

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

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

Lecture 1 - Course Intro & Historical development of flights

Lecture 2 - Early development of aircraft propulsive devices

Lecture 3 - Development of Jet propulsion for aircraft

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

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

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

Lecture 7 - Tutorial

Lecture 8 - First law of thermodynamics for closed systems

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

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

Lecture 11 - Reversible and irreversible processes, concept of entropy

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

Lecture 13 - Tutorial

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

Lecture 15 - Exergy, availability and second law efficiency

Lecture 16 - Tutorial

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

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

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

Lecture 20 - Tutorial

Lecture 21 - Properties of gas and vapour mixtures

Lecture 22 - One-dimensional compressible flows, isentropic flows

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

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

Lecture 25 - IC Engines for aircraft application

Lecture 26 - Performance parameters of IC engines

Lecture 27 - Supercharging of aircraft IC engines

Lecture 28 - Tutorial: IC Engines

Lecture 29 - Propeller fundamentals

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

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

[Lecture 32 - Tutorial: Propellers](#)

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

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

[Lecture 35 - Tutorial](#)

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

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

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

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

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

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

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

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

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

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

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

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

[Lecture 36 - Tute-6](#)

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

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

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

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

[Lecture 41 - Tute-7](#)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

[Lecture 32 - Swept Wings](#)

[Lecture 33 - Introduction to Drag and Types of Drag](#)

[Lecture 34 - Factors Affecting Induced Drag](#)

[Lecture 35 - Skin Friction Drag](#)

[Lecture 36 - Tutorial on Critical Mach Number and Wave Drag](#)

[Lecture 37 - Introduction to Propulsion](#)

[Lecture 38 - Gas Turbine Engine Types - Part I](#)

[Lecture 39 - Gas Turbine Engine Types - Part II](#)

[Lecture 40 - Introduction to Electric Propulsion and Ion Propulsion](#)

[Lecture 41 - Steady Level Flight](#)

[Lecture 42 - Power Required for the Steady Level Flight](#)

[Lecture 43 - Steady Level Flight - A Pilot's View](#)

[Lecture 44 - Tutorial on Steady Level Flight](#)

[Lecture 45 - Gliding Flight](#)

[Lecture 46 - Climbing Flight and Ceiling](#)

[Lecture 47 - Introduction to Turning Flight](#)

[Lecture 48 - Turning Flight Equations](#)

[Lecture 49 - Instantaneous and Sustained Turn](#)

[Lecture 50 - Tutorial on Climbing Flight and Turning Flight](#)

[Lecture 51 - Introduction to Static Stability: Center of Pressure, Center of Gravity and Neutral Point](#)

[Lecture 52 - Aerodynamic Center and Effect of Center of Gravity](#)

[Lecture 53 - Effect of Center of Gravity - A Practical Demonstration](#)

[Lecture 54 - Introduction to V-n Diagram](#)

[Lecture 55 - V-n Diagram as per FAR 23 Regulations](#)

[Lecture 56 - Effect of Gusts on V-n Diagram](#)

[Lecture 57 - Tutorial on Stability and Control](#)

[Lecture 58 - Range](#)

[Lecture 59 - Specific Fuel Consumption and Generalized Range Equation](#)

[Lecture 60 - Endurance](#)

[Lecture 61 - Take-off Performance of Flight - Part I](#)

[Lecture 62 - Take-off Performance of Flight - Part II](#)

[Lecture 63 - Landing Performance of Flight](#)

[Lecture 64 - Tutorial on Range Payload Diagram](#)



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

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

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

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

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

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

Lecture 1 - Introduction

Lecture 2 - Course Plan

Lecture 3 - Ascent Mission Basics

Lecture 4 - Force and Geometry Models - 1

Lecture 5 - Force and Geometry Models - 2

Lecture 6 - Idealized Performance

Lecture 7 - Trajectory Under Gravity

Lecture 8 - Impact of Gravity

Lecture 9 - Impact of Drag

Lecture 10 - Curvilinear Motion Concept

Lecture 11 - Constant Pitch Rate Solution

Lecture 12 - Constant Velocity Solution

Lecture 13 - Constant (T/m) Solution

Lecture 14 - Ascent Mission Design

Lecture 15 - Multi-stage Rocket Basics

Lecture 16 - Multi-stage Configuration Basics

Lecture 17 - Multi-stage Solution Basics

Lecture 18 - Multi-stage Problem Definition

Lecture 19 - Optimal Staging Strategy

Lecture 20 - Lagrange Solution

Lecture 21 - Approximate Staging Solution

Lecture 22 - Variant Concept

Lecture 23 - Variant Design Solution

Lecture 24 - Parallel Staging Concept

Lecture 25 - Parallel Staging Benefits

Lecture 26 - Jet Damping and Ballistic Missiles

Lecture 27 - Current Rocket Concepts

Lecture 28 - Launch Widow and SSTO Concepts

Lecture 29 - Reentry Concept

Lecture 30 - Ballistic Reentry Solution

Lecture 31 - Lifting and Other Reentry Modes

[Lecture 32 - Concluding Remarks](#)

