - Asthma - Status Asthmaticus - Part 2

Lecture 9 - Asthma - Clinical Scenario

Lecture 10 - Chest Pain Of Cardiac Origin - Myocardial Infarction And Anigina Pectoris - Part 1

Lecture 11 - Chest Pain Of Cardiac Origin - Myocardial Infarction And Anigina Pectoris - Part 2

Lecture 12 - Chest Pain - Clinical Scenario

Lecture 13 - Acute Adrenal Insufficiency

Lecture 14 - Acute Adrenal Insufficiency - Clinical Scenario

Lecture 15 - Diabetes Mellitus

Lecture 16 - Diabetes Mellitus - Clinical Scenario

Lecture 17 - Throid Dysfunction

Lecture 18 - Allergies/Hypersensitivity Reaction - Part 1

Lecture 19 - Allergies/Hypersensitivity Reaction - Part 2

Lecture 20 - Epilepsy- Status Epilepticus

Lecture 21 - Chronic Kidney Disease

Lecture 22 - Hepatic Dysfunction

Lecture 23 - Basic Life Support - Part 1

Lecture 24 - Basic Life Support - Part 2

**Co-ordinators : Prof. Mousumi Ghosh, Prof. Manjari Jain, Prof. R Jayapal, Prof. Anand Krishnan, Prof. Suhel Quader, Prof. V.V. Robin, Prof. Umesh Srinivasan**

Lecture 1 - Introduction to Ornithology

Lecture 2 - Diversity and Classification - Part 1

Lecture 3 - Diversity and Classification - Part 2

Lecture 4 - Evolution and Speciation - Part 1

Lecture 5 - Evolution and Speciation - Part 2

Lecture 6 - Anatomy

Lecture 7 - Physiology

Lecture 8 - Colour

Lecture 9 - Life History

Lecture 10 - Foraging Behaviour

Lecture 11 - Mating and Breeding Behaviour

Lecture 12 - Social Behaviour

Lecture 13 - Methods of Science and Research Questions

Lecture 14 - Vocal Behaviour: Mechanisms - Part 1

Lecture 15 - Vocal Behaviour: Mechanisms - Part 2

Lecture 16 - Vocal Behaviour: Ecology and Evolution - Part 1

Lecture 17 - Vocal Behaviour: Ecology and Evolution - Part 2

Lecture 18 - Vocal Mimicry in Birds

Lecture 19 - Basics of Research Design

Lecture 20 - Bird Migration - LIVE Guest Lectuer

Lecture 21 - Bird Populations: Concepts

Lecture 22 - Bird Communities: Concepts - Part 1

Lecture 23 - Bird Communities: Concepts - Part 2

Lecture 24 - Interactive Session by Dr Mousumi Ghosh (NCF) and Dr Umesh Srinivasan (IISc)

Lecture 25 - Studying bird populations and communities - Part 1

Lecture 26 - Studying bird populations and communities - Part 2

Lecture 27 - Mixed Species Flocks - Live Session

Lecture 28 - Interactive session with Dr. Priti Bangal (NCF) and Dr. Umesh Srinivasan (IISc)

Lecture 29 - Introduction to Data Visualisation Analysis - Part 1

Lecture 30 - Introduction to Data Visualisation Analysis - Part 2

## DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

[Lecture 31 - Basic Course in Ornithology - Guest Session on Avian Diseases](#)

[Lecture 32 - Biogeography](#)

[Lecture 33 - Macroecology](#)

[Lecture 34 - Macroecology - Case Study - LIVE](#)

[Lecture 35 - Week 10 Interactive session with Dr VV Robin and Dr Umesh Srinivasan](#)

[Lecture 36 - Bird Conservation - Concepts](#)

[Lecture 37 - Avian Conservation: Case study 1](#)

[Lecture 38 - Avian Conservation: Case study 2](#)

[Lecture 39 - Avian Conservation: Case study 3](#)

[Lecture 40 - Avian Conservation: Case study 4](#)

[Lecture 41 - Avian Conservation: Case study 5](#)

[Lecture 42 - LIVE - Citizen Science - Guest faculty by Dr Ashwin Viswanathan \(NCF\)](#)

[Lecture 43 - Molecular Techniques - Part 1](#)

[Lecture 44 - Molecular Techniques - Part 2](#)

- Lecture 1 - Craniofacial anatomy - Part 1
- Lecture 2 - Craniofacial anatomy - Part 2
- Lecture 3 - Tooth and It's Supporting Structures - Part 1
- Lecture 4 - Tooth and It's Supporting Structures - Part 2
- Lecture 5 - Specialised mucosa
- Lecture 6 - Saliva-Composition and functions
- Lecture 7 - Saliva Diagnostics
- Lecture 8 - Stem cells in the oro-dental region
- Lecture 9 - Stem cell isolation
- Lecture 10 - Mineralization dynamics - Part 1
- Lecture 11 - Mineralization dynamics - Part 2
- Lecture 12 - TMJ Anatomy and Function
- Lecture 13 - Oral defense mechanisms
- Lecture 14 - Mucosal and regional immunology
- Lecture 15 - Oral microbiome
- Lecture 16 - Evaluation of Oral microbiome
- Lecture 17 - Dysbiosis
- Lecture 18 - Molecular mechanisms in oral cancer
- Lecture 19 - Flow cytometry in cell and molecular biology
- Lecture 20 - Basics of Biomaterial science and engineering
- Lecture 21 - Biomimetics - Part 1
- Lecture 22 - Biomimetics - Part 2
- Lecture 23 - Biomaterials - Polymers
- Lecture 24 - Biomaterials - Metals
- Lecture 25 - Biomaterials - Ceramics and Colloids
- Lecture 26 - 3-D Bioprinting
- Lecture 27 - Protein mediated biomaterials
- Lecture 28 - Immune response to biomaterials
- Lecture 29 - Biomaterial Applications
- Lecture 30 - Biocompatible assays
- Lecture 31 - Immunoassay





Lecture 1 - Course overview

Lecture 2 - What is biomimicry ?

Lecture 3 - Why is biomimicry important ?

Lecture 4 - Nature's unifying patterns - Introduction

Lecture 5 - Case study

Lecture 6 - How to do biomimicry ?

Lecture 7 - Learning resources - Biomimicry Institute

Lecture 8 - Skills, attitudes and mindset for a biomimic

Lecture 9 - Course activity

Lecture 10 - Recap of Week 1

Lecture 11 - What are we mimicking ?

Lecture 12 - Function and Strategy

Lecture 13 - Approaches to biomimicry

Lecture 14 - From Problem to Solution

Lecture 15 - Using the UNSDG to identify challenges

Lecture 16 - Recap of Week 2

Lecture 17 - Step 1 - Define the problem

Lecture 18 - Step 2 - Biologize the problem

Lecture 19 - Step 3 - Discover strategies in nature

Lecture 20 - Applying the Biomimicry Design Spiral

Lecture 21 - Step 4 - Abstract design strategies from nature

Lecture 22 - Step 5 - Emulate nature's strategies in your solution

Lecture 23 - Step 6 - Evaluate feasibility

Lecture 24 - How to apply the biomimicry process ?

Lecture 25 - Recap of Week 4

Lecture 26 - Nature's Unifying Patterns I

Lecture 27 - Systems Thinking - Introduction

Lecture 28 - Systems Thinking - Understanding consequences

Lecture 29 - Nature's Unifying Patterns II

Lecture 30 - Tools - Mind mapping

Lecture 31 - Using biomimicry to design a solution

[Lecture 32 - Recap of Week 6](#)

[Lecture 33 - Developing creative confidence](#)

[Lecture 34 - Learning from the biomimicry process](#)

[Lecture 35 - The need for creativity in our lives](#)

[Lecture 36 - Unlocking your creativity](#)

[Lecture 37 - Taking your biomimicry ideas to market](#)

[Lecture 38 - The journey so far](#)

[Lecture 39 - Finding the hero in you](#)

[Lecture 40 - Course wrap-up](#)

Lecture 1 - Introduction - Electrocardiogram - Interpretation and application in clinical practice

Lecture 2 - Basic Conduction of Heart

Lecture 3 - ECG Lead system

Lecture 4 - Recording of a Standard ECG (Lead placements and measurements)

Lecture 5 - Waveforms, Intervals and Segments

Lecture 6 - Vector Electrocardiography

Lecture 7 - From Action Potentials to Arrhythmias

Lecture 8 - Pathophysiology, Myocardial Ischemia / Injury

Lecture 9 - Myocardial Infarction (MI), Pathophysiology

Lecture 10 - Drug effects on ECG

Lecture 11 - Patient identification, preparation and interpretation of ECG

Lecture 12 - Sinus rhythms and Bradyarrhythmias

Lecture 13 - Approach to tachyarrhythmias

Lecture 14 - AV Blocks and Bundle Branch Block

Lecture 15 - Chamber enlargement and Heart Failure

Lecture 16 - Electrolyte Abnormalities on ECG

Lecture 17 - Recognizing signs and ECG changes in Myocardial Ischemia/Injury

Lecture 18 - ECG changes in myocardial infarction

Lecture 19 - Miscellaneous ECG findings and cardiac arrest

Lecture 20 - Pacemaker Rhythms

**NPTEL : NOC:One Health (Multi-Disciplinary)**

**Co-ordinators : Multi Faculty**

Lecture 1 - Introduction to the One Health Concept and National and International health/public health agencies

Lecture 2 - Global Health vs One Health

Lecture 3 - Basics of Research Ethics

Lecture 4 - Integrated human and animal disease surveillance systems

Lecture 5 - Emerging infectious diseases

Lecture 6 - Process of disease emergence and assessment of the risk factors

Lecture 7 - Mechanisms of pathogen cross over across species boundaries

Lecture 8 - Importance of disease detection, Identification and monitoring in public health

Lecture 9 - Introduction to disease vectors and basics of Medical Entomology

Lecture 10 - The factors influencing an emerging disease

Lecture 11 - Antimicrobial resistance a global threat and Importance of antibiotic stewardship program

Lecture 12 - Introduction of Food safety and food borne diseases

Lecture 13 - What are zoonotic diseases and its role in our changing world

Lecture 14 - The integration of human, animal and ecosystem health in control and prevention of these diseases

Lecture 15 - Community engagement for zoonotic disease control in humans and animals through One Health

Lecture 16 - Basics of Epidemiological Studies

Lecture 17 - Rapid Response system, Disaster Management and Outbreak Investigation Plans

Lecture 18 - Basic statistical methods and their application and the measurement of disease frequency

Lecture 19 - Principles of survey design and the concepts of sampling and Mixed method research

Lecture 20 - Introduction to health policy

Lecture 21 - Risk Communication and Pandemic Preparedness

Lecture 22 - Role of community in disease control and ways for community engagement

Lecture 23 - Uses of different types of media for communication

- Lecture 1 - Course overview Canning technology and Value addition of sea food
- Lecture 2 - Introduction and the concept of canning technology
- Lecture 3 - History of canning technology - Part 1
- Lecture 4 - History of canning technology - Part 2
- Lecture 5 - Canning Technology and Value Addition Containers and their Properties - Part 1
- Lecture 6 - Canning Technology and Value Addition Containers and their Properties - Part 2
- Lecture 7 - Canning Technology and Value Addition Containers and their Properties - Part 3
- Lecture 8 - Canning Technology and Value Addition Containers and their Properties - Part 4
- Lecture 9 - Canning Technology and Value Addition - Canning process - Part 1
- Lecture 10 - Canning Technology and Value Addition - Canning process - Part 2
- Lecture 11 - Canning Technology and Value Addition - Thermal process calculations - Part 1
- Lecture 12 - Canning Technology and Value Addition - Thermal process calculations - Part 2
- Lecture 13 - Microbiology and spoilage of canned food - Part 1
- Lecture 14 - Microbiology and spoilage of canned food - Part 2
- Lecture 15 - Process of seafood canning - Part 1
- Lecture 16 - Process of seafood canning - Part 2
- Lecture 17 - Seafood pre-processing - Part 1
- Lecture 18 - Seafood pre-processing - Part 2
- Lecture 19 - Additives - Part 1
- Lecture 20 - Additives - Part 2
- Lecture 21 - SOP for seafood canning - Part 1
- Lecture 22 - SOP for seafood canning - Part 2
- Lecture 23 - SOP for seafood canning - Part 3
- Lecture 24 - Nutritional quality of seafood
- Lecture 25 - Muscle structure of seafood
- Lecture 26 - Spoilage in seafood
- Lecture 27 - Preservation methods
- Lecture 28 - Value addition in thermally processed foods
- Lecture 29 - Quality standards for seafood value added products - Part 1
- Lecture 30 - Quality standards for seafood value added products - Part 2
- Lecture 31 - Quality standards for seafood value added products - Part 3



Lecture 1 - Course overview

Lecture 2 - Introduction

Lecture 3 - Paper as packaging material - Part 1

Lecture 4 - Paper as packaging material - Part 2

Lecture 5 - Paper as packaging material - Part 3

Lecture 6 - Glass as packaging material

Lecture 7 - Metal as packaging material - Part 1

Lecture 8 - Metal as packaging material - Part 2

Lecture 9 - Plastic as packaging material - Part 1

Lecture 10 - Plastic as packaging material - Part 2

Lecture 11 - Introduction to packaging system

Lecture 12 - Product characteristics and packaging requirements

Lecture 13 - Rigid, semi-rigid, flexible packaging forms - Part 1

Lecture 14 - Rigid, semi-rigid, flexible packaging forms - Part 2

Lecture 15 - Designing of packaging material

Lecture 16 - Testing of packaging material - Part 1

Lecture 17 - Testing of packaging material - Part 2

Lecture 18 - Testing of packaging material - Part 3

Lecture 19 - Testing of packaging material - Part 4

Lecture 20 - Testing of package performance

Lecture 21 - Principles developing safe and protective packing

Lecture 22 - Transport worthiness test - Part 1

Lecture 23 - Transport worthiness test - Part 2

Lecture 24 - Transport worthiness test - Part 3

Lecture 25 - Safety aspects of food packaging

Lecture 26 - Packaging accessories and advances in packaging

Lecture 27 - Active packaging - Part 1

Lecture 28 - Active packaging - Part 2

Lecture 29 - MA and Aseptic packaging

Lecture 30 - Edible packaging - Part 1

Lecture 31 - Edible packaging - Part 2

[Lecture 32 - Vacuum packing machine](#)

[Lecture 33 - CA and MA packing machine](#)

[Lecture 34 - Gas packing machine](#)

[Lecture 35 - Seal and shrink packing machine](#)

[Lecture 36 - Form fill sealing machine](#)

[Lecture 37 - Aseptic packaging systems](#)

[Lecture 38 - Retort pouches](#)

[Lecture 39 - Bottling machine - Part 1](#)

[Lecture 40 - Bottling machine - Part 2](#)

[Lecture 41 - Carton making machine](#)

[Lecture 42 - Package printing machines - Part 1](#)

[Lecture 43 - Package printing machines - Part 2](#)



Lecture 1 - Introduction

Lecture 2 - Fragility

Lecture 3 - Resilience

Lecture 4 - Interpreting Vulnerability, precarity of work and Access Equality for Equal Opportunity - Part I

Lecture 5 - Interpreting Vulnerability, precarity of work and Access Equality for Equal Opportunity - Part II

Lecture 6 - Social Vulnerability and Group Vulnerability

Lecture 7 - Willed Vulnerability - Endurance Sports

Lecture 8 - Illness, Storytelling and Embodiment

Lecture 9 - Illness, Storytelling and Embodiment Reading - Audre Lorde's : The Cancer Journals

Lecture 10 - Group Discussion - Vulnerable Bodies

Lecture 11 - The Aesthetics of Vulnerability - I

Lecture 12 - The Aesthetics of Vulnerability - II Traumatic Materialism

Lecture 13 - The Aesthetics of Vulnerability - III Melodrama

Lecture 14 - Vulnerability Aesthetics The Sublime

Lecture 15 - The Aesthetics of Vulnerability - Discussion

Lecture 16 - Biopolitics, biopower and vulnerability - I

Lecture 17 - Biopolitics, biopower and vulnerability - II

Lecture 18 - Pandemics and Biopolitics

Lecture 19 - Biopolitics and vulnerable populations in Contemporary Literature

Lecture 20 - Discussion on Biopolitics

Lecture 21 - Ecoprecarity

Lecture 22 - Ecodystopia - I

Lecture 23 - Ecodystopia - II

Lecture 24 - Discussion on Ecoprecarity and Ecodystopias - I

Lecture 25 - Discussion on Ecoprecarity and Ecodystopias - II

Lecture 26 - Aging and Vulnerability in Literature

Lecture 27 - Aging and Vulnerability - 2

Lecture 28 - Aging and Vulnerability - 3

Lecture 29 - Discussion on Vulnerability and Aging - 1

Lecture 30 - Discussion on Vulnerability and Aging - 2

Lecture 31 - Childhood and Vulnerability - 1

[Lecture 32 - Childhood and Vulnerability - 2](#)

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- Lecture 38 - Coastal structures and environmental management
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**NPTEL : Wave Hydrodynamics (Ocean Engineering)**

**Co-ordinators : Prof. V. Sundar**

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- Lecture 10 - Methods of writing equation of motion
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- Lecture 18 - Two degrees - of - freedom systems
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- Lecture 23 - Natural frequencies and mode shapes
- Lecture 24 - Stodla, Rayleigh - Ritz and influence coefficient methods, Dunkerley
- Lecture 25 - Continuous system
- Lecture 26 - Structural action of offshore structures
- Lecture 27 - Fluid - Structure interaction - I
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- Lecture 29 - Steps of analysis using software
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Lecture 29 - Plastic capacity of sections under combined loads - II

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- Lecture 33 - Fluid structure interaction - I
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- Lecture 43 - Reliability framework in Marine structures
- Lecture 44 - Ultimate Limit state and Reliability approach - I
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**NPTEL : Special Theory of Relativity (Physics)**

**Co-ordinators : Prof. Shiva Prasad**

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Lecture 2 - Michelson-Morley Experiment

Lecture 3 - Postulates of Special Theory of Relativity and Galilean Transformation

Lecture 4 - Look out for a New Transformation

Lecture 5 - Lorentz Transformation

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Lecture 8 - Velocity Transformation and Examples

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Lecture 10 - A Problem involving Light and Concept of Casuality

Lecture 11 - Problems involving Casuality and Need to Redefine Momentum

Lecture 12 - Minikowski Space and Four Vectors

Lecture 13 - Proper Time a Four Scalar

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- Lecture 5 - Qubit - Bloch sphere representation
- Lecture 6 - Multiple Qubit States and Quantum Gates
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- Lecture 10 - Super Dense Coding
- Lecture 11 - Density Matrix - I
- Lecture 12 - Density Matrix - II
- Lecture 13 - Bloch Sphere and Density Matrix
- Lecture 14 - Measurement Postulates - I
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- Lecture 16 - Simple Algorithms-Deutsch Algorithm
- Lecture 17 - Deutsch-Josza and Bernstein - Vazirani Algorithms
- Lecture 18 - Simon Problem
- Lecture 19 - Grover's Search Algorithm - I
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- Lecture 23 - Quantum Fourier Transform
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- Lecture 26 - Implementing QFT-3 qubits (and more)
- Lecture 27 - Shor's Factorization Algorithm
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- Lecture 35 - Group Algebras;  $SO(3)$ - $SU(2)$  Correspondence - I
- Lecture 36 - Group Algebras;  $SO(3)$ - $SU(2)$  Correspondence - II
- Lecture 37 -  $SO(3)$ ,  $SU(2)$  Representations - I
- Lecture 38 -  $SO(3)$ ,  $SU(2)$  Representations - II
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- Lecture 45 -  $SU(3)$  And Lie's Classification - I
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- Lecture 3 - Review of Particle in Box, Potential Well, Barrier, Harmonic Oscillator - I
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- Lecture 11 - Tutorial 2
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- Lecture 15 - Basis for Operators and States in LVS - I
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- Lecture 23 - Tutorial 4 - Part I
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- Lecture 29 - Tutorial 5 - Part I
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- Lecture 3 - Path Integral Formulation - I
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- Lecture 10 - Generating Functional, Forced Harmonic Oscillator - II
- Lecture 11 - Generating Function in Field Theory - I
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- Lecture 17 - Asymptotic Theory - I
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- Lecture 22 - Gauge Invariance - Geometric Picture
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- Lecture 26 - Yang Mills Theory - Physical Content
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- Lecture 28 - Yang Mills Theory Constraint Dynamics - II
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- Lecture 31 - Topological Vacuum of Yang Mills Theories - I



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Lecture 3 - Shape and function

Lecture 4 - Numbers and sizes

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Lecture 8 - Random walks to model Biology

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Lecture 17 - Introduction to the navier stokes equation

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Lecture 21 - Bacterial flagellar motion

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Lecture 26 - Internal states of macromolecules

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- Lecture 32 - The hierarchical chromatin packing model
- Lecture 33 - FISH and DNA looping
- Lecture 34 - Nucleosomes as barriers, Hi-C, and contact probabilities
- Lecture 35 - Deriving the full force extension curve
- Lecture 36 - Random walk models for proteins
- Lecture 37 - Hydrophobic polar protein model
- Lecture 38 - Diffusion in crowded environments
- Lecture 39 - Depletion interactions
- Lecture 40 - Examples and implications of depletion interactions
- Lecture 41 - Introduction to Biological dynamics
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- Lecture 44 - Structure and treadmilling of actins and microtubules
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- Lecture 48 - Introduction to molecular motors
- Lecture 49 - Force generation by molecular motors
- Lecture 50 - Models of motor motion
- Lecture 51 - molecular motors
- Lecture 52 - Free energies of motor for stepping
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- Lecture 54 - cooperative transport of cargo
- Lecture 55 - Cytoskeleton as a motor
- Lecture 56 - translocation ratchet
- Lecture 57 - Spatial pattern in biology
- Lecture 58 - Some common spatial patterns in biology
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- Lecture 61 - Condition for destabilization in pattern formation
- Lecture 62 - Schnakenberg kinetics

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Lecture 3 - Normal subgroup, Coset, Conjugate group

Lecture 4 - Factor group, Homomorphism, Isomorphism

Lecture 5 - Factor group, Homomorphism, Isomorphism

Lecture 6 - Conjugacy Classes

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Lecture 30 - Molecular vibration normal modes: Group Theory approach

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- Lecture 32 - Vibrational representation of character
- Lecture 33 - Infrared Spectra and Raman Spectra
- Lecture 34 - Introduction to continuous group
- Lecture 35 - Generators of translational and rotational transformation
- Lecture 36 - Generators of Lorentz transformation
- Lecture 37 - Introduction to  $O(3)$  and  $SO(3)$  group
- Lecture 38 -  $SO(n)$  and Lorentz group
- Lecture 39 - Generalised orthogonal group and Lie algebra
- Lecture 40 - Subalgebra of Lie algebra
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- Lecture 42 -  $U(n)$  and  $SU(n)$  group
- Lecture 43 - Symplectic group
- Lecture 44 -  $SU(2)$  and  $SU(3)$  groups
- Lecture 45 - Rank, weight and weight vector
- Lecture 46 - Weight vector, root vector, comparison between  $SU(2)$  and  $SU(3)$  algebra
- Lecture 47 - Root diagram, simple roots, adjoint representation
- Lecture 48 -  $SU(2)$  sub-algebra, Dynkin diagrams
- Lecture 49 - Fundamental weights, Young diagrams, dimension of irreducible representation
- Lecture 50 - Young diagrams and tensor products
- Lecture 51 - Tensor product, Wigner - Eckart theorem
- Lecture 52 - Tensor product of irreducible representation 1: Composite objects from fundamental particles
- Lecture 53 - Tensor product of irreducible representation 2: Decimet and octet diagrams in the Quark Model
- Lecture 54 - Clebsch - Gordan coefficients
- Lecture 55 - 1) Quadrupole moment tensor (Wigner-Eckart theorem) 2) Decimet Baryon wavefunction
- Lecture 56 - Higher dimensional multiplets in the quark model
- Lecture 57 - Symmetry breaking in continuous groups
- Lecture 58 - Dynamical symmetry in hydrogen atom:  $SO(4)$  algebra
- Lecture 59 - Hydrogen atom energy spectrum and degeneracy using Runge-Lenz vector

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Lecture 2 - Sources for thermal neutrons used in neutron scattering

Lecture 3

Lecture 4 - Calculating Neutron Scattering cross-section

Lecture 5

Lecture 6 - Scattering theory and introducing dynamics in the formalism

Lecture 7 - Scattering theory and introducing dynamics in the formalism

Lecture 8 - Scattering theory and introducing dynamics in the formalism

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Lecture 10 - Scattering law's correlation with double-Fourier transform of real space correlation function

Lecture 11 - Correlation function to resolution and accessible( $Q, \tilde{\omega}$ ). Introducing experimental facilities

Lecture 12 - Correlation function to resolution and accessible( $Q, \tilde{\omega}$ ). Introducing experimental facilities

Lecture 13 - Correlation function to resolution and accessible( $Q, \tilde{\omega}$ ). Introducing experimental facilities

Lecture 14 - Correlation function to resolution and accessible( $Q, \tilde{\omega}$ ). Introducing experimental facilities

Lecture 15 - Introducing resolution and components of neutron scattering facilities.

