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**NPTEL : Project and Production Management (Mechanical Engineering)**

**Co-ordinators : Prof. Arun Kanda**

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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

[Lecture 32 - Theories of Failure \(Continued...\)](#)

- 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

Lecture 1 - Introduction

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

Lecture 17 - Example Projection of an object

Lecture 18 - Types of Solids

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

Lecture 27 - Pictorial Drawings

Lecture 28 - Construction of Isometric Drawings

Lecture 29 - Example Isometric drawings

Lecture 30 - Working Drawing

Lecture 31 - Example Sectional View of Assembly

[Lecture 32 - Computer Aided Design](#)

[Lecture 33 - Autodesk Inventor Environment](#)

[Lecture 34 - Sketching for Solid Modelling](#)

[Lecture 35 - Example 1 Extrude Hole Fillet Chamfer](#)

[Lecture 36 - Example 2 Rib Mirror](#)

[Lecture 37 - Example 3](#)

[Lecture 38 - Revolve Loft Pattern](#)

[Lecture 39 - Example 4](#)

[Lecture 40 - Example 5](#)

[Lecture 41 - Spline Sweep Shell](#)

[Lecture 42 - Example 6](#)

[Lecture 43 - Example 7](#)

[Lecture 44 - Drawing from Solid Model](#)

[Lecture 45 - Assembly with constraints](#)

[Lecture 46 - Example 8](#)

[Lecture 47 - Example 9](#)

[Lecture 48 - Example 10](#)

[Lecture 49 - Example 11](#)

[Lecture 50 - Civil and architectural drawings](#)

Lecture 1 - Ideal fluids, Velocity potential, Potential flows

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

Lecture 8 - Superposition of uniform flow, doublet and free vortex

Lecture 9 - Superposition of source and uniform flow

Lecture 10 - Problem solving session - 1

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

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

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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

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
- Lecture 9 - Force and velocity diagram - 1
- 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
- Lecture 15 - Mechanics of sheet metal forming - 1
- Lecture 16 - Mechanics of sheet metal forming - 2
- Lecture 17 - Heat transfer and thermomechanical processing
- Lecture 18 - Fusion welding processes - 1
- Lecture 19 - Fusion welding processes - 2
- Lecture 20 - Physics of welding and metal transfer
- Lecture 21 - Heat source model in fusion welding
- Lecture 22 - Heat transfer and material flow
- Lecture 23 - Solidification in welding - 1
- Lecture 24 - Solidification in welding - 2
- Lecture 25 - Solid state welding - 1
- Lecture 26 - Solid state welding - 2
- Lecture 27 - Hybrid welding, residual stress and distortion
- Lecture 28 - Cooling and solidification at different casting processes
- Lecture 29 - Powder metallurgy
- Lecture 30 - Principle of surface and coating technologies
- Lecture 31 - Principle and development of additive manufacturing technologies - 1

[Lecture 32 - Principle and development of additive manufacturing technologies - 2](#)

[Lecture 33 - Fundamentals of heat treatment](#)

[Lecture 34 - Evaluation of microstructural properties and residual stress](#)

[Lecture 35 - Down-scaling of conventional manufacturing processes and Micro-to-nano manufacturing](#)

[Lecture 36 - Packaging, micro-finishing and micro-manufacturing processes](#)

[Lecture 37 - Processing and shaping of non-metals and bio-materials](#)

[Lecture 38 - Principle of glass and ceramics processing and their shaping](#)

[Lecture 1 - Introduction and Notation](#)

[Lecture 2 - Flow Regimes and Flow Regime Maps](#)

[Lecture 3 - The Homogeneous Model](#)

[Lecture 4 - The Separated Flow Model](#)

[Lecture 5 - The Separated Flow Model \(Continued...\)](#)

[Lecture 6 - The Drift Flux Model](#)

[Lecture 7 - Estimation of pressure drop in two phase flow](#)

[Lecture 8 - Two phase flow and pressure drop in miniature channels](#)

- Lecture 1 - Overview of thermodynamic system and state
- Lecture 2 - First and second laws of thermodynamics
- Lecture 3 - Concept of entropy and entropy generation
- Lecture 4 - Concept of exergy and exergy destruction
- Lecture 5 - Thermodynamic potentials and Maxwell relations
- Lecture 6 - Generalized relations for entropy and specific heats
- 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
- Lecture 12 - Otto, Diesel and Dual combustion cycles
- 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
- Lecture 21 - Improvements and modifications in Rankine cycle
- 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
- Lecture 29 - Vapor absorption refrigeration cycle
- Lecture 30 - P-v-T behavior of gas mixtures
- Lecture 31 - Numerical examples

[Lecture 32 - Properties of moist air](#)

[Lecture 33 - Psychrometric chart and various psychrometric processes](#)

[Lecture 34 - Sensible heat factor and bypass factor](#)

[Lecture 35 - Theoretical and actual combustion process](#)

[Lecture 36 - Thermodynamic analyses of reacting systems](#)

Lecture 1 - Relationship of Thermodynamics with Heat transfer

Lecture 2 - Modes of heat transfer

Lecture 3 - Fourier's law and thermal conductivity

Lecture 4 - Generalized heat diffusion equation

Lecture 5 - Heat diffusion equation in curvilinear coordinates

Lecture 6 - Concept of thermal resistance

Lecture 7 - Use of network of resistances in wall and cylinder

Lecture 8 - Critical thickness of insulation

Lecture 9 - Conduction with energy generation - I

Lecture 10 - Conduction with energy generation - II

Lecture 11 - General Heat Transfer Analysis

Lecture 12 - Fins with uniform cross-section area - I

Lecture 13 - Fins with uniform cross-section area - II

Lecture 14 - Fins with non-uniform cross-section area

Lecture 15 - Method of Separation of Variables

Lecture 16 - Graphical approach

Lecture 17 - Method of Superposition

Lecture 18 - Lumped capacitance approach - I

Lecture 19 - Lumped capacitance approach - II

Lecture 20 - Semi-infinite Solid

Lecture 21 - Steady Heat Conduction

Lecture 22 - Unsteady Heat Conduction

Lecture 23 - Problem solving using Energy Balance Method

Lecture 24 - Introduction to radiative heat fluxes

Lecture 25 - Spectral and directional definitions

Lecture 26 - Blackbody radiation

Lecture 27 - Emissivity

Lecture 28 - Irradiation of real surfaces

Lecture 29 - View factor

Lecture 30 - Blackbody radiation exchange

Lecture 31 - Radiation networks

[Lecture 32 - Gas radiation](#)

[Lecture 33 - Radiative Transfer Equation](#)