[Lecture 33 - Rectilinear Trajectories](#)

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Lecture 3 - The three conventional LTA systems

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

Lecture 5 - Introduction of Skyship 600 and USP of Airships

Lecture 6 - Applications of Airships

Lecture 7 - Tethered Aerostat systems

Lecture 8 - Why use Aerostats

Lecture 9 - Some Queries on Aerostats

Lecture 10 - Historical developments of LTA systems - Part I

Lecture 11 - Historical developments of LTA systems - Part II

Lecture 12 - Historical developments of LTA systems - Part III

Lecture 13 - Historical developments of LTA systems - Part IV

Lecture 14 - Historical developments of LTA systems - Part V

Lecture 15 - Historical developments of LTA systems - Part VI

Lecture 16 - Overview of PADD

Lecture 17 - Remote Controlled Airships

Lecture 18 - Autonomous Airships

Lecture 19 - Indoor Blimp Projects by students

Lecture 20 - Biomimetic Airships

Lecture 21 - Introduction to Buoyancy

Lecture 22 - Basic Concepts of Aerostatics

Lecture 23 - Ballasting, Weigh off and Fuel weight recovery

Lecture 24 - In flight Ballast Collection methods

Lecture 25 - Static Lift Prediction - Part I

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Lecture 27 - Tutorial Problem 1 on Static Lift Estimation

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Lecture 29 - Calculation of Ambient Air Density

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

Lecture 32 - Ballonet Air Weight Estimation

Lecture 33 - Net Static Lift of non rigid airships

Lecture 34 - Net Static Lift for other LTA systems

Lecture 35 - Tutorial Problem 4 on Net Static Lift Estimation

Lecture 36 - Parameters affecting Static Lift

Lecture 37 - Effect of change in Atmospheric Pressure

Lecture 38 - Tutorial Problem 5 on Change in Atmospheric Pressure

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Lecture 40 - Tutorial Problem 6 on effect of Superpressure

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

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

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Lecture 58 - Descent Following Exceedance

Lecture 59 - Pressure Height for other LTA Vehicles

Lecture 60 - Discussion of Practice Questions

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- Lecture 65 - Fabric Testing Machines - Part II
- Lecture 66 - Need for Ground Handling
- Lecture 67 - Aerial Hanger for CL 160 Airship
- Lecture 68 - Ground Handling of Airships
- Lecture 69 - Types of Mooring Masts and Design Requirements
- Lecture 70 - Nose Battens for Envelopes
- Lecture 71 - Need for Airship Design Methodology
- Lecture 72 - Overview of Airship Design Methodology ADM
- Lecture 73 - Details of Airship Design Methodology ADM
- Lecture 74 - Inputs to Airship Design Methodology - Part 1
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- Lecture 76 - Design Constants in Airship Design Methodology
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- Lecture 78 - Statistical Data Used in Airship Design Methodology
- Lecture 79 - Validation of Airship Design Methodology
- Lecture 80 - Envelope Shapes for LTA Systems
- Lecture 81 - Example of Application of Airship Design Methodology
- Lecture 82 - Conclusions and Limitations of Airship Design Methodology
- Lecture 83 - Sizing Procedure for Indoor Remotely Controlled Airships - Part 1
- Lecture 84 - Sizing Procedure for Indoor Remotely Controlled Airships - Part 2
- Lecture 85 - Sizing Procedure for Indoor Remotely Controlled Airships - Part 3
- Lecture 86 - Tutorial on Sizing of an Indoor Non Rigid Remotely Controlled Airship
- Lecture 87 - Transportation Problems Faced by Remote Regions
- Lecture 88 - Airships vs Helicopters - Part I
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- Lecture 90 - Char Dham Yatra - Part I
- Lecture 91 - Char Dham Yatra - Part II
- Lecture 92 - Char Dham Yatra - Part III
- Lecture 93 - Steam and IC engines for Airships
- Lecture 94 - Electric motors for Airships
- Lecture 95 - Turboprops for Airships
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- Lecture 97 - Lecture on Dynamics