Lecture 16 - Introducing resolution and components of neutron scattering facilities.

Lecture 17 - Continue with neutron scattering set up and its components like collimators, filters, detectors etc

Lecture 18 - Continue with neutron scattering set up and its components like collimators, filters, detectors etc

Lecture 19 - Describe the operation of various kinds of neutron detectors

Lecture 20 - Describe the operation of various kinds of neutron detectors

Lecture 21 - Introducing neutron choppers, velocity selectors and polarizers, some important components of beam tailoring devices

Lecture 22 - Introducing neutron choppers, velocity selectors and polarizers, some important components of beam tailoring devices

Lecture 23 - Neutron polarizers and spin-flippers

Lecture 24 - Neutron polarizers and spin-flippers

Lecture 25 - Diffraction at various length scales at a reactor and at a spallation neutron source

Lecture 26 - Diffraction at various length scales at a reactor and at a spallation neutron source

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Lecture 28 - Application of neutron crystallography

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Lecture 31 - Magnetic interaction in solids and magnetic neutron diffraction

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[Lecture 51 - Neutron reflectometry data analysis and reflectometers at various sources](#)

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Lecture 2 - Accelerator as a microscope

Lecture 3 - Charging and Discharging of capacitors

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Lecture 6 - Cockcroft Walton Accelerator (1929)

Lecture 7 - Van-de-Graaff accelerator and Tandem and Pelletron accelerators

Lecture 8 - Van-de-Graaff accelerator and Tandem and Pelletron accelerators

Lecture 9 - Voltage measurement and stabilisation

Lecture 10 - Voltage measurement and stabilisation

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Lecture 13 - Beam focussing using electrostatic and magnetic lenses and beam optics

Lecture 14 - Beam focussing using electrostatic and magnetic lenses and beam optics

Lecture 15 - Beam focussing using electrostatic and magnetic lenses and beam optics

Lecture 16 - Ion Sources

Lecture 17 - Ion Sources

Lecture 18 - Introduction and Basic concepts of linear accelerators

Lecture 19 - Introduction and Basic concepts of linear accelerators

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Lecture 21 - RF Acceleration - 1

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Lecture 45 - Cyclic accelerators: Some basic principles  
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- Lecture 2 - p-n Junction/Diode (Continued...)
- Lecture 3 - p-n diode (Continued...)
- Lecture 4 - Diode Application
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- Lecture 11 - H and R Parameters and their use in small amplifiers
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- Lecture 22 - FETs ans MOSFET
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Lecture 8 - Electromagnetic Wave Propagation in Plasma (Continued...)

Lecture 9 - Electromagnetic Wave Propagation Inhomogeneous Plasma

Lecture 10 - Electrostatic Waves in Plasmas

Lecture 11 - Energy Flow with an Electrostatic Wave

Lecture 12 - Two Stream Instability

Lecture 13 - Relativistic electron Beam- Plasma Interaction

Lecture 14 - Cerenkov Free Electron Laser

Lecture 15 - Free Electron Laser

Lecture 16 - Free Electron Laser: Energy gain

Lecture 17 - Free Electron Laser: Wiggler Tapering and Compton Regime Operation

Lecture 18 - Weibel Instability

Lecture 19 - Rayleigh Taylor Instability

Lecture 20 - Single Particle Motion in Static Magnetic and Electric Fields

Lecture 21 - Plasma Physics Grad B and Curvature Drifts

Lecture 22 - Adiabatic Invariance of Magnetic Moment and Mirror confinement

Lecture 23 - Mirror machine

Lecture 24 - Thermonuclear fusion

Lecture 25 - Tokamak

Lecture 26 - Tokamak operation

Lecture 27 - Auxiliary heating and current drive in tokamak

Lecture 28 - Electromagnetic waves propagation in magnetised plasma

Lecture 29 - Longitudinal electromagnetic wave propagation cutoffs, resonances and Faraday rotation

Lecture 30 - Electromagnetic propagation at oblique angles to magnetic field in a plasma

Lecture 31 - Low frequency EM waves magnetized plasma

[Lecture 32 - Electrostatic waves in magnetized plasma](#)

[Lecture 33 - Ion acoustic, ion cyclotron and magneto sonic waves in magnetized plasma](#)

[Lecture 34 - Vlasov theory of plasma waves](#)

[Lecture 35 - Landau damping and growth of waves](#)

[Lecture 36 - Landau damping and growth of waves \(Continued...\)](#)

[Lecture 37 - Anomalous resistivity in a plasma](#)

[Lecture 38 - Diffusion in plasma](#)

[Lecture 39 - Diffusion in magnetized plasma](#)

[Lecture 40 - Surface plasma wave](#)

[Lecture 41 - Laser interaction with plasmas embedded with clusters](#)

[Lecture 42 - Current trends and epilogue](#)

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- Lecture 2 - Anisotropic Media
- Lecture 3 - Anisotropic Media (Continued...)
- Lecture 4 - Anisotropic Media (Continued...)
- Lecture 5 - Nonlinear optical effects and nonlinear polarization
- Lecture 6 - Non - Linear Optics (Continued...)
- Lecture 7 - Non - Linear Optics (Continued...)
- Lecture 8 - Non - Linear Optics (Continued...)
- Lecture 9 - Non - Linear Optics (Continued...)
- Lecture 10 - Non - Linear Optics - Quasi Phase Matching
- Lecture 11 - Non - Linear Optics
- Lecture 12 - Non Linear Optics (Continued...)
- Lecture 13 - Non Linear Optics (Continued...)
- Lecture 14 - Non Linear Optics (Continued...)
- Lecture 15 - Non Linear Optics (Continued...)
- Lecture 16 - Non Linear Optics (Continued...)
- Lecture 17 - Non Linear Optics (Continued...)
- Lecture 18 - Non Linear Optics (Continued...)
- Lecture 19 - Non Linear Optics (Continued...)
- Lecture 20 - Third Order Non - Linear Effects
- Lecture 21 - Third Order Non - Linear Effects (Continued...)
- Lecture 22 - Third Order Non - Linear Effects (Continued...)
- Lecture 23 - Third Order Non - Linear Effects (Continued...)
- Lecture 24 - Review of Quantum Mechanics
- Lecture 25 - Review of Quantum Mechanics (Continued...)
- Lecture 26 - Review of Quantum Mechanics (Continued...)
- Lecture 27 - Quantization of EM Field
- Lecture 28 - Quantization of EM Field (Continued...)
- Lecture 29 - Quantization of EM Field (Continued...)
- Lecture 30 - Quantum States of EM Field
- Lecture 31 - Quantum States of EM Field (Continued...)



[Lecture 32 - Quantization of EM Field \(Continued...\)](#)

[Lecture 33 - Quantization of EM Field \(Continued...\)](#)

[Lecture 34 - Quantization of EM Field \(Continued...\)](#)

[Lecture 35 - Quantization of EM Field \(Continued...\)](#)

[Lecture 36 - Quantization of EM Field \(Continued...\)](#)

[Lecture 37 - Beam Splitter](#)

[Lecture 38 - Beam Splitter \(Continued...\)](#)

[Lecture 39 - Beam Splitter and Balanced Homodyning](#)

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[Lecture 41 - Quantum Picture of Parametric Down Conversion](#)

[Lecture 42 - Questions](#)

**NPTEL : Quantum Mechanics and Applications (Physics)**

**Co-ordinators : Prof. Ajoy Ghatak**

Lecture 1 - Basic Quantum Mechanics I: Wave Particle Duality

Lecture 2 - Basic Quantum Mechanics II: The Schrodinger Equation and The Dirac Delta Function

Lecture 3 - Dirac Delta Function & Fourier Transforms

Lecture 4 - The Free Particle

Lecture 5 - Physical Interpretation of The Wave Function

Lecture 6 - Expectation Values & The Uncertainty Principle

Lecture 7 - The Free Particle (Continued...)

Lecture 8 - Interference Experiment & The Particle in a Box Problem

Lecture 9 - On Eigen Values and Eigen Functions of the 1 Dimensional Schrodinger Equation

Lecture 10 - Linear Harmonic Oscillator

Lecture 11 - Linear Harmonic Oscillator (Continued...1)

Lecture 12 - Linear Harmonic Oscillator (Continued...2)

Lecture 13 - Linear Harmonic Oscillator (Continued...3)

Lecture 14 - Tunneling through a Barrier

Lecture 15 - The 1-Dimensional Potential Wall & Particle in a Box

Lecture 16 - Particle in a Box and Density of States

Lecture 17 - The Angular Momentum Problem

Lecture 18 - The Angular Momentum Problem (Continued...)

Lecture 19 - The Hydrogen Atom Problem

Lecture 20 - The Two Body Problem

Lecture 21 - The Two Body Problem: The Hydrogen atom, The Deuteron and The Diatomic Molecule

Lecture 22 - Two Body Problem: The Diatomic molecule (Continued...) and the 3 Dimensional Oscillator

Lecture 23 - 3d Oscillator & Dirac's Bra and Ket Algebra

Lecture 24 - Dirac's Bra and Ket Algebra

Lecture 25 - Dirac's Bra and Ket Algebra : The Linear Harmonic Oscillator

Lecture 26 - The Linear Harmonic Oscillator using Bra and Ket Algebra (Continued...)

Lecture 27 - The Linear Harmonic Oscillator: Coherent State and Relationship with the Classical Oscillator

Lecture 28 - Coherent State and Relationship with the Classical Oscillator

Lecture 29 - Angular Momentum Problem using Operator Algebra

Lecture 30 - Angular Momentum Problem (Continued...)

Lecture 31 - Pauli Spin Matrices and The Stern Gerlach Experiment

[Lecture 32 - The Larmor Precession and NMR Spherical Harmonics using Operator Algebra](#)

[Lecture 33 - Addition of Angular Momentum: Clebsch Gordon Coefficient](#)

[Lecture 34 - Clebsch Gordon Coefficients](#)

[Lecture 35 - The JWKB Approximation](#)

[Lecture 36 - The JWKB Approximation: Use of Connection Formulae to solve Eigen value Problems.](#)

[Lecture 37 - The JWKB Approximation: Use of Connection Formulae to calculate Tunneling Probability.](#)

[Lecture 38 - The JWKB Approximation: Tunneling Probability Calculations and Applications.](#)

[Lecture 39 - The JWKB Approximation: Justification of the Connection Formulae](#)

[Lecture 40 - Time Independent Perturbation Theory](#)

[Lecture 41 - Time Independent Perturbation Theory \(Continued...1\)](#)

[Lecture 42 - Time Independent Perturbation Theory \(Continued...2\)](#)

**NPTEL : Semiconductor Optoelectronics (Physics)**

**Co-ordinators : Prof. M.R. Shenoy**

Lecture 1 - Context and Scope of the Course

Lecture 2 - Energy Bands in Solids

Lecture 3 - E-K Diagram

Lecture 4 - The Density of States

Lecture 5 - The Density of States (Continued...)

Lecture 6 - The Density of states in a Quantum well Structure

Lecture 7 - Occupation Probability and Carrier Concentration

Lecture 8 - Carrier Concentration and Fermi Level

Lecture 9 - Quasi Fermi Levels

Lecture 10 - Semiconductor Materials

Lecture 11 - Semiconductor Hetrostructures-Lattice-Matched Layers

Lecture 12 - Strained -Layer Epitaxy and Quantum Well Structures

Lecture 13 - Bandgap Engineering

Lecture 14 - Hetrostructure p-n junctions

Lecture 15 - Schottky Junction and Ohmic Contacts

Lecture 16 - Fabrication of Heterostructure Devices

Lecture 17 - Interaction od Photons with Electrons and Holes in a Semiconductor

Lecture 18 - Optical Joint Density of States

Lecture 19 - Rates of Emission and Absorption

Lecture 20 - Amplication by Stimulated Emission

Lecture 21 - The Semiconductor (Laser) Amplifier

Lecture 22 - Absorption Spectrum of Semiconductor

Lecture 23 - Gain and Absorption Spectrum of Quantum Well Structures

Lecture 24 - Electro-absorption Modulator

Lecture 25 - Electro-absorption Modulator - II Device Configuration

Lecture 26 - Mid-Term Revision Question and Discussion

Lecture 27 - Part - III Semiconductor Light Sources

Lecture 28 - Light Emitting Diode-I Device Structure and Parameters

Lecture 29 - Light Emitting Diode-II Device Chraacteristics

Lecture 30 - Light Emitting Diode-III Output Characteristics

Lecture 31 - Light Emitting Diode-IV Modulation Bandwidth

[Lecture 32 - Light Emitting Diode-V materials and Applications](#)

[Lecture 33 - Laser Basics](#)

[Lecture 34 - Semiconductor Laser-I Device Structure](#)

[Lecture 35 - Semiconductor Laser-II Output Characteristics](#)

[Lecture 36 - Semiconductor Laser-III Single Frequency Lasers](#)

[Lecture 37 - Vertical Cavity Surface Emitting Laser \(VCSEL\)](#)

[Lecture 38 - Quantum Well Laser](#)

[Lecture 39 - Practical Laser Diodes and Handling](#)

[Lecture 40 - General Characteristics of Photodetectors](#)

[Lecture 41 - Responsivity and Impulse Response](#)

[Lecture 42 - Photoconductors](#)

[Lecture 43 - Semiconductor Photo-Diodes](#)

[Lecture 44 - Semiconductor Photo-Diodes-II : APD](#)

[Lecture 45 - Other Photodectors](#)

[Lecture 46 - Photonic Integrated Circuits](#)

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- Lecture 5 - The Density of States  $\tilde{I}(k)$ ,  $\tilde{I}(E)$
- Lecture 6 - Density of States in a Quantum Well Structure
- Lecture 7 - Occupation Probability and Carrier Concentration
- Lecture 8 - Carrier Concentration and Fermi Level
- Lecture 9 - Quasi Fermi Levels
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- Lecture 28 - Light emitting diode-II Device Characteristics
- Lecture 29 - Light emitting diode-III Output Characteristics
- Lecture 30 - Light emitting diode-IV Modulation Bandwidth
- Lecture 31 - Light emitting diode-V Material and Applications

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Lecture 1 - General Introduction, Scope and Contents

Lecture 2 - Interaction of Radiation with Matter

Lecture 3 - The Einstein Coefficients

Lecture 4 - Atomic Lineshape Function,  $g(\hat{\nu})$

Lecture 5 - Amplification by Stimulated Emission

Lecture 6 - Line Broadening Mechanisms - 1

Lecture 7 - Line Broadening Mechanisms - 2

Lecture 8 - Laser Rate Equations: 2-Level System

Lecture 9 - Laser Rate Equations: 3-Level System

Lecture 10 - Laser Rate Equations: 4-Level System

Lecture 11 - Laser Amplifiers

Lecture 12 - Er-Doped Fiber Amplifier

Lecture 13 - Resonance Frequencies

Lecture 14 - Spectral Response of an Optical Resonator

Lecture 15 - Resonator Loss and Cavity Lifetime

Lecture 16 - Spherical Mirror Resonators

Lecture 17 - Resonator Stability Condition

Lecture 18 - Ray Paths in Spherical Mirror Resonators

Lecture 19 - Transverse Modes of a Spherical Mirror Resonator

Lecture 20 - Gaussian Mode of the Spherical Mirror Resonator

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Lecture 22 - Laser Oscillations and The Threshold Condition

Lecture 23 - Spectral Hole Burning

Lecture 24 - Variation of Laser Power around Threshold

Lecture 25 - Optimum Output Coupling

Lecture 26 - Laser Output Characteristics

Lecture 27 - Laser Beam Properties

Lecture 28 - Ultimate Linewidth of a Laser

Lecture 29 - Pulsed Lasers

Lecture 30 - Q-Switching

Lecture 31 - Mode Locking



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[Lecture 36 - Lasers and Laser Amplifiers in Optical Fiber Communication](#)

[Lecture 37 - Lasers in Nonlinear Optics](#)

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Lecture 1 - Introduction

Lecture 2 - Nuclear Properties

Lecture 3 - Properties of Nuclear Force

Lecture 4 - Deuteron

Lecture 5 - Nucleons Scattering

Lecture 6 - Nuclear Models - I

Lecture 7 - Nuclear Models - II

Lecture 8 - Radioactive Decay - General Properties

Lecture 9 - Nuclear Alpha Decay

Lecture 10 - Nuclear Beta decay

Lecture 11 - Beta-decay details

Lecture 12 - Gamma decay

Lecture 13 - Nuclear Scattering - Preliminaries

Lecture 14 - Types of Reactions

Lecture 15 - Particle Accelerators - I

Lecture 16 - Particle Accelerators - II

Lecture 17 - Detectors

Lecture 18 - Elementary Particles - Introduction and Overview

Lecture 19 - Quark Model - I

Lecture 20 - Quark Model - II

Lecture 21 - Quark Model - III

Lecture 22 - Structure of the Hadron - Nucleus

Lecture 23 - Structure of the Hadron - Proton

Lecture 24 - Deep Inelastic Scattering

Lecture 25 - Relativistic Kinematics

Lecture 26 - Klein-Gordon Equation

Lecture 27 - Interaction of charged scalar with EM field

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Lecture 30 - Interaction between charged scalars

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[Lecture 36 - Scattering Cross Section Revisited - 1](#)

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Lecture 1 - Propagators - I

Lecture 2 - Propagators - II

Lecture 3 - Second quantization - I

Lecture 4 - Second quantization - II

Lecture 5 - Second quantized Hamiltonian

Lecture 6 - Tight Binding Hamiltonian, Hubbard model

Lecture 7 - Magnetism

Lecture 8 - Singlet and Triplet State: Magnetic Hamiltonian

Lecture 9 - Antiferromagnetism in Hubbard model

Lecture 10 - Green's function and representations in quantum mechanics

Lecture 11 - S matrix and free electron Green's function

Lecture 12 - Wick's theorem and normal ordering

Lecture 13 - Green's function and Feynman diagrams

Lecture 14 - Feynman diagram

Lecture 15 - phonon Green' function and Hartree Fock approximation

Lecture 16 - Finite temperature Green's function and Matsubara frequencies

Lecture 17 - Dyson's equation and disorder in electronic systems

Lecture 18 - Introduction to electrodynamics, Meissner effect

Lecture 19 - London penetration depth, Type I and II superconductors

Lecture 20 - Cooper's problem, BCS gap equation

Lecture 21 - BCS theory, Transition temperature

Lecture 22 - Ginzburg Landau Theory, Coherence length and penetration depth

Lecture 23 - Quantum Hall Effect

Lecture 24 - Spin Hall effect, 2D topological insulator

Lecture 25 - Bose-Einstein condensation

Lecture 1 - Introduction, Postulates of Quantum Mechanics

Lecture 2 - Stern Gerlach Experiment, Spin Quantization, Young's Double Slit Experiment

Lecture 3 - The Mathematical Formalism of Quantum Mechanics, Uncertainty Principle

Lecture 4 - The Density Matrix Formalism, Expectation values of Operators

Lecture 5 - Quantum Harmonic Oscillator, Creation and annihilation Operators

Lecture 6 - Coherent States and their Properties

Lecture 7 - Applications of Coherent States, squeezed states

Lecture 8 - Symmetries and Conservation Principles in Quantum Mechanics

Lecture 9 - Rotation Operator and Invariance of Angular Momentum, Parity

Lecture 10 - Spherically Symmetric System and Applications to quantum dots

Lecture 11 - Spin Angular Momentum, Addition of Angular Momentum, Clebsch gordan coefficients

Lecture 12 - Magnetic Hamiltonian, Heisenberg Model

Lecture 13 - Nuclear Magnetic Resonance (NMR)

Lecture 14 - Applications of NMR, time evolution of Magnetic Moments

Lecture 15 - Introduction to Quantum Computing

Lecture 16 - Qubits,EPR Paradox

Lecture 17 - Quantum Entanglement (QE)

Lecture 18 - Teleportation, Quantum Teleportation for one spin

Lecture 19 - Entangled state for two spins

Lecture 20 - Quantum Gates, Walsh Hadamard Transformation, No cloning theorem

Lecture 21 - Perturbation Theory

Lecture 22 - Stark Effect: First order in ground state

Lecture 23 - Stark Effect: Second order in ground state

Lecture 24 - Variational method, Variation of constants, Upper bound on ground state energy

Lecture 25 - Application of Variational method,Hydrogen,Helium atom,Comparison with perturbation theory

Lecture 26 - WKB Approximation, Bohr Sommerfeld quantization condition

Lecture 27 - Summary of Approximation methods, Time dependent Perturbation Theory

Lecture 28 - Time dependent Perturbation Theory, Fermi's Golden rule, Einstein's A and B coefficients

Lecture 29 - Scattering Theory

Lecture 30 - Linear Response Theory: Derivation of Kubo formula

Lecture 31 - Quantum Dynamics: Two level system

[Lecture 32 - Examples](#)

[Lecture 33 - Interaction of Radiation with matter, Landau levels](#)

Lecture 1 - Historical introduction of superconductivity

Lecture 2 - Meissner effect, Electrodynamics of Superconductors, coherence length and penetration depth

Lecture 3 - Electron Pairing, Basics of BCS Theory

Lecture 4 - BCS ground state, variational calculation, expression for  $T_c$

Lecture 5 - Order parameter, Free energy functional, Ginzburg-Landau (GL) Theory, GL equations

Lecture 6 - London Equations, Flux quantization

Lecture 7 - Thermodynamic properties of superconductors, specific heat

Lecture 8 - Experimental determination of Superconducting properties

Lecture 9 - Unconventional Superconductivity, Uemura plot, High- $T_c$  superconductivity, d-wave pairing, ARPES

Lecture 10 - Singlet and triplet states of two  $s=1/2$ , magnetic Hamiltonian

Lecture 11 - t-J model, discrete symmetry groups, example square lattice

Lecture 12 - Cuprate Superconductors, electron vs hole doped superconductors

Lecture 13 - Non-Fermi Liquid Theory, Adiabatic continuity

Lecture 14 - Quasiparticle lifetime, breakdown of Fermi Liquid Theory in cuprate superconductors

Lecture 15 - Josephson junctions, Josephson equations

Lecture 16 - Numerical Differentiation

Lecture 17 - Richardson's extrapolation

- Lecture 1 - Prerequisites and Introduction
- Lecture 2 - Combinatorics and Entropy
- Lecture 3 - Method of steepest descent
- Lecture 4 - Bose and Fermi gases
- Lecture 5 - Maxwell Boltzmann distribution
- Lecture 6 - Thermodynamic potentials
- Lecture 7 - Legendre transformation
- Lecture 8 - Specific heats of quantum gases
- Lecture 9 - Low and high temperature equations of state
- Lecture 10 - Chandrasekhar Limit
- Lecture 11 - Radiation thermodynamics
- Lecture 12 - Thermodynamics of black holes
- Lecture 13 - Van der Waals fluid
- Lecture 14 - Landau Diamagnetism
- Lecture 15 - Relations between ensembles and Pauli paramagnetism
- Lecture 16 - Ferromagnetism
- Lecture 17 - Correlations and Mean Field
- Lecture 18 - Theories of Specific Heat of Solids
- Lecture 19 - Tutorial - I
- Lecture 20 - Tutorial - II
- Lecture 21 - Tutorial - III
- Lecture 22 - Tutorial - IV
- Lecture 23 - Tutorial - V
- Lecture 24 - RG method Ising model
- Lecture 25 - Introduction to Second Quantisation: Harmonic Oscillator
- Lecture 26 - Quantum Theory of EM Field - I
- Lecture 27 - Quantum Theory of EM Field - II
- Lecture 28 - Creation and Annihilation in Fock Space - I
- Lecture 29 - Creation and Annihilation in Fock Space - II
- Lecture 30 - Green functions in many particle systems
- Lecture 31 - Second quantised hamiltonians