- Lecture 1 - Review of thermodynamics
- Lecture 2 - Rankine cycle
- Lecture 3 - Performance estimation of steam power cycles
- Lecture 4 - Carnot cycle examples
- Lecture 5 - Rankine cycle with superheat
- Lecture 6 - Rankine cycle with reheat theory and example
- Lecture 7 - Examples of Rankine cycle
- Lecture 8 - Examples of reheat Rankine cycle
- Lecture 9 - Rankine cycle with regeneration
- Lecture 10 - Feedwater heaters
- Lecture 11 - Cogeneration of power and process heat
- Lecture 12 - Examples of regeneration
- Lecture 13 - Examples of regenerative Rankine cycle
- Lecture 14 - Binary/multi-fluid cycles
- Lecture 15 - Low temperature power cycles
- Lecture 16 - Examples of binary cycles
- Lecture 17 - Types of boilers
- Lecture 18 - Boiler accessories
- Lecture 19 - Practice examples
- Lecture 20 - Stagnation conditions and Nozzle flow
- Lecture 21 - Nozzle flow
- Lecture 22 - Examples of Nozzle
- Lecture 23 - Impulse Turbine - 1
- Lecture 24 - Impulse Turbine - 2
- Lecture 25 - Examples on Impulse Turbine
- Lecture 26 - Reaction Turbine
- Lecture 27 - Reheat Factor
- Lecture 28 - Examples on Turbine - 1
- Lecture 29 - Examples on Turbine - 2
- Lecture 30 - Gas Mixture
- Lecture 31 - Psychrometry - 1

[Lecture 32 - Psychrometry - 2](#)

[Lecture 33 - Condensers](#)

- Lecture 1 - Introduction to Dynamic Behaviour of Materials - I
- Lecture 2 - Introduction to Dynamic Behaviour of Materials - II
- Lecture 3 - Introduction to Waves
- Lecture 4 - Quasi-static vs Dynamic Deformation
- Lecture 5 - Elastic Wave and its Classification
- Lecture 6 - Propagation of Elastic Waves in Continuum
- Lecture 7 - Wave Reflection, Refraction and Interaction
- Lecture 8 - General Solution of Elastic Wave Equation
- Lecture 9 - Additional Considerations of Elastic Wave in Cylindrical Bar
- Lecture 10 - Introduction to Plastic Waves
- Lecture 11 - Plastic Waves of Uniaxial Stress
- Lecture 12 - Plastic Waves of Combined Stress
- Lecture 13 - Taylor's Experiment for Plastic Wave Propagation - 1
- Lecture 14 - Taylor's Experiment for Plastic Wave Propagation - 2
- Lecture 15 - Taylor's Experiment: Wilkins-Guinan Analysis
- Lecture 16 - Introduction to Shock Waves - I
- Lecture 17 - Introduction to Shock Waves - II
- Lecture 18 - Shock Wave: Rankine Hugoniot Treatment
- Lecture 19 - Rankine Hugoniot Treatment and Shock Wave under Impact
- Lecture 20 - Shock Wave under Impact
- Lecture 21 - Equations of States (Shock Waves) : Experimental Methods
- Lecture 22 - Equations of States (Shock Waves) : Theoretical Calculations
- Lecture 23 - Complex Problems of Shock Waves and Temperature Rise under Shock Wave
- Lecture 24 - Shock Wave Attenuation, Interaction and Reflection - I
- Lecture 25 - Shock Wave Attenuation, Interaction and Reflection - II
- Lecture 26 - Shock Wave Interaction and Reflection
- Lecture 27 - Fundamentals of Materials Science and Engineering
- Lecture 28 - Shock Wave Induced Phase Transformations - 1
- Lecture 29 - Shock Wave Induced Phase Transformations - 2
- Lecture 30 - Shock Wave Induced Phase Transformations - 3
- Lecture 31 - Shock Wave Induced Phase Transformations - 4

[Lecture 32 - Experimental Techniques for Dynamic Deformation - 1](#)

[Lecture 33 - Experimental Techniques for Dynamic Deformation - 2](#)

[Lecture 34 - Plastic Deformation at High Strain Rates - 1](#)

[Lecture 35 - Plastic Deformation at High Strain Rates - 2](#)

[Lecture 36 - Plastic Deformation at High Strain Rates - 3](#)

[Lecture 37 - Plastic Deformation at High Strain Rates - 4](#)

[Lecture 38 - Plastic Deformation at High Strain Rates - 5](#)

[Lecture 39 - Plastic Deformation Under Shock Waves - 1](#)

[Lecture 40 - Plastic Deformation Under Shock Waves - 2](#)

[Lecture 41 - Plastic Deformation Under Shock Waves - 3](#)

[Lecture 42 - Shear Band - 1](#)

[Lecture 43 - Shear Band - 2](#)

[Lecture 44 - Dynamic Fracture - 1](#)

[Lecture 45 - Dynamic Fracture - 2](#)

Lecture 1 - Introduction to Plastic Working of Metals

Lecture 2 - Uniaxial Tension Test Analysis

Lecture 3 - Temperature effects in metal forming

Lecture 4 - Friction and Lubrication

Lecture 5 - Friction and Lubrication (Continued...)

Lecture 6 - Deformation zone + worked examples

Lecture 7 - Stresses at point and Theory of Plasticity

Lecture 8 - Slab Analysis

Lecture 9 - Slip Line Field Theory - Part 1

Lecture 10 - Slip Line Field Theory - Part 2

Lecture 11 - Upper Bound Theorem

Lecture 12 - Plasticity equations

Lecture 13 - Forging

Lecture 14 - Analysis of Forging

Lecture 15 - Analysis of Forging (Continued...)

Lecture 16 - Forging Die Design consideration

Lecture 17 - Forging Load

Lecture 18 - Rolling of Metals

Lecture 19 - Analysis of Rolling

Lecture 20 - Analysis of Rolling (Continued...)

Lecture 21 - Strain rate in the deformation zone

Lecture 22 - Rolling mills

Lecture 23 - Prblem on rolling

Lecture 24 - Drawing of Rods, Wires and Tubes

Lecture 25 - Drawing of Rods, Wires and Tubes (Continued...)

Lecture 26 - Analysis of Wire Drawing

Lecture 27 - Wire Drawing: Tutorial Problems

Lecture 28 - Extrusion Process

Lecture 29 - Analysis of Extrusion

Lecture 30 - Introduction

Lecture 31 - Sheet deformation process

[Lecture 32 - Deformation of sheet in plane stress](#)

[Lecture 33 - Analysis of stamping](#)

[Lecture 34 - Instability in sheet metal forming](#)

[Lecture 35 - Deep drawing](#)

[Lecture 36 - Hydroforming](#)

Lecture 1 - Introduction to Artificial Intelligence

Lecture 2 - Problem Solving as State Space Search

Lecture 3 - Uninformed Search

Lecture 4 - Heuristic Search

Lecture 5 - Informed Search

Lecture 6 - Constraint Satisfaction Problems

Lecture 7 - Searching AND/OR Graphs

Lecture 8 - Game Playing

Lecture 9 - Minimax + Alpha-Beta

Lecture 10 - Introduction to Knowledge Representation

Lecture 11 - Propositional Logic

Lecture 12 - First Order Logic - I

Lecture 13 - First Order Logic - II

Lecture 14 - Inference in First Order Logic - I

Lecture 15 - Inference in First Order Logic - II

Lecture 16 - Answer Extraction

Lecture 17 - Procedural Control of Reasoning

Lecture 18 - Reasoning under Uncertainty

Lecture 19 - Bayesian Network

Lecture 20 - Decision Network

Lecture 21 - Introduction to Planning

Lecture 22 - Plan Space Planning

Lecture 23 - Planning Graph and GraphPlan

Lecture 24 - Practical Planning and Acting

Lecture 25 - Sequential Decision Problems

Lecture 26 - Making Complex Decisions

Lecture 27 - Introduction to Machine Learning

Lecture 28 - Learning Decision Trees

Lecture 29 - Linear Regression

Lecture 30 - Support Vector Machines

Lecture 31 - Unsupervised Learning

[Lecture 32 - Reinforcement Learning](#)