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

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

Lecture 1 - Aero elasticity

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Lecture 7 - Aero elasticity

Lecture 8 - Aero elasticity

Lecture 9 - Aero elasticity

Lecture 10 - Aero elasticity

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Lecture 12 - Aero elasticity

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

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

Lecture 1 - Instability and Transition of Fluid Flows

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

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

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

- Lecture 1 - Fundamentals of Aerospace Propulsion
- Lecture 2 - Fundamentals of Aerospace Propulsion
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**NPTEL : Jet and Rocket Propulsion (Aerospace Engineering)**

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

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Lecture 14 - Jet and Rocket Propulsion

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Lecture 18 - Jet and Rocket Propulsion

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- Lecture 1 - General Introduction: Airplane Performance Characteristics
- Lecture 2 - George Cayley: Concept of Lift and Drag
- Lecture 3 - Introduction to airplane and its components
- Lecture 4 - Hansa 3 Aircraft and its Primary Systems
- Lecture 5 - Concept of Lift Aerofoil: Wing : Complete Aircraft
- Lecture 6 - Drag Polar
- Lecture 7 - Revision
- Lecture 8 - Standard Atmosphere: Description and Modeling
- Lecture 9 - Measuring Instruments: Altimeter, Airspeed Indicator
- Lecture 10 - Equations of Motion: Static Performance
- Lecture 11 - Thrust Required, Power Required: Cruise
- Lecture 12 - Excess Thrust and Power: Climb Angle and Rate of Climb
- Lecture 13 - Review
- Lecture 14 - Thrust Required: A Closer Look
- Lecture 15 - Modeling of CL: Dimensional Analysis
- Lecture 16 - A Closer Look: Point Mass Model, Dimensional Analysis
- Lecture 17 - Estimation of Drag Polar Through Flight Test
- Lecture 18 - Estimation of Rate of Climb
- Lecture 19 - Revision.
- Lecture 20 - Range and Endurance
- Lecture 21 - Range and Endurance: (Continued...)
- Lecture 22 - Gliding Flight
- Lecture 23 - Accelerated Flight
- Lecture 24 - V-n Diagram
- Lecture 25 - Revision..
- Lecture 26 - V stall: Cruise and Manoeuvre
- Lecture 27 - Flaps:High Lift Devices to Reduce Take off / Landing Distance
- Lecture 28 - Take off
- Lecture 29 - Take off Performance
- Lecture 30 - Take off Performance: (Continued...)
- Lecture 31 - Revision...

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[Lecture 33 - Landing Performance: \(Continued...\)](#)

[Lecture 34 - Challenges in Takeoff and Landing: Single and Twin Engines](#)

[Lecture 35 - Introduction to Static Stability](#)

[Lecture 36 - Positioning of Center of Pressure for Static Stability](#)

[Lecture 37 - Revision.....](#)

[Lecture 38 - Stability and Control: Designers Perspective](#)

[Lecture 39 - Stability and Control: Designers Perspective \(Continued...\)](#)

[Lecture 40 - Longitudinal Control: Elevator](#)

[Lecture 41 - Contribution of Wing and Tail: Stability](#)

[Lecture 42 - Stability: Wing and Tail Contribution](#)

[Lecture 43 - Control: Elevator](#)

[Lecture 44 - Control: Delta-e Required](#)

[Lecture 45 - Control: Delta-e Required \(Continued...\)](#)

[Lecture 46 - Design Basics: Wing Loading & Thrust Loading](#)

[Lecture 47 - Design Basics: Sweep & Dihedral](#)

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Lecture 1 - Introduction

Lecture 2 - Introduction to Static Stability

Lecture 3 - Stability and Trim

Lecture 4 - Stability : Wing Contribution

Lecture 5 - Stability : Tail Contribution and Static Margin

Lecture 6 - Problems : Stability and Wing Contribution Completed

Lecture 7 - Problems : Stability Tail Contribution Completed

Lecture 8 - Neutral Point and Fuselage Contribution Completed

Lecture 9 - Longitudinal Control Completed

Lecture 10 - Longitudinal Control (Continued...)

