

**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 Turboshaft 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](#)

- 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 - Airliners

Lecture 14 - Key Issues in Design of Airliners

Lecture 15 - Design Considerations - Future Airliners

Lecture 16 - Supersonic Transport Aircraft

Lecture 17 - Airliner and Supersonic Aircraft, some additional concepts

Lecture 18 - Design Considerations - Cargo Aircraft

Lecture 19 - Design Considerations - GA Aircraft

Lecture 20 - Types of Military Aircraft

Lecture 21 - Cargo, GA and Military Aircraft, Some additional concepts

Lecture 22 - Aircraft Configuration Design

Lecture 23 - Podded Engines on Wings

Lecture 24 - Wing Sweep

Lecture 25 - Canards and Flying Wing

Lecture 26 - Three Surface Aircraft

Lecture 27 - Winglets

Lecture 28 - Thrust Vectoring

Lecture 29 - Few Novel Concepts\_01

Lecture 30 - Aircraft Configuration Design - Closing Remarks

Lecture 31 - Choices in Aircraft Layout

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

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

Lecture 1 - Introduction

Lecture 2 - Course Plan

Lecture 3 - Ascent Mission Basics

Lecture 4 - Force and Geometry Models - 1

Lecture 5 - Force and Geometry Models - 2

Lecture 6 - Idealized Performance

Lecture 7 - Trajectory Under Gravity

Lecture 8 - Impact of Gravity

Lecture 9 - Impact of Drag

Lecture 10 - Curvilinear Motion Concept

Lecture 11 - Constant Pitch Rate Solution

Lecture 12 - Constant Velocity Solution

Lecture 13 - Constant (T/m) Solution

Lecture 14 - Ascent Mission Design

Lecture 15 - Multi-stage Rocket Basics

Lecture 16 - Multi-stage Configuration Basics

Lecture 17 - Multi-stage Solution Basics

Lecture 18 - Multi-stage Problem Definition

Lecture 19 - Optimal Staging Strategy

Lecture 20 - Lagrange Solution

Lecture 21 - Approximate Staging Solution

Lecture 22 - Variant Concept

Lecture 23 - Variant Design Solution

Lecture 24 - Parallel Staging Concept

Lecture 25 - Parallel Staging Benefits

Lecture 26 - Jet Damping and Ballistic Missiles

Lecture 27 - Current Rocket Concepts

Lecture 28 - Launch Widow and SSTO Concepts

Lecture 29 - Reentry Concept

Lecture 30 - Ballistic Reentry Solution

Lecture 31 - Lifting and Other Reentry Modes

[Lecture 32 - Concluding Remarks](#)

[Lecture 33 - Rectilinear Trajectories](#)

[Lecture 34 - Curvilinear Trajectories](#)

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

[Lecture 36 - Optimal Multi-stage Solutions](#)