[Lecture 33 - Learning in Neural Networks](#)

[Lecture 34 - Deep Learning: A Brief Overview](#)

Lecture 1 - Overview of Basic Thermodynamics

Lecture 2 - Solved Examples for Flow process

Lecture 3 - Turbomachines: Introduction, Classification, Types

Lecture 4 - Components of Gas Turbine Power Plant, Gas Turbine Attachments

Lecture 5 - Introduction to Various Aircraft engines, Engine Performance parameters

Lecture 6 - Air Standard Ideal Brayton Cycle

Lecture 7 - Examples for Ideal Brayton Cycle

Lecture 8 - Non-Ideal Brayton Cycle

Lecture 9 - Examples for Non-Ideal Brayton Cycle

Lecture 10 - Brayton Cycle with Heat Exchanger / Re-heater

Lecture 11 - Brayton Cycle with Intercooler / All Attachments

Lecture 12 - Examples of Gas Turbine Attachment

Lecture 13 - Examples of Gas Turbine Attachment

Lecture 14 - Stagnation Conditions, Real Brayton Cycle with Stagnation Conditions

Lecture 15 - Polytropic Efficiency of Compressor and Turbine

Lecture 16 - Examples of Real Cycle

Lecture 17 - Nozzle Flow: Isentropic Relations, Area Velocity Relation, Choked Mass Flow Rate

Lecture 18 - Aircraft Engine Intake, Intake Efficiency

Lecture 19 - Propelling Nozzle, Nozzle Efficiency

Lecture 20 - Turbojet engine: Configuration and Examples

Lecture 21 - Turbofan engine: Configuration and Examples

Lecture 22 - Ramjet engine: Parameters and losses

Lecture 23 - Examples of Ramjet Engine

Lecture 24 - Thrust Augmentation and Engine performance parameters for Aircrafts

Lecture 25 - Introduction to Turbomachinery

Lecture 26 - Centrifugal Compressor: Velocity diagrams, Workdone

Lecture 27 - Centrifugal Compressor: Thermodynamic analysis, Stage efficiency and Degree of reaction

Lecture 28 - Examples of Centrifugal compressor

Lecture 29 - Axial Flow Compressor: Velocity diagrams, Workdone and Degree of Reaction

Lecture 30 - Axial Flow Compressor: Free vortex Condition

Lecture 31 - Examples of Axial Flow Compressor

[Lecture 32 - Examples of Axial Flow Compressor](#)

[Lecture 33 - Examples of Axial Flow Compressor](#)

[Lecture 34 - Axial Turbine: Velocity diagrams, Workdone, and Degree of Reaction](#)

[Lecture 35 - Radial Turbine: Velocity diagrams, h-s diagram, Stage efficiency and degree of reaction](#)

[Lecture 36 - Examples of Axial Turbine](#)

[Lecture 37 - Practice examples of Axial Turbine and centrifugal compressor](#)

[Lecture 38 - Cascade theory and Blade design](#)

[Lecture 39 - Cascade variables and Turbine Cascade](#)

[Lecture 40 - Velocity diagrams of Turbine Cascade, Compressor cascade](#)

[Lecture 41 - Turbine cooling methods](#)

[Lecture 42 - Practice examples of aircraft engine](#)

Lecture 1 - Applications of CFD

Lecture 2 - Basic equations of fluid dynamics and heat transfer

Lecture 3 - Initial and boundary conditions

Lecture 4 - Physical Classification, System of first-order PDEs

Lecture 5 - System of second-order PDEs

Lecture 6 - Finite difference by Taylor series expansion

Lecture 7 - Finite difference by general approximation and polynomials

Lecture 8 - Finite difference in non-uniform grid

Lecture 9 - Types of error and accuracy of FD solutions

Lecture 10 - Finite difference formulations of Elliptic Equations with boundary condition treatment

Lecture 11 - Iterative Methods

Lecture 12 - Applications

Lecture 13 - Linear Solvers

Lecture 14 - Finite difference formulations of Parabolic Equations

Lecture 15 - Finite difference formulations of Parabolic Equations: Implicit Methods

Lecture 16 - Finite difference formulations of Parabolic Equations: Unsteady Two-Dimensional Equation

Lecture 17 - Finite difference formulations of Parabolic Equations: Unsteady Three-Dimensional Equation

Lecture 18 - Finite difference formulations of the first order wave equation: Explicit Method

Lecture 19 - Finite difference formulations of the first order wave equation: Implicit Method

Lecture 20 - Von Neumann stability analysis of different schemes for Parabolic equations

Lecture 21 - Von Neumann stability analysis of different schemes for Parabolic equations

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Lecture 23 - Modified equation, Artificial viscosity, Numerical diffusion

Lecture 24 - Discretization vorticity-stream function equations using FDM

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Lecture 4 - Basic concept of dynamic measurements (Continued...)

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Lecture 6 - System response and distortion, Impedence matching

Lecture 7 - Dimensional measurement Gauge blocks, The pneumatic displacement gauge

Lecture 8 - Dimensional measurement Gauge blocks, The pneumatic displacement gauge

Lecture 9 - Pressure Measurements: Definition of pressure and Dynamic response considerations

Lecture 10 - Mechanical pressure measurement devices, U-tube manometer, The inclined well type manometer

Lecture 11 - The aneroid barometer, Diaphragm and Bellows Gauges

Lecture 12 - The Mcleod gauge, The Pirani gauge, The Ionization gauge

Lecture 13 - The Mcleod gauge, The Pirani gauge, The Ionization gauge (Continued...)

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Lecture 15 - Pressure measurement using 3 holes/probes

Lecture 16 - Pressure measurement using 3 holes/probes (Continued...)

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Lecture 18 - Flow obstruction flow rate measuerement(venturimeter/orificemeter), the Rotameter (Continued...)

Lecture 19 - Thermal Anemometry(hot wire/hot film), Hot wire anemometer

Lecture 20 - Thermal Anemometry(hot wire/hot film), Hot wire anemometer (Continued...)

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Lecture 22 - Measurement of velocity components by 3 holes and 4 holes probes

Lecture 23 - Ideal gas thermometer, Temperature measurement by mechanical and electrical effects

Lecture 24 - Ideal gas thermometer, Temperature measurement by mechanical and electrical effects (Continued...)

Lecture 25 - Thermostatic temperature, Resistance Temperature Detectors (RTD), Thermistors, Thermocouples

Lecture 26 - Temperature measurement by Radiation, The optical pyrometer

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Lecture 28 - Transient response of thermal system, Thermocouple compensation, high speed flow (Continued...)