Lecture 32 - Current algebra

- Lecture 1 - Error analysis and estimates, significant digits, convergence
- Lecture 2 - Roots of Non-linear equations, Bisection method
- Lecture 3 - Newton Raphson method, Secant method
- Lecture 4 - Newton Raphson Method
- Lecture 5 - Newton Raphson Method (example), Curve fitting and interpolation of data
- Lecture 6 - Newton's interpolation formula, statistical interpolation of data
- Lecture 7 - Linear and Polynomial regression
- Lecture 8 - Numerical differentiation
- Lecture 9 - Numerical differentiation, Error analysis
- Lecture 10 - Numerical integration, Trapezoidal rule
- Lecture 11 - Simpson's 1/3rd rule
- Lecture 12 - Simpson's 1/3rd rule, Gaussian integration
- Lecture 13 - Ordinary Differential equations
- Lecture 14 - Solution of differential equation, Taylor series and Euler method
- Lecture 15 - Heun's method
- Lecture 16 - Runge Kutta method
- Lecture 17 - Examples of differential equation: Heat conduction equation
- Lecture 18 - Introduction to Monte Carlo technique
- Lecture 19 - Details of the Monte Carlo method
- Lecture 20 - Importance sampling
- Lecture 21 - Applications: Ising model
- Lecture 22 - Introduction to Molecular Dynamics
- Lecture 23 - Verlet algorithm
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- Lecture 1 - Introduction, Constraints
- Lecture 2 - Generalized Coordinates, Configuration Space
- Lecture 3 - Principle of Virtual Work
- Lecture 4 - D'Alembert's Principle
- Lecture 5 - Lagrange's Equations
- Lecture 6 - Hamilton's Principle
- Lecture 7 - Variational Calculus, Lagrange's Equations
- Lecture 8 - Conservation Laws and Symmetries
- Lecture 9 - Velocity Dependent Potentials, Non-holonomic Constraints
- Lecture 10 - An Example: Hoop on a ramp
- Lecture 11 - Phase Space
- Lecture 12 - Legendre Transforms
- Lecture 13 - Hamilton's Equations
- Lecture 14 - Conservation Laws, Routh's procedure
- Lecture 15 - An Example: Bead on Spinning Ring
- Lecture 16 - Canonical Transformations
- Lecture 17 - Symplectic Condition
- Lecture 18 - Canonical Invariants, Harmonic Oscillator
- Lecture 19 - Poisson Bracket Formulation
- Lecture 20 - Infinitesimal Canonical Transformations
- Lecture 21 - Symmetry Groups of Mechanical Systems
- Lecture 22 - Hamilton Jacobi Theory
- Lecture 23 - Action-Angle Variables
- Lecture 24 - Separation of Variables and Examples
- Lecture 25 - Continuous Systems and Fields
- Lecture 26 - The Stress-Energy Tensor
- Lecture 27 - Hamiltonian Formulation

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Lecture 2 - Overview of solar energy conversion devices and applications

Lecture 3 - Physics of propagation of solar radiation from the sun to the earth

Lecture 4 - Solar radiation and sunshine measuring instruments

Lecture 5 - Geometry, angles and measurement - I

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Lecture 7 - Estimation of radiation under different climatic conditions

Lecture 8 - Estimation of radiation in horizontal and inclined surface

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Lecture 10 - Semiconductor physics

Lecture 11 - Performance characterization of PV cells

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Lecture 13 - Components of standalone PV system

Lecture 14 - Design of standalone PV system

Lecture 15 - Functioning and components of PV system

Lecture 16 - Design of a grid connected PV system

Lecture 17 - Performance analysis of a grid connected PV system

Lecture 18 - Basics of thermal collectors

Lecture 19 - Basics of heat transfer

Lecture 20 - Solar collector losses and loss estimation

Lecture 21 - Analysis of flat plate collector

Lecture 22 - Influence of various parameters on the performance of LFPC

Lecture 23 - Testing and application of LFPC

Lecture 24 - Basics and performance analysis of solar air heaters

Lecture 25 - Testing and application of solar air heaters

Lecture 26 - Fundamentals of concentrating collectors

Lecture 27 - Concentrating collector technologies and working principle

Lecture 28 - Tutorial: Concentrating Collector

Lecture 29 - Sensible heat, latent heat and thermochemical energy storage

Lecture 30 - Solar pond

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- Lecture 3 - Two-level System - I
- Lecture 4 - Bloch Sphere: Supplementary Lectuer - I
- Lecture 5 - Two-level Systems - II
- Lecture 6 - Two-level Systems - III
- Lecture 7 - Dressed States;Introduction to Density Matrix
- Lecture 8 - Problem Solving Session - 2
- Lecture 9 - Density-matrix formalism
- Lecture 10 - Quantum Harmonic Oscillators
- Lecture 11 - Quantization of Electromagnetic Radiation
- Lecture 12 - Quantization of Standing EM Waves;Quantum States of Radiation Fields - I
- Lecture 13 - Problem Solving Session - 3
- Lecture 14 - Quantum States of Radiation Fields-II: Squeezed States
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- Lecture 16 - Introduction and Basics of Superconductivity
- Lecture 17 - Cooper Pair Box as TLS;Introduction to Transmission Line
- Lecture 18 - Quantization of Transmission Line - I
- Lecture 19 - Quantization of Transmission Line - II
- Lecture 20 - The Jaynes Cummings Model - I
- Lecture 21 - Problem Solving Session - 5
- Lecture 22 - The Jaynes Cummings Model - II
- Lecture 23 - Josephson Junctions - I
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- Lecture 25 - Problem Solving Session - 6
- Lecture 26 - Transmon;Introduction to Dissipation in Quantum Systems
- Lecture 27 - Quantum Master Equation
- Lecture 28 - Pure dephasing and Dissipative Bloch Equations
- Lecture 29 - Derivation of Fermi-Golden Rule
- Lecture 30 - Introduction to Cavity Optomechanics;Fabry-Perot Cavity
- Lecture 31 - Cavity Optomechanics: Basic Physics - I

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- Lecture 3 - Hamiltonian Mechanics
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- Lecture 5 - Examples of Continuum Systems
- Lecture 6 - Symmetries and Noether's Theorem
- Lecture 7 - Dynamical Symmetries
- Lecture 8 - Symmetries in Field Theories
- Lecture 9 - The Relativistic Electromagnetic Field
- Lecture 10 - Stress-Energy (Energy-Momentum) Tensor
- Lecture 11 - Green's Theorem and Green's Functions
- Lecture 12 - Diffraction Theory
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- Lecture 14 - Solution of the rubber band problem
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- Lecture 16 - Strain Energy
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Lecture 21 - Birefringence phase-matching (BPM), Type I and Type II phase matching

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Lecture 21 - Demonstration on the experiment of Young's modulus of mettalic bar and data collection

Lecture 22 - Calculate the value of young's modulus of given metallic bar form the recorded datas

Lecture 23 - Experimental demonstration to calculate the spring constant of a given spring

Lecture 24 - Calculate the value of calculate the spring constant of a given spring form the recorded datas

Lecture 25 - Theory regarding Moment of inertia of a flywheel

Lecture 26 - Experimental demonstration to calculate the moment of inertia of a given flywheel

Lecture 27 - How to calculate the value of moment of inertia of a flywheelform the recorded data

Lecture 28 - Theory regarding surface tension of the liquid

Lecture 29 - Demonstration on the experiment of surface tension and data collection

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Lecture 34 - Forced Oscillations Pohls pendulum

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Lecture 36 - Demonstration on the experiment of compound pendulum

Lecture 37 - Theory regarding compound pendulum has been discussed

Lecture 38 - Experimental demonstration on the standing Waves on a String has been shown clearly how to determine the linear mass density of the string.

Lecture 39 - Linear expansion of metal

Lecture 40 - Expt. to study linear expansion

Lecture 41 - Determine the coefficient of thermal conductivity of a bad conductor

Lecture 42 - Determination of electrical equivalent of heat

Lecture 43 - Determination of specific heat of the given solid metals using Dulong-Petit's law

Lecture 44 - Determination of the calibration curve of a given (Type K chromel- $\alpha$ alumel) thermocouple and hence determination of Seebeck coefficient

Lecture 45 - Theory and Demonstration Platinum Resistance thermometer

Lecture 46 - Experiment on Platinum Resistance thermometer

Lecture 47 - To study the current-voltage relationship of an L-R circuit

Lecture 48 - To study the variation in current and voltage in a series LCR circuit

Lecture 49 - Sensitivity of Blastic Galvanometer

Lecture 50 - Expt. for Sensitivity of Blastic Galvanometer

Lecture 51 - Theory on RC Circuit

Lecture 52 - Expt. on RC Circuit

Lecture 53 - Theory regarding the magnetic field along the axis of a circular coil

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Lecture 55 - Study the induced e.m.f of inductance coil

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Lecture 12 - Determination of focal length of concave mirror

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Lecture 14 - Determination of focal length of convex mirror

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Lecture 17 - Determination of focal length of convex lens by displacement method

Lecture 18 - Applications of mirrors and lenses

Lecture 19 - Determination of refractive index of liquid using travelling microscope

Lecture 20 - Basic discussion on spectrometer and prism

Lecture 21 - Basic discussion on spectrometer and prism (Continued...)

Lecture 22 - Basic discussion on spectrometer and prism (Continued...)

Lecture 23 - Schuster's method

Lecture 24 - Discussion on angle of the prism, angular dispersion and dispersive power of given prism

Lecture 25 - Determination of the angle of prism

Lecture 26 - Determination of the angle of minimum deviation for a given prism and hence to determine the refractive index of the given prism

Lecture 27 - Discussion on the angle of incidence and corresponding deviation of light through a prism and determination of the angle of minimum deviation for a given prism from the plot of the angle of incidence versus deviation.

Lecture 28 - Determination of the angle of minimum deviation from (i-D) plot for a given prism and hence to determine the refractive index of the given prism.

Lecture 29 - Determination of the calibration plot of deviation versus wavelength for a given prism and hence determination of the wavelength of the unknown light source using the calibration plot

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Lecture 32 - Interference Phenomena (Continued...)

Lecture 33 - Interference Phenomena (Continued...)

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Lecture 43 - Single slit diffraction

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Lecture 58 - Thomson experiment to determine the specific charge of an electron ( $e/m$ )

Lecture 59 - Frank-Hertz Experiment

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Lecture 18 - To study the variation of resistivity of metal and semiconductor at low temperature region (Continued...)

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Lecture 22 - Experiment of Quincke's Tube Method

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Lecture 2 - Weidemann Franz Law

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Lecture 4 - Schrodinger Equation: Boundary Conditions

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Lecture 6 - Properties of Degenerate Fermi Gas

Lecture 7 - Statistics Fermi-Dirac distribution and Maxwell-Boltzmann Distribution: comparison and Specific Heat

Lecture 8 - Sommerfeld Expansion and Band Formation: Temperature dependent densities, Chemical Potential, Specific Heat

Lecture 9 - Bonding and Band Formation: N=2 solid Molecular Orbitals, Linear combinations of Atomic Orbitals (LCAO)

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Lecture 13 - Bloch's Theorem

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- Lecture 37 - Exchange interaction for 2 electrons
- Lecture 38 - Exchange interactions of different types
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- Lecture 40 - Magnetic Order of different types and Heisenberg model
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- Lecture 44 - Symmetries of Ising model, Exact Solution
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- Lecture 59 - Vortices, SQUID, Quantum Supremacy and Qubits
- Lecture 60 - Topological state of matter, XY Model, Topological Insulators

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- Lecture 2 - EM wave in vacuum, Poynting vector, Maxwell's equation in Dielectric Medium
- Lecture 3 - Poynting Vector, Maxwell's equation in dielectric medium (Continued...)
- Lecture 4 - Total Internal reflection, Evanescent wave
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- Lecture 6 - Light guidance in SIF (Skew Ray), V-Parameter, Discrete Ray
- Lecture 7 - Cutoff wavelength, Fiber characteristics
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- [Lecture 44 - Reflectivity Calculation \(Continued...\)](#)
- [Lecture 45 - Reflectivity calculation of FBG \(Continued...\)](#)
- [Lecture 46 - Reflectivity calculation of FBG \(Continued...\)](#)
- [Lecture 47 - Reflectivity calculation of FBG \(Continued...\)](#)
- [Lecture 48 - Bandwidth of reflectivity](#)
- [Lecture 49 - Basic nonlinear optics](#)
- [Lecture 50 - Frequency mixing, Optical Kerr effect](#)
- [Lecture 51 - Optical Kerr effect \(Continued...\)](#)
- [Lecture 52 - Self Phase Modulation](#)
- [Lecture 53 - Self Phase Modulation \(Continued...\)](#)
- [Lecture 54 - Self Phase Modulation \(Continued...\)](#)
- [Lecture 55 - Pulse propagation in nonlinear waveguide](#)
- [Lecture 56 - Pulse propagation in nonlinear waveguide \(Continued...\)](#)
- [Lecture 57 - Pulse propagation in nonlinear dispersive waveguide](#)
- [Lecture 58 - Pulse propagation in nonlinear dispersive waveguide \(Continued...\)](#)
- [Lecture 59 - Concept of optical soliton](#)
- [Lecture 60 - Concept of optical soliton \(Continued...\)](#)

- Lecture 1 - Introduction and relevance of the course
- Lecture 2 - Energy sources
- Lecture 3 - Solar Radiation
- Lecture 4 - Solar Photovoltaic Systems
- Lecture 5 - Origin of Band Structure and Energy Band Gap
- Lecture 6 - Basics of Semiconductors
- Lecture 7 - Construction of Solar Cells
- Lecture 8 - Characterization of Solar Cells and Future Direction
- Lecture 9 - Solar Heaters
- Lecture 10 - Introduction to Wind Energy
- Lecture 11 - Continuity Equation and its applications
- Lecture 12 - Betz Criteria for extracting wind power
- Lecture 13 - Wind turbines and their operation
- Lecture 14 - Materials Aspects and future direction
- Lecture 15 - Introduction to Hydroelectric Power
- Lecture 16 - Hydroelectric Power Station and Turbines
- Lecture 17 - Wave power and converters
- Lecture 18 - Introduction to Tidal Power
- Lecture 19 - Tidal Power and Geothermal Energy
- Lecture 20 - Introduction to Energy Storage Systems
- Lecture 21 - Thermal Energy Storage
- Lecture 22 - Basics of Mechanical Energy Storage
- Lecture 23 - Pumped Hydroelectric to Flywheels (Mechanical Energy Storage Systems)
- Lecture 24 - Introduction to Li-ion battery
- Lecture 25 - Characteristics and Parameters of Li-ion batteries
- Lecture 26 - Cathode Materials for Li-ion batteries
- Lecture 27 - Anode Materials for Li-ion batteries
- Lecture 28 - Electrolytes and Separators for Li-batteries
- Lecture 29 - From battery to supercapacitors
- Lecture 30 - Construction, development and classification of Supercapacitors
- Lecture 31 - Electric double layer capacitors (EDLCs)

[Lecture 32 - Pseudocapacitors](#)

[Lecture 33 - Electrochemical Techniques for Supercapacitors and Batteries](#)

[Lecture 34 - From material to a supercapacitor device](#)

[Lecture 35 - Effect of temperature on supercapacitor performance](#)

[Lecture 36 - Effect of external magnetic field and frequency on supercapacitors](#)

[Lecture 37 - Introduction to Fuel Cells](#)

[Lecture 38 - Explanation of Fuel cell systems](#)

[Lecture 39 - Microbial Fuel Cells](#)

[Lecture 40 - Nanotechnology and Nanomaterials for Energy Applications](#)

[Lecture 41 - Synthesis of nanomaterials](#)

[Lecture 42 - Carbon- and metal-oxide based nanomaterials](#)

[Lecture 43 - Nanocatalysts](#)

[Lecture 44 - Characterization techniques for solid materials](#)

[Lecture 45 - X-ray diffraction method](#)

[Lecture 46 - UV-Visible Spectroscopy](#)

[Lecture 47 - Fourier Transform Infrared Spectroscopy](#)

[Lecture 48 - SEM, TEM and XPS](#)

[Lecture 49 - Particle size and zeta potential analysis](#)

[Lecture 50 - BET analysis](#)

[Lecture 51 - Electrochemical Impedance Spectroscopy](#)

- Lecture 1 - Foundation of kinetic theory of gasses
- Lecture 2 - Maxwell's law for speed distribution of gas molecules
- Lecture 3 - Average speeds in an ideal gas assembly
- Lecture 4 - Principle of equipartition of energy
- Lecture 5 - Maxwell's law for energy distribution of gas molecules
- Lecture 6 - The mean free path of a gas assembly
- Lecture 7 - Expression for mean free path
- Lecture 8 - Experimental determination of mean free path
- Lecture 9 - Pressure an molecular flux from mean free path
- Lecture 10 - Problems on mean free path
- Lecture 11 - Transport in fluids: introduction
- Lecture 12 - Viscosity: transport of momentum
- Lecture 13 - Thermal conductivity: tranSPORT of thermal energy
- Lecture 14 - Diffusion coefficient: transport of mass
- Lecture 15 - Molecular effusion: theory and applications
- Lecture 16 - Brownian motion: concept, features, theory of fluctuation
- Lecture 17 - Brownian motion: mean square displacement and vertical distribution of particles
- Lecture 18 - Perrin's experiment on Brownian motion - Part 1
- Lecture 19 - Perrin's experiment on Brownian motion - Part 2
- Lecture 20 - Problems on Brownian motion, Rotational brownian motion
- Lecture 21 - Specific heat of solids: Dulong-Petit law and Einstein theory
- Lecture 22 - Limitaion of Einstein theory of specific heat
- Lecture 23 - Debye theory of specific heat
- Lecture 24 - Behavior of real gasses
- Lecture 25 - Van der Waals equation of state
- Lecture 26 - Critical parameters from Van der Waal's equation
- Lecture 27 - Determination of Van der Waals' constants and Boyle temperature
- Lecture 28 - Other equations of state
- Lecture 29 - Measurement of temperature: Celcius scale, ideal gas scale, absolute zero
- Lecture 30 - The platinum resistance thermometer
- Lecture 31 - Basic concepts of classical thermodynamics

Lecture 32 - Basic concepts of classical thermodynamics (Continued...)

Lecture 33 - First law of thermodynamics

Lecture 34 - General description of work done and specific heat

Lecture 35 - General discussion on Heat conduction and elastic properties

Lecture 36 - Cyclic processes

Lecture 37 - The reversible heat engine: Carnot cycle

Lecture 38 - Refrigerator and Carnot Theorem

Lecture 39 - 2nd law and Clausius theorem

Lecture 40 - Concept of Entropy and mathematical form of 2nd law

Lecture 41 - The entropy principle

Lecture 42 - Efficiency of a cycle from T-S diagram

Lecture 43 - The Otto cycle

Lecture 44 - The Diesel cycle

Lecture 45 - Entropy and available energy

Lecture 46 - Thermodynamic relations

Lecture 47 - Application of thermodynamic relation

Lecture 48 - The free energy functions

Lecture 49 - Condition for thermodynamic equilibri

Lecture 50 - Thermodynamics of chemical reaction

Lecture 51 - Equilibrium between phases: The Clapeyron equation

Lecture 52 - 1st order phase transition along liquid-vapor equilibrium

Lecture 53 - Phase diagram and triple point

Lecture 54 - The 2nd latent heat equation

Lecture 55 - Gibbs phase rule and basics of second order phase transition

Lecture 56 - Basic concepts of radiation

Lecture 57 - Diffused radiation and Kirchhoff's law

Lecture 58 - Cavity radiation as a thermodynamic system: Stefan-Boltzmann law

Lecture 59 - Thermodynamics of cavity radiation

Lecture 60 - 3rd law of thermodynamics



- Lecture 1 - Introduction: Magnetism and superconductivity as macroscopic quantum phenomena
- Lecture 2 - Bohr magneton, BvL theorem
- Lecture 3 - An electron in a magnetic field, magnetism of isolated atoms
- Lecture 4 - Magnetism of isolated atoms (Continued...), Diamagnetism
- Lecture 5 - Magnetism of atoms-dia and paramagnetic susceptibilities. Hund's rules, Van Vleck paramagnetism
- Lecture 6 - Van Vleck paramagnetism (Continued...), Paramagnetism
- Lecture 7 - Curie's law for arbitrary J, adiabatic demagnetization
- Lecture 8 - Paramagnetism of conduction electrons - Pauli paramagnetism
- Lecture 9 - Ions in a solid: crystal field, orbital quenching, Jahn-Teller effect
- Lecture 10 - Jahn-Teller effect (Continued...), Magnetic resonance techniques NMR, ESR
- Lecture 11 - Resonance techniques (Continued...), Recapitulation and overview
- Lecture 12 - Recapitulation, interacting moments and long range order, dipolar exchange
- Lecture 13 - Interacting moments, 2-electron system, origin of exchange and spin Hamiltonian
- Lecture 14 - Spin Hamiltonian, Heisenberg model, Exchange interactions: direct
- Lecture 15 - GMR, spin model and mean-field theory, Ising model
- Lecture 16 - Ising model and its properties
- Lecture 17 - Ising model and its properties (Continued...), absence of LRO in  $d=1$ , mean-field theory
- Lecture 18 - Ising model recap, applications, exact solutions
- Lecture 19 - Exact solution of Ising model in  $d=1$ , exact results in  $d=2$ . Mermin-Wagner theorem
- Lecture 20 - Recap - Exact solution of Ising model. Mermin-Wagner theorem on the absence
- Lecture 21 - Ferromagnetic Heisenberg model ground state
- Lecture 22 - Ferromagnetic Heisenberg model, spin-waves and magnons
- Lecture 23 - Antiferromagnetic Heisenberg model, AF magnetic structures
- Lecture 24 - AF magnetic structures, susceptibility and excitations
- Lecture 25 - Antiferromagnets and frustration, spin glass
- Lecture 26 - Superconductivity: discovery, properties
- Lecture 27 - Superconductivity: Meissner effect, London Equation
- Lecture 28 - Electron-phonon interaction, Cooper problem
- Lecture 29 - Cooper problem, setting up the BCS theory
- Lecture 30 - BCS wave function, the Superconducting state and calculations of various properties
- Lecture 31 - BCS theory (Continued...), energy gap, transition temperature

Lecture 32 - Consequences of BCS theory, gap vs T, Transition temperature, specific heat, tunnelling

Lecture 33 - Transition temperature, specific heat, tunnelling

Lecture 34 - Andreev reflection, Ginzburg-Landau Theory and electrodynamics of superconductors

Lecture 35 - Ginzburg-Landau theory, coherence length and Type I and II superconductors

Lecture 36 - Flux lattice, Flux quantization, Josephson junctions

Lecture 37 - Josephson effect and Josephson junctions

Lecture 38 - SQUID, Quantum computers and Josephson junction Qubits

Lecture 39 - High-Temperature Superconductivity: an enduring enigma

Lecture 40 - Overview and conclusion

- Lecture 1 - Vector analysis, Scalar and vector fields, vector identities
- Lecture 2 - Vector Analysis (Continued...)
- Lecture 3 - Use of Levi-Civita Symbol, Coordinate system
- Lecture 4 - Coordinate system, Orthogonal Transformation
- Lecture 5 - Spherical Coordinate system, Line, surface and volume element
- Lecture 6 - Line, surface and volume element (Continued...)
- Lecture 7 - Line, surface and volume integral
- Lecture 8 - Differential calculus, Gradient
- Lecture 9 - Gradient operator, Concept of divergence
- Lecture 10 - Divergence operator, Divergence Theorem
- Lecture 11 - Curl operator, Stokes Theorem
- Lecture 12 - Gradient, Divergence and Curl (A recap), Vector identities
- Lecture 13 - Curvilinear coordinate system
- Lecture 14 - Curvilinear coordinate system (Continued...)
- Lecture 15 - Curvilinear coordinate system (Continued...)
- Lecture 16 - Delta Function
- Lecture 17 - Delta Function (Continued...)
- Lecture 18 - Helmholtz's Theorem
- Lecture 19 - Helmholtz's Theorem(Recap), Tutorial
- Lecture 20 - Tutorial (Continued...)
- Lecture 21 - Concept of charge, Charge density
- Lecture 22 - Coulomb's Law
- Lecture 23 - Coulomb's Law (Continued...), Charge distribution
- Lecture 24 - Charge distribution problem, Gauss's Law
- Lecture 25 - Topics More on Gauss's Law
- Lecture 26 - Application of Gauss's Law
- Lecture 27 - Electrostatic potential
- Lecture 28 - Electrostatic potential (Continued...)
- Lecture 29 - Electrostatic energy
- Lecture 30 - Electrostatic energy (Continued...)
- Lecture 31 - Electrostatic energy calculation

- Lecture 32 - Electrostatic dipole
- Lecture 33 - Electric dipole (Continued...)
- Lecture 34 - Multipole expansion
- Lecture 35 - Monopole and Dipole moment
- Lecture 36 - Quadrupole moment
- Lecture 37 - Dipole and Quadrupole moment (Continued...)
- Lecture 38 - Conductor
- Lecture 39 - Conductor (Continued...)
- Lecture 40 - Boundary condition
- Lecture 41 - Electrostatic pressure, Capacitor
- Lecture 42 - Energy of the Capacitor, Dielectric
- Lecture 43 - Dielectric (Continued...)
- Lecture 44 - Displacement Vector
- Lecture 45 - Electrostatic boundary value problem
- Lecture 46 - Electrostatic boundary value problem (Continued...)
- Lecture 47 - Electrostatic boundary value problem (Continued...), Image method
- Lecture 48 - Image method (Continued...)
- Lecture 49 - Charge particle in magnetic field
- Lecture 50 - Biot-Savart Law
- Lecture 51 - Application of Biot-Savart Law
- Lecture 52 - Ampere's Law
- Lecture 53 - Application of Ampere's Law
- Lecture 54 - Magnetic vector potential
- Lecture 55 - Magnetic vector potential (Continued...)
- Lecture 56 - Magnetic dipole moment
- Lecture 57 - Magnetic dipole moment (Continued...)
- Lecture 58 - Torque and potential energy of magnetic dipole, Magnetization
- Lecture 59 - Bound Current
- Lecture 60 - Magnetic materials
- Lecture 61 - Electromagnetic Induction
- Lecture 62 - Self and mutual inductance
- Lecture 63 - Wave equation, Maxwell's Equation
- Lecture 64 - Maxwells Equation (Continued...)