Lecture 1 - Introduction to the Course Content

Lecture 2 - Differences between LTA and HTA systems

Lecture 3 - The three conventional LTA systems

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

Lecture 5 - Introduction of Skyship 600 and USP of Airships

Lecture 6 - Applications of Airships

Lecture 7 - Tethered Aerostat systems

Lecture 8 - Why use Aerostats

Lecture 9 - Some Queries on Aerostats

Lecture 10 - Historical developments of LTA systems - Part I

Lecture 11 - Historical developments of LTA systems - Part II

Lecture 12 - Historical developments of LTA systems - Part III

Lecture 13 - Historical developments of LTA systems - Part IV

Lecture 14 - Historical developments of LTA systems - Part V

Lecture 15 - Historical developments of LTA systems - Part VI

Lecture 16 - Overview of PADD

Lecture 17 - Remote Controlled Airships

Lecture 18 - Autonomous Airships

Lecture 19 - Indoor Blimp Projects by students

Lecture 20 - Biomimetic Airships

Lecture 21 - Introduction to Buoyancy

Lecture 22 - Basic Concepts of Aerostatics

Lecture 23 - Ballasting, Weigh off and Fuel weight recovery

Lecture 24 - In flight Ballast Collection methods

Lecture 25 - Static Lift Prediction - Part I

Lecture 26 - Static Lift Prediction - Part II

Lecture 27 - Tutorial Problem 1 on Static Lift Estimation

Lecture 28 - Effect of Humidity and Vapour Pressure

Lecture 29 - Calculation of Ambient Air Density

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

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

Lecture 32 - Ballonet Air Weight Estimation

Lecture 33 - Net Static Lift of non rigid airships

Lecture 34 - Net Static Lift for other LTA systems

Lecture 35 - Tutorial Problem 4 on Net Static Lift Estimation

Lecture 36 - Parameters affecting Static Lift

Lecture 37 - Effect of change in Atmospheric Pressure

Lecture 38 - Tutorial Problem 5 on Change in Atmospheric Pressure

Lecture 39 - Effect of Superpressure

Lecture 40 - Tutorial Problem 6 on effect of Superpressure

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

Lecture 42 - Effect of Rapid change in Atmospheric Temperature

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

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

Lecture 45 - Effect of change in Relative Humidity

Lecture 46 - Effect of change in Lifting Gas Purity

Lecture 47 - Effect of change in Lifting Gas Volume

Lecture 48 - Determination of Inflation Fraction

Lecture 49 - Flight To Lower Ground Elevation

Lecture 50 - Tutorial Problem 10 on Helium Addition

Lecture 51 - Outdoor Hot Air Balloon

Lecture 52 - Pressure Height

Lecture 53 - Tutorial Problem 11 on Pressure Height Calculation

Lecture 54 - Sea Level Inflation Fraction

Lecture 55 - Flight above Pressure Height

Lecture 56 - Effect of Change in Operating Altitude

Lecture 57 - Tutorial Problem 12 on Lifting Gas Loss

Lecture 58 - Descent Following Exceedance

Lecture 59 - Pressure Height for other LTA Vehicles

Lecture 60 - Discussion of Practice Questions

Lecture 61 - Envelope Materials - Part I

Lecture 62 - Envelope Materials - Part II

Lecture 63 - Envelope Materials - Part III

Lecture 64 - Fabric Testing Machines - Part I



[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](#)

[Lecture 75 - Inputs to Airship Design Methodology - Part 2](#)

[Lecture 76 - Design Constants in Airship Design Methodology](#)

[Lecture 77 - Outputs from Airship Design Methodology](#)

[Lecture 78 - Statistical Data Used in Airship Design Methodology](#)

[Lecture 79 - Validation of Airship Design Methodology](#)

[Lecture 80 - Envelope Shapes for LTA Systems](#)

[Lecture 81 - Example of Application of Airship Design Methodology](#)

[Lecture 82 - Conclusions and Limitations of Airship Design Methodology](#)

[Lecture 83 - Sizing Procedure for Indoor Remotely Controlled Airships - Part 1](#)

[Lecture 84 - Sizing Procedure for Indoor Remotely Controlled Airships - Part 2](#)

[Lecture 85 - Sizing Procedure for Indoor Remotely Controlled Airships - Part 3](#)

[Lecture 86 - Tutorial on Sizing of an Indoor Non Rigid Remotely Controlled Airship](#)

[Lecture 87 - Transportation Problems Faced by Remote Regions](#)

[Lecture 88 - Airships vs Helicopters - Part I](#)

[Lecture 89 - Airships vs Helicopters - Part II](#)

[Lecture 90 - Chaar Dham Yatra - Part I](#)

[Lecture 91 - Chaar Dham Yatra - Part II](#)

[Lecture 92 - Chaar Dham Yatra - Part III](#)

[Lecture 93 - Steam and IC engines for Airships](#)

[Lecture 94 - Electric motors for Airships](#)

[Lecture 95 - Turboprops for Airships](#)

[Lecture 96 - Solar Propulsion and Thrust Vectoring on Airships](#)

[Lecture 97 - Lecture on Dynamics](#)

[Lecture 98 - Lectuer on Drag](#)

[Lecture 99 - Aerodynamic Stability](#)