Lecture 11 - Control: Elevator

Lecture 12 -  $CL_{trim}$  Vs  $e_{trim}$

Lecture 13 - Neutral Point: A Closer Look

Lecture 14 - Contribution of Engine towards Stability

Lecture 15 - Revision

Lecture 16 - Trim: Cruise, Climb and Landing

Lecture 17 - Trim: Maneuver

Lecture 18 - Maneuvering Point: Stick Fixed

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

Lecture 20 - Revision

Lecture 21 - Directional Stability

Lecture 22 - Directional Control

Lecture 23 - Lateral Stability and Control

Lecture 24 - Numericals : Directional, Lateral Stability and Control

Lecture 25 - Revision

Lecture 26 - Stick Free Stability

Lecture 27 - Stick Free Stability (Continued...)

Lecture 28 - Hinge Moment and Hinge Moment Derivative

Lecture 29 - Aircraft Handling Qualities

Lecture 30 - Aircraft Handling Qualities (Continued...)

Lecture 31 - Reversible Control: Stick Free and Trim Tabs

- Lecture 32 - Numericals: Stick Free
- Lecture 33 - Numericals: Stick Free (Continued...)
- Lecture 34 - Handling Qualities: Maneuvering Flight
- Lecture 35 - Determination of Neutral Point and Maneuvering Point by Flight Experiment
- Lecture 36 - Ponit Mass Equation of Motion
- Lecture 37 - Forces and Moments
- Lecture 38 - Aircraft Equations of Motion
- Lecture 39 - Six Degrees of Freedom of an Aircraft
- Lecture 40 - 6 DoF : Angular Momentum Components
- Lecture 41 - Vector in a Rotating Frame
- Lecture 42 - Euler Angles
- Lecture 43 - Small Perturbation Theory
- Lecture 44 - Small Perturbation Theory (Continued...)
- Lecture 45 - Perturbed Equations of Motion: Longitudinal Case
- Lecture 46 - Perturbed Force : fz
- Lecture 47 - Perturbed Force : fz (Continued...)
- Lecture 48 - Perturbed Pitching Moment
- Lecture 49 - Longitudinal Dimensional Stability Derivatives
- Lecture 50 - Dynamic Stability
- Lecture 51 - Longitudinal Modes
- Lecture 52 - Short Period and Phugoid Approximations
- Lecture 53 - Pure Pitching Motion
- Lecture 54 - Stability Augmentation System (SAS)
- Lecture 55 - Lateral-Directional Motion
- Lecture 56 - Tutorial - 1
- Lecture 57 - Tutorial - 2
- Lecture 58 - Tutorial - 3
- Lecture 59 - Tutorial - 4
- Lecture 60 - History of Aviation

- Lecture 1 - Thermodynamics and its Applications
- Lecture 2 - System and its Surroundings
- Lecture 3 - Property of System
- Lecture 4 - Energy and its Various Forms
- Lecture 5 - Concepts of Equilibrium and its State
- Lecture 6 - Energy and its Interactions
- Lecture 7 - Heat Interactions
- Lecture 8 - Thermodynamic Properties of Fluids - 1
- Lecture 9 - Thermodynamic Properties of Fluids - 2
- Lecture 10 - Thermodynamic Properties of Fluids - 3
- Lecture 11 - Thermodynamic Properties of Fluids - 4
- Lecture 12 - Thermodynamic Properties of Fluids - 5
- Lecture 13 - First Law of Thermodynamics for Cyclic Process
- Lecture 14 - First Law of Thermodynamics for Non-cyclic Process - 1
- Lecture 15 - First Law of Thermodynamics for Non-cyclic Process - 2
- Lecture 16 - Control Mass and Control Volume
- Lecture 17 - First Law of Thermodynamics for Steady Flow Processes
- Lecture 18 - First Law of Thermodynamics for Unsteady Flow Processes
- Lecture 19 - First Law of Thermodynamics to Reacting Systems
- Lecture 20 - Second Law of Thermodynamics: Basic Concepts - 1
- Lecture 21 - Second Law of Thermodynamics: Basic Concepts - 2
- Lecture 22 - Second Law of Thermodynamics: Carnot Cycle and Efficiency
- Lecture 23 - Second Law of Thermodynamics: Clausius Inequality
- Lecture 24 - Applications of Second Law of Thermodynamics: Entropy - 1
- Lecture 25 - Applications of Second Law of Thermodynamics: Entropy - 2
- Lecture 26 - Exergy
- Lecture 27 - Gas Turbine Cycle
- Lecture 28 - Vapor Power Cycle - 1
- Lecture 29 - Vapor Power Cycle - 2
- Lecture 30 - Vapor Power Cycle - 3
- Lecture 31 - Gas Power Cycles - 1