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[Lecture 32 - Use of PIV \(Continued...\)](#)

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- Lecture 10 - Normal Shock Waves - I
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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
- Lecture 6 - Solving one Ordinary Differential Equation using Quadratic Finite Element
- 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
- Lecture 10 - Beam Element: Variational statement; Hermite shape function
- 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 - Indicjal Notation: Summation convention, Kronecker delta, Permutation symbol
- Lecture 18 - Second order tensor; Gradient, Divergence, Curl and Laplacian in Indicjal 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
- Lecture 23 - Numerical integration, Neumann boundary, and higher order shape functions
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- Lecture 31 - Solving eigenvalue problem in bar and beam, writing FEM code in MATLAB

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Lecture 11 - Idea of Motion, Material and Spatial Descriptions, Deformation Gradient Tensor

Lecture 12 - Strain, Polar Decomposition - 1

Lecture 13 - Polar Decomposition - 2, Volume and Area Change

Lecture 14 - Worked Examples, Linearized Kinematics

Lecture 15 - Velocity, Acceleration, Material Time Derivative

Lecture 16 - Velocity Gradient, Rate of Deformation tensor, Area and Volume Rate, Reynolds Transport Theorem

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Lecture 18 - Conservation of Mass, Balance of Linear Momentum, Cauchy's Stress Principle - 1

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Lecture 23 - Second Piola-Kirchhoff Stress Tensor, Decomposition of Stress - 1

Lecture 24 - Decomposition of Stress - 2, Objective Stress Measures

Lecture 25 - Solved Examples

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Lecture 27 - Spatial Elasticity Tensor, Solved Example

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Lecture 29 - Isotropic Hyperelasticity, Neo-Hookean Material Model, Solved Examples

Lecture 30 - Introduction, Linearization Process Overview

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- 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
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- 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
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- 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
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- Lecture 2 - Basic terminology in Shell
- Lecture 3 - Derivation of fundamental theorem of surfaces
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- 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
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- Lecture 10 - Derivation of special cases
- Lecture 11 - Derivation of shell constitutive relations
- Lecture 12 - Solved examples on membrane theory and moment shell theory
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- Lecture 14 - Derivation of Navier solution for infinite shell panel
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- 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
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- Lecture 26 - 3D Buckling
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Lecture 17 - Heat source models in welding - I

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- Lecture 5 - Extended Hamilton's principle
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- 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
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- Lecture 19 - Floquet theory, Hill's infinite determinant, Resonance in parametrically excited systems
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- Lecture 29 - Active vibration absorber with time delay acceleration feedback by HBM
- Lecture 30 - Application of Active vibration absorber with combination feedback
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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

[Lecture 32 - Gas Turbine Performance Cycle - I](#)

[Lecture 33 - Gas Turbine Performance Cycle - II](#)

[Lecture 34 - Real Gas Turbine Performance Cycle](#)

[Lecture 35 - Aircraft Propulsion Cycle - I](#)

[Lecture 36 - Aircraft Propulsion Cycle - II](#)

[Lecture 37 - Vapour Compression Refrigeration System - I](#)

[Lecture 38 - Vapour Compression Refrigeration System - II](#)

[Lecture 39 - Absorption Refrigeration and Refrigerants](#)

[Lecture 40 - Fundamentals of Psychrometrics](#)

[Lecture 41 - Air-Conditioning Processes](#)

[Lecture 42 - Cooling Tower and Air Washers](#)

[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
- Lecture 25 - Reaction Mechanisms - Part II
- Lecture 26 - Chemical and Thermal Analysis of Reacting Systems
- Lecture 27 - Simplified Conservation Equations for Reacting Flows
- Lecture 28 - Laminar Premixed Flame - Part I
- Lecture 29 - Laminar Premixed Flame - Part II
- 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
- Lecture 42 - Cooling Tower Performance
- 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
- Lecture 51 - Engine Operating Characteristics: MEP and Indicator diagram
- Lecture 52 - Performance Analysis parameters of IC Engine
- Lecture 53 - Fuel of IC Engines
- Lecture 54 - Alternative Fuels and Self Ignition Characteristics of Fuel: Octane Number, Cetane Number
- Lecture 55 - Thermodynamic Analysis of SI Engine
- Lecture 56 - Thermodynamic Analysis of CI Engine
- Lecture 57 - Numerical Problems on Engine Performance
- Lecture 58 - Pressure-Crank angle diagram, Engine Efficiencies
- Lecture 59 - Numerical Problems on SI and CI Engines
- Lecture 60 - Vapour Compression Refrigeration Cycle and its analysis
- Lecture 61 - Problems on Vapour Compression Refrigeration Cycle
- 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

[Lecture 65 - Gas Turbine Unit: Combined Cycle](#)

[Lecture 66 - Problems On Gas Turbine Cycle](#)

**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](#)

[Lecture 2 - Advanced Machining Processes](#)

[Lecture 3 - Advanced Machining Processes](#)

[Lecture 4 - Advanced Machining Processes](#)

[Lecture 5 - Advanced Machining Processes](#)

[Lecture 6 - Advanced Machining Processes](#)

[Lecture 7 - Advanced Machining Processes](#)

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[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[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](#)

[Lecture 44 - Vibration Measurement Types of Pickups](#)

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[Module 13 - Lecture 1](#)

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**NPTEL : Kinematics of Machines (Mechanical Engineering)**

**Co-ordinators : Prof. Ashok K Mallik**

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[Module 1 - Lecture 2](#)

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[Module 10 - Lecture 1](#)

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[Lab session 1 - Advanced manufacturing process for micro sytem fabrication](#)

[Lab session 2 - EDM Micro Machening](#)

[Lab session 3 - EDM Micro Drilling](#)

[Lab session 4 - Laser Machening Process](#)

[Lab session 5 - Vaccume Assisted Forming](#)

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[Lab session 7 - Photolithiography](#)

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[Lecture 1 - Technical Arts 101](#)

[Lecture 2 - Technical Arts 101](#)

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Lecture 1 - Lecture 1

Lecture 2 - Lecture 2

Lecture 3 - Lecture 3

Lecture 4 - Review Lecture 1,2,3

Lecture 5 - Lecture 4

Lecture 6 - Lecture 5

Lecture 7 - Lecture 6

Lecture 8 - Review Lecture 4,5,6

Lecture 9 - Lecture 7

Lecture 10 - Lecture 8

Lecture 11 - Lecture 9-10

Lecture 12 - Lecture-11

Lecture 13 - Lecture-12

Lecture 14 - Lecture-13

Lecture 15 - Lecture-14

Lecture 16 - Lecture-15

Lecture 17 - Lecture-16

Lecture 18 - Lecture-17

Lecture 19 - Lecture-18

Lecture 20 - Lecture-19

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

Lecture 25 - Lecture-21

Lecture 26 - Lecture-22

Lecture 27 - Lecture-23

Lecture 28 - Lecture-24

Lecture 29 - Lecture-25

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

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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

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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

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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

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[Lecture 38 - Finite element formulation for shear deformable beams : Part - I](#)

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[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

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Lecture 30 - Fourier Transform - Continuation

Lecture 31 - Discrete Fourier Transform (DFT)

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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

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Lecture 30 - Riser Design and Placement - Part 1

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[Lecture 35 - Estimation of Cutting Ratio and Shear Angle](#)

[Lecture 36 - Merchant's Force Analysis](#)

[Lecture 37 - Merchant Theory \(Cutting Forces Analysis\)](#)

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[Lecture 39 - Lee Shaffer's Solution](#)