[Lecture 65 - Maxwells Equation: a complete overview](#)

[Lecture 66 - Maxwells Equation: a complete overview \(Continued...\)](#)

[Lecture 67 - Lorentz Gauge, Maxwell's wave equation](#)

[Lecture 68 - Maxwell's wave equation \(Coninued...\)](#)

[Lecture 69 - Maxwell's Equation in matter](#)

[Lecture 70 - Maxwell's Equation in matter \(Continued...\)](#)

[Lecture 71 - Tutorial 2 \(Electrostatic\)](#)

[Lecture 72 - Tutorial 3 \(Magnetostatic\)](#)

[Lecture 73 - Tutorial 4 \(Magnetostatic and EM Wave\)](#)

Lecture 1 - Introduction to solid state materials - From conventional to functional

Lecture 2 - Ceramics and Composites - I

Lecture 3 - Ceramics and Composites - II

Lecture 4 - Polymers

Lecture 5 - Introduction to Nanomaterials and functionality

Lecture 6 - Synthesis protocols - I

Lecture 7 - Synthesis protocols - II

Lecture 8 - Synthesis protocols - III

Lecture 9 - Crystal structure - I

Lecture 10 - Crystal structure - II

Lecture 11 - Crystal structure - III

Lecture 12 - Crystal imperfections

Lecture 13 - Alloys and Melts

Lecture 14 - Theory of Solids

Lecture 15 - Nearly free electron model

Lecture 16 - Bonds in molecules and solids

Lecture 17 - Transformations kinetics and reaction rates

Lecture 18 - Thermodynamics

Lecture 19 - Phase and phase transitions

Lecture 20 - Diffusion and various properties

Lecture 21 - Mechanical properties of solids

Lecture 22 - Thermal Properties of Solids

Lecture 23 - Negative and Zero Expansion Ceramics

Lecture 24 - Heat Capacity

Lecture 25 - Thermogravimetric (TGA) analysis

Lecture 26 - Introduction to magnetism and Magnetic properties of solids

Lecture 27 - From magnetic to multiferroic materials

Lecture 28 - Magnetic materials and their applications

Lecture 29 - Magnetism at nanoscale

Lecture 30 - GMR materials

Lecture 31 - CMR materials

[Lecture 32 - Ferrofluids](#)

[Lecture 33 - Spintronics and devices](#)

[Lecture 34 - Introduction to the basic properties of liquids and melts](#)

[Lecture 35 - Heat capacity and diffusion of liquids and melts](#)

[Lecture 36 - Viscosity, electric and thermal conduction of liquids and melts](#)

[Lecture 37 - Sensors](#)

[Lecture 38 - Electrochemical Sensors](#)

[Lecture 39 - Introduction to energy storage devices and basics of supercapacitors](#)

[Lecture 40 - Supercapacitors - II](#)

[Lecture 41 - Magnetic supercapacitors](#)

[Lecture 42 - Battery - I](#)

[Lecture 43 - Battery - II](#)

[Lecture 44 - Solar Cells - I](#)

[Lecture 45 - Solar Cells - II](#)

[Lecture 46 - X-ray Diffraction \(XRD\)](#)

[Lecture 47 - Fourier Transform Infrared Spectroscopy](#)

[Lecture 48 - UV- Vis Spectroscopy](#)

[Lecture 49 - Scanning and Transmission Electron Microscopy](#)

[Lecture 50 - Summary](#)

Lecture 1 - Introduction to waves, 1D wave equation and its solutions

Lecture 2 - 1D Light waves

Lecture 3 - Characteristics of light waves - amplitude, absolute phase, wavelength and frequency

Lecture 4 - Phase, Phase velocity and Phase delay

Lecture 5 - Complex notation for the description light waves and superposition

Lecture 6 - Maxwell's equations to the 3D wave equation and its solutions

Lecture 7 - Recap of Week 1

Lecture 8 - 3D wave equation and plane waves

Lecture 9 - Complex notation for Electric fields, Superposition and interference

Lecture 10 - Fabry-Perot interferometer and its transmittance

Lecture 11 - Physical interpretation of FP transmittance

Lecture 12 - Recap of Fabry-Perot modes

Lecture 13 - Free spectral range of a Fabry-Perot etalon

Lecture 14 - Resonator modes and optical pulses - insight

Lecture 15 - Table - Top Coherent and Incoherent Imaging

Lecture 16 - Recap of Etalon free spectral range

Lecture 17 - Line width and finesse of an etalon

Lecture 18 - Actual resonator modes

Lecture 19 - Resonator configurations and stability

Lecture 20 - Recap of optical resonators

Lecture 21 - Introduction of light pulses

Lecture 22 - Complex amplitude, Gaussian pulse

Lecture 23 - Recap of light pulses

Lecture 24 - Introduction of Fourier Transforms

Lecture 25 - Tutorial 1

Lecture 26 - Motivating Fourier Transforms

Lecture 27 - Fourier Transform Properties

Lecture 28 - Frequency domain electric field

Lecture 29 - Recap of Fourier transform properties

Lecture 30 - Frequency domain description of pulses

Lecture 31 - Spectral Phase



Lecture 32 - Recap of spectral phase

Lecture 33 - Instantaneous Frequency and group delay

Lecture 34 - Phase wrapping, blanking, and Taylor series expansion

Lecture 35 - Recap of instantaneous frequency, phase wrapping, and phase blanking

Lecture 36 - Frequency domain phase expansion, group delay dispersion

Lecture 37 - Absolute Phase

Lecture 38 - Recap of concepts + discussion

Lecture 39 - Absolute Phase (revisited)

Lecture 40 - Carrier envelope phase, frequency comb

Lecture 41 - Discussion

Lecture 42 - Recap of concepts

Lecture 43 - First order phase

Lecture 44 - Second order phase

Lecture 45 - Recap of first order and second order phase

Lecture 46 - Chirped pulse: Instantaneous frequency and Fourier transform

Lecture 47 - Group delay, nonlinearly chirped pulse

Lecture 48 - Recap of chirped pulses

Lecture 49 - Quadratic chirp pulses

Lecture 50 - Higher order spectral phase

Lecture 51 - Recap and discussion on higher order phase

Lecture 52 - Relative importance of intensity and phase

Lecture 53 - Pulse propagation through a medium

Lecture 54 - Recap of pulse propagation and pulse length

Lecture 55 - Discussion of RMS pulse width and uncertainty principle

Lecture 56 - Time-bandwidth product

Lecture 57 - Recap of previous module

Lecture 58 - Introduction of Lorentz Oscillator Model

Lecture 59 - Effect of matter on light

Lecture 60 - Recap of Lorentz oscillator, Polarization tensor

Lecture 61 - Dynamics of electrons in the Lorentz oscillator

Lecture 62 - Solving the inhomogeneous wave equation

Lecture 63 - Inhomogeneous wave equation, absorption coefficient, refractive index

Lecture 64 - Nonlinear response of matter

[Lecture 65 - Origin of nonlinear optical effects](#)

[Lecture 66 - Wave equation in an inert gas](#)

[Lecture 67 - Perturbation theory and second harmonics](#)

[Lecture 68 - Numerical simulation strategy](#)

[Lecture 69 - Atoms in the presence of fields](#)

[Lecture 70 - Ionization models](#)

[Lecture 71 - Attosecond pulse generation and metrology](#)

[Lecture 72 - Nonlinear optics review](#)

[Lecture 73 - Nonlinear response of matter to light](#)

[Lecture 74 - Sum and difference frequency generation](#)

[Lecture 75 - Recap of sum and difference frequency generation, second harmonic generation](#)

[Lecture 76 - Generalized nonlinear effects, conservation laws in SHG](#)

[Lecture 77 - Phase matching in SHG, polarization dependent refractive index](#)

Lecture 1 - Introductory lecture about this course

Lecture 2 - Quantum Mechanics and Symmetry of the Hydrogen Atom

Lecture 3 - Hydrogen atom: Rotational and Dynamical Symmetry of the  $1/r$  Potential

Lecture 4 - Hydrogen atom: Dynamical Symmetry of the  $1/r$  Potential

Lecture 5 - Degeneracy of the Hydrogen Atom:  $SO(4)$

Lecture 6 - Wavefunctions of the Hydrogen Atom

Lecture 7 - Angular Momentum in Quantum Mechanics

Lecture 8 - Angular Momentum in Quantum Mechanics: half-odd-integer and integer quantum numbers:  $SU(2)$  &  $SO(3)$

Lecture 9 - Angular Momentum in Quantum Mechanics: Addition Theorem for Spherical Harmonics - Coupling of Angular Momenta

Lecture 10 - Angular Momentum in Quantum Mechanics Dimensionality of the Direct-Product (Composite) Vector Space CGC recursion relations

Lecture 11 - Angular Momentum in Quantum Mechanics CGC matrix, Wigner D Rotation Matrix, Irreducible Tensor Operators

Lecture 12 - Angular Momentum in Quantum Mechanics - more on ITO, and the Wigner-Eckart Theorem

Lecture 13 - Angular Momentum in Quantum Mechanics Wigner-Eckart Theorem - 2

Lecture 14 - Relativistic Quantum Mechanics of the Hydrogen Atom - 1

Lecture 15 - Relativistic Quantum Mechanics of the Hydrogen Atom - 2

Lecture 16 - Relativistic Quantum Mechanics of the Hydrogen Atom - PAULI Equation - Foldy - Wouthysen Transformations - 1

Lecture 17 - Relativistic Quantum Mechanics of the Hydrogen Atom - Foldy - Wouthysen Transformations - 2

Lecture 18 - Relativistic Quantum Mechanics of the Hydrogen Atom - Foldy - Wouthysen Transformations - 3

Lecture 19 - Relativistic Quantum Mechanics of the Hydrogen Atom - Spherical Symmetry of the Coulomb Potential

Lecture 20 - Hartree-Fock Self-Consistent Field formalism - 1

Lecture 21 - Hartree-Fock Self-Consistent Field formalism - 2

Lecture 22 - Hartree-Fock Self-Consistent Field formalism - 3

Lecture 23 - Hartree-Fock Self-Consistent Field formalism - 4

Lecture 24 - Hartree-Fock Self-Consistent Field formalism - 5

Lecture 25 - Perturbative treatment of relativistic effects | Schrodinger's and Dirac QM

Lecture 26 - Perturbative treatment of relativistic effects | Schrodinger's and Dirac QM

Lecture 27 - Probing the atom - Collisions and Spectroscopy - boundary conditions - 1

Lecture 28 - Atomic Probes - Collisions and Spectroscopy - boundary conditions - 2

Lecture 29 - Atomic Probes - Collisions and Spectroscopy - Scattering phase shifts and boundary conditions

Lecture 30 - Atomic Probes - Time reversal symmetry - applications in atomic collisions and photoionization processes

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[Lecture 31 - Atomic Photoionization cross sections, angular distributions of photoelectrons - 1](#)

[Lecture 32 - Atomic Photoionization cross sections, angular distributions of photoelectrons - 2](#)

[Lecture 33 - Atomic Photoionization cross sections, angular distributions of photoelectrons - 3](#)

[Lecture 34 - Atomic Photoionization cross sections, angular distributions of photoelectrons - 4](#)

[Lecture 35 - Atomic Photoionization cross sections, angular distributions of photoelectrons Cooper Zare Formula](#)

[Lecture 36 - Stark- Zeeman Spectroscopy - Stark effect](#)

[Lecture 37 - Stark- Zeeman Spectroscopy - Stark effect on  \$n=2\$  excited state of the H atom Zeeman effect](#)

[Lecture 38 - Stark- Zeeman Spectroscopy - Normal, Anomalous Zeeman effect; Paschen- Back effect](#)

[Lecture 39 - Stark- Zeeman Spectroscopy - Anomalous Zeeman effect](#)

[Lecture 40 - Zeeman effect Fine structure, Hyperfine structure - Elemental, rudimentary introduction to Laser Cooling, BEC, Atomic Clock / Attosecond metrology](#)

Lecture 1 - What is Classical Field Theory?

Lecture 2 - Symmetries and Invariances - I

Lecture 3 - Symmetries and Invariances - II

Lecture 4 - Group Theory in Physics - I

Lecture 5 - Group Theory in Physics - II

Lecture 6 - Finite Groups - I

Lecture 7 - Finite Groups - II

Lecture 8 - Basics of CFT - I

Lecture 9 - Basics of CFT - II

Lecture 10 - Basics of CFT - III

Lecture 11 - Green Functions - I

Lecture 12 - Green Functions - II

Lecture 13 - Noether's Theorem - I

Lecture 14 - Noether's Theorem - II

Lecture 15 - Kink Soliton

Lecture 16 - Hidden Symmetry

Lecture 17 - Local Symmetries

Lecture 18 - The Abelian Higgs model

Lecture 19 - Lie Algebras - I

Lecture 20 - Lie Algebras - II

Lecture 21 - Magnetic Vortices - I

Lecture 22 - Magnetic Vortices - II

Lecture 23 - Non-abelian gauge theories - I

Lecture 24 - Non-abelian gauge theories - II

Lecture 25 - Irreps of Lie algebras - I

Lecture 26 - Irreps of Lie algebras - II

Lecture 27 - The Standard Model - I

Lecture 28 - The Standard Model - II

Lecture 29 - Irreps of the Lorentz/Poincare algebras

Lecture 30 - The Dirac monopole

Lecture 31 - The 't Hooft-Polyakov monopole

[Lecture 32 - Revisiting Derrick's Theorem](#)

[Lecture 33 - The Julia-Zee dyon](#)

[Lecture 34 - Instantons - I](#)

[Lecture 35 - Instantons - II](#)

[Lecture 36 - Instantons - III](#)

[Lecture 37 - Instantons - IV](#)

[Lecture 38 - Dualities](#)

[Lecture 39 - Geometrization of Field Theory](#)

**NPTEL : Topics in Nonlinear Dynamics (Physics)**

**Co-ordinators : Prof. V. Balakrishnan**

Lecture 1 - Overview

Lecture 2 - Critical points of a dynamical system

Lecture 3 - Two-dimensional flows

Lecture 4 - Stable and unstable manifolds

Lecture 5 - Hamiltonian dynamics - Part I

Lecture 6 - Hamiltonian dynamics - Part II

Lecture 7 - Hamiltonian dynamics - Part III

Lecture 8 - Hamiltonian dynamics - Part IV

Lecture 9 - Hamiltonian dynamics - Part V

Lecture 10 - Elementary bifurcations

Lecture 11 - Limit cycles

Lecture 12 - Poincaré index

Lecture 13 - Illustrative examples

Lecture 14 - Quiz 1. Questions and answers

Lecture 15 - Bead on a rotating hoop

Lecture 16 - Types of dynamical behaviour

Lecture 17 - Discrete time dynamics - Part I

Lecture 18 - Discrete time dynamics - Part II

Lecture 19 - Discrete time dynamics - Part III

Lecture 20 - Discrete time dynamics - Part IV

Lecture 21 - Coarse-grained dynamics in phase space - Part I

Lecture 22 - Coarse-grained dynamics in phase space - Part II & Stochastic dynamics - Part I

Lecture 23 - Stochastic dynamics - Part II

Lecture 24 - Stochastic dynamics - Part III

Lecture 25 - Coarse-grained dynamics in phase space - Part IV & Stochastic dynamics - Part IV

Lecture 26 - Discrete time dynamics - Part V

Lecture 27 - Quiz 2. Questions and answers

Lecture 28 - Stochastic dynamics - Part V

Lecture 29 - Stochastic dynamics - Part VI

Lecture 1 - Principles of Condensed Matter Physics

Lecture 2 - Symmetry in Perfect Solids

Lecture 3 - Symmetry in Perfect Solids (Continued...)

Lecture 4 - Symmetry in Perfect Solids - Worked Examples

Lecture 5 - Diffraction Methods For Crystal Structures

Lecture 6 - Diffraction Methods For Crystal Structures (Continued...)

Lecture 7 - Diffraction Methods For Crystal Structures - Worked Examples

Lecture 8 - Physical Properties of Crystals

Lecture 9 - Physical Properties of Crystals (Continued...)

Lecture 10 - Physical Properties of Crystals - Worked Examples

Lecture 11 - Cohesion in Solids

Lecture 12 - Cohesion in Solids - Worked Examples

Lecture 13 - The Free Electron Theory of Metals

Lecture 14 - The Free Electron Theory of Metals - Worked Examples

Lecture 15 - The Free Electron Theory of Metals - Electrical Conductivity

Lecture 16 - The Free Electron Theory of Metals - Electrical Conductivity - Worked Examples

Lecture 17 - Thermal Conductivity of Metals

Lecture 18 - Thermal Conductivity of Metals - Worked Examples

Lecture 19 - The Concept of Phonons

Lecture 20 - Debye Theory of Specific Heat, Lattice Vibrations

Lecture 21 - Debye Theory of Specific Heat, Lattice Vibrations - Worked Examples

Lecture 22 - Lattice Vibrations (Continued) Phonon thermal conductivity

Lecture 23 - Lattice Vibrations (Continued) Phonon Thermal Conductivity - Worked Examples

Lecture 24 - Anharmonicity and Thermal Expansion

Lecture 25 - Dielectric (Insulating) Solids

Lecture 26 - Dispersion and Absorption of Electromagnetic Waves in Dielectric Media, Ferro-and Antiferroelectrics

Lecture 27 - Optical Properties of Metals; Ionic Polarization in Alkali Halides; Piezoelectricity

Lecture 28 - Dielectric Solids - Worked Examples

Lecture 29 - Dia - and Paramagnetism

Lecture 30 - Paramagnetism of Transition Metal and Rare Earth Ions

Lecture 31 - Quenching of Orbital Angular Momentum; Ferromagnetism



- Lecture 32 - Exchange Interactions, Magnetic Order, Neutron Diffraction
- Lecture 33 - Hysteresis and Magnetic Domains; Spin Waves and Magnons
- Lecture 34 - Magnetic Resonance
- Lecture 35 - Magnetism and Magnetic Resonance - Worked Examples
- Lecture 36 - Magnetism - Worked Examples (Continued...)
- Lecture 37 - Pauli Paramagnetism and Landau Diamagnetism
- Lecture 38 - Band Magnetism; Itinerant Electrons; Stoner Model
- Lecture 39 - Superconductivity - Perfect Electrical Conductivity and Perfect Diamagnetism
- Lecture 40 - Type I and Type II Superconductors
- Lecture 41 - Ginsburg - Landau Theory, Flux Quantization
- Lecture 42 - Cooper Pairs
- Lecture 43 - Microscopic (BCS) Theory of Superconductivity
- Lecture 44 - BCS Theory (Continued...): Josephson Tunneling: Quantum Interference
- Lecture 45 - Josephson Effect (Continued...); High Temperature Superconductors
- Lecture 46 - Superconductors - Worked Examples
- Lecture 47 - Energy Bands in Solids
- Lecture 48 - Electron Dynamics in a Periodic Solid
- Lecture 49 - Semiconductors
- Lecture 50 - Semiconductors (Continued...)
- Lecture 51 - Semiconductors - Worked Examples
- Lecture 52 - Defects in Solids - Point Defects
- Lecture 53 - Point Defects in Solids - Worked Examples
- Lecture 54 - Defects in Solids - Line and Surface Defects
- Lecture 55 - Dislocations in Solids - Worked Examples
- Lecture 56 - Quantum Fluids and Quantum Solids
- Lecture 57 - Quantum Liquids and Quantum Solids - Worked Examples
- Lecture 58 - Epilogue

Lecture 1 - Introduction

Lecture 2 - Introduction to Classical Field Theory

Lecture 3 - Quantization of Real Scalar Field - I

Lecture 4 - Quantization of Real Scalar Field - II

Lecture 5 - Quantization of Real Scalar Field - III

Lecture 6 - Quantization of Real Scalar Field - IV

Lecture 7 - Quantization of Complex Scalar Field

Lecture 8 - Interacting Field Theory - I

Lecture 9 - Interacting Field Theory - II

Lecture 10 - Interacting Field Theory - III

Lecture 11 - Interacting Field Theory - IV

Lecture 12 - Interacting Field Theory - V

Lecture 13 - Interacting Field Theory - VI

Lecture 14 - Interacting Field Theory - VII

Lecture 15 - Quantization of Electromagnetic Field - I

Lecture 16 - Quantization of Electromagnetic Field - II

Lecture 17 - Fermion Quantization - I

Lecture 18 - Fermion Quantization - II

Lecture 19 - Fermion Quantization - III

Lecture 20 - Fermion Quantization - IV

Lecture 21 - Fermion Quantization - V

Lecture 22 - Fermion Quantization - VI

Lecture 23 - The S-Matrix Expansion in QED - I

Lecture 24 - The S-Matrix Expansion in QED - II

Lecture 25 - Feynman Rules in QED - I

Lecture 26 - Feynman Rules in QED - II

Lecture 27 - Compton Scattering - I

Lecture 28 - Compton Scattering - II

Lecture 29 - Compton Scattering - III

Lecture 30 - Moller Scattering - I

Lecture 31 - Moller Scattering - II

[Lecture 32 - Vertex Correction - I](#)

[Lecture 33 - Vertex Correction - II](#)

[Lecture 34 - Vertex Correction - III](#)

[Lecture 35 - Vertex Correction - IV](#)

[Lecture 36 - Electron Selfenergy](#)

[Lecture 37 - Photon Selfenergy - I](#)

[Lecture 38 - Photon Selfenergy - II](#)

**NPTEL : Quantum Mechanics I (Physics)**

**Co-ordinators : Prof. S. Lakshmi Bala**

- Lecture 1 - Quantum Mechanics "An Introduction"
- Lecture 2 - Linear Vector Spaces - I
- Lecture 3 - Linear Vector Spaces - II: The two-level atom
- Lecture 4 - Linear Vector Spaces - III: The three-level atom
- Lecture 5 - Postulates of Quantum Mechanics - I
- Lecture 6 - Postulates of Quantum Mechanics - II
- Lecture 7 - The Uncertainty Principle
- Lecture 8 - The Linear Harmonic Oscillator
- Lecture 9 - Introducing Quantum Optics
- Lecture 10 - An Interesting Quantum Superposition: The Coherent State
- Lecture 11 - The Displacement and Squeezing Operators
- Lecture 12 - Exercises in Finite Dimensional Linear Vector Spaces
- Lecture 13 - Exercises on Angular Momentum Operators and their algebra
- Lecture 14 - Exercises on Quantum Expectation Values
- Lecture 15 - Composite Systems
- Lecture 16 - The Quantum Beam Splitter
- Lecture 17 - Addition of Angular Momenta - I
- Lecture 18 - Addition of Angular Momenta - II
- Lecture 19 - Addition of Angular Momenta - III
- Lecture 20 - Infinite Dimensional Linear Vector Spaces
- Lecture 21 - Square-Integrable Functions
- Lecture 22 - Ingredients of Wave Mechanics
- Lecture 23 - The Schrodinger equation
- Lecture 24 - Wave Mechanics of the Simple Harmonic Oscillator
- Lecture 25 - One-Dimensional Square Well Potential: The Bound State Problem
- Lecture 26 - The Square Well and the Square Potential Barrier
- Lecture 27 - The Particle in a one-dimensional Box
- Lecture 28 - A Charged Particle in a Uniform Magnetic Field
- Lecture 29 - The Wavefunction: Its Single-valuedness and its Phase
- Lecture 30 - The Central Potential
- Lecture 31 - The Spherical Harmonics

[Lecture 32 - Central Potential: The Radial Equation](#)

[Lecture 33 - Illustrative Exercises - I](#)

[Lecture 34 - Illustrative Exercises - II](#)

[Lecture 35 - Ehrenfest's Theorem](#)

[Lecture 36 - Perturbation Theory - I](#)

[Lecture 37 - Perturbation Theory - II](#)

[Lecture 38 - Perturbation Theory - III](#)

[Lecture 39 - Perturbation Theory - IV](#)

[Lecture 40 - Time-dependent Hamiltonians](#)

[Lecture 41 - The Jaynes-Cummings model](#)

Lecture 1 - Course Overview

Lecture 2 - Equations of Motion (i)

Lecture 3 - Equations of Motion (ii)

Lecture 4 - Equations of Motion (iii)

Lecture 5 - Equations of Motion (iv)

Lecture 6 - Equations of Motion (v)

Lecture 7 - Oscillators, Resonances, Waves (i)

Lecture 8 - Oscillators, Resonances, Waves (ii)

Lecture 9 - Oscillators, Resonances, Waves (iii)

Lecture 10 - Oscillators, Resonances, Waves (iv)

Lecture 11 - Polar Coordinates (i)

Lecture 12 - Polar Coordinates (ii)

Lecture 13 - Dynamical Symmetry in the Kepler Problem (i)

Lecture 14 - Dynamical Symmetry in the Kepler Problem (ii)

Lecture 15 - Real Effects of Pseudo-Forces (i)

Lecture 16 - Real Effects of Pseudo-Forces (ii)

Lecture 17 - Real Effects of Pseudo-Forces (iii)

Lecture 18 - Real Effects of Pseudo-Forces (iv)

Lecture 19 - Special Theory of Relativity (i)

Lecture 20 - Special Theory of Relativity (ii)

Lecture 21 - Special Theory of Relativity (iii)

Lecture 22 - Special Theory of Relativity (iv)

Lecture 23 - Potentials Gradients Fields (i)

Lecture 24 - Potentials Gradients Fields (ii)

Lecture 25 - Potentials Gradients Fields (iii)

Lecture 26 - Gauss Law Eq of continuity (i)

Lecture 27 - Gauss Law Eq of continuity (ii)

Lecture 28 - Gauss Law Eq of continuity (iii)

Lecture 29 - Fluid Flow Bernoulli Principle (i)

Lecture 30 - Fluid Flow Bernoulli Principle (ii)

Lecture 31 - Classical Electrodynamics (i)

[Lecture 32 - Classical Electrodynamics \(ii\)](#)

[Lecture 33 - Classical Electrodynamics \(iii\)](#)

[Lecture 34 - Classical Electrodynamics \(iv\)](#)

[Lecture 35 - Chaotic Dynamical Systems \(i\)](#)

[Lecture 36 - Chaotic Dynamical Systems \(ii\)](#)

[Lecture 37 - Chaotic Dynamical Systems \(iii\)](#)

[Lecture 38 - Chaotic Dynamical Systems \(iv\)](#)

[Lecture 39 - Chaotic Dynamical Systems \(v\)](#)

[Lecture 40 - The Scope and Limitations of Classical Mechanics](#)

Lecture 1 - Introduction to the STiTACS course

Lecture 2 - Quantum Theory of collisions

Lecture 3 - Quantum Theory of collisions: optical Theorem

Lecture 4 - Quantum Theory of collisions: Optical Theorem (Continued...)