[Lecture 100 - Added Mass Effects](#)

[Lecture 101 - Introduction to Aerostat Design Methodology](#)

[Lecture 102 - Inputs for Aerostat Design Methodology](#)

[Lecture 103 - Design Constants in Aerostat Design Methodology](#)

[Lecture 104 - Overview of Aerostat Design Methodology](#)

[Lecture 105 - Equilibrium Analysis of Aerostats - Part I](#)

[Lecture 106 - Equilibrium Analysis of Aerostats - Part II](#)

[Lecture 107 - Methodology for Tether Profile Estimation](#)

[Lecture 108 - Sizing of Reusable Indoor Hot Air Balloon](#)

[Lecture 109 - Tutorial on Sizing of RIHAB](#)

[Lecture 110 - Features of Hybrid Airships](#)

[Lecture 111 - Technological challenges in HALE Platforms development - Part I](#)

[Lecture 112 - Technological challenges in HALE Platforms development - Part II](#)

[Lecture 113 - Initial sizing of Stratospheric Airships](#)

[Lecture 114 - Introduction to Hybrid Airships](#)

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

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

[Lecture 117 - SkyCat Hybrid Airship](#)

[Lecture 118 - Rotary and Winged Hybrid Airships](#)

[Lecture 119 - Hybrid Ultra Heavy Lift Cargo Vehicle Transport](#)

[Lecture 120 - Features of Hybrid Airships](#)

[Lecture 121 - Solar Powered Airships](#)

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28 - LABORATORY SESSION \(Introduction\)](#)

[Lecture 29 - EXPERIMENT 1](#)

[Lecture 30 - EXPERIMENT 2](#)

[Lecture 31 - EXPERIMENT No. 2](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35 - LABORATORY SESSION #3](#)

[Lecture 36 - LABORATORY SESSION #4](#)

[Lecture 37 - LABORATORY SESSION #5](#)

[Lecture 38](#)

[Lecture 39](#)

[Lecture 40](#)

[Lecture 41 - LABORATORY SESSION #6](#)

[Lecture 42 - LABORATORY SESSION #7](#)

[Lecture 43 - LABORATORY SESSION #8](#)

[Lecture 44](#)

[Lecture 45](#)

[Lecture 46](#)

[Lecture 47](#)

[Lecture 48](#)

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

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

[Lecture 1 - Aero elasticity](#)

[Lecture 2 - Aero elasticity](#)

[Lecture 3 - Aero elasticity](#)

[Lecture 4 - Aero elasticity](#)

[Lecture 5 - Aero elasticity](#)

[Lecture 6 - Aero elasticity](#)

[Lecture 7 - Aero elasticity](#)

[Lecture 8 - Aero elasticity](#)

[Lecture 9 - Aero elasticity](#)

[Lecture 10 - Aero elasticity](#)

[Lecture 11 - Aero elasticity](#)

[Lecture 12 - Aero elasticity](#)

[Lecture 13 - Aero elasticity](#)

[Lecture 14 - Aero elasticity](#)

[Lecture 15 - Aero elasticity](#)

[Lecture 16 - Aero elasticity](#)

[Lecture 17 - Aero elasticity](#)

[Lecture 18 - Aero elasticity](#)

[Lecture 19 - Aero elasticity](#)

[Lecture 20 - Aero elasticity](#)

[Lecture 21 - Aero elasticity](#)

[Lecture 22 - Aero elasticity](#)

[Lecture 23 - Aero elasticity](#)

[Lecture 24 - Aero elasticity](#)

[Lecture 25 - Aero elasticity](#)

[Lecture 26 - Aero elasticity](#)

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 23](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37](#)

[Lecture 38](#)

[Lecture 39](#)

[Lecture 40](#)