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[Lecture 41 - Modeling of Heat Generation and Cutting Tool Temperature](#)

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[Lecture 46 - Joining Process](#)

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- 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](#)

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[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](#)
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- [Lecture 39 - 2-D Heat transfer problems - Part I](#)
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- [Lecture 41 - Numerical integration schemes for 2-D problems](#)
- [Lecture 42 - Jacobian and transformation matrix for 2-D problems](#)
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- [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
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- Lecture 19 - Controllability and Observability of System
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- Lecture 21 - SMSS Laboratory Demonstration

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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

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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

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[Lecture 43 - Lesson 1 - Noise reduction - Mass Attenuation Method](#)

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[Lecture 50 - Lesson 2 - Designing of Reactive Mufflers](#)

[Lecture 51 - Lesson 3 - Designing of Dissipative Mufflers](#)

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[Lecture 64 - Lesson 4 - Weighting](#)

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[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  $-T\hat{H}^*S_{mix}$  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),  $\hat{H}^*T$ ,  $\hat{H}^*G_v$  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

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Lecture 15 - Introduction to device fabrications

Lecture 16 - Introduction to Silicon as a MEMS material

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Lecture 18 - Types of Photolithography

Lecture 19 - Introduction to actuators

Lecture 20 - Designing of the Micro-Valve

Lecture 21 - Electrochemical valves

Lecture 22 - Micropumps

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- Lecture 46 - Turbulent Combustion : Stochastic method of solution
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- Lecture 58 - Multiphase Combustion : Introduction + Droplet Evaporation
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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

Lecture 18 - Rake angles in oblique cutting; Economics of Machining

Lecture 19 - Economics of Machining (Continued...); Thermal aspects of machining

Lecture 20 - Surface finish

Lecture 1 - Introduction to Cognitive Robotics (Private)

Lecture 2 - Smart Materials - I (Private)

Lecture 3 - Smart Materials - II (Private)

Lecture 4 - Smart Materials - III (Private)

Lecture 5 - Architecture of the Brain

Lecture 6 - Architecture of the Brain (Continued...)

Lecture 7 - Nerve Cells

Lecture 8 - Introduction to Synchronisation Models

Lecture 9 - Synchronisation models (Continued...)

Lecture 10 - Introduction to EEG

Lecture 11 - Theories of Intelligence - I

Lecture 12 - Theories of Intelligence - II

Lecture 13 - Kuramoto Model

Lecture 14 - Child Robot Interaction

Lecture 1 - Introduction to Robotics

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

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Lecture 9 - Inverse Kinematics

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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

Lecture 45 - MATLAB Demonstration for Transmission Loss Calculations

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

Lecture 8 - Stress, Strain and Strain Rate and Shear Plane Angle

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

Lecture 13 - Cost analysis, Casting Defects and Product Design

Lecture 14 - Introduction to Joining Processes

Lecture 15 - Characteristic Features of Welding Processes

Lecture 16 - Various Welding Processes

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Lecture 18 - Characteristic Features of Arc Welding

Lecture 19 - Shielded metal arc welding, MIG and TIG Welding

Lecture 20 - Gas Welding, Brazing and Soldering, Welding Defects

Lecture 1 - Historical Perspectives and Introduction to the Course

Lecture 2 - Finite Difference Method - Basic Idea of Discretization

Lecture 3 - Explicit and Implicit Formulations, Stability Analysis - Part 1

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Lecture 5 - Important Aspects of Flow Modelling - Part 1

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Lecture 8 - Applications of Our Knowledge to a Problem of Practical Interest and Setting up an Algorithm

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Lecture 15 - Vorticity Stream Function Approach (Formulation and Algorithm)

Lecture 16 - Vorticity-Stream Function Approach For Solving Navier-Stokes Equations

Lecture 17 - Solving Navier-Stokes Equations For Incompressible Flows using SIMPLE Algorithm - Part 1

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Lecture 20 - MAC Algorithm (Pressure - Velocity Iteration and the Solution)

Lecture 21 - MAC Algorithm (Solution of Energy Equation)

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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
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- Lecture 16 - Metal Machining-13: Grinding; Economics of Machining
- Lecture 17 - Machining-14: Economics of Machining
- Lecture 18 - Non-Traditional Machining-1: Introduction; Classification
- Lecture 19 - Non-Traditional Machining-2: Various Non-Traditional Machining Processes
- Lecture 20 - Non-Traditional Machining-3, Computer Numerical Control (CNC) -1
- Lecture 21 - Computer Numerical Control (CNC) - 2
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- Lecture 23 - Engineering Metrology
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Lecture 11 - CTCEAC

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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
- Lecture 27 - Fluid Flow Applications - Part VI
- Lecture 28 - Fluid Flow Applications - Part VII
- Lecture 29 - Incompressible Viscous Flows - Part I
- Lecture 30 - Incompressible Viscous Flows - Part II
- Lecture 31 - Incompressible Viscous Flows - Part III

- [Lecture 32 - Incompressible Viscous Flows - Part IV](#)
- [Lecture 33 - Application of ViscousFlow Through Pipes - Part I](#)
- [Lecture 34 - Application of ViscousFlow Through Pipes - Part II](#)
- [Lecture 35 - Application of ViscousFlow Through Pipes - Part III](#)
- [Lecture 36 - Principles of Similarity - Part I](#)
- [Lecture 37 - Principles of Similarity - Part II](#)
- [Lecture 38 - Principles of Similarity - Part III](#)
- [Lecture 39 - Flow of Ideal Fluids - Part I](#)
- [Lecture 40 - Flow of Ideal Fluids - Part II](#)
- [Lecture 41 - Flows with a Free Surface - Part I](#)
- [Lecture 42 - Flows with a Free Surface - Part II](#)
- [Lecture 43 - Flows with a Free Surface - Part III](#)
- [Lecture 44 - A Few Unsteady Flow Phenomena in Practice - Part I](#)
- [Lecture 45 - A Few Unsteady Flow Phenomena in Practice - Part II](#)
- [Lecture 46 - Introduction to Laminar Boundary Layer - Part I](#)
- [Lecture 47 - Introduction to Laminar Boundary Layer - Part II](#)
- [Lecture 48 - Introduction to Turbulent Flow - Part I](#)
- [Lecture 49 - Introduction to Turbulent Flow - Part II](#)

- Lecture 1 - Introduction to Fluid Machines I
- 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](#)

[Lecture 33 - Normal Shock - Part I](#)

[Lecture 34 - Normal Shock - Part II](#)

[Lecture 35 - Normal Shock - Part III](#)

[Lecture 36 - Normal Shock - Part IV](#)

[Lecture 37 - Normal Shock - Part V](#)

[Lecture 38 - Oblique Shock - Part I](#)

[Lecture 39 - Oblique Shock - Part II](#)

[Lecture 40 - Introduction to Expansion Wave and Prandtl Meyer Flow](#)

[Lecture 1 - Introductory Concepts](#)

[Lecture 2 - Introductory Concepts \(Continued...\)](#)

[Lecture 3 - Introductory Concepts \(Continued...\)](#)

[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 \(Continued...\)](#)

[Lecture 20 - Dynamics of Inviscid Flows \(Continued...\)](#)