Lecture 5 - Quantum Theory of collisions: Differential scattering cross section

Lecture 6 - Quantum Theory of collisions: Differential scattering cross section, Partial wave analysis

Lecture 7 - Quantum Theory of collisions: Optical Theorem – Unitarity of the Scattering Operator

Lecture 8 - Quantum Theory of collisions: Reciprocity Theorem, Phase shift analysis

Lecture 9 - Quantum Theory of collisions: More on Phase shift analysis

Lecture 10 - Quantum Theory of collisions: resonant condition in the  $l$ th partial wave.

Lecture 11 - Quantum Theory of collisions: Levinson's theorem

Lecture 12 - Quantum Theory of collisions: Levinson's theorem (Continued...)

Lecture 13 - Many body theory, electron correlations

Lecture 14 - Second Quantization Creation, Destruction and Number operators

Lecture 15 - Many-particle Hamiltonian & Schrodinger Equation in 2nd Quantization

Lecture 16 - Many-electron problem in quantum mechanics

Lecture 17 - Hartree-Fock Self-Consistent-Field

Lecture 18 - Exchange, Statistical, Fermi-Dirac correlations

Lecture 19 - Limitations of the Hartree-Fock Self-Consistent-Field formalism

Lecture 20 - Many-Body formalism, II Quantization

Lecture 21 - Density fluctuations in an electron gas

Lecture 22 - Bohm-Pines approach to Random Phase Approximation

Lecture 23 - Bohm-Pines approach to Random Phase Approximation (Continued...)

Lecture 24 - Bohm-Pines approach to Random Phase Approximation (Continued...)

Lecture 25 - Schrodinger, Heisenberg and Dirac "pictures" of QM

Lecture 26 - Dyson's chronological operator

Lecture 27 - Gell-Mann-Low Theorem

Lecture 28 - Reyleigh-Schrodinger perturbation methods and adiabatic switching

Lecture 29 - Feynman Diagrams

Lecture 30 - I Order Feynman Diagrams

Lecture 31 - II and higher order Feynman Diagrams



[Lecture 32 - Linear response of electron correlations](#)

[Lecture 33 - Lippman Schwinger equation of potential scattering](#)

[Lecture 34 - Born Approximation](#)

[Lecture 35 - Coulomb scattering](#)

[Lecture 36 - Scattering of partial waves](#)

[Lecture 37 - Scattering at high energy](#)

[Lecture 38 - Resonances in Quantum Collisions](#)

[Lecture 39 - Breit-Wigner Resonances](#)

[Lecture 40 - Fano parameterization of Breit-Wigner formula](#)

[Lecture 41 - Discrete state embedded in the continuum](#)

[Lecture 42 - Resonance life times](#)

[Lecture 43 - Wigner-Eisenbud formalism of time-delay in scattering](#)

[Lecture 44 - Photoionization and Photoelectron Angular Distributions](#)

[Lecture 45 - Ionization and Excitation of Atoms by Fast Charged Particles](#)

[Lecture 46 - Photo-absorption by Free and Confined Atoms and Ions: Recent Developments](#)

- Lecture 1 - Analytic functions of a complex variable - Part I
- Lecture 2 - Analytic functions of a complex variable - Part II
- Lecture 3 - Calculus of residues - Part I
- Lecture 4 - Calculus of residues - Part II
- Lecture 5 - Calculus of residues - Part III
- Lecture 6 - Calculus of residues - Part IV
- Lecture 7 - Linear response; dispersion relations - Part I
- Lecture 8 - Linear response; dispersion relations - Part II
- Lecture 9 - Analytic continuation and the gamma function - Part I
- Lecture 10 - Analytic continuation and the gamma function - Part II
- Lecture 11 - Möbius transformations - Part I
- Lecture 12 - Möbius transformations - Part II
- Lecture 13 - Möbius transformations - Part III
- Lecture 14 - Multivalued functions; integral representations - Part I
- Lecture 15 - Multivalued functions; integral representations - Part II
- Lecture 16 - Multivalued functions; integral representations - Part III
- Lecture 17 - Multivalued functions; integral representations - Part IV
- Lecture 18 - Laplace transforms - Part I
- Lecture 19 - Laplace transforms - Part II
- Lecture 20 - Fourier transforms - Part I
- Lecture 21 - Fourier transforms - Part II
- Lecture 22 - Fourier transforms - Part III
- Lecture 23 - Fundamental Green function for  $\hat{p}^2$  - Part I
- Lecture 24 - Fundamental Green function for  $\hat{p}^2$  - Part II
- Lecture 25 - The diffusion equation - Part I
- Lecture 26 - The diffusion equation - Part II
- Lecture 27 - The diffusion equation - Part III
- Lecture 28 - The diffusion equation - Part IV
- Lecture 29 - Green function for  $(\hat{p}^2 + k^2)$ ; nonrelativistic scattering - Part I
- Lecture 30 - Green function for  $(\hat{p}^2 + k^2)$ ; nonrelativistic scattering - Part II
- Lecture 31 - Green function for  $(\hat{p}^2 + k^2)$ ; nonrelativistic scattering - Part III

[Lecture 32 - The wave equation - Part I](#)

[Lecture 33 - The wave equation - Part II](#)

[Lecture 34 - The rotation group and all that - Part I](#)

[Lecture 35 - The rotation group and all that - Part II](#)

[Lecture 36 - The rotation group and all that - Part III](#)

- Lecture 1 - Energy Sources
- Lecture 2 - Nuclear Power Production Cycle
- Lecture 3 - Basic Physics of Nuclear Fission
- Lecture 4 - Basic Physics of Nuclear Fission (Continued...)
- Lecture 5 - Nuclear Reactors
- Lecture 6 - Reactors Generation
- Lecture 7 - Radiation Sources and Protection
- Lecture 8 - Biological Effects of Radiation
- Lecture 9 - Safety Principles
- Lecture 10 - Safety Principles (Continued...)
- Lecture 11 - Safety Approach
- Lecture 12 - Risk and Probabilistic safety analysis (PSA)
- Lecture 13 - History of Events in Nuclear Power Plants and Radiation facilities
- Lecture 14 - Other Events
- Lecture 15 - Validation and Dynamic Analysis
- Lecture 16 - Validation and Dynamic Analysis (Continued...)
- Lecture 17 - Quality Assurance
- Lecture 18 - Siting of Nuclear Plants
- Lecture 19 - Siting of Nuclear Plants (Continued...)
- Lecture 20 - Engineered Safety Systems
- Lecture 21 - Engineered Safety Systems (Continued...)
- Lecture 22 - Assessment of Radiological Consequences of Incidents
- Lecture 23 - Safety Regulation in India
- Lecture 24 - Safety Regulation in India (Continued...)
- Lecture 25 - Safety Regulation in India (Continued...)
- Lecture 26 - Safety Practices in Indian NPPs
- Lecture 27 - Safety Practices in Indian NPPs (Continued...)
- Lecture 28 - Safety Practices in Indian NPPs (Continued...)
- Lecture 29 - Passive Safety
- Lecture 30 - Passive Safety (Continued...)

- Lecture 1 - Discrete probability distributions - Part 1
- Lecture 2 - Discrete probability distributions - Part 2
- Lecture 3 - Continuous random variables
- Lecture 4 - Central Limit Theorem
- Lecture 5 - Stable distributions
- Lecture 6 - Stochastic processes
- Lecture 7 - Markov processes - Part 1
- Lecture 8 - Markov processes - Part 2
- Lecture 9 - Markov processes - Part 3
- Lecture 10 - Birth-and-death processes
- Lecture 11 - Continuous Markov processes
- Lecture 12 - Langevin dynamics - Part 1
- Lecture 13 - Langevin dynamics - Part 2
- Lecture 14 - Langevin dynamics - Part 3
- Lecture 15 - Langevin dynamics - Part 4
- Lecture 16 - Itô and Fokker-Planck equations for diffusion processes
- Lecture 17 - Level-crossing statistics of a continuous random process
- Lecture 18 - Diffusion of a charged particle in a magnetic field
- Lecture 19 - Power spectrum of noise
- Lecture 20 - Elements of linear response theory
- Lecture 21 - Random pulse sequences
- Lecture 22 - Dichotomous diffusion
- Lecture 23 - First passage time (Part 1)
- Lecture 24 - First passage time (Part 2)
- Lecture 25 - First passage and recurrence in Markov chains
- Lecture 26 - Recurrent and transient random walks
- Lecture 27 - Non-Markovian random walks
- Lecture 28 - Statistical aspects of deterministic dynamics (Part 1)
- Lecture 29 - Statistical aspects of deterministic dynamics (Part 2)

Lecture 1 - The Nature of Physical Laws

Lecture 2 - Fundamental Constants and Dimensional Analysis

Lecture 3 - Dimensional analysis and scaling

Lecture 4 - sketching Elementary Functions

Lecture 5 - The fundamental forces of nature

Lecture 6 - Scalars, Vectors and All That

Lecture 7 - Plane Polar Coordinates

Lecture 8 - Vectors In a Plane, Scalars and Pseudoscalars

Lecture 9 - Kinematics In a Plane

Lecture 10 - Vectors in 3-Dimensional Space

Lecture 11 - Vectors in 3-Dimensional space (Continued...)

Lecture 12 - The Finite Rotation Formula, Polar Coordinates in 3-dimensions

Lecture 13 - Cylindrical and Spherical polar coordinates

Lecture 14 - Motion in a circle - Acceleration

Lecture 15 - Newtons laws of motion

Lecture 16 - Conservation Laws and Newtons Equations

Lecture 17 - Conservation of Angular Momentum

Lecture 18 - Two-Body Scattering

Lecture 19 - Two-Body Collision Kinematics

Lecture 20 - Conservative Forces - The Concept of a Potential

Lecture 21 - Central Potential and Central Force

Lecture 22 - The 2-Body Central Force Problem

Lecture 23 - Keplers Laws of Planetary Motion

Lecture 24 - Non-Inertial Forces (Pseudo-forces)

Lecture 25 - More on the Kepler problem; Satellite motion

Lecture 26 - Linear Elasticity of Solids

Lecture 27 - Simple Harmonic Motion

Lecture 28 - Some Physical Examples of Simple Harmonic Motion

Lecture 29 - More on Simple Harmonic Motion

Lecture 30 - Damped Simple Harmonic Motion

Lecture 31 - Wave Motion - Travelling and Standing Waves

[Lecture 32 - Wave Motion - Wave Equation, General Solution](#)

[Lecture 33 - Fluid Dynamics - Hydrostatic Equilibrium](#)

[Lecture 34 - Fluid Dynamics - Equation of Continuity](#)

[Lecture 35 - Fluid Flow - Bernoulli's Principle](#)

[Lecture 36 - Circulation and Vorticity](#)

[Lecture 37 - What is Thermodynamics?](#)

[Lecture 38 - The Classical Ideal Gas](#)

[Lecture 39 - The Laws of Thermodynamics](#)

[Lecture 40 - Specific Heat of an Ideal Gas](#)

[Lecture 41 - Van der Waals Equation](#)

[Lecture 42 - Phase Transitions](#)

[Lecture 43 - Summary](#)

Lecture 1 - Recapitulation of equilibrium statistical mechanics

Lecture 2 - The Langevin model (Part 1)

Lecture 3 - The Langevin model (Part 2)

Lecture 4 - The Langevin model (Part 3)

Lecture 5 - The Langevin model (Part 4)

Lecture 6 - Linear response theory (Part 1)

Lecture 7 - Linear response theory (Part 2)

Lecture 8 - Linear response (Part 3)

Lecture 9 - Linear response(Part 4)

Lecture 10 - Linear response (Part 5)

Lecture 11 - Linear response (Part 6)

Lecture 12 - Linear response theory (Part 7)

Lecture 13 - Quiz 1 - Questions and answers

Lecture 14 - Linear response theory (Part 8)

Lecture 15 - Linear response theory (Part 9)

Lecture 16 - The dynamic mobility

Lecture 17 - Fokker-Planck equations (Part 1)

Lecture 18 - Fokker-Planck equations (Part 2)

Lecture 19 - Fokker-Planck equations (Part 3)

Lecture 20 - The generalized Langevin equation (Part 1)

Lecture 21 - The generalized Langevin equation (Part 2)

Lecture 22 - Diffusion in a magnetic field

Lecture 23 - The Boltzmann equation for a dilute gas (Part 1)

Lecture 24 - The Boltzmann equation for a dilute gas (Part 2)

Lecture 25 - The Boltzmann equation for a dilute gas (Part 3)

Lecture 26 - The Boltzmann equation for a dilute gas (Part 4)

Lecture 27 - The Boltzmann equation for a dilute gas (Part 5)

Lecture 28 - Quiz 2 - Questions and answers

Lecture 29 - Critical phenomena (Part 1)

Lecture 30 - Critical phenomena (Part 2)

Lecture 31 - Critical phenomena (Part 3)



[Lecture 32 - Critical phenomena \(Part 4\)](#)

[Lecture 33 - Critical phenomena \(Part 5\)](#)

[Lecture 34 - Critical phenomena \(Part 6\)](#)

[Lecture 35 - Critical phenomena \(Part 7\)](#)

[Lecture 36 - The Wiener process \(standard Brownian motion\)](#)

Lecture 1 - Discrete Probability

Lecture 2 - Continuous Probability

Lecture 3 - Characteristic Function

Lecture 4 - Gaussian Distribution

Lecture 5 - Binomial Distribution

Lecture 6 - Poisson Distribution

Lecture 7 - Central Limit Theorem

Lecture 8 - Many Random Variables

Lecture 9 - Entropy and Probability

Lecture 10 - Entropy Maximization

Lecture 11 - Transformation of Random Variables

Lecture 12 - Tutorial

Lecture 13 - Mathematical Preliminaries - 1

Lecture 14 - Microcanonical Ensemble

Lecture 15 - Two Level System (Microcanonical Ensemble)

Lecture 16 - Classical Ideal Gas (Microcanonical Ensemble)

Lecture 17 - Entropy of Mixing

Lecture 18 - Canonical Ensemble

Lecture 19 - Two Level System (Canonical Ensemble)

Lecture 20 - Classical Ideal Gas (Canonical Ensemble)

Lecture 21 - Gibbs Canonical Ensemble

Lecture 22 - Classical Ideal Gas (Gibbs Canonical Ensemble)

Lecture 23 - N Spins in a Uniform Magnetic Field

Lecture 24 - Grand Canonical Ensemble

Lecture 25 - Ideal Gas (Grand Canonical Ensemble)

Lecture 26 - N Non - Interacting Spins in Constant Magnetic Field

Lecture 27 - Quantum Statistical Mechanics

Lecture 28 - Statistics of Fermions and Bosons

Lecture 29 - Quantum to Classical Correspondance

Lecture 30 - Vibrations of Solid (Low Temperature)

Lecture 31 - Vibrations of Solid (Continuation)

[Lecture 32 - Free Electrons\(Fermi Gas\) in a Metal](#)

[Lecture 33 - Free Electrons\(Fermi Gas\) in a Metal \(Continuation\)](#)

[Lecture 34 - Problem solving demo - Part 1](#)

[Lecture 35 - Problem solving demo - Part 2](#)

Lecture 1 - Introduction to Fortran - Part 1

Lecture 2 - Introduction to Fortran - Part 2

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Lecture 6 - Numerical Integration - Part 1

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Lecture 8 - Numerical Integration - Part 3

Lecture 9 - Numerical Integration - Part 4

Lecture 10 - Numerical Integration - Part 5

Lecture 11 - Numerical Integration - Part 6

Lecture 12 - Numerical Integration - Part 7

Lecture 13 - Numerical Integration - Part 8

Lecture 14 - Numerical Integration - Part 9

Lecture 15 - Numerical Integration - Part 10

Lecture 16 - Monte Carlo Simulation Introduction - Part 1

Lecture 17 - Monte Carlo Simulation Introduction - Part 2

Lecture 18 - Implementing the Ising model on computer

Lecture 19 - Periodic Boundary conditions and the Metropolis scheme

Lecture 20 - Testing the simulation and relaxation to equilibrium, finite size effects

Lecture 21 - Monte Carlo Simulation Analysis - Part 1

Lecture 22 - Monte Carlo Simulation Analysis - Part 2

Lecture 23 - Monte Carlo Simulation Analysis: Thermodynamic Quantities - Part 1

Lecture 24 - Monte Carlo Simulation Analysis: Thermodynamic Quantities - Part 2

Lecture 25 - Calculating  $T_c$  using Binder's cumulant; Principle of detailed balance

Lecture 26 - Differential Equations Euler and Runge Kutta - Part 1

Lecture 27 - Differential Equations Euler and Runge Kutta - Part 2

Lecture 28 - Differential Coupled Equation Non Linear Equation - Part 1

Lecture 29 - Differential Coupled Equation Non Linear Equation - Part 2

Lecture 30 - Coupled Differential Equation Visualisation and Making Movie

Lecture 31 - Differential Equations With Specified Boundary Conditions - Part 1

- Lecture 32 - Differential Equations With Specified Boundary Conditions - Part 2
- Lecture 33 - Partial Differential equations - 1
- Lecture 34 - Partial Differential equations - 2
- Lecture 35 - Partial Differential equations - 3
- Lecture 36 - Differential Equation for Quantum Mechanical Problems: Numerov Algorithm - 1
- Lecture 37 - Differential Equation for Quantum Mechanical Problems: Numerov Algorithm - 2
- Lecture 38 - Differential Equation for Quantum Mechanical Problems: Numerov Algorithm - 3
- Lecture 39 - Differential Equation for Quantum Mechanical Problems: Numerov Algorithm - 4
- Lecture 40 - Differential Equation for Quantum Mechanical Problems: Numerov Algorithm - 5
- Lecture 41 - Differential Equation for Quantum Mechanical Problems: Variational principle - 1
- Lecture 42 - Differential Equation for Quantum Mechanical Problems: Variational principle - 2
- Lecture 43 - Differential Equation for Quantum Mechanical Problems: Variational principle - 3
- Lecture 44 - Differential Equation for Quantum Mechanical Problems: Variational principle - 4
- Lecture 45 - Differential Equation for Quantum Mechanical Problems: Variational principle - 5
- Lecture 46 - Molecular Dynamics Introduction - Part 1
- Lecture 47 - Molecular Dynamics Introduction - Part 2
- Lecture 48 - Molecular Dynamics Details and Algorithm - Part 1
- Lecture 49 - Molecular Dynamics Details and Algorithm - Part 2
- Lecture 50 - Molecular Dynamics Details and Algorithm - Part 3
- Lecture 51 - Molecular Dynamics Analysis - Part 1
- Lecture 52 - Molecular Dynamics Analysis - Part 2
- Lecture 53 - Molecular Dynamics Neighbours Lists - Part 1
- Lecture 54 - Molecular Dynamics Neighbours Lists - Part 2
- Lecture 55 - Molecular Dynamics: Calculation Of Thermodynamics Quantities
- Lecture 56 - Molecular Dynamics Diffusion Constant Calculation - Part 1
- Lecture 57 - Molecular Dynamics Diffusion Constant Calculation - Part 2
- Lecture 58 - Molecular Dynamics Diffusion Constant Calculation - Part 3

- Lecture 1 - Simple Harmonic Motion
- Lecture 2 - Superposition of Oscillations : Beats
- Lecture 3 - Superposition of Oscillations : Beats
- Lecture 4 - Superposition of Oscillations : Lissajous Figures
- Lecture 5 - Simple Harmonic Motion : Problems
- Lecture 6 - Damped oscillator - Part 1
- Lecture 7 - Damped oscillator - Part 2
- Lecture 8 - Damped oscillator and Q-factor
- Lecture 9 - Damped oscillator : Problems
- Lecture 10 - Forced oscillator - Part 1
- Lecture 11 - Forced oscillator - Part 2
- Lecture 12 - Resonances
- Lecture 13 - Q-factor of forced oscillator
- Lecture 14 - Applications of forced oscillator
- Lecture 15 - Forced Oscillator : Problems
- Lecture 16 - Coupled Oscillations - Part 1
- Lecture 17 - Coupled Oscillations - Part 2
- Lecture 18 - Solving for normal modes
- Lecture 19 - Coupled oscillations - More examples
- Lecture 20 - Coupled oscillator : Problems
- Lecture 21 - Coupled Oscillations of Loaded String
- Lecture 22 - Solutions for Loaded String
- Lecture 23 - Oscillations of Loaded String
- Lecture 24 - Continuum Limit of Loaded String
- Lecture 25 - Wave equation and its solutions
- Lecture 26 - Wave equation - impedance and velocities
- Lecture 27 - Standing waves
- Lecture 28 - Transverse waves in periodic structures
- Lecture 29 - Wave equation : Problems
- Lecture 30 - Reflection and transmission of waves
- Lecture 31 - Impedance matching

- Lecture 32 - Energy of vibrating string
- Lecture 33 - Dispersion of waves
- Lecture 34 - Bandwidth theorem and problems
- Lecture 35 - Longitudnal Waves and Speed of Sound
- Lecture 36 - Longitudnal Standing Waves
- Lecture 37 - Sound Intensity
- Lecture 38 - Longitudnal Waves: Problems
- Lecture 39 - Fourier Series - Part 1
- Lecture 40 - Fourier Series - Part 2
- Lecture 41 - Fourier Series and Energy of Vibrating String
- Lecture 42 - Frequency Spectrum and Fourier Transforms
- Lecture 43 - Fourier Series : Problems
- Lecture 44 - Waves in Optical Systems
- Lecture 45 - Waves in Optical Systems: Applying Fermat's Principle
- Lecture 46 - Waves in Optical Systems: Thin Lens
- Lecture 47 - Waves in Optical Systems: Matrix Method
- Lecture 48 - Waves in Optical Systems: Problems
- Lecture 49 - Interference: Part 1
- Lecture 50 - Interference: Newton's rings
- Lecture 51 - Michelson and Fabry-Perot Interferometers
- Lecture 52 - Young's Double Slit Experiment
- Lecture 53 - Diffraction
- Lecture 54 - Beyond Linear Oscillators: Non-linear Pendulum
- Lecture 55 - Beyond Linear Oscillators: Forced Oscillator
- Lecture 56 - Beyond Linear Oscillators: Chaotic Oscillator
- Lecture 57 - Beyond Linear Waves: Solitary Waves
- Lecture 58 - Waves in Quantum Mechanics and Summary