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

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

- Lecture 1 - Instability and Transition of Fluid Flows
- Lecture 2 - Instability and Transition of Fluid Flows
- Lecture 3 - Instability and Transition of Fluid Flows
- Lecture 4 - Instability and Transition of Fluid Flows
- Lecture 5 - Instability and Transition of Fluid Flows
- Lecture 6 - Instability and Transition of Fluid Flows
- Lecture 7 - Instability and Transition of Fluid Flows
- Lecture 8 - Instability and Transition of Fluid Flows
- Lecture 9 - Instability and Transition of Fluid Flows
- Lecture 10 - Instability and Transition of Fluid Flows
- Lecture 11 - Instability and Transition of Fluid Flows
- Lecture 12 - Instability and Transition of Fluid Flows
- Lecture 13 - Instability and Transition of Fluid Flows
- Lecture 14 - Instability and Transition of Fluid Flows
- Lecture 15 - Instability and Transition of Fluid Flows
- Lecture 16 - Instability and Transition of Fluid Flows
- Lecture 17 - Instability and Transition of Fluid Flows
- Lecture 18 - Instability and Transition of Fluid Flows
- Lecture 19 - Instability and Transition of Fluid Flows
- Lecture 20 - Instability and Transition of Fluid Flows
- Lecture 21 - Instability and Transition of Fluid Flows
- Lecture 22 - Instability and Transition of Fluid Flows
- Lecture 23 - Instability and Transition of Fluid Flows
- Lecture 24 - Instability and Transition of Fluid Flows
- Lecture 25 - Instability and Transition of Fluid Flows
- Lecture 26 - Instability and Transition of Fluid Flows
- Lecture 27 - Instability and Transition of Fluid Flows
- Lecture 28 - Instability and Transition of Fluid Flows
- Lecture 29 - Instability and Transition of Fluid Flows
- Lecture 30 - Instability and Transition of Fluid Flows
- Lecture 31 - Instability and Transition of Fluid Flows



[Lecture 32 - Instability and Transition of Fluid Flows](#)

[Lecture 33 - Instability and Transition of Fluid Flows](#)

[Lecture 34 - Instability and Transition of Fluid Flows](#)

[Lecture 35 - Instability and Transition of Fluid Flows](#)

[Lecture 36 - Instability and Transition of Fluid Flows](#)

[Lecture 37 - Instability and Transition of Fluid Flows](#)

[Lecture 38 - Instability and Transition of Fluid Flows](#)

[Lecture 39 - Instability and Transition of Fluid Flows](#)

- Lecture 1 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 2 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 3 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 4 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 5 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 6 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 7 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 8 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 9 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 10 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 11 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 12 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 13 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 14 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 15 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 16 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 17 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 18 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 19 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 20 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 21 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 22 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 23 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 24 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 25 - Introduction to Helicopter Aerodynamics and Dynamics
- Lecture 26 - Introduction to Helicopter Aerodynamics and Dynamics

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

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

[Lecture 1 - Fundamentals of Aerospace Propulsion](#)

[Lecture 2 - Fundamentals of Aerospace Propulsion](#)

[Lecture 3 - Fundamentals of Aerospace Propulsion](#)

[Lecture 4 - Fundamentals of Aerospace Propulsion](#)

[Lecture 5 - Fundamentals of Aerospace Propulsion](#)

[Lecture 6 - Fundamentals of Aerospace Propulsion](#)

[Lecture 7 - Fundamentals of Aerospace Propulsion](#)

[Lecture 8 - Fundamentals of Aerospace Propulsion](#)

[Lecture 9 - Fundamentals of Aerospace Propulsion](#)

[Lecture 10 - Fundamentals of Aerospace Propulsion](#)

[Lecture 11 - Fundamentals of Aerospace Propulsion](#)

[Lecture 12 - Fundamentals of Aerospace Propulsion](#)

[Lecture 13 - Fundamentals of Aerospace Propulsion](#)

[Lecture 14 - Fundamentals of Aerospace Propulsion](#)

[Lecture 15 - Fundamentals of Aerospace Propulsion](#)

[Lecture 16 - Fundamentals of Aerospace Propulsion](#)

[Lecture 17 - Fundamentals of Aerospace Propulsion](#)

[Lecture 18 - Fundamentals of Aerospace Propulsion](#)

[Lecture 19 - Fundamentals of Aerospace Propulsion](#)