[Lecture 32 - Gas Power Cycles - 2](#)

[Lecture 33 - Refrigeration Cycles](#)

[Lecture 34 - Non-Reacting Mixture and Psychrometry](#)

[Lecture 35 - Gas-Vapor Mixture and Air Conditioning - 1](#)

[Lecture 36 - Gas-Vapor Mixture and Air Conditioning - 2](#)

[Lecture 37 - Thermodynamic Property Relations - 1](#)

[Lecture 38 - Thermodynamic Property Relations - 2](#)

Lecture 1 - Introduction to Dynamic Stability

Lecture 2 - Spring-Mass-Damper System : Underdamped

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

Lecture 4 - Laplace Transform

Lecture 5 - Pitch Dynamics : 1 D

Lecture 6 - Numericals: Week - 1

Lecture 7 - Aircraft Rigid Body Equation of Motion

Lecture 8 - Six Degree of Freedom Equation of Motion

Lecture 9 - Vector in Rotating Frame

Lecture 10 - Forces and Moments on Aircraft

Lecture 11 - Euler Angles

Lecture 12 - Trajectory of the Aircraft

Lecture 13 - Small Perturbation Theory

Lecture 14 - Perturbed Aerodynamic Forces and Moments

Lecture 15 - U-derivatives

Lecture 16 - Alpha - derivatives

Lecture 17 - Alpha Dot Derivatives

Lecture 18 - q and delta Derivatives

Lecture 19 - Dimensional Stability Derivatives

Lecture 20 - Longitudinal Characteristic Equation

Lecture 21 - Routh's Criteria and Longitudinal Dynamic Stability

Lecture 22 - Longitudinal Modes: Short Period and Phugoid

Lecture 23 - Short period Mode Approximation

Lecture 24 - Long Period Mode (Phugoid) Approximation

Lecture 25 - Lateral Directional Stability Derivatives

Lecture 26 - Lateral Directional Stability Derivatives (Continued...)

Lecture 27 - Perturbed Equation of Motion for Lateral Dynamics

Lecture 28 - Modes of Lateral Directional Dynamics

Lecture 29 - Spiral and Dutch Roll modes Approximation

Lecture 30 - Routh-Hurwitz Stability Criterion

Lecture 31 - Introduction to Stability Augmentation

[Lecture 32 - Pure Yawing and Pure Rolling Motion](#)

[Lecture 33 - SAS for Longitudinal Dynamics](#)

[Lecture 34 - SAS for Lateral Dynamics](#)

[Lecture 35 - Flight Handling Qualities](#)

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[Lecture 38 - Mode Shape : Longitudinal Case](#)

[Lecture 39 - Mode Shape : Lateral Directional Case](#)

[Lecture 40 - Numericals : Transfer Functions and Response](#)

[Lecture 41 - Stability Augmentation System](#)

[Lecture 42 - Numericals : SAS](#)

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Lecture 1 - Introduction to Ancient Indian Civilization

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

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

Lecture 4 - Glimpses of Ancient Indian Science and Technology

Lecture 5 - Brief Review of Ancient Indian Scriptures

Lecture 6 - Basic Principles of carrying out science and technology

Lecture 7 - Arrays of Physics, chemistry and Indoor games

Lecture 8 - Marvels of Ancient Indian Technology

Lecture 9 - Introduction to Indian Agriculture

Lecture 10 - Problems arising due to modern agricultural practices

Lecture 11 - Pesticides and soil degradation

Lecture 12 - Agriculture - A Primary Productive Activity

Lecture 13 - An Agricultural Tools - A Plough

Lecture 14 - Soil and seeds

Lecture 15 - Sowing Methods

Lecture 16 - Indigenous cattle and manuring

Lecture 17 - Ancient Indian Textile Technology

Lecture 18 - Handlooms and Charkha

Lecture 19 - Different types of Handlooms

Lecture 20 - Ancient Rural Indian Housing

Lecture 21 - Thatched Roof House

Lecture 22 - Rural Walls and Roof materials

Lecture 23 - Indus Valley and Harappan Civilization

Lecture 24 - First and Second of Indian Civilization

Lecture 25 - Town topologies and Brick and Tile making process

Lecture 26 - Availability of Water and Freshwater

Lecture 27 - Ancient Indian Wells

Lecture 28 - Temple Water tanks and Dams

Lecture 29 - Tank Irrigation system and Rainwater Harvesting

Lecture 30 - Waterbodies - Lakes and Canals

Lecture 31 - Sluices and Embankments

[Lecture 32 - World of Materials](#)