Lecture 1 - Introduction to Mathematica, Wolfram language and Wolfram Cloud

Lecture 2 - Technical Prelim 1

Lecture 3 - Plotting Simple Functions

Lecture 4 - Function Behaviour near Extrema

Lecture 5 - Radicals and Logarithms

Lecture 6 - Properties of Functions

Lecture 7 - Vector Fields, Vector and Streamline Plots and Contour Plots

Lecture 8 - Introduction to Non-dimensionalisation

Lecture 9 - Non-dimensionalization and visual thinking

Lecture 10 - Non-dimensionalisation and Parametric Plot

Lecture 11 - Technical Prelim 2: Loops

Lecture 12 - Introduction to Simple Harmonic Oscillator

Lecture 13 - Simple Harmonic Oscillator with a spring mass system

Lecture 14 - More Examples of Simple Harmonic Oscillator

Lecture 15 - Anharmonic Oscillator

Lecture 16 - Introduction to Data Analysis - 1

Lecture 17 - Introduction to Data Analysis - 2

Lecture 18 - Curve fitting

Lecture 19 - Linear superposition of oscillations

Lecture 20 - Technical Prelim 3: Introduction to Calculus Tools

Lecture 21 - Damped Harmonic Oscillator: LCR Circuit

Lecture 22 - Solving Initial Value Problem with Mathematica

Lecture 23 - Damped Harmonic Oscillator: Spring-mass System with Friction

Lecture 24 - Technical Prelim 4: Manipulation of Lists using @, @@, /@ operators

Lecture 25 - Introduction to Euler's Method for Solving Differential Equation

Lecture 26 - Technical Prelim 5: Writing Custom Functions

Lecture 27 - Writing Euler's Method as a custom function

Lecture 28 - Mean Global Error in Euler's method and Application of Euler's method to damped oscillator

Lecture 29 - Improved Euler (RK2) and RK4 Methods for solving ODEs

Lecture 30 - Driven oscillations

Lecture 31 - Driven oscillations using the Improved Euler method



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[Lecture 33 - Escape velocity](#)

[Lecture 34 - Driven oscillations: Variations](#)

[Lecture 35 - Linear systems: Insights from the phase space picture - 1](#)

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[Lecture 39 - The Monte Carlo Method - 1](#)

[Lecture 40 - The Monte Carlo Method - 2](#)

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[Lecture 44 - Random Walks - 1](#)

[Lecture 45 - Random Walks - 2](#)

[Lecture 46 - Random Walks - 3](#)

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Lecture 6 - Band Theory

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Lecture 8 - Charge Carrier Dynamics in Semiconductor

Lecture 9 - P-N junction model and Diode working principle

Lecture 10 - Current-Voltage Characteristics of Solar Cell

Lecture 11 - Equivalent Circuits of Solar Cells, Fill Factor

Lecture 12 - Fabrication Process of Semiconductor Grade Silicon

Lecture 13 - Fabrication Process of Single crystalline Silicon

Lecture 14 - Thin Film deposition Techniques

Lecture 15 - Thin Film Solar Cells: Amorphous Silicon

Lecture 16 - Photo Physics of Dye Sensitized Solar Cells

Lecture 17 - Fabrication of Dye Sensitized Solar Cells

Lecture 18 - Design of Novel dyes

Lecture 19 - Design of Electrolytes

Lecture 20 - Quantum Dot Solar Cells

Lecture 21 - Fabrication of Organic Solar Cells

Lecture 22 - Physics of Bulk Hetero Junction (BHJ) Solar Cells

Lecture 23 - Photo Physics of Organic Solar Cells

Lecture 24 - Morphology Optimization of Organic Solar Cells

Lecture 25 - Perovskite Solar Cells

Lecture 26 - Fabrication of Perovskite Solar Cells

Lecture 27 - Photo Physics of Perovskite Solar Cells

Lecture 28 - Stability in Perovskite Solar Cells

Lecture 29 - Morphology Optimization of Perovskite Solar Cells

Lecture 30 - Perovskite Single Crystal Solar Cells

Lecture 31 - Photophysics in Perovskite Single Crystal Solar Cells

[Lecture 32 - Applications of Perovskite Single Crystal Solar Cells](#)

[Lecture 33 - Organic Nano Particles Based Solar Cells](#)

[Lecture 34 - Morphology Optimization in Organic Nanoparticle Based Solar Cells](#)

[Lecture 35 - Multijunction Tandem Solar Cells](#)

[Lecture 36 - Introduction to Characterization Techniques](#)

[Lecture 37 - Vacuum Technology in Solar Photovoltaics](#)

[Lecture 38 - Introduction of Pressure Gauges](#)

[Lecture 39 - Electron Microscopy in Solar Photovoltaics](#)

[Lecture 40 - Impedance Spectroscopy](#)

Lecture 1 - An Introduction to the Earth's Atmosphere and Source of Energy - The Sun

Lecture 2 - Primary Source of Energy on the Earth - The Sun

Lecture 3 - Evolution of the Earth's Atmosphere

Lecture 4 - Earth's Second Atmosphere and Rise of Oxygen

Lecture 5 - Atmosphere of Other Planets in Solar System

Lecture 6 - Structure of Earth's Atmosphere

Lecture 7 - Vertical Structure of Atmosphere

Lecture 8 - Characterization of Atmosphere Based on Electrical Properties

Lecture 9 - Coupling of Solar Radiation with the Earth's Atmosphere

Lecture 10 - Forces and Their Classifications

Lecture 11 - Forces - Gravitational Force

Lecture 12 - Forces - Viscous Force

Lecture 13 - Forces - Coriolis Force

Lecture 14 - Coriolis Force and Curvature Effect

Lecture 15 - Hydrostatic Equation

Lecture 16 - Hypsometric Equation

Lecture 17 - Atmospheric Thermodynamics

Lecture 18 - Thermodynamics - Dry Air

Lecture 19 - Thermodynamics - Moist Air

Lecture 20 - Geopotential and Scale Height

Lecture 21 - Specific Heats

Lecture 22 - Air Parcel and Potential Temperature

Lecture 23 - Moisture Parameters

Lecture 24 - Saturation Mixing Ratio and Relative Humidity

Lecture 25 - Pseudo-Adiabatic Processes

Lecture 26 - Convection of Air

Lecture 27 - Atmospheric Stability and Cloud Formation

Lecture 28 - Cloud Formation

Lecture 29 - Cloud Formation and Lifting

Lecture 30 - Cloud Morphology

Lecture 31 - Secondary Cloud Classification and Fog

- Lecture 32 - Atmospheric Stability
- Lecture 33 - Atmospheric Stability Conditions
- Lecture 34 - Stable Unstable and Neutral Atmosphere
- Lecture 35 - Cloud Seeding and Precipitation
- Lecture 36 - Measuring Precipitation
- Lecture 37 - Droplet Growth and Curvature Effect
- Lecture 38 - Droplet Growth and Solute Effect
- Lecture 39 - Radial Growth of Droplets by Diffusion
- Lecture 40 - Radial Growth of Droplets by Diffusion (Continued...)
- Lecture 41 - Ionospheric Layers and Photochemistry
- Lecture 42 - Ionization Processes
- Lecture 43 - Ionospheric Chemical Reactions and Layers
- Lecture 44 - Chapman's Theory of Layer Production
- Lecture 45 - Chapman's Theory of Layer Production (Continued...)
- Lecture 46 - Chapman's Alpha Layer
- Lecture 47 - Hydrogen in Ionosphere
- Lecture 48 - Debye's Shielding
- Lecture 49 - Debye's Shielding and Debye's Potential
- Lecture 50 - Debye's Potential (Continued...)
- Lecture 51 - Particle Motion in Uniform Electric Field
- Lecture 52 - Particle Motion in Uniform Magnetic Field
- Lecture 53 - Particle Motion in Uniform Magnetic Field and Guiding Center
- Lecture 54 - Particle Motion in Uniform Electric and Magnetic Fields
- Lecture 55 - Gradient Magnetic Field
- Lecture 56 - Gradient Drift and Curvature Drift
- Lecture 57 - Vacuum Drift and Planetary Ring Current
- Lecture 58 - Magnetic Mirroring
- Lecture 59 - Magnetic Mirroring and Loss Cone
- Lecture 60 - Airglow and Aurora

Lecture 1 - Introduction

Lecture 2 - Sensor Fabrication and Characterization

Lecture 3 - Basic Optics for Optical Sensing - I

Lecture 4 - Basic Optics for Optical Sensing - II

Lecture 5 - Basic Optics for Optical Sensing - III

Lecture 6 - Basic Optics for Optical Sensing - IV

Lecture 7 - Basic Optics for Optical Sensing - V

Lecture 8 - Basic Optics for Optical Sensing - VI

Lecture 9 - Basic Optics for Optical Sensing - VII

Lecture 10 - Plasmons - I

Lecture 11 - Plasmons - II

Lecture 12 - Plasmons - III

Lecture 13 - Plasmons - IV

Lecture 14 - Plasmons - V

Lecture 15 - Plasmons - VI

Lecture 16 - Multiple Optical Sensors of Different Mechanisms

Lecture 17 - Interference based Sensors

Lecture 18 - Interference, Diffraction and Optical Fiber Sensors

Lecture 19 - Review of Biomaterial Optics

Lecture 20 - Terahertz Based Detection and Circular Dichroism

Lecture 1 - Atmospheric Forces and Dynamics - Part 1

Lecture 2 - Atmospheric Forces and Dynamics - Part 2

Lecture 3 - Total Derivative (Introduction)

Lecture 4 - Total Derivative of a Vector in a Rotating Frame of Reference

Lecture 5 - Momentum Equations and its Vectorial Form in Spherical Polar Coordinates - Part 1

Lecture 6 - Momentum Equations and its Vectorial Form in Spherical Polar Coordinates - Part 2

Lecture 7 - Momentum Equations and its Vectorial Form in Spherical Polar Coordinates - Part 3

Lecture 8 - Total Derivative and Lagrangian

Lecture 9 - Continuity Equation: Eulerian

Lecture 10 - Energy Equations - Part 1

Lecture 11 - Energy Equations - Part 2

Lecture 12 - Scaling analysis - Part 1

Lecture 13 - Scaling analysis - Part 2

Lecture 14 - Scaling Analysis of Governing Equations - Part 1

Lecture 15 - Scaling Analysis of Governing Equations - Part 2

Lecture 16 - Scaling Analysis - Part 3, A Tutorial

Lecture 17 - Scaling Analysis - Part 4, A Tutorial

Lecture 18 - Introduction of Atmospheric Waves - Part 1

Lecture 19 - Introduction of Atmospheric Waves - Part 2

Lecture 20 - Problems based on Total Derivative - Part 1

Lecture 21 - Problems based on Total Derivative - Part 2

Lecture 22 - Shallow Water Gravity Waves - Part 1

Lecture 23 - Shallow Water Gravity Waves - Part 2

Lecture 24 - Acoustic Waves

Lecture 25 - Internal Gravity Waves - Part 1

Lecture 26 - Internal Gravity Waves - Part 2

Lecture 27 - Internal Gravity Waves - Part 3

Lecture 28 - Pressure as a vertical coordinate - Part 1

Lecture 29 - Pressure as a vertical coordinate - Part 2

Lecture 30 - Pressure as a vertical coordinate - Part 3

Lecture 31 - General circulation and global winds



- Lecture 32 - Introduction to different types of Fronts
- Lecture 33 - Geostrophic winds
- Lecture 34 - Natural coordinate and Inertial flows
- Lecture 35 - Cyclostrophic winds and Rossby number
- Lecture 36 - Gradient winds
- Lecture 37 - Thermal winds
- Lecture 38 - Problems on thermal winds
- Lecture 39 - Ionosphere introduction (Basics)- Part 1
- Lecture 40 - Ionosphere introduction (Different layers) - Part 2
- Lecture 41 - Ionosphere introduction (Photochemistry) - Part 3
- Lecture 42 - Ionosphere introduction (Recombination) - Part 4
- Lecture 43 - Composite F layer - Part 1
- Lecture 44 - Composite F layer - Part 2
- Lecture 45 - Composite F layer H/He ions - Part 3
- Lecture 46 - The Sun - Earth Energetics and Aurora
- Lecture 47 - Airglows and Aurora
- Lecture 48 - Sun's magnetic field, Formation of Aurora, and Solar cycle
- Lecture 49 - Sun's internal structure, Prominences
- Lecture 50 - Solar wind - Magnetosphere interactions
- Lecture 51 - Solar wind interactions with different planets
- Lecture 52 - Solar wind properties and its interaction with different planets
- Lecture 53 - Static Model of Corona
- Lecture 54 - Parker's Theory of Solar Wind Acceleration - Part 1
- Lecture 55 - Parker's Theory of Solar Wind Acceleration - Part 2
- Lecture 56 - Parker's Theory of Solar Wind Acceleration - Part 3
- Lecture 57 - Parker's Theory of Solar Wind Acceleration - Part 4
- Lecture 58 - Introduction to Space Weather - Part 1
- Lecture 59 - Introduction to Space Weather - Part 2
- Lecture 60 - Introduction to Space Weather - Part 3

Lecture 1 - Historical Background, Observational Astronomy, Properties of Sun and of Stars

Lecture 2 - Properties of Galaxies and Universe

Lecture 3 - Background of elemental abundance curve

Lecture 4 - Evidences of Nucleosynthesis - I

Lecture 5 - Evidences of Nucleosynthesis - II

Lecture 6 - Evidences of Nucleosynthesis - III and Mass gaps

Lecture 7 - H-R Diagram

Lecture 8 - M-L relation, Hubble's Law and Echo of Big Bang

Lecture 9 - Thermonuclear reactions and Reaction cross-section

Lecture 10 - Reaction rate

Lecture 11 - Reaction rate and Neutron induced reactions

Lecture 12 - Gamma induced reactions and Inverse reactions

Lecture 13 - Inverse reactions

Lecture 14 - Inverse reactions and Mean life time of a nuclei

Lecture 15 - Mean life time of a nuclei and Time dependent abundance evolution

Lecture 16 - Non-resonant charged particle induced reactions

Lecture 17 - Astrophysical S-factor and Non-resonant charged particle induced reactions

Lecture 18 - Gamow peak and Electron screening effect

Lecture 19 - Resonant reactions

Lecture 20 - Resonant reactions

Lecture 21 - Neutron induced non-resonant reactions

Lecture 22 - Burning stages of stars and Hydrogen burning

Lecture 23 - pp chain

Lecture 24 - pp chain and CN cycle

Lecture 25 - CNO cycle, Shell model and Gamma decay

Lecture 26 - Formation of  $^{12}\text{C}$

Lecture 27 - Survival of  $^{12}\text{C}$

Lecture 28 - Carbon, Neon, Oxygen and Silicon burning

Lecture 29 - Nucleosynthesis beyond Iron

Lecture 30 - s-, r- and p-process

Lecture 31 - Charged particle and Neutron beams

[Lecture 32 - Accelerators and Targets](#)

[Lecture 33 - Backing materials and Target preparation](#)

[Lecture 34 - Contaminants and Radiation sources](#)

[Lecture 35 - Detectors - I](#)

[Lecture 36 - Detectors - II](#)

[Lecture 37 - Activity method](#)

[Lecture 38 - Kinematics - I](#)

[Lecture 39 - Kinematics - II](#)

[Lecture 40 - Time of flight method and Indirect methods](#)

Lecture 1 - Course Overview

Lecture 2 - Introduction to Geometrical Optics

Lecture 3 - Ray Theory, Fermat's Principle

Lecture 4 - Refraction from Single Interface

Lecture 5 - Refraction from double interface

Lecture 6 - Matrix method in paraxial optics - I

Lecture 7 - Matrix Method in Paraxial Optics - II

Lecture 8 - Thick and Thin Lenses, Unit Planes

Lecture 9 - Nodal Planes, System of Thin Lenses

Lecture 10 - Problems on Geometrical Optics

Lecture 11 - Concept of Wavefront, Huygens Principle - I

Lecture 12 - Concept of Wavefront, Huygens Principle - II

Lecture 13 - Superposition of Waves

Lecture 14 - Introduction to Polarization, Linear and Circular Polarization

Lecture 15 - Elliptical Polarization

Lecture 16 - Interference of Light Waves, Interference of Polarized Light - I

Lecture 17 - Interference of Light Waves, Interference of Polarized Light - II

Lecture 18 - Young's Double Slit Experiment - I

Lecture 19 - Young's Double Slit Experiment - II

Lecture 20 - Interference with White Light, Displacement of Fringes, Fresnel's Biprism

Lecture 21 - Interference by Division of Amplitude

Lecture 22 - Thin Parallel Films, Wedge Shaped Films

Lecture 23 - Newton's Rings

Lecture 24 - Michelson Interferometer and Its Applications - I

Lecture 25 - Michelson Interferometer and Its Applications - II

Lecture 26 - Multiple Beam Interference

Lecture 27 - Fabry-Perot Interferometer and Etalon - I

Lecture 28 - Fabry-Perot Interferometer and Etalon - II

Lecture 29 - Concept of Coherence - I

Lecture 30 - Concept of Coherence - II

Lecture 31 - Introduction to Diffraction

- Lecture 32 - Fraunhofer Diffraction
- Lecture 33 - Single Slit Diffraction
- Lecture 34 - Double Slit Diffraction
- Lecture 35 - Multiple Slit Diffraction
- Lecture 36 - Diffraction at a Rectangular Aperture
- Lecture 37 - Diffraction at a Circular Aperture
- Lecture 38 - Diffraction Grating
- Lecture 39 - Grating Spectrum and Resolving Power
- Lecture 40 - Fresnel Diffraction
- Lecture 41 - Fresnel Half Period Zones
- Lecture 42 - Vibration Curve
- Lecture 43 - Circular Obstacle, Zone Plates
- Lecture 44 - Rectangular Aperture
- Lecture 45 - Diffraction of a Plane Wave by a Long Narrow Slit
- Lecture 46 - Brewster's Law, Malus' Law
- Lecture 47 - Phenomenon of Double Refraction
- Lecture 48 - Normal and Oblique Incidence
- Lecture 49 - Production of Polarized Light
- Lecture 50 - Quarter and Half Wave Plates
- Lecture 51 - Analysis of Polarized Light and Optical Activity
- Lecture 52 - Plane Wave Propagation in Anisotropic Media - I
- Lecture 53 - Plane Wave Propagation in Anisotropic Media - II
- Lecture 54 - Antireflecting Coating
- Lecture 55 - Basic Concepts of Holography - I
- Lecture 56 - Basic Concepts of Holography - II
- Lecture 57 - Basic Concepts and Ray Optics Consideration of Optical Fiber
- Lecture 58 - Introduction to Lasers - I
- Lecture 59 - Introduction to Lasers - II
- Lecture 60 - Trifle

Lecture 1 - Scalars vectors, and tensors - basic definitions

Lecture 2 - Scalars, vectors and tensors - most general definition

Lecture 3 - Elementary vector algebra - I (unit vector, dot product)

Lecture 4 - Elementary vector algebra - II (cross product, triple product)

Lecture 5 - Review of Newton's laws of motion - tools for analysis

Lecture 6 - Newton's laws of motion - third and second law

Lecture 7 - Newton's laws of motion - first law

Lecture 8 - Solving mechanics problems - how to draw free body diagram correctly

Lecture 9 - Mechanical equilibrium (statics) using force and torque balance

Lecture 10 - Mechanical equilibrium (statics) using force and torque balance - more examples

Lecture 11 - Mechanical equilibrium of rope like structures, nature of tension force

Lecture 12 - Massless, flexible suspension cable in mechanical equilibrium

Lecture 13 - Massive flexible suspension cable in mechanical equilibrium

Lecture 14 - Mechanical equilibrium of truss (framework) - nature of internal forces

Lecture 15 - Mechanical equilibrium of truss (framework) - examples

Lecture 16 - Mechanical equilibrium of truss - uniqueness of solution, beam with distributed load

Lecture 17 - Mechanical equilibrium of truss - more on beam with distributed load

Lecture 18 - Mechanical equilibrium - more examples, principle of virtual work, constrained motion

Lecture 19 - Mechanical equilibrium: constraints, degrees of freedom, work done by constrained force

Lecture 20 - d'Alembert - Lagrange principle of virtual work - statement and examples

Lecture 21 - Equivalence of principles of force, torque balance and virtual work, stability analysis

Lecture 22 - Mechanical equilibrium: stability analysis, energy diagram technique

Lecture 23 - Friction between solids - Amonton-Coulomb laws, common misconceptions

Lecture 24 - Friction between solids - worked out examples

Lecture 25 - Friction between solid and fluid - drag force

Lecture 26 - Friction examples - projectile motion with drag force, tying a rope

Lecture 27 - Work-energy theorem in one dimension, importance of conservation laws

Lecture 28 - Work-energy theorem in higher dimensions, conservative forces

Lecture 29 - Momentum balance principle, critical review: projectile motion in real-life

Lecture 30 - Projectile motion - effect of lift and thrust force by examples

Lecture 31 - More on rocket motion - comparing effect of thrust in deep space and at lift off

Lecture 32 - Collisions in daily life - application of energy and momentum balance principles

Lecture 33 - Collision at micro-meter, atomic and sub-atomic scales - Brownian motion, Compton effect

Lecture 34 - Concepts necessary for translation and rotation of rigid bodies - centre of mass

Lecture 35 - Centre of mass of composite objects

Lecture 36 - Concepts necessary for translation and rotation of rigid bodies - moment of inertia

Lecture 37 - More on moment of inertia - 3D objects, composite objects, engineering applications

Lecture 38 - Symmetry of mass distribution - product of inertia

Lecture 39 - Determining the principal axes of rotation and moment of inertia about them

Lecture 40 - Example of finding principal axes, introduction to rotation, the angular velocity vector

Lecture 41 - Rotation of rigid bodies - the angular momentum vector

Lecture 42 - Rotation of rigid bodies - torque

Lecture 43 - Translation and rotation of rigid bodies - computing rules

Lecture 44 - Translation and rotation of rigid bodies - examples (rolling, collision with rotation)

- Lecture 1 - Introduction to Plasma - I
- Lecture 2 - Introduction to Plasma - II
- Lecture 3 - Plasma Oscillations
- Lecture 4 - Debye Shielding
- Lecture 5 - Debye Potential - I
- Lecture 6 - Debye Potential - II
- Lecture 7 - Debye Length and Plasma Criteria
- Lecture 8 - More Aspects of Debye Shielding
- Lecture 9 - Numerical Problems on Debye Shielding - I
- Lecture 10 - Plasma as a Gas and Distribution of Velocities
- Lecture 11 - Numerical Problems on Debye Shielding - II
- Lecture 12 - Single-Particle Motion in Uniform Electric Field
- Lecture 13 - Single-Particle Motion in Uniform Magnetic Field - I
- Lecture 14 - Single-Particle Motion in Uniform Magnetic Field - II
- Lecture 15 - Single-Particle Motion in Uniform Magnetic Field - III
- Lecture 16 - Single-Particle Motion Under Uniform Magnetic field - IV
- Lecture 17 - Motion in Perpendicular Electric and Magnetic fields - I
- Lecture 18 - Motion in Perpendicular Electric and Magnetic fields - II
- Lecture 19 - Gradient Drift
- Lecture 20 - Gradient and Curvature Drifts
- Lecture 21 - Vacuum Drift
- Lecture 22 - Numerical Problems on Drifts
- Lecture 23 - Magnetic Mirroring - I
- Lecture 24 - Magnetic Mirroring - II
- Lecture 25 - Magnetic Mirroring - III
- Lecture 26 - Magnetic Mirroring - IV
- Lecture 27 - Motion in Time Varying Magnetic Field - I
- Lecture 28 - Motion in Time Varying Magnetic Field - II
- Lecture 29 - Motion in Time Varying Electric field - I
- Lecture 30 - Motion in Time Varying Electric field - II
- Lecture 31 - Plasma as a Fluid: Equation of Continuity



- Lecture 32 - Plasma as a Fluid: Fluid Equation - I
- Lecture 33 - Plasma as a Fluid: Fluid Equation - II
- Lecture 34 - Plasma as a fluid: Governing Equations
- Lecture 35 - MHD Approximation - I
- Lecture 36 - MHD Approximation - II
- Lecture 37 - Plasma as a fluid: Electric and Magnetic Properties - I
- Lecture 38 - Plasma as a fluid: Electric and Magnetic Properties - II
- Lecture 39 - Plasma as a fluid: Fluid Drift - I
- Lecture 40 - Plasma as a fluid: Fluid Drift - II
- Lecture 41 - Magnetic Pressure
- Lecture 42 - Wave in Plasma: Perturbation Theory
- Lecture 43 - Wave in Plasma: Plasma Oscillation
- Lecture 44 - Wave in Plasma: Dispersion Relation
- Lecture 45 - Ion Acoustic Wave - I
- Lecture 46 - Ion Acoustic Wave - II
- Lecture 47 - Ion Acoustic Wave - III
- Lecture 48 - Invalidity of Plasma Approximation - I
- Lecture 49 - Invalidity of Plasma Approximation - II
- Lecture 50 - Electromagnetic Waves in Plasma
- Lecture 51 - Collisions and Diffusion in Plasma - I
- Lecture 52 - Collisions and Diffusion in Plasma - II
- Lecture 53 - Ambipolar Diffusion - I
- Lecture 54 - Ambipolar Diffusion - II
- Lecture 55 - Diffusion Equation
- Lecture 56 - Diffusion in Presence of B - I
- Lecture 57 - Diffusion in Presence of B - II
- Lecture 58 - Instabilities in Plasma
- Lecture 59 - Laser Produced Plasma and Pulsed Laser Deposited (PLD) Thin Film - I
- Lecture 60 - Laser Produced Plasma and Pulsed Laser Deposited (PLD) Thin Film - II
- Lecture 61 - Surface Modification of Metallic Components by Plasma Nitriding - I
- Lecture 62 - Surface Modification of Metallic Components by Plasma Nitriding - II