[Lecture 21 - Integral Forms of Control Volume Conservation Equations \(Reynolds Transport Theorem\)](#)

[Lecture 22 - Integral Forms of Control Volume Conservation Equations \(Reynolds Transport Theorem\) \(Continued...\)](#)

[Lecture 23 - Integral Forms of Control Volume Conservation Equations \(Reynolds Transport Theorem\) \(Continued...\)](#)

[Lecture 24 - Integral Forms of Control Volume Conservation Equations \(Reynolds Transport Theorem\) \(Continued...\)](#)

[Lecture 25 - Integral Forms of Control Volume Conservation Equations \(Reynolds Transport Theorem\) \(Continued...\)](#)

[Lecture 26 - Integral Forms of Control Volume Conservation Equations \(Reynolds Transport Theorem\) \(Continued...\)](#)

[Lecture 27 - Integral Forms of Control Volume Conservation Equations \(Reynolds Transport Theorem\) \(Continued...\)](#)

[Lecture 28 - Dynamics of Viscous Flows : Navier Stokes Equation](#)

[Lecture 29 - Dynamics of Viscous Flows : Navier Stokes Equation \(Continued...\)](#)

[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 \(Continued...\)](#)
- [Lecture 37 - Boundary Layer Theory](#)
- [Lecture 38 - Boundary Layer Theory \(Continued...\)](#)
- [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](#)
- [Lecture 55 - Compressible Flows \(Continued...\)](#)
- [Lecture 56 - Compressible Flows \(Continued...\)](#)
- [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

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- Lecture 38 - Gyroscopic motion - I
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- Lecture 41 - Kinematics of rotation - I
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- Lecture 43 - Kinematics of rotation - III
- Lecture 44 - Kinematics of rotation - IV
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- Lecture 46 - Introduction to Analytical Dynamics: generalized coordinates - I
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- Lecture 48 - Hamilton's principle and Lagrange's equation of motion - I
- Lecture 49 - Hamilton's principle and Lagrange's equation of motion - II
- Lecture 50 - Hamilton's principle and Lagrange's equation of motion - III
- Lecture 51 - Hamilton's principle and Lagrange's equation of motion - IV
- Lecture 52 - Systems with constraints - I
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- Lecture 56 - Symmetries and conservation laws - I
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Lecture 3 - Synovial Joints

Lecture 4 - The Hip Joint

Lecture 5 - The Knee Joint

Lecture 6 - The Shoulder and Elbow Joints

Lecture 7 - The Spine

Lecture 8 - Biomechanics of the Hip Joint

Lecture 9 - Biomechanics of the Knee Joint

Lecture 10 - Biomechanics of the Shoulder Joint

Lecture 11 - Biomechanics of the Elbow Joint - Part I

Lecture 12 - Biomechanics of the Elbow Joint - Part II

Lecture 13 - Biomechanics of the Spine

Lecture 14 - Gait Cycle

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Lecture 16 - Measurement Techniques of Gait Analysis - Part I

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Lecture 18 - Motion Capture System

Lecture 19 - Fundamentals of Joint Kinematics

Lecture 20 - Joint Kinematics and Kinetics

Lecture 21 - Introduction to Musculoskeletal Modelling

Lecture 22 - Inverse Dynamics in Musculoskeletal Modelling

Lecture 23 - Muscle Force Estimation Using Static Optimization

Lecture 24 - Concepts of Stress and Strain

Lecture 25 - Stress Transformation

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Lecture 27 - Bone Adaptation and Viscoelastic Behaviour

Lecture 28 - Anisotropic Nature of Bone

Lecture 29 - Implant Classification and Failure Mechanisms

Lecture 30 - Introduction to Finite Element Modelling of Bone and Implant

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[Lecture 41 - Mathematical Modelling of Tissue Differentiation](#)

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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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Lecture 3 - Geometry of turning tools - 2

Lecture 4 - Geometry of single point turning tools -3

Lecture 5 - Geometry of cutting tools and numerical problems

Lecture 6 - Different types of tools and mcq

Lecture 7 - Mechanism of chip formation

Lecture 8 - Mechanics of material removal

Lecture 9 - Measurement Of Cutting Forces

Lecture 10 - Numerical problems and MCQ

Lecture 11 - Tool wear and Tool life

Lecture 12 - Wear and life of cutting tools - 2

Lecture 13 - The lathe

Lecture 14 - Calculations on mechanisms in machine tools

Lecture 15 - Numerical problems on lathe

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Lecture 17 - Milling machine - indexing

Lecture 18 - Gear cutting CNC and non traditional machining

Lecture 19 - CNC and non-traditional machining methods

Lecture 20 - Numerical problems for week 4

Lecture 21 - Introduction

Lecture 22 - Simple Gear Calculations

Lecture 23 - Gear Geometry

Lecture 24 - Helical Gear Problems

Lecture 25 - Numerical Problem MCQ

Lecture 26 - Numerical Problem Milling of Helical Gears

Lecture 27 - Simple and Compound Indexing

Lecture 28 - Differential Indexing

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[Lecture 47 - Stepper motors, Permanent magnet DC motors](#)

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[Lecture 58 - Cutter Path Generation for Curved Surfaces](#)

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- Lecture 7 - Elements of Calculation of Variations - II
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- Lecture 10 - Rayleigh - Ritz Method - I
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- Lecture 12 - Weighted Residual Method
- Lecture 13 - Weighted Residual Method - Example
- Lecture 14 - Concepts of Element and Axial Bar Problem
- Lecture 15 - Axial Bar Problem
- Lecture 16 - Axial Bar - II
- Lecture 17 - Beam Formulation
- Lecture 18 - Beam Stiffness Matrix
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- Lecture 20 - Beam Column
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- Lecture 22 - Share Deformable Beam Theory
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- Lecture 27 - Element of Formulation
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- Lecture 29 - Analysis of Plane Truss (Computer Implementation)
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- [Lecture 59 - Iso-parametric Formulation and Gauss Quadrature](#)
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Lecture 3 - Introduction to Design Thinking

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Lecture 6 - FFE Interface with HLD and DT

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Lecture 9 - Product Design Specification

Lecture 10 - FAST in Functional Design

Lecture 11 - Design Thinking and Product Conceptualization and Development

Lecture 12 - Product specification and related methods

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Lecture 14 - Conceptual design: tools and techniques

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Lecture 18 - Concept evaluation methods

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Lecture 22 - Pugh Method (Concept Selection leading to Embodiment Design)

Lecture 23 - Introduction to Sustainability

Lecture 24 - Sustainability and Eco-design

Lecture 25 - LCA and design thinking on LCA

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Lecture 27 - Design for Rapid prototyping, DFAM

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Lecture 5 - Fixed Installation Robots - Serial and Parallel Robots

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Lecture 7 - DC Motors/Actuators and Drives

Lecture 8 - Stepper Motors

Lecture 9 - Brushless DC Motors/Actuators

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Lecture 11 - Introduction to Sensor and Transducers, Position Sensors

Lecture 12 - Position Sensors: Potentiometers, and Hall-effect. Velocity Sensors

Lecture 13 - Acceleration Sensors, AC Sensors (Resolvers and Synchros)