[Lecture 33 - Metals - Gold Silver Lead](#)

[Lecture 34 - History of Copper](#)

[Lecture 35 - Iron during Vedic period](#)

[Lecture 36 - Iron smelting process in ancient India](#)

[Lecture 37 - Iron and Steel crafts in ancient India](#)

[Lecture 38 - Extraction and smelting of Zinc in Ancient India](#)

[Lecture 39 - Metal Casting in Ancient India](#)

[Lecture 40 - Glass Technology in Ancient India](#)



- Lecture 1 - Weighment and Calculation of CG (Theory)
- Lecture 2 - Cruise Experiment (Theory)
- Lecture 3 - Weighment Experiment and cockpit panel description
- Lecture 4 - Drag Polar Experiment
- Lecture 5 - CG and Climb Experiment
- Lecture 6 - Calibration of Control Surface
- Lecture 7 - Calibration of Control Surfaces (Experiment)
- Lecture 8 - Introduction to Flight Data Recorder
- Lecture 9 - Sensors - Part I
- Lecture 10 - Sensors - Part II
- Lecture 11 - Data Acquisition using MEMS devices
- Lecture 12 - Estimation of Stick-Fixed Neutral Point
- Lecture 13 - Estimation of Stick-Free Neutral Point and Stick-Free Maneuvering Point
- Lecture 14 - Static: Lateral-Directional Stability Test
- Lecture 15 - Static: Lateral-Directional Stability Test (Continued...)
- Lecture 16 - Steady Coordinated Turn
- Lecture 17 - Introduction to Parameter Estimation
- Lecture 18 - Parameter Estimation using Least Squares Method
- Lecture 19 - Aerodynamic Parameter Estimation using Least Squares Method
- Lecture 20 - Aerodynamic Parameter Estimation using Delta Method
- Lecture 21 - Aerodynamic Parameter Estimation using Delta Method (Continued...)

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

Lecture 32 - Clausius inequality, application of second law

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

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

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

Lecture 36 - Entropy balance in closed system and control volume

Lecture 37 - Examples on entropy change in a system

Lecture 38 - Exergy and second law efficiency

Lecture 39 - Exergy of a fixed mass and flowing stream

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

Lecture 41 - Exergy balance and second law efficiency for closed systems and steady flow devices

Lecture 42 - Examples related to exergy change and exergy destruction

Lecture 43 - Gas power cycles and air-standard assumptions

Lecture 44 - An overview of reciprocating engines and otto cycle

Lecture 45 - Analysis of Diesel cycle

Lecture 46 - Analysis of Brayton cycle

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

Lecture 48 - Rankin and Carnot vapour power cycles

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

Lecture 50 - Refrigeration cycles

Lecture 51 - Examples on vapour power cycles

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

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

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

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

Lecture 56 - Energy balance for reacting systems

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

Lecture 58 - Examples on property relations and reaction thermodynamics

Lecture 1 - Introduction

Lecture 2 - Wing Loading and Thrust Loading

Lecture 3 - Basic Design - Lift and Drag

Lecture 4 - Range and Endurance

Lecture 5 - Mission Requirements

Lecture 6 - Range and Endurance : Propeller-driven Aircraft

Lecture 7 - Fuel Consumption : Cruise Flight

Lecture 8 - L/D for Maximum Range and Endurance

Lecture 9 - Range and endurance for Jet-driven Aircraft

Lecture 10 - Estimation of Fuel for a Mission

Lecture 11 - Design Considerations : Power Plant, Gross Weight

Lecture 12 - Design Considerations : Aerofoil Selection

Lecture 13 - Design Considerations : Wing

Lecture 14 - Wing Design: Aerofoil

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

Lecture 16 - Wing Design: Aspect Ratio

Lecture 17 - Wing Design: Sweep, Twist and Taper Ratio

Lecture 18 - Wing Arrangements

Lecture 19 - Tail Arrangements

Lecture 20 - Tail Arrangements (Continued...)