**NPTEL : Relativistic Quantum Mechanics (Physics)**

**Co-ordinators : Prof. Apoorva D Patel**

Lecture 1 - Introduction, The Klein-Gordon equation

Lecture 2 - Particles and antiparticles, Two component framework

Lecture 3 - Coupling to electromagnetism, Solution of the Coulomb problem

Lecture 4 - Bohr-Sommerfeld semiclassical solution of the Coulomb problem, The Dirac equation and the Clifford algebra

Lecture 5 - Dirac matrices, Covariant form of the Dirac equation, Equations of motion, Spin, Free particle solutions

Lecture 6 - Electromagnetic interactions, Gyromagnetic ratio

Lecture 7 - The Hydrogen atom problem, Symmetries, Parity, Separation of variables

Lecture 8 - The Frobenius method solution, Energy levels and wavefunctions

Lecture 9 - Non-relativistic reduction, The Foldy-Wouthuysen transformation

Lecture 10 - Interpretation of relativistic corrections, Reflection from a potential barrier

Lecture 11 - The Klein paradox, Pair creation process and examples

Lecture 12 - Zitterbewegung, Hole theory and antiparticles

Lecture 13 - Charge conjugation symmetry, Chirality, Projection operators, The Weyl equation

Lecture 14 - Weyl and Majorana representations of the Dirac equation, Unitary and antiunitary symmetries

Lecture 15 - Time reversal symmetry, The PCT invariance

Lecture 16 - Arrow of time and particle-antiparticle asymmetry, Band theory for graphene

Lecture 17 - Dirac equation structure of low energy graphene states, Relativistic signatures in graphene properties

Lecture 18 - Groups and symmetries, The Lorentz and Poincare groups

Lecture 19 - Group representations, generators and algebra, Translations, rotations and boosts

Lecture 20 - The spinor representation of  $SL(2,C)$ , The spin-statistics theorem

Lecture 21 - Finite dimensional representations of the Lorentz group, Euclidean and Galilean groups

Lecture 22 - Classification of one particle states, The little group, Mass, spin and helicity

Lecture 23 - Massive and massless one particle states

Lecture 24 - P and T transformations, Lorentz covariance of spinors

Lecture 25 - Lorentz group classification of Dirac operators, Orthogonality and completeness of Dirac spinors, Projection operators

Lecture 26 - Propagator theory, Non-relativistic case and causality

Lecture 27 - Relativistic case, Particle and antiparticle contributions, Feynman prescription and the propagator

Lecture 28 - Interactions and formal perturbative theory, The S-matrix and Feynman diagrams

Lecture 29 - Trace theorems for products of Dirac matrices

Lecture 30 - Photons and the gauge symmetry

Lecture 31 - Abelian local gauge symmetry, The covariant derivative and invariants

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Lecture 32 - Charge quantisation, Photon propagator, Current conservation and polarisations

Lecture 33 - Feynman rules for Quantum Electrodynamics, Nature of perturbative expansion

Lecture 34 - Dyson's analysis of the perturbation series, Singularities of the S-matrix, Elementary QED processes

Lecture 35 - The T-matrix, Coulomb scattering

Lecture 36 - Mott cross-section, Compton scattering

Lecture 37 - Klein-Nishina result for cross-section

Lecture 38 - Photon polarisation sums, Pair production through annihilation

Lecture 39 - Unpolarised and polarised cross-sections

Lecture 40 - Helicity properties, Bound state formation

Lecture 41 - Bound state decay, Non-relativistic potentials

Lecture 42 - Lagrangian formulation of QED, Divergences in Green's functions, Superficially divergent 1-loop diagrams and regularisation

Lecture 43 - Infrared divergences due to massless particles, Renormalisation and finite physical results

Lecture 44 - Symmetry constraints on Green's functions, Furry's theorem, Ward-Takahashi identity, Spontaneous breaking of gauge symmetry and superconductivity

Lecture 45 - Status of QED, Organisation of perturbative expansion, Precision tests

Lecture 1 - Introduction

Lecture 2 - Linear Systems

Lecture 3 - Homogeneous linear time invariant ordinary differential equations

Lecture 4 - In-homogeneous linear time invariant ordinary differential equations

Lecture 5 - Fourier transforms - Part 1

Lecture 6 - Fourier transforms - Part 2

Lecture 7 - Laplace transforms - Part 1

Lecture 8 - Laplace transforms - Part 2

Lecture 9 - Introduction to feedback control - Part 1

Lecture 10 - Introduction to feedback control - Part 2

Lecture 11 - Nyquist stability theory - Part 1

Lecture 12 - Nyquist stability theory - Part 2

Lecture 13 - Nyquist stability theory - Part 3

Lecture 14 - Bode plots

Lecture 15 - Steps for performing control design - Part 1

Lecture 16 - Steps for performing control design - Part 2

Lecture 17 - General controllers - Part 1

Lecture 18 - General controllers - Part 2

Lecture 19 - General controllers - Part 3

Lecture 20 - Bode plot-based control design - Part 1

Lecture 21 - Bode plot-based control design - Part 2

Lecture 22 - Introduction to root-locus

Lecture 23 - Control system design using root-locus

Lecture 24 - Control of systems with some known parameters - Part 1

Lecture 25 - Control of systems with some known parameters - Part 2

Lecture 26 - Limitations of 1-degree of freedom control

Lecture 27 - Introduction to 2-degree of freedom control

Lecture 28 - 2-Degree of freedom robust control design for plants with gain uncertainty - Part 1

Lecture 29 - 2-Degree of freedom robust control design for plants with uncertain gain - Part 2

Lecture 30 - 2-Degree of freedom robust control design for plants with uncertain pole

Lecture 31 - 2-Degree of freedom robust control design for plants with multiple uncertainties in their structure

Lecture 32 - Issues connected with 2-Degree of freedom control design using root-locus

Lecture 33 - Introduction to Nichols plot

Lecture 34 - Feedback control design using Nichols plot

Lecture 35 - Robust control design using Quantitative feedback theory - Part 1

Lecture 36 - Robust control design using Quantitative feedback theory - Part 2

Lecture 37 - Tutorial on QFT Toolbox software - Part 1

Lecture 38 - Tutorial on QFT Toolbox software - Part 2

Lecture 39 - Tutorial on QFT Toolbox software - Part 3

Lecture 40 - Fundamental properties of the loop gain - Part 1

Lecture 41 - Fundamental properties of the loop gain - Part 2

Lecture 42 - Ideal Bode Characteristic - Part 1

Lecture 43 - Ideal Bode Characteristic - Part 2

Lecture 44 - Introduction to nonminimum phase systems

Lecture 45 - Fundamental properties of nonminimum phase systems - Part 1

Lecture 46 - Fundamental properties of nonminimum phase systems - Part 2

Lecture 47 - Fundamental properties of unstable systems

Lecture 48 - Consequences of actuator bandwidth limitations while controlling unstable systems

Lecture 49 - Describing functions - Part 1

Lecture 50 - Describing functions - Part 2

- Lecture 1 - Born-Oppenheimer approximation
- Lecture 2 - Self-consistent field (SCF) method
- Lecture 3 - Simple MO Theory of Hydrogen Molecule
- Lecture 4 - Bloch's theorem
- Lecture 5 - Tight binding approximation
- Lecture 6 - Energy band theory - 1
- Lecture 7 - Energy band theory - 2
- Lecture 8 - Density of states
- Lecture 9 - Energy band theory - 3
- Lecture 10 - Energy band theory - 4
- Lecture 11 - Drude's classical free electron model - 1
- Lecture 12 - Drude's classical free electron model - 2
- Lecture 13 - Drude's classical free electron model - 3
- Lecture 14 - Drude's classical free electron model - 4
- Lecture 15 - Sommerfeld's quantum free electron model
- Lecture 16 - Specific heat of Fermi gas
- Lecture 17 - Energy dispersion relation in a periodic potential - 1
- Lecture 18 - Energy dispersion relation in a periodic potential - 2
- Lecture 19 - Brief overview of space groups and constant energy surface in 2D
- Lecture 20 - Energy band and effective mass
- Lecture 21 - Effective mass
- Lecture 22 -  $k \cdot p$  perturbation method
- Lecture 23 - Revisiting Bloch's theorem and tight binding functions
- Lecture 24 - Symmetries in crystal Hamiltonian - 1
- Lecture 25 - Symmetries in crystal Hamiltonian - 2
- Lecture 26 - Tight binding method - 1
- Lecture 27 - Tight binding method - 2
- Lecture 28 - Tight binding method - 3
- Lecture 29 - Plane wave method
- Lecture 30 - Pseudo potential method
- Lecture 31 - Cellular method of energy band calculation

- Lecture 32 - Muffin tin potential and APW functions
- Lecture 33 - Augmented plane wave method of energy band calculation - 1
- Lecture 34 - Augmented plane wave method of energy band calculation - 2
- Lecture 35 - Greenâ€™s function method of energy band calculation - 1
- Lecture 36 - Greenâ€™s function method of energy band calculation - 2
- Lecture 37 - Cyclotron resonance technique
- Lecture 38 - De Haas-van Alphen effect
- Lecture 39 - De Haas-van Alphen effect conclusion.Introduction to point impurity effect on band structure
- Lecture 40 - Point impurity in crystal
- Lecture 41 - Friedel Oscillations
- Lecture 42 - Lindhard dielectric constant
- Lecture 43 - Dielectric anomaly. Crystal momentum
- Lecture 44 - Spatial and time reversal symmetries in crystals
- Lecture 45 - Time reversal symmetry (Continued...)
- Lecture 46 - Spin orbit interaction
- Lecture 47 - Disordered solids and transport in disordered solids
- Lecture 48 - Optical properties of semiconductors
- Lecture 49 - Excitonic states in semiconductors
- Lecture 50 - Excitonic states in semiconductors (Continued...)
- Lecture 51 - Molecular orbital calculation - I
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[Lecture 34 - High Level Optimizations - Part 6](#)

Lecture 1 - Introduction to Computational Geometry

Lecture 2 - Convex hull

Lecture 3 - Quick hull

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Lecture 5 - Voronoi Diagram - I

Lecture 6 - Convex Geometry - I

Lecture 7 - Convex Geometry - II

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Lecture 11 - Polygon Triangulation

Lecture 12 - Geometric and Abstract Simplicial Complexes

Lecture 13 - Convex Polytopes and Polyhedra

Lecture 14 - Art Gallery Theorem

Lecture 15 - Smallest Enclosing Disc

Lecture 16 - Point Hyperplane Duality

Lecture 17 - Voronoi Diagrams and Delaunay triangulations - I

Lecture 18 - Voronoi Diagrams and Delaunay triangulations - II

Lecture 19 - Point Location

Lecture 20 - Range Searching (KD Tree)

Lecture 21 - Range Searching (Range Tree)

Lecture 22 - Visibility Graph and motion planning

Lecture 23 - Geometric Approximation: The Shifting Strategy, Hochbaum and Mass, 1984

Lecture 24 - Application of incidence geometry in combinatorics

Lecture 25 - Robot motion planning and visibility

Lecture 26 - Reeb Graph Introduction and Morse Theory basics

Lecture 27 - Reeb Graph Properties

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Lecture 29 - Arrangements - I

Lecture 30 - Linear Programming

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[Lecture 32 - Zone Theorem and Application](#)

[Lecture 33 - Randomized Incremental Construction - I](#)

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[Lecture 35 - VC-dimension, Epsilon-nets, LP-based approximation for Geometric Covering](#)

[Lecture 36 - Quasi-uniform Sampling for Weighted Covering Problems.](#)

[Lecture 37 - Local Search for Packing and Covering](#)

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# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

**NPTEL : ACM Summer School on Algorithmic and Theoretical Aspects of Machine Learning (Special Lecture Series)**

**Co-ordinators : Meenakshi D'Souza**

Lecture 1 - Learning on Finite State Automata and Decision Session - 1

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Lecture 3 - Learning on Finite State Automata and Decision Session - 3

Lecture 4 - Probability Session - 1

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Lecture 14 - Algebra for Machine Learning Session - 1

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Lecture 17 - Crptography and Machine Learning

Lecture 18 - Neural Networks Session - 1

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Lecture 22 - Neural Networks Session - 5

Lecture 23 - Enterprise Applications of ML Session - 1

Lecture 24 - Basic of Algorithm Design Session - 1

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Lecture 28 - Introduction to Optimization Session - 1

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Lecture 30 - Introduction to Reinforcement Learning Session - 1

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**HTML Links for 1,14,300+ NPTEL Video Lectures, Created by LinuXpert Systems, Chennai**

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Lecture 2 - Introduction to Cloud Computing - Part 1

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Lecture 4 - Cloud IaaS and Virtualization

Lecture 5 - System Virtualization

Lecture 6 - Mechanisms for System Virtualization

Lecture 7 - Containers - Part 1

Lecture 8 - Containers - Part 2

Lecture 9 - AI and Hybrid Cloud

Lecture 10 - Container Orchestration - Part 1

Lecture 11 - Container Orchestration - Part 2

Lecture 12 - Container Orchestration - Part 3

Lecture 13 - Application Devops - Part 1

Lecture 14 - Application Devops - Part 2

Lecture 15 - Application Devops - Part 3

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Lecture 18 - Application Devops - Part 6

Lecture 19 - Cloud as Distributed System - Part 1

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- Lecture 1 - Review of Basic Concepts - Dr. Abhijat Vichare - Session - 1
- Lecture 2 - Review of Basic Concepts - Dr. Abhijat Vichare - Session - 2
- Lecture 3 - Review of Basic Concepts - Dr. Abhijat Vichare - Session - 3
- Lecture 4 - Introduction to Lex and Yacc - Sameera Deshpande - Session - 1
- Lecture 5 - Introduction to Lex and Yacc - Sameera Deshpande - Session - 2
- Lecture 6 - Hello world, Revisiting the first program we write in c - Siddhesh Poyarekar - Session - 1
- Lecture 7 - Compiler as system - Vivek Buzruk - Session - 1
- Lecture 8 - Compiler as system - Vivek Buzruk - Session - 2
- Lecture 9 - Introduction to Data Flow Analysis - Prof. Uday Khedker - Session - 1
- Lecture 10 - Introduction to Data Flow Analysis - Prof. Uday Khedker - Session - 2
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- Lecture 15 - Undefined Behavior Compiler Optimization - Prathamesh K Session - 1
- Lecture 16 - Program Semantics - Prof. Subhajit Roy Session - 1
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- Lecture 24 - Introduction to Optimizations - Prof. V. Krishna N Session - 1
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- Lecture 28 - Compiler as system - Vivek S. Buzruk Session - 1
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Lecture 1 - Basics of Computer Architecture and OS

Lecture 2 - An Introduction to High Performance Computing

Lecture 3 - Introduction to OpenMP

Lecture 4 - Advanced OpenMP

Lecture 5 - Introduction to MPI

Lecture 6 - Advanced MPI

Lecture 7 - Supercomputing in India

Lecture 8 - Job Scheduling

Lecture 9 - Introduction to GPU

Lecture 10 - Introduction to Open ACC

Lecture 11 - CPU and GPU Memory

Lecture 12 - Optimizations and GPU Profiling

Lecture 13 - CUDA C

Lecture 14 - HPC Networking - I

Lecture 15 - HPC Networking - II

Lecture 16 - Research in HPS

Lecture 17 - Case Study - Parallel Graph Algorithms

Lecture 18 - Case Study - Solving PDEs at Extreme Scale

Lecture 1 - Basic thermodynamic functions: Enthalpy, entropy, configurational entropy, Gibbs free energy

Lecture 2 - State of equilibrium: Chemical potential, activity, equilibrium between solutions

Lecture 3 - Case study: Mechanical alloying, alloying by deformation.

Lecture 4 - Computer calculation of phase diagrams

Lecture 5 - Thermodynamics of irreversible processes: Multiple irreversible processes

Lecture 6 - Quasichemical solutions

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- Lecture 5 - Basics of Architecture - Part 4
- Lecture 6 - A Review of Architectural Features for supporting Program Execution - Part 1
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- Lecture 30 - The Future of Compute - Part 1
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Lecture 2 - Panel Discussion Q and A - Part 2

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Lecture 4 - Runtime and Linkers - Discussion - 2

Lecture 5 - Runtime and Linkers - Linkers

Lecture 6 - Runtime and Linkers - Program Execution - Loader

Lecture 7 - Runtime and Linkers - Static Libraries - Dynamic Linking

Lecture 8 - Code Generation and Backend - An Introduction to LLVM Backend

Lecture 9 - Code Generation and Backend - An Introduction to Loop Backend

Lecture 10 - Code Generation and Backend - Code Generation with LLVM - Part 1

Lecture 11 - Code Generation and Backend - Code Generation with LLVM - Part 2

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Lecture 20 - Machine Architecture and Machine Dependent Optimizations - Machine Architecture - 3

Lecture 21 - Machine Architecture and Machine Dependent Optimizations - Register Allocation - 1

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# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

**NPTEL : ACM Winter School on Design, Implementation and Verification of Computer Systems (Special Lecture Series)**

**Co-ordinators : Multi-Faculty**

Lecture 1 - Mathematical Logic - Session 1

Lecture 2 - Mathematical Logic - Session 2

Lecture 3 - Industry Perspectives on Compiler Design

Lecture 4 - Processor Datapath and Introduction to ILP Architecture - Session 1

Lecture 5 - Processor Datapath and Introduction to ILP Architecture - Session 2

Lecture 6 - Instruction Level Parallelism - Session 1

Lecture 7 - Multithreading and Multicores

Lecture 8 - Instruction Level Parallelism - Session 2

Lecture 9 - DRAM Memory Organization

Lecture 10 - Reactive Synthesis: A High-Level Introduction - Session 1

Lecture 11 - Reactive Synthesis: A High-Level Introduction - Session 2

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Lecture 14 - Reduced Ordered Binary Decision Diagrams and And-Inverter Graphs - Session 1

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Lecture 19 - Hexagon DSPs in Snapdragon

Lecture 20 - Types and Program Analysis

Lecture 21 - Local and Global Optimizations

Lecture 22 - Introduction to Data-Flow and Control-Flow Analyses

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[Lecture 2 - Hilbert's Tenth Problem](#)

[Lecture 3 - SAT Solvers](#)

[Lecture 4 - Polynomial Identity Testing](#)

[Lecture 5 - Finite Graphs for Infinite Functions](#)

[Lecture 6 - A Panorama of Computational Problems](#)



# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

**NPTEL : ACM India Summer School on IoT and Embedded Systems (Special Lecture Series)**

**Co-ordinators : Prof. Meenakshi DSouza**

[Lecture 1 - ACM India Summer School on IoT and Embedded Systems - Introduction](#)

[Lecture 2 - Embedded Sysyem: An Introduction](#)

[Lecture 3 - Introducton to Embedded Sysyems](#)

[Lecture 4 - Introduction to IoT](#)

[Lecture 5 - AWS IoT: Tutorial and demonstration](#)

[Lecture 6 - IoT: Components, operating systems and protocols](#)

[Lecture 7 - Arduino programming](#)

[Lecture 8 - Arduino programming: Tutorial](#)

[Lecture 9 - IoT Applications](#)

[Lecture 10 - IoT Applications: Tutorial and demonstration - 1](#)

[Lecture 11 - IoT Applications: Tutorial and demonstration - 2](#)

[Lecture 12 - Cloud, edge and fog computing for IoT - Part I](#)

[Lecture 13 - Cloud, edge and fog computing for IoT - Part II](#)

[Lecture 14 - IoT Communication](#)

Lecture 1 - Introduction - ACM India Summer School on Algorithms for Data Science

Lecture 2 - Introduction to Probability

Lecture 3 - Selection Problems

Lecture 4 - Median from Read-Only Memory

Lecture 5 - Majority and Heavy Hitters

Lecture 6 - Introduction to Probability Tail inequalities

Lecture 7 - Chernoff Bounds

Lecture 8 - Quickselect and Quicksort

Lecture 9 - Introduction to Randomized Algorithms: Graph Minimum Cut

Lecture 10 - Introduction to Streaming Algorithm and Reservoir Sampling

Lecture 11 - Approximate Counting in Streaming: MORRIS Counter

Lecture 12 - Median of Means Technique Applied to Approximate Counting

Lecture 13 - Counting Distinct Elements in Streaming

Lecture 14 - 2-Universal Hashing and Applications for Derandomizing

Lecture 15 - Approximate Heavy Hitters

Lecture 16 - Frequency Moments

Lecture 17 - Graph Streaming Algorithms

Lecture 18 - Locality Sensitive Hashing - Part 1

Lecture 19 - Locality Sensitive Hashing - Part 2

Lecture 20 - Locality Sensitive Hashing - Part 3

Lecture 21 - Graph Streaming Lower Bounds

Lecture 22 - Bloom Filters

Lecture 23 - Frequent Pattern Mining - Part 1

Lecture 24 - Frequent Pattern Mining - Part 2

Lecture 25 - Is AI ready for The real world?

Lecture 26 - Online Learning and Multiarmed Bandits - Part 1

Lecture 27 - Online Learning and Multiarmed Bandits - Part 2

Lecture 28 - Reinforcement Learning - Part 1

Lecture 29 - Reinforcement Learning - Part 2

Lecture 30 - Singular Value Decomposition - Part 1

Lecture 31 - Singular Value Decomposition - Part 2

[Lecture 32 - Graph Centralities](#)

[Lecture 33 - Johnson Lindenstrauss Lemma](#)

[Lecture 34 - Graph Centralities Clustering and Partition](#)

Lecture 1 - Mathematical Foundation for Cryptography - Part 1

Lecture 2 - Mathematical Foundation for Cryptography - Part 2

Lecture 3 - Modern Cryptography

Lecture 4 - Modern Cryptography

Lecture 5 - Modern Cryptography - Asymmetric Cryptography

Lecture 6 - Network Security protocols and mechanisms - Part 1

Lecture 7 - Network Security protocols and mechanisms - Part 2

Lecture 8 - IOT Security Protocols - Part 1

Lecture 9 - IOT Security Protocols - Part 2

Lecture 10 - Introduction to Ethical Hacking - Part 1

Lecture 11 - Introduction to Ethical Hacking - Part 2

Lecture 12 - DevSecOps Embedding Security into DevOps - Part 1

Lecture 13 - Web App Security

Lecture 14 - Navigating the privacy landscape

Lecture 15 - Hardware security

Lecture 16 - Introduction to Blockchain

Lecture 17 - Social Engineering and OSINT - Part 1

Lecture 18 - Social Engineering and OSINT - Part 2

Lecture 19 - Cloud Security and Secure Coding Practices - Part 1

Lecture 20 - Cloud Security and Secure Coding Practices - Part 2

Lecture 21 - Career Opportunities, Challenges and Support

Lecture 22 - Quantum Cryptography - Part 1

Lecture 23 - Quantum Cryptography - Part 2

Lecture 24 - AI in cybersecurity

**NPTEL : Theory of Yarn Structures (Textile Engineering)**

**Co-ordinators : Prof. Bohuslav Neckar**

Lecture 1 - Fibers and Yarns : Terms, Definitions and Relations

Lecture 2 - Fibers and Yarns : Terms, Definitions and Relations

Lecture 3 - Compression of Fibrous Assemblies

Lecture 4 - Compression of Fibrous Assemblies (Continued...)

Lecture 5 - Pores Among Fibers

Lecture 6 - Pores Among Fibers (Continued...)

Lecture 7 - Orientation of Fibers

Lecture 8 - Orientation of Fibers (Continued...)

Lecture 9 - Mechanics of Parallel Fiber Bundles

Lecture 10 - Mechanics of Parallel Fiber Bundles (Continued...)

Lecture 11 - Modelling of Internal Yarn Geometry

Lecture 12 - Modelling of Internal Yarn Geometry

Lecture 13 - Relations Among Yarn Count T, Twist Z, Packing Density, And Diameter D

Lecture 14 - Relations Among Yarn Count T, Twist Z, Packing Density, And Diameter D (Continued...)

Lecture 15 - Relations Among Yarn Count T, Twist Z, Packing Density, And Diameter D (Continued...)

Lecture 16 - Relations Among Yarn Count T, Twist Z, Packing Density, And Diameter D (Continued...)

Lecture 17 - Bundle Theory of Yarn Unevenness

Lecture 18 - Bundle Theory of Yarn Unevenness (Continued...)

Lecture 19 - Yarn Strength as a Stochastic Process

Lecture 20 - Yarn Strength as a Stochastic Process (Continued...)

Lecture 1 - Science of Clothing Comfort-Outline

Lecture 2 - Understanding Clothing and Clothing Comfort

Lecture 3 - Understanding Clothing and Clothing Comfort (Continued...)

Lecture 4 - Understanding Clothing and Clothing Comfort (Continued...)

Lecture 5 - Psychology and Comfort

Lecture 6 - Psychology and Comfort (Continued...)

Lecture 7 - Psychology and Comfort (Continued...)

Lecture 8 - Psychology and Comfort (Continued...)