Lecture 14 - Non-contact (Inductive and Capacitive), Force/Torque Sensors

Lecture 15 - Limit Switches, Classification and Characteristics of Sensors

Lecture 16 - Degrees of Freedom and Kinematic Transformations : Translation

Lecture 17 - Pure Rotation, Arbitrary Axis Rotations, Euler Angles

Lecture 18 - Link and Joint Parameters (DH Notations), 2 and 3 DoF Robots

Lecture 19 - 3 DoF Cylindrical Robot (Spatial), SphericalWrist, Cylindrical Robot with Wrist

Lecture 20 - Forward Kinematics of 6-DoF Industrial Robot

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Lecture 24 - Differential Motion Analysis, Velocity, and Robot Jacobian

Lecture 25 - Jacobian (2R), Jacobian Inverse, Singularity, and Acceleration Analysis

Lecture 26 - Installing the Mechanical Arm and Test Run

Lecture 27 - Mastering an Industrial Robot

Lecture 28 - TCP Calibration using 4-Point method and External reference method

Lecture 29 - TCP Orientation Calibration using World Frame and Two-Point method

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- Lecture 32 - Base Linear Track and External Turn-Table Calibration
- Lecture 33 - Link Forces and Moments
- Lecture 34 - Gravity Compensation and External Forces/Torques
- Lecture 35 - Kinetostatic Measures for Robot Design
- Lecture 36 - Introduction to Dynamics, LE Approach, Dynamics of 1DoF System
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- Lecture 38 - Newton-Euler (NE) Approach
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- Lecture 40 - Payload and Supplementary Load Calibration
- Lecture 41 - Identification Experiments
- Lecture 42 - Repeatability Tests and ISO 9283:1998
- Lecture 43 - Introduction to Control, Linear Control, Second Order System
- Lecture 44 - Response of a Second Order Linear System
- Lecture 45 - Transfer Function and State-space representation, ODE
- Lecture 46 - A Robot Joint : DC Motor Model
- Lecture 47 - Feedback control of a robot arm, PID Control, Gain Tuning
- Lecture 48 - Workspace and Operator Safety
- Lecture 49 - Industrial Robot Programming
- Lecture 50 - Course Conclusion and Suggestions

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- Lecture 2 - Review of Basic Thermodynamics Continued
- Lecture 3 - An introduction to Normal Shocks
- Lecture 4 - The Mach Number and Compressible Flow
- Lecture 5 - The relation of physical properties across a normal shock
- Lecture 6 - Normal Shock in a duct: Throat and Reservoir conditions
- Lecture 7 - Example Problems in Normal Shocks
- Lecture 8 - An introduction to Oblique Shocks
- Lecture 9 - The relation of physical properties across an oblique shock
- Lecture 10 - Example Problems in Oblique Shocks
- Lecture 11 - Pressure - Deflection relationship of Shocks
- Lecture 12 - An introduction to Expansion waves
- Lecture 13 - Area - Mach Relationship
- Lecture 14 - Unsteady Shock Waves: The Shock Tube
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- Lecture 17 - Wave propagation: Small Perturbation Theory
- Lecture 18 - Finite Wave Theory: An introduction to the Method of Characteristics
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Lecture 22 - Properties of objective function and cardinal ideas in optimization

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Lecture 5 - Fracture Mechanics is Holistic

Lecture 6 - Fatigue Crack Growth Model

Lecture 7 - Crack Growth and Fracture Mechanisms

Lecture 8 - Elastic Strain Energy

Lecture 9 - Fracture Strength by Griffith

Lecture 10 - Energy Release Rate

Lecture 11 - Utility of Energy Release Rate

Lecture 12 - Pop-in Phenomenon

Lecture 13 - Displacement and Stress Formulations

Lecture 14 - Forms of Stress Functions

Lecture 15 - Airy's Stress Function for Mode-I

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Lecture 2 - Optical Methods Work as Optical Computers

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Lecture 5 - Introduction to Moiré, Brittle Coatings and Holography

Lecture 6 - Hologram Interferometry, Speckle Methods

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Lecture 8 - Fringe Patterns – Richness of Qualitative Information

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Lecture 11 - Introduction to Transmission Photoelasticity

Lecture 12 - Ordinary and Extraordinary Rays

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**NPTEL : Rocket Propulsion (Mechanical Engineering)**

**Co-ordinators : Prof. K. Ramamurthi**

Lecture 1 - Introduction

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 Nozzle

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 - 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  \$\infty\$  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  \$\hat{=}\$  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

Lecture 2 - Advanced Finite Elements Analysis

Lecture 3 - Advanced Finite Elements Analysis

Lecture 4 - Advanced Finite Elements Analysis

Lecture 5 - Advanced Finite Elements Analysis

Lecture 6 - Advanced Finite Elements Analysis

Lecture 7 - Advanced Finite Elements Analysis

Lecture 8 - Advanced Finite Elements Analysis

Lecture 9 - Advanced Finite Elements Analysis

Lecture 10 - Advanced Finite Elements Analysis

Lecture 11 - Advanced Finite Elements Analysis

Lecture 12 - Advanced Finite Elements Analysis

Lecture 13 - Advanced Finite Elements Analysis

Lecture 14 - Advanced Finite Elements Analysis

Lecture 15 - Advanced Finite Elements Analysis

Lecture 16 - Advanced Finite Elements Analysis

Lecture 17 - Advanced Finite Elements Analysis

Lecture 18 - Advanced Finite Elements Analysis

Lecture 19 - Advanced Finite Elements Analysis

Lecture 20 - Advanced Finite Elements Analysis

Lecture 21 - Advanced Finite Elements Analysis

Lecture 22 - Advanced Finite Elements Analysis

Lecture 23 - Advanced Finite Elements Analysis

Lecture 24 - Advanced Finite Elements Analysis

Lecture 25 - Advanced Finite Elements Analysis

Lecture 26 - Advanced Finite Elements Analysis

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](#)

[Lecture 4 - Principles Of Mechanical Measurements](#)

[Lecture 5 - Principles Of Mechanical Measurements](#)

[Lecture 6 - Principles Of Mechanical Measurements](#)

[Lecture 7 - Principles Of Mechanical Measurements](#)

[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  $\epsilon_{\lambda}$  and  $\epsilon_{T\lambda}$  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 A- 1 (Angle plate, steel rule, spring calipers)

Lecture 5 - Linear measuring instruments A- 2 (Combination set, Vernier calipers)

Lecture 6 - Linear measuring instruments A- 3 (Height gauge, Micrometers A- 1)

Lecture 7 - Linear measuring instruments A- 4 (Micrometers A- 2, Bore gauge)

Lecture 8 - Linear measuring instruments 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