Lecture 21 - Aircraft Structure

Lecture 22 - Wing Loading and Power Loading

Lecture 23 - Thrust Loading and Wing Loading

Lecture 24 - Thrust Loading

Lecture 25 - Wing Loading

Lecture 26 - Wing Loading : Maneuver,Climb and glide

Lecture 27 - Take off: Wing Loading and Thrust Loading

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

Lecture 29 - Wing Loading: Take off and Landing

Lecture 30 - Revision (Wing Loading and Thrust Loading)

Lecture 31 - Numerical: Wing Loading

[Lecture 32 - Wing Loading: Designers Approach](#)

[Lecture 33 - Stability Considerations](#)

[Lecture 34 - Static Stability Basics](#)

[Lecture 35 - Wing and tail contribution to Longitudinal Static Stability](#)

[Lecture 36 - Conceptual Design](#)

[Lecture 37 - Conceptual design \(Continued...\)](#)

[Lecture 38 - Elevator Effectiveness](#)

[Lecture 39 - Elevator Effectiveness \(Continued...\)](#)

[Lecture 40 - Numerical - Pitching moment](#)

[Lecture 41 - Numerical - Elevator Effectiveness](#)

[Lecture 42 - Aircraft Maintenance Guidelines](#)

[Lecture 43 - Inspection for Aircraft](#)

[Lecture 44 - Numerical of Weight Fraction](#)

[Lecture 45 - Inspection of Sinus 912 Motor Glider](#)

[Lecture 46 - Numericals](#)

- Lecture 1 - Introduction to fundamentals of combustion
- Lecture 2 - Scope and applications of combustion
- Lecture 3 - Scope of combustion (Continued...) and types of fuel and oxidizers
- Lecture 4 - Characterization of liquid and gaseous fuel
- Lecture 5 - Properties of liquid and solid fuels, various modes of combustion
- Lecture 6 - Thermodynamics of combustion
- Lecture 7 - Thermodynamics of combustion (Continued...)
- Lecture 8 - Laws of thermodynamics and Stoichiometry
- Lecture 9 - Stoichiometric calculations for air-gas mixture
- Lecture 10 - Mixture fraction calculation for diffusion flames
- Lecture 11 - Thermochemistry
- Lecture 12 - Heat of reaction and bond energy
- Lecture 13 - Adiabatic flame temperature
- Lecture 14 - Adiabatic flame temperature and its effect on various parameters
- Lecture 15 - Introduction to chemical equilibrium
- Lecture 16 - Chemical equilibrium and Gibbs free energy
- Lecture 17 - Equilibrium constants and Le chatlier principle
- Lecture 18 - Determination of chemical equilibrium composition
- Lecture 19 - Chemical and reaction kinetics
- Lecture 20 - Compact notation and reaction rate of chemical reaction
- Lecture 21 - Collision Theory
- Lecture 22 - Collision theory (Continued...)
- Lecture 23 - Collision frequency of molecules
- Lecture 24 - Specific reaction rate and Arrhenius law
- Lecture 25 - First order, Second order and Third-order reactions
- Lecture 26 - Classification of chemical reactions
- Lecture 27 - Elementary chain reactions
- Lecture 28 - Quasi-steady state and partial equilibrium approximation
- Lecture 29 - Physics of combustion
- Lecture 30 - Transport equations and molecular model for transport process
- Lecture 31 - Mean free path length

[Lecture 32 - Lennard-Jones potential model for diffusivity](#)

[Lecture 33 - Lennard-Jones potential model \(Continued...\)](#)

[Lecture 34 - Mass conservation law](#)

[Lecture 35 - Momentum conservation equation](#)

[Lecture 36 - Introduction to mass transfer](#)

[Lecture 37 - Species transport equation](#)

[Lecture 38 - Energy conservation equation](#)

[Lecture 39 - Conserved scalar approach for one dimensional flows](#)

[Lecture 40 - Introduction to turbulent combustion](#)

[Lecture 1 - Rules and Regulations for Civil Aviation in India](#)

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- Lecture 2 - Measurement of Flight Velocity and Standard Atmosphere
- Lecture 3 - Anatomy of Airplane and Airfoil Nomenclature
- Lecture 4 - Examples, Pitot and static tube and differential pressure sensor
- Lecture 5 - Generation of Lift and Drag
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- Lecture 7 - Lifting line theory, NACA airfoil nomenclature
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- Lecture 9 - Interpreting airfoil data,  $C_l$  vs  $\alpha$  and drag polar, selection of airfoil
- Lecture 10 - Introduction to Airplane performance, Equation of motion
- Lecture 11 - Thrust required and Power required
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- Lecture 13 - Climb Performance, Engine Sizing and Power Plant selection
- Lecture 14 - Weight Estimation , Common propulsion systems
- Lecture 15 - Weight Estimation contd., Electric propulsion, Battery Sizing
- Lecture 16 - Iterative weight estimation and Wing sizing
- Lecture 17 - Wing Planform selection and sizing and Flight test of Cropped delta wing UAVs
- Lecture 18 - Effect of variation of CG location and Static Stability
- Lecture 19 - C.G. location and Longitudinal Static stability
- Lecture 20 - Tutorial 1
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Lecture 2 - Governing Equations and Discretization