Lecture 9 - Neurophysiological Processes in Clothing Comfort

Lecture 10 - Neurophysiological Processes in Clothing Comfort (Continued...)

Lecture 11 - Neurophysiological Processes in Clothing Comfort (Continued...)

Lecture 12 - Neurophysiological Processes in Clothing Comfort (Continued...)

Lecture 13 - Neurophysiological Processes in Clothing Comfort (Continued...)

Lecture 14 - Neurophysiological Processes in Clothing Comfort (Continued...)

Lecture 15 - Tactile Aspects of Clothing Comfort

Lecture 16 - Tactile Aspects of Clothing Comfort (Continued...)

Lecture 17 - Tactile Aspects of Clothing Comfort (Continued...)

Lecture 18 - Tactile Aspects of Clothing Comfort (Continued...)

Lecture 19 - Understanding Clothing and Clothing Comfort (Continued...)

Lecture 20 - Tactile Aspects of Clothing Comfort (Continued...)

Lecture 21 - Tactile Aspects of Clothing Comfort (Continued...)

Lecture 22 - Clothing Comfort Related to Thermal Transmission

Lecture 23 - Clothing Comfort Related to Thermal Transmission (Continued...)

Lecture 24 - Clothing Comfort Related to Thermal Transmission (Continued...)

Lecture 25 - Clothing Comfort Related to Thermal Transmission (Continued...)

Lecture 26 - Clothing Comfort Related to Thermal Transmission (Continued...)

Lecture 27 - Clothing Comfort Related to Thermal Transmission (Continued...)

Lecture 28 - Clothing Comfort Related to Thermal Transmission (Continued...)

Lecture 29 - Moisture Transmission and Clothing Comfort

Lecture 30 - Moisture Transmission and Clothing Comfort (Continued...)

Lecture 31 - Moisture Transmission and Clothing Comfort (Continued...)

[Lecture 32 - Moisture Transmission and Clothing Comfort \(Continued...\)](#)

[Lecture 33 - Moisture Transmission and Clothing Comfort \(Continued...\)](#)

[Lecture 34 - Moisture Transmission and Clothing Comfort \(Continued...\)](#)

[Lecture 35 - Moisture Transmission and Clothing Comfort \(Continued...\)](#)

[Lecture 36 - Combined Heat and Mass Transmission and Clothing Comfort](#)

[Lecture 37 - Combined Heat and Mass Transmission and Clothing Comfort \(Continued...\)](#)

[Lecture 38 - Thermo-Physiological Comfort of Functional Clothing](#)

[Lecture 39 - Garment Fit and Comfort](#)

[Lecture 40 - Garment Fit and Comfort \(Continued...\)](#)

- Lecture 1 - Impurities and Contaminants in Cotton
- Lecture 2 - Opening Principle and Opening Devices
- Lecture 3 - Cleaning Principle
- Lecture 4 - Machines and their Layout
- Lecture 5 - Bale Opening Machines
- Lecture 6 - Machines in Blow Room - Part II
- Lecture 7 - Opening Cleaning Machines - Part II
- Lecture 8 - Mixing/Blending
- Lecture 9 - Transportation of Tuft
- Lecture 10 - Lap formation and Material Flow Regulation
- Lecture 11 - Process Performance
- Lecture 12 - Introduction
- Lecture 13 - Card Feed Zone
- Lecture 14 - Carding Zone
- Lecture 15 - Analysis of flat action
- Lecture 16 - Sliver Formation
- Lecture 17 - Package Formation
- Lecture 18 - Card Clothing
- Lecture 19 - Card Setting, Draft, Production
- Lecture 20 - Fibre Configuration and Neps in Card sliver
- Lecture 21 - Carding Process
- Lecture 22 - Numerical Problems and Solution
- Lecture 23 - Introduction and Drafting principle
- Lecture 24 - Design Features and operating principle of drawframe
- Lecture 25 - Drafting Rolles,Web Condensation and Packaging
- Lecture 26 - Drafting Roller Arrangement
- Lecture 27 - Drafting Theory,Wave Fromation and Control
- Lecture 28 - Drafting Force and Roller Slip
- Lecture 29 - Significance of Process Parameters
- Lecture 30 - Draft and production Calculation
- Lecture 31 - Blending on Drawframe



[Lecture 32 - Process Monitoring and Control](#)

[Lecture 33 - Drawframe Autoleveller](#)

[Lecture 34 - Card Autoleveller](#)

[Lecture 35 - Numericals on Drawing](#)

Lecture 1 - Evaluation of Textile Materials - Outline

Lecture 2 - Evaluation of Textile Materials - Outline (Continued...)

Lecture 3 - Sampling Methods and Sample Size

Lecture 4 - Sampling Methods and Sample Size (Continued...)

Lecture 5 - Sampling Methods and Sample Size (Continued....)

Lecture 6 - Sampling Methods and Sample Size: Practical Statistics

Lecture 7 - Sampling Methods and Sample Size: Practical Statistics (Continued...)

Lecture 8 - Sampling Methods and Sample Size: Practical Statistics (Continued...)

Lecture 9 - Evaluation of Fibre Length

Lecture 10 - Evaluation of Fibre Length (Continued...)

Lecture 11 - Evaluation of Fibre Length (Continued...)

Lecture 12 - Evaluation of Fibre Fineness

Lecture 13 - Evaluation of Fibre Fineness - 1

Lecture 14 - Evaluation of Cotton Fibre Maturity

Lecture 15 - Evaluation of Cotton Fibre Properties: (HVI and AFIS)

Lecture 16 - Evaluation of Linear Density of Textile Materials

Lecture 17 - Evaluation of Linear Density of Textile Materials (Continued...)

Lecture 18 - Evaluation of Tensile Properties of Textile Materials

Lecture 19 - Evaluation of Tensile Properties of Textile Materials (Continued...)

Lecture 20 - Evaluation of Tensile Properties of Textile Materials-1 (Continued...)

Lecture 21 - Evaluation of Tensile Properties of Textile Materials-2 (Continued...)

Lecture 22 - Evaluation of Tensile Properties of Textile Materials-3 (Continued...)

Lecture 23 - Evaluation of Tensile Properties of Textile Materials-4 (Continued...)

Lecture 24 - Evaluation of Tensile Properties of Textile Materials-5 (Continued...)

Lecture 25 - Evaluation of Yarn and Fabric Hairiness

Lecture 26 - Evaluation of Yarn and Fabric Hairiness (Continued...)

Lecture 27 - Evaluation of Yarn Twist

Lecture 28 - Evaluation of Yarn Twist (Continued...)

Lecture 29 - Evaluation of Moisture in Textiles

Lecture 30 - Evaluation of Moisture in Textiles (Continued...)

Lecture 31 - Evaluation of Yarn Evenness

[Lecture 32 - Evaluation of Yarn Evenness-1 \(Continued...\)](#)

[Lecture 33 - Evaluation of Yarn Evenness-2 \(Continued...\)](#)

[Lecture 34 - Evaluation of Yarn Evenness-3 \(Continued...\)](#)

[Lecture 35 - Evaluation of Yarn Evenness-3 \(Continued...\)](#)

[Lecture 36 - Evaluation of Yarn Evenness-4 \(Continued...\)](#)

[Lecture 37 - Evaluation of Bursting and Tear Strength of Fabrics](#)

[Lecture 38 - Evaluation of Pilling and Abrasion Properties of Fabrics](#)

[Lecture 39 - Evaluation of Low Stress Mechanical Properties of Textile Materials](#)

[Lecture 40 - Evaluation of Low Stress Mechanical Properties of Textile Materials \(Continued...\)](#)

- Lecture 1 - Testing of Low Stress mechanical Properties of Textile Fabrics
- Lecture 2 - Testing of Low Stress mechanical Properties of Textile Fabrics (Continued...)
- Lecture 3 - Testing of Low Stress mechanical Properties of Textile Fabrics (Continued...)
- Lecture 4 - Testing of Transmission Characteristics of Textile Fabrics
- Lecture 5 - Testing of Transmission Characteristics of Textile Fabrics (Continued...)
- Lecture 6 - Testing of Transmission Characteristics of Textile Fabrics (Continued...)
- Lecture 7 - Testing of Transmission Characteristics of Textile Fabrics (Continued...)
- Lecture 8 - Testing of Transmission Characteristics of Textile Fabrics (Continued...)
- Lecture 9 - Testing of Transmission Characteristics of Textile Fabrics (Continued...)
- Lecture 10 - Testing of Fibre Reinforced Composite Materials
- Lecture 11 - Testing of Fibre Reinforced Composite Materials (Continued...)
- Lecture 12 - Testing of Fibre Reinforced Composite Materials (Continued...)
- Lecture 13 - Testing of Fibre Reinforced Composite Materials (Continued...)
- Lecture 14 - Testing of Fibre Reinforced Composite Materials (Continued...)
- Lecture 15 - Testing of Fibre Fabrics
- Lecture 16 - Testing of Fibre Fabrics (Continued...)
- Lecture 17 - Testing of Fibre Fabrics (Continued...)
- Lecture 18 - Testing of Geotextiles
- Lecture 19 - Testing of Geotextiles (Continued...)
- Lecture 20 - Testing of Geotextiles (Continued...)
- Lecture 21 - Testing of Ballistics Protective Clothing
- Lecture 22 - Testing of UV Radiation Protective Textiles
- Lecture 23 - Testing of Compression Bandages
- Lecture 24 - Testing of Electromagnetic Shielding Textiles

[Lecture 1 - The Building Block of Yarns](#)

[Lecture 2 - The Building Block of Yarns \(Continued...\)](#)

[Lecture 3 - Basic Characteristics of Yarns](#)

[Lecture 4 - Basic Characteristics of Yarns \(Continued...\)](#)

[Lecture 5 - Basic Characteristics of Yarns \(Continued...\)](#)

[Lecture 6 - Relations Among Yarn Count, Twist, and Diameter](#)

[Lecture 7 - Relations Among Yarn Count, Twist, and Diameter \(Continued...\)](#)

[Lecture 8 - Helical Model of Fibers in Yarns](#)

[Lecture 9 - Helical Model of Fibers in Yarns \(Continued...\)](#)

[Lecture 10 - Helical Model of Fibers in Yarns \(Continued...\)](#)

[Lecture 11 - Helical Model of Fibers in Yarns \(Continued...\)](#)

[Lecture 12 - Mass Irregularity of Yarns](#)

[Lecture 13 - Mass Irregularity of Yarns \(Continued...\)](#)

[Lecture 14 - Mass Irregularity of Yarns \(Continued...\)](#)

[Lecture 15 - Mass Irregularity of Yarns \(Continued...\)](#)

[Lecture 16 - Radial Migration of Fibres in Yarns](#)

[Lecture 17 - Radial Migration of Fibres in Yarns \(Continued...\)](#)

[Lecture 18 - Radial Migration of Fibres in Yarns \(Continued...\)](#)

[Lecture 19 - Yarn Shrinkage due to Washing](#)

[Lecture 20 - Tensile Mechanics of Yarns](#)

[Lecture 21 - Tensile Mechanics of Yarns \(Continued...\)](#)

[Lecture 22 - Tensile Mechanics of Yarns \(Continued...\)](#)

[Lecture 23 - Tensile Mechanics of Yarns \(Continued...\)](#)

[Lecture 24 - Tensile Mechanics of Yarns \(Continued...\)](#)

- Lecture 1 - Conventional Printing
- Lecture 2 - Colourants
- Lecture 3 - Dyes and pigments
- Lecture 4 - Thickeners
- Lecture 5 - Measurement of viscosity
- Lecture 6 - Discharge and resist printing
- Lecture 7 - Transfer Printing
- Lecture 8 - Sublimation Transfer Printing : Paper Printing
- Lecture 9 - Sublimation Transfer Printing : Dyes and inks
- Lecture 10 - Free path length and mechanism of transfer
- Lecture 11 - Transfer Printing Machines and Other Transfer Methods
- Lecture 12 - Introduction to Digital Textile Printing
- Lecture 13 - Revision and Doubt Clarification Session - 1
- Lecture 14 - Digital Textile Printing: Inkjet Technologies
- Lecture 15 - Inkjet Technologies: drop-on-demand
- Lecture 16 - Revision and Doubt Clarification Session - 2
- Lecture 17 - Inkjet Technologies: Machines
- Lecture 18 - Inkjet Printing
- Lecture 19 - Printing inks
- Lecture 20 - Water-based inks
- Lecture 21 - Water-based inks (Continued...)

- Lecture 1 - Introduction to texturing
- Lecture 2 - General principles involved in the manufacture of textured yarns
- Lecture 3 - General principles involved in the manufacture of textured yarns (Continued...)
- Lecture 4 - Bulked yarns
- Lecture 5 - Mechanisms of setting and texturing
- Lecture 6 - Thermo-mechanical texturing
- Lecture 7 - Characterization and optimization
- Lecture 8 - Influence of material and process parameters
- Lecture 9 - Influence of process parameters
- Lecture 10 - Influence of process parameters (Continued...)
- Lecture 11 - Revision and clarification of doubts - Session 1
- Lecture 12 - Influence of process parameters (Continued...)
- Lecture 13 - Draw Texturing
- Lecture 14 - Simultaneous draw texturing with POY
- Lecture 15 - Draw Texturing (Continued...)
- Lecture 16 - Draw Texturing Machines and Process Parameters
- Lecture 17 - Draw Texturing : Effect of Process Parameters
- Lecture 18 - Draw Texturing : Positorque System
- Lecture 19 - Friction Draw Texturing
- Lecture 20 - Friction Draw Texturing (Continued...)
- Lecture 21 - Air-Jet Texturing
- Lecture 22 - Air-Jet Texturing (Continued...)
- Lecture 23 - Air-Jet Texturing (Continued...)
- Lecture 24 - Air-Jet Texturing : Effect of Process parameters
- Lecture 25 - Air-Jet Texturing : Effect of Water parameters
- Lecture 26 - Air-Texturing Jets
- Lecture 27 - Interlacement: need and jet design
- Lecture 28 - Bulked continuous filament yarns
- Lecture 29 - Hi-bulk yarns
- Lecture 30 - Revision and Clarification of Doubts Session 2
- Lecture 31 - Hi-bulk yarns (Continued...)

[Lecture 32 - Texturing of spun yarns](#)

[Lecture 33 - Texturing of spun yarns \(Continued...\)](#)

[Lecture 34 - Solvent texturing](#)



- Lecture 1 - Introduction to Finishing
- Lecture 2 - Wrinkle Resistant Finishing
- Lecture 3 - Wrinkle Resistant Finishing (Continued...)
- Lecture 4 - Wrinkle Resistant Finishing : Performance characteristics
- Lecture 5 - Catalysis and Catalysts
- Lecture 6 - Other Crosslinking agents
- Lecture 7 - Non-nitrogenous Agents
- Lecture 8 - Control of Formaldehyde Release
- Lecture 9 - Stiff and Soft Finishing
- Lecture 10 - Soft Finishing (Continued...)
- Lecture 11 - Soft Finishing (Continued...)
- Lecture 12 - Emulsion Softeners
- Lecture 13 - Water Proofing and Water Repellency
- Lecture 14 - Water Repellency (Continued...)
- Lecture 15 - Water Repellency (Continued...)
- Lecture 16 - Waterproof Breathable Textiles
- Lecture 17 - Soil Repellency and Soil Release
- Lecture 18 - Soil Release Finishing
- Lecture 19 - Fire Retardant Finishing
- Lecture 20 - Chemistry of Flame Retardants
- Lecture 21 - More Flame retardants and evaluation of fire retardancy
- Lecture 22 - Antimicrobial Finishing
- Lecture 23 - Finishing of Wool
- Lecture 24 - Shrink Resistant Wool
- Lecture 25 - Wool Setting
- Lecture 26 - Mothproofing of Wool
- Lecture 27 - Biopolishing
- Lecture 28 - Finishing of synthetics
- Lecture 29 - Finishing of synthetics : Antistatic Finish
- Lecture 30 - Low Liquor Application
- Lecture 31 - Waste heat recovery

[Lecture 32 - Principles of some Finishing machines](#)

- Lecture 1 - Pre-combing operation - Part 1
- Lecture 2 - Pre-combing operation - Part 2
- Lecture 3 - Introduction to Comber - Part 1
- Lecture 4 - Introduction to Comber - Part 2
- Lecture 5 - Sequence of Operation
- Lecture 6 - Combing Mechanism
- Lecture 7 - Timing Diagram
- Lecture 8 - Sliver Formation
- Lecture 9 - Theoretical Aspects in Combing - Part 1
- Lecture 10 - Theoretical Aspects in Combing - Part 2
- Lecture 11 - Parameters Influencing Combing Performance
- Lecture 12 - Analysis of Drive
- Lecture 13 - Calculation of Process Performance Parameters
- Lecture 14 - Introduction, Working Principle and Creel
- Lecture 15 - DRAFTING Unit - Part 1
- Lecture 16 - DRAFTING Unit - Part 2
- Lecture 17 - Flyer Twisting
- Lecture 18 - Package Formation
- Lecture 19 - Bobbin Speed Regulation
- Lecture 20 - Building Motion and Drive Analysis
- Lecture 21 - Calculation for Change Gears and Production
- Lecture 22 - Introduction and Working Principle
- Lecture 23 - Creel and Drafting Unit
- Lecture 24 - Twisting Process and Twisting Elements
- Lecture 25 - Bobbin Building
- Lecture 26 - Spinning Geometry
- Lecture 27 - Analysis of Forces on Traveller
- Lecture 28 - Analysis of Forces on Ballon
- Lecture 29 - Analysis of Drive, Production Calculation
- Lecture 30 - End Breaks

- Lecture 1 - Introduction to Knitting
- Lecture 2 - Knitting Glossary
- Lecture 3 - Loop Formation in Weft Knitting
- Lecture 4 - Lab Demo 1: Analysis of a Weft Knit Fabric
- Lecture 5 - Automation in Loop Formation
- Lecture 6 - Flat Bed Machine Needle/Cam Interaction
- Lecture 7 - Circular Knitting
- Lecture 8 - Single Bed Weft Knitting-Flat and Circular M/C
- Lecture 9 - Lab Demo 2: Single Flat Bed Machine
- Lecture 10 - Lab Demo 3: Single Bed Circular Machine
- Lecture 11 - Single Bed Weft Knitting Fabric Curling
- Lecture 12 - Weft Knitting Double Flat Beds
- Lecture 13 - Weft Knitting Double Circular Beds
- Lecture 14 - Weft Knitting V-Bed Machine
- Lecture 15 - Analysis of a Double Jersey Fabric
- Lecture 16 - Single and Double Jersey Construction
- Lecture 17 - Weft Knit Stitches - Loop, Tuck and Float
- Lecture 18 - Lab Demo 6 (Part 1) Knitting Notations
- Lecture 19 - Lab Demo 6 (Part 2) Knitting Notations
- Lecture 20 - Fabric Analysis - Influence of Loop Length
- Lecture 21 - Fabric Design - Float and Tuck Formation
- Lecture 22 - Fabric Analysis - Influence of Float and Tuck Stitches
- Lecture 23 - Fabric Analysis - Shrinkage (Relaxation)
- Lecture 24 - Fabric Analysis - Extensibility and Recovery
- Lecture 25 - Knitting Calculation - Yarn Selection
- Lecture 26 - Knitting Calculation - Production (Circular)
- Lecture 27 - Knitting Calculation - Production (Flat)
- Lecture 28 - Knitting Calculation - Fabric Calculations
- Lecture 29 - Knitting Calculation - Geometrical Modeling
- Lecture 30 - Knitting Calculation - Fabric Spirality in Single Jersey (Tubular)
- Lecture 31 - Advancement in Knitting Technology

[Lecture 32 - Knitting Designs Possibilities](#)

[Lecture 33 - Knitting Designs Possibilities - 1](#)

[Lecture 34 - Design Software](#)

[Lecture 35 - Weft Knitting- Revision](#)

[Lecture 36 - Introduction to Warp Knitting](#)

[Lecture 37 - Warp Knitting Technology- Loop Formation](#)

[Lecture 38 - Swinging and Shogging Motions \(Overlap and Underlap\)](#)

[Lecture 39 - Warp Knit - Structural Identification](#)

[Lecture 40 - Warp Knit Fabric Notation - Lapping Diagram and Lapping Plan](#)

[Lecture 41 - Warp Knit Structure - Design Principles](#)

[Lecture 42 - Single Bar Warp Knit Constructions](#)

[Lecture 43 - Double Bar Warp Knit Constructions](#)

[Lecture 44 - Lapping Plan Execution - Pattern Disc and Pattern Drum](#)

[Lecture 45 - Chain Links Arrangement - Single and Double Bar Constructions](#)

[Lecture 46 - Warp Knits : Structure - Property Relationship](#)

[Lecture 47 - Warp Knits : Multi-bar Structures and Double Bed Designs](#)

[Lecture 48 - Weft and Warp Knitting - Summary](#)

[Lecture 49 - Technical Applications of Knitting](#)

[Lecture 50 - Technical Applications of Knitting \(Continued...\)](#)

- Lecture 1 - Introduction to Technical Textiles
- Lecture 2 - Introduction to Technical Textiles (Continued...)
- Lecture 3 - Textile Reinforced Composites
- Lecture 4 - Textile Reinforced Composites (Continued...)
- Lecture 5 - Textile Reinforced Composites (Continued...)
- Lecture 6 - Textile Reinforced Composites (Continued...)
- Lecture 7 - Textile Reinforced Composites (Continued...)
- Lecture 8 - Textile Reinforced Composites (Continued...)
- Lecture 9 - Textile Reinforced Composites (Continued...)
- Lecture 10 - Textile Reinforced Composites (Continued...)
- Lecture 11 - Textile Reinforced Composites (Continued...)
- Lecture 12 - Textile Reinforced Composites (Continued...)
- Lecture 13 - Filter Fabrics
- Lecture 14 - Filter Fabrics (Continued...)
- Lecture 15 - Filter Fabrics (Continued...)
- Lecture 16 - Geotextiles
- Lecture 17 - Geotextiles (Continued...)
- Lecture 18 - Geotextiles (Continued...)
- Lecture 19 - Geotextiles (Continued...)
- Lecture 20 - Extreme Cold Protective Clothing
- Lecture 21 - Extreme Cold Protective Clothing (Continued...)
- Lecture 22 - Extreme Heat Protective Clothing
- Lecture 23 - Extreme Heat Protective Clothing (Continued...)
- Lecture 24 - Sports Textiles
- Lecture 25 - Sports Textiles (Continued...)
- Lecture 26 - Sports Textiles (Continued...)
- Lecture 27 - Ultraviolet Protective Textiles
- Lecture 28 - Ultraviolet Protective Textiles (Continued...)
- Lecture 29 - Ultraviolet Protective Textiles (Continued...)
- Lecture 30 - Ballistic Protective Textiles
- Lecture 31 - Compression Bandage

[Lecture 32 - Compression Bandage \(Continued...\)](#)

[Lecture 33 - Compression Bandage \(Continued...\)](#)

[Lecture 34 - Automotive Textiles](#)

[Lecture 35 - Textiles in Hygiene](#)

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[Lecture 37 - Additional Lectuer on Geotextiles \(Continued...\)](#)

[Lecture 38 - Additional Lectuer on Composites](#)

[Lecture 39 - Additional Lectuer on Composites \(Continued...\)](#)

[Lecture 40 - Additional Lectuer on Composites \(Continued...\)](#)

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- Lecture 1 - New Spinning Technology
- Lecture 2 - Sliver Feed Arrangement
- Lecture 3 - Principle of Yarn Formation
- Lecture 4 - Twist Equation
- Lecture 5 - Rotor: Construction, Geometry and Drive
- Lecture 6 - Package Formation
- Lecture 7 - Significance of Fibre and Process Parameters
- Lecture 8 - Rotor Selection
- Lecture 9 - Spinning Tension
- Lecture 10 - Production and Energy Consumption Calculation
- Lecture 11 - Rotor Yarn: Structure, Properties and Application
- Lecture 12 - Air Jet Spinning: Introduction
- Lecture 13 - High Draft System
- Lecture 14 - Yarn Formation Mechanism
- Lecture 15 - Structure and Characteristics of Air-Jet Yarn
- Lecture 16 - Material and Process Parameters
- Lecture 17 - Friction Spinning: Dref-2
- Lecture 18 - Dref-3 Friction Spinning
- Lecture 19 - Yarn Formation, Structure and Applications
- Lecture 20 - Vortex Spinning
- Lecture 21 - Influence of Machine and Process Parameters
- Lecture 22 - Wrap Spinning
- Lecture 23 - Wrap Spinning (Continued...)
- Lecture 24 - SIRO Spinning
- Lecture 25 - Compact Spinning
- Lecture 26 - Spinning by Adhesive and Felting Process
- Lecture 27 - Self Twist Spinning
- Lecture 28 - Comparative Analysis Between Spinning Technologies
- Lecture 29 - Productivity Enhancement: Limitations

**NPTEL : Natural Dyes (Textile Engineering)**

**Co-ordinators : Dr. Padma S Vankar**

[Lecture 1 - Natural Dyes](#)

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