- Lecture 1 - Introduction to the course
- Lecture 2 - Newton's laws
- Lecture 3 - Equilibrium
- Lecture 4 - Example 1 - Statics
- Lecture 5 - Example 2 - Rigid Body Systems
- Lecture 6 - Example 3 - Rigid Body Systems
- Lecture 7 - Structural Systems with rigid bodies
- Lecture 8 - Types of 1-D Structural Elements
- Lecture 9 - Axial members
- Lecture 10 - Analysis of the truss system
- Lecture 11 - Stability of Structural systems
- Lecture 12 - Beams - Example 1
- Lecture 13 - Beams - BMD and SFD
- Lecture 14 - Beams - Loading, Shear and Bending Moment Relations
- Lecture 15 - Static Friction
- Lecture 16 - Friction - Solving Problems
- Lecture 17 - Particle Kinematics - 1
- Lecture 18 - Particle Kinematics - 2 (Example)
- Lecture 19 - Particle Kinematics - Curvilinear Coordinates
- Lecture 20 - Rigid Body Kinematics
- Lecture 21 - Rotational Motion (Example 1)
- Lecture 22 - Rotational Motion (Example 2)
- Lecture 23 - Dynamics (Introduction)
- Lecture 24 - Dynamics - Example 1
- Lecture 25 - Dynamics - Example 2
- Lecture 26 - Dynamics - Example 3
- Lecture 27 - Dynamics - Example 4
- Lecture 28 - Center of Percussion - Example
- Lecture 29 - Impulse / Momentum - Example 1
- Lecture 30 - Impulse / Momentum - Example 2
- Lecture 31 - Impulse / Momentum - Example 3

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Lecture 2 - Review of fundamentals of fluid mechanics - II

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Lecture 5 - Concepts of BL thickness (?)

Lecture 6 - Concepts of BL displacement thickness ( $\delta^*$ ) and BL momentum thickness ( $\delta^2$ )

Lecture 7 - Control Volume approach to derive expressions for  $\delta^*$  over a flat plate

Lecture 8 - Control Volume approach to derive expressions for  $\delta^2$  over a flat plate

Lecture 9 - Concept of wall friction

Lecture 10 - Concept of friction drag

Lecture 11 - Skin Friction Coefficient - I

Lecture 12 - Skin Friction Coefficient - II

Lecture 13 - Derivation of Prandtl's Laminar BL Equations - I

Lecture 14 - Derivation of Prandtl's Laminar BL Equations - II

Lecture 15 - Derivation of Prandtl's Laminar BL Equations - III

Lecture 16 - Derivation of Prandtl's Laminar BL Equations - IV

Lecture 17 - Similarity Solutions to the BL Equations Applied to a Flat Plate - I

Lecture 18 - Similarity Solutions to the BL Equations Applied to a Flat Plate - II

Lecture 19 - Similarity Solutions to the BL Equations Applied to a Flat Plate - III

Lecture 20 - Runge-Kutta Method to Numerically Solve the BL Equations Applied to a Flat Plate

Lecture 21 - Description of the Numerical Code to Solve the BL Equations Applied to a Flat Plate

Lecture 22 - Similarity Solutions to the BL Equations (other than flat plate) - I

Lecture 23 - Similarity Solutions to the BL Equations (other than flat plate) - II

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Lecture 25 - Similarity Solutions to the BL Equations (other than flat plate) - IV

Lecture 26 - Description of the Numerical Code to Solve the BL Equations (other than flat plate)

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Lecture 28 - The Energy Equation - II

Lecture 29 - Similarity Solutions to Thermal BL - I

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[Lecture 32 - BL Separation with Pressure-Gradient - I](#)

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[Lecture 34 - Effect of Prandtl Number in Thermal BL - I](#)

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Lecture 7 - Energy Equation

Lecture 8 - Concept of stagnation

Lecture 9 - Discussion on stagnation

Lecture 10 - Velocity of sound

Lecture 11 - Discussion on velocity of sound and mach number

Lecture 12 - Wave propagation

Lecture 13 - Mach wave

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Lecture 16 - Variable Area Adiabatic flow (Continued...)

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Lecture 18 - Importance of stagnation temperature in relation to v

Lecture 19 - Discussion on variable area adiabatic flow and \* reference quantities

Lecture 20 - Gas tables

Lecture 21 - Converging nozzle

Lecture 22 - Condition of choked flow and associated properties

Lecture 23 - Area ratio and pressure ratio in converging nozzles

Lecture 24 - Discussion on converging nozzles

Lecture 25 - Converging - Diverging (C-D) nozzles

Lecture 26 - More on C-D nozzles

Lecture 27 - Discussion on C-D nozzles - 1

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Lecture 29 - Examples and applications of flow through C-D nozzles

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[Lecture 47 - Discussion on Prandtl-Meyer expansion](#)

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- Lecture 4 - Continuum heat transfer and its limitation
- Lecture 5 - Energy carriers at Micro/Nanoscale and their attributes
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- Lecture 9 - Fundamentals of Quantum mechanics - Part 3
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- Lecture 12 - Fundamentals of solid state physics - Part 1
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- Lecture 20 - Kinetic theory of energy carriers - Part 1
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- Lecture 23 - Boltzmann Transport Equation under the relaxation time approximation
- Lecture 24 - Derivation of Continuum laws from Boltzmann Transport Equation - Part 1
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- Lecture 7 - Understanding IUCr tables
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- Lecture 9 - Reciprocal lattice
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- Lecture 11 - Interplanar distances and angles
- Lecture 12 - Diffraction - 1
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- Lecture 16 - Microscope - 1
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- Lecture 19 - Double Diffraction and CBED
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- Lecture 26 - Contrast from Strain Fields
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- Lecture 7 - Module 4 - Reflection Of Plane Waves - 1
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- Lecture 13 - Module 8 - Acoustic Mode Shapes, Reflection
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- Lecture 16 - Module 11 - Near Field Acoustic Waves
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- Lecture 18 - Module 13 - Power Calculation
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- Lecture 27 - Module 22 - Electro Mechanical Analogies - Part 1
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Lecture 5 - Cleanliness Requirements for Different applications

Lecture 6 - Limitation of Primary Steelmaking and Importance of secondary Refining

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Lecture 9 - Desulphurisation

Lecture 10 - Degassing

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Lecture 17 - Nature and Distribution of Entrapments in Casting

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Lecture 25 - Static Analysis of the Knee and Ankle

Lecture 26 - Kinetics: Linear Motion - Part I

Lecture 27 - Kinetics: Linear Motion - Part II

Lecture 28 - Kinetics: Linear Motion - Part III

Lecture 29 - Kinetics: Angular Motion - Part I

Lecture 30 - Kinetics: Angular Motion - Part II

Lecture 31 - Kinetics: Angular Motion - Part III

- [Lecture 32 - Kinetics: Angular Motion - Part IV](#)
- [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 Centrodes
- 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

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**Co-ordinators : Dr. D. B. Karunakar**

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- Lecture 10 - Problem solving on frequency compounding of interest and gradient series factors
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- Lecture 17 - Proper treatment of sunk cost in replacement
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- 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
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- Lecture 24 - Modified accelerated cost recovery system (MACRS) method of depreciation, Depletion
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- 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](#)

[Lecture 34 - Loaded sample in a polarizer](#)

[Lecture 35 - Stress-induced birefringence](#)

[Lecture 36 - Analyses of optical paths using matrix methods](#)

[Lecture 37 - Putting it all together](#)

[Lecture 38 - What is tomography ?](#)

[Lecture 39 - Signal processing and Fourier methods](#)

[Lecture 40 - Rays and the Radon transforms](#)

[Lecture 41 - Geometric interpretations](#)

[Lecture 42 - The inverse problem: From Radon transform to 2D cross-section](#)

[Lecture 43 - Cone beams, parallel beams and the Feldkamp algorithm](#)

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