[Lecture 20 - Fundamentals of Aerospace Propulsion](#)

[Lecture 21 - Fundamentals of Aerospace Propulsion](#)

[Lecture 22 - Fundamentals of Aerospace Propulsion](#)

[Lecture 23 - Fundamentals of Aerospace Propulsion](#)

[Lecture 24 - Fundamentals of Aerospace Propulsion](#)

[Lecture 25 - Fundamentals of Aerospace Propulsion](#)

[Lecture 26 - Fundamentals of Aerospace Propulsion](#)

[Lecture 27 - Fundamentals of Aerospace Propulsion](#)

[Lecture 28 - Fundamentals of Aerospace Propulsion](#)

[Lecture 29 - Fundamentals of Aerospace Propulsion](#)

[Lecture 30 - Fundamentals of Aerospace Propulsion](#)

[Lecture 31 - Fundamentals of Aerospace Propulsion](#)

[Lecture 32 - Fundamentals of Aerospace Propulsion](#)

[Lecture 33 - Fundamentals of Aerospace Propulsion](#)

[Lecture 34 - Fundamentals of Aerospace Propulsion](#)

[Lecture 35 - Fundamentals of Aerospace Propulsion](#)

[Lecture 36 - Fundamentals of Aerospace Propulsion](#)

[Lecture 37 - Fundamentals of Aerospace Propulsion](#)

[Lecture 38 - Fundamentals of Aerospace Propulsion](#)

[Lecture 39 - Fundamentals of Aerospace Propulsion](#)

[Lecture 40 - Fundamentals of Aerospace Propulsion](#)

[Lecture 1 - Jet and Rocket Propulsion](#)

[Lecture 2 - Jet and Rocket Propulsion](#)

[Lecture 3 - Jet and Rocket Propulsion](#)

[Lecture 4 - Jet and Rocket Propulsion](#)

[Lecture 5 - Jet and Rocket Propulsion](#)

[Lecture 6 - Jet and Rocket Propulsion](#)

[Lecture 7 - Jet and Rocket Propulsion](#)

[Lecture 8 - Jet and Rocket Propulsion](#)

[Lecture 9 - Jet and Rocket Propulsion](#)

[Lecture 10 - Jet and Rocket Propulsion](#)

[Lecture 11 - Jet and Rocket Propulsion](#)

[Lecture 12 - Jet and Rocket Propulsion](#)

[Lecture 13 - Jet and Rocket Propulsion](#)

[Lecture 14 - Jet and Rocket Propulsion](#)

[Lecture 15 - Jet and Rocket Propulsion](#)

[Lecture 16 - Jet and Rocket Propulsion](#)

[Lecture 17 - Jet and Rocket Propulsion](#)

[Lecture 18 - Jet and Rocket Propulsion](#)

[Lecture 19 - Jet and Rocket Propulsion](#)

[Lecture 20 - Jet and Rocket Propulsion](#)

[Lecture 21 - Jet and Rocket Propulsion](#)

[Lecture 22 - Jet and Rocket Propulsion](#)

[Lecture 23 - Jet and Rocket Propulsion](#)

[Lecture 24 - Jet and Rocket Propulsion](#)

[Lecture 25 - Jet and Rocket Propulsion](#)

[Lecture 26 - Jet and Rocket Propulsion](#)

[Lecture 27 - Jet and Rocket Propulsion](#)

[Lecture 28 - Jet and Rocket Propulsion](#)

[Lecture 29 - Jet and Rocket Propulsion](#)

[Lecture 30 - Jet and Rocket Propulsion](#)

[Lecture 31 - Jet and Rocket Propulsion](#)

[Lecture 32 - Jet and Rocket Propulsion](#)

[Lecture 33 - Jet and Rocket Propulsion](#)

[Lecture 34 - Jet and Rocket Propulsion](#)

[Lecture 35 - Jet and Rocket Propulsion](#)

[Lecture 36 - Jet and Rocket Propulsion](#)

[Lecture 37 - Jet and Rocket Propulsion](#)

[Lecture 38 - Jet and Rocket Propulsion](#)

[Lecture 39 - Jet and Rocket Propulsion](#)

[Lecture 40 - Jet and Rocket Propulsion](#)

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...