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Lecture 5 - Mathematical description of fluid flow - II

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- Lecture 2 - Introduction to Engines (Continued...)
- Lecture 3 - Construction of Reciprocating Engine
- Lecture 4 - Construction of Reciprocating Engine (Continued...)
- Lecture 5 - Construction of Reciprocating Engine (Continued...)
- Lecture 6 - Lubrication System
- Lecture 7 - Lubrication System Demonstration
- Lecture 8 - Lubrication System (Continued...)
- Lecture 9 - Induction System
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- Lecture 11 - Cooling System
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- Lecture 13 - Cooling and Exhaust System (Lab Session)
- Lecture 14 - Engine fuel and Fuel Metering Systems
- Lecture 15 - Engine Fuel and Fuel Metering Systems (Continued...)
- Lecture 16 - Engine Fuel and Fuel Metering Systems (Lab Session)
- Lecture 17 - Carburetor troubleshooting and Fuel Injection System
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- Lecture 24 - Aircraft Reciprocating Engine Inspection - Part 1
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Lecture 8 - Linear solvers - VIII

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Lecture 4 - Fundamentals of Aero-thermodynamics

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- Lecture 37 - Effect of Acceleration and Particle Size on Burning Rate
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- Lecture 40 - Types of Propellant Grains
- Lecture 41 - Types of Solid Propellant Grains and Evolution of Burning Surface
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- Lecture 44 - Injection System in LPRE
- Lecture 45 - Atomization of Liquid Propellants
- Lecture 46 - Types of Injection System in LPRE
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Lecture 12 - Introduction to gas turbine engines (Continued...)

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

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

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

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

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

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

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

Lecture 28 - Performance/cycle analysis: Turbojet

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

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

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

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

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

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

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

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

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

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

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Method, Gauss-Seidel

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

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

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

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

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

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

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**NPTEL : Combustion (Aerospace Engineering)**

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

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- Lecture 4 - Static vs dynamic stability
- Lecture 5 - Criterion for stability, Wing contribution
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- Lecture 7 - Wing plus tail contribution
- Lecture 8 - Static margin and CG limits
- Lecture 9 - Fuselage contribution
- Lecture 10 - Powerplant contribution
- Lecture 11 - Power effects on neutral point
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- Lecture 13 - Stick free stability, Most fwd CG location
- Lecture 14 - Longitudinal stick force per 'g', Ground effect
- Lecture 15 - Control requirement, Pull-up maneuver, Maneuver point
- Lecture 16 - Elevator per 'g', Maneuver point
- Lecture 17 - Example problems
- Lecture 18 - Lateral-Directional Stability Derivatives, Fuselage/Vertical fin contribution
- Lecture 19 - Roll stability, Wing sweep effect, Rudder
- Lecture 20 - Dihedral effect, Various contributions
- Lecture 21 - Power effects, Roll control, Aileron
- Lecture 22 - Example problems
- Lecture 23 - Derivation of Translational Motion Equations
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- Lecture 25 - Description of various forces and moments
- Lecture 26 - Nonlinearities and Associated Aircraft Behavior
- Lecture 27 - Small perturbation method, Linearization of equations
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- Lecture 29 - Contribution of Aircraft components to Aerodynamic Derivatives
- Lecture 30 - Linear Model and Aircraft Dynamics Modes
- Lecture 31 - Short Period, Phugoid (Lanchester's formulation)

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

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

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

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

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

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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

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Lecture 14 - Unconventional Nozzles and Problems in Nozzles

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Lecture 16 - Choice of Fuel-Rich Propellants

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Lecture 18 - Factors Influencing Choice of Chemical Propellants

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

Lecture 20 - Introduction to Solid Propellant Rockets

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

Lecture 22 - Design Aspects of Solid Propellant Rockets

Lecture 23 - Burning Surface Area of Solid Propellant Grains

Lecture 24 - Ignition of Solid Propellant Rockets

Lecture 25 - Review of Solid Propellant Rockets

Lecture 26 - Feed Systems for Liquid Propellant Rockets

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

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

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

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

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- Lecture 19 - Stability of Linear Time Invariant Systems
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- Lecture 21 - Pole Placement Control Design
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