[Lecture 32 - Landing Performance](#)

[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](#)

[Lecture 48 - Revision.](#)



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

Lecture 13 - Neutral Point: A Closer Look

Lecture 14 - Contribution of Engine towards Stability

Lecture 15 - Revision

Lecture 16 - Trim: Cruise, Climb and Landing

Lecture 17 - Trim: Maneuver

Lecture 18 - Maneuvering Point: Stick Fixed

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

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 - Point Mass Equation of Motion](#)

[Lecture 37 - Forces and Moments](#)

[Lecture 38 - Aircraft Equations of Motion](#)

[Lecture 39 - Six Degrees of Freedom of an Aircraft](#)

[Lecture 40 - 6 DoF : Angular Momentum Components](#)

[Lecture 41 - Vector in a Rotating Frame](#)

[Lecture 42 - Euler Angles](#)

[Lecture 43 - Small Perturbation Theory](#)

[Lecture 44 - Small Perturbation Theory \(Continued...\)](#)

[Lecture 45 - Perturbed Equations of Motion: Longitudinal Case](#)

[Lecture 46 - Perturbed Force :  \$f\_z\$](#)

[Lecture 47 - Perturbed Force :  \$f\_z\$  \(Continued...\)](#)

[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](#)

[Lecture 36 - Numericals](#)

[Lecture 37 - Revision](#)

[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](#)

[Lecture 43 - Numericals : Mode Shapes](#)

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 - Thermodynamic 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 Lift 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](#)

[Lecture 2 - Rules and Regulations for Civil Aviation in India \(Continued...\)](#)

[Lecture 3 - Aircraft Hydraulic System](#)

[Lecture 4 - Aircraft Fuel System](#)

[Lecture 5 - Aircraft Landing Gear System](#)

[Lecture 6 - Aircraft Wheels](#)

[Lecture 7 - Aircraft Brakes System](#)

[Lecture 8 - Basic Aircraft Design](#)

[Lecture 9 - Aircraft Electrical System](#)

[Lecture 10 - Aircraft Electrical Circuit](#)

[Lecture 11 - Inspection of Aircraft](#)

[Lecture 12 - Maintenance Schedule](#)

[Lecture 13 - Maintenance Schedule \(Continued...\)](#)

[Lecture 14 - Inspection of Cessna 206](#)



Lecture 1 - Combustion Modes and Classification of Flames

Lecture 2 - Analysis of One Dimensional Combustion Wave

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

Lecture 4 - Introduction to Laminar Premixed Flame

Lecture 5 - Structure of One Dimensional Premixed Flame

Lecture 6 - Laminar Flame Theory for Premixed Flames

Lecture 7 - Laminar Flame Theory for Premixed Flames (Continued...)

Lecture 8 - Determination of Laminar Burning Velocity for Premixed Flames

Lecture 9 - Flame Thickness and Burning Velocity Measurement Methods

Lecture 10 - Stationary Flame Method for Burning Velocity Measurement

Lecture 11 - Effects of Chemical and Physical Variables on Burning Velocity

Lecture 12 - Effects of Chemical and Physical Variables on Burning Velocity (Continued...)

Lecture 13 - Effect of Inert Additives on Burning Velocity and Flame Extinction

Lecture 14 - Simplified Analysis for Quenching Diameter

Lecture 15 - Flammability Limits and Flame Stabilization

Lecture 16 - Ignition in Premixed Flames

Lecture 17 - Introduction to Turbulent Premixed Flames

Lecture 18 - Turbulent Burning Velocity and Premixed Flame Regimes

Lecture 19 - Introduction to Gaseous Jet Diffusion Flame

Lecture 20 - Phenomenological Analysis of a Laminar Jet Diffusion Flame

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

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

Lecture 23 - Flame Height Estimation and Smoke point in Diffusion Flames

Lecture 24 - Mechanism of Soot Formation and Introduction to Liquid Fuel Combustion

Lecture 25 - Introduction to Droplet Combustion

Lecture 26 - Liquid Droplet Combustion

Lecture 27 - Droplet Combustion (Continued...)

Lecture 28 - Droplet Combustion in Convective Environment

Lecture 29 - Droplet Combustion in Convective Environment and Introduction to Spray Combustion Mode

Lecture 30 - Spray Combustion Model

Lecture 31 - Introduction to Solid Fuel Combustion

[Lecture 32 - Solid Fuel Combustion \(Continued...\)](#)

[Lecture 33 - Diffusional theory for Carbon Combustion](#)

[Lecture 34 - Carbon Burning Rate](#)

[Lecture 35 - Carbon Burning Rate \(Continued...\)](#)

[Lecture 36 - Carbon Sphere in Convective Environment](#)

[Lecture 37 - Combustion and Effects on Environment](#)

[Lecture 38 - Chemicals from Combustion](#)

[Lecture 39 - Emission Control Methods](#)

[Lecture 40 - Combustion Modification Methods](#)

- Lecture 1 - Introduction, course content and classification of UAVs
- Lecture 2 - Measurement of Flight Velocity and Standard Atmosphere
- Lecture 3 - Anatomy of Airplane and Airfoil Nomenclature
- Lecture 4 - Examples, Pitot and static tube and differential pressure sensor
- Lecture 5 - Generation of Lift and Drag
- Lecture 6 - Aerodynamic center and center of pressure, Various wing planform
- Lecture 7 - Lifting line theory, NACA airfoil nomenclature
- Lecture 8 - Airfoil and Finite wing, Various wing planform
- Lecture 9 - Interpreting airfoil data, Cl vs Alpha and drag polar, selection of airfoil
- Lecture 10 - Introduction to Airplane performance, Equation of motion
- Lecture 11 - Thrust required and Power required
- Lecture 12 - Calculation of Performance parameters and selection of power plant
- Lecture 13 - Climb Performance, Engine Sizing and Power Plant selection
- Lecture 14 - Weight Estimation , Common propulsion systems
- Lecture 15 - Weight Estimation contd., Electric propulsion, Battery Sizing
- Lecture 16 - Iterative weight estimation and Wing sizing
- Lecture 17 - Wing Planform selection and sizing and Flight test of Cropped delta wing UAVs
- Lecture 18 - Effect of variation of CG location and Static Stability
- Lecture 19 - C.G. location and Longitudinal Static stability
- Lecture 20 - Tutorial 1
- Lecture 21 - Contribution of tail in static stability and Neutral point.
- Lecture 22 - Tutorial 2
- Lecture 23 - Tutorial 3

Lecture 1 - Introduction to Finite Volume Method

Lecture 2 - Governing Equations and Discretization

Lecture 3 - Boundary Conditions and Classification of PDEs

Lecture 4 - Mathematical Description of fluid flow - I

Lecture 5 - Mathematical description of fluid flow - II

Lecture 6 - Discretization Process - I

Lecture 7 - Discretization Process - II

Lecture 8 - Discretization Process - III

Lecture 9 - Taylor Series - I

Lecture 10 - Taylor Series - II

Lecture 11 - Derivatives and Errors - I

Lecture 12 - Derivatives and errors - II

Lecture 13 - Grid Transformation

Lecture 14 - Finite Volume Formulation - I

Lecture 15 - Finite Volume Formulation - II

Lecture 16 - Properties of discretized equations

Lecture 17 - Introduction to Finite Volume Mesh

Lecture 18 - Structured Mesh System

Lecture 19 - Unstructured Mesh System - I

Lecture 20 - Unstructured Mesh System - II

Lecture 21 - Properties of Unstructured Mesh - I

Lecture 22 - Properties of Unstructured Mesh - II

Lecture 23 - Finite Volume discretization of Diffusion Equation - I

Lecture 24 - Finite Volume discretization of Diffusion equation - II

Lecture 25 - Finite Volume discretization of Diffusion equation - III

Lecture 26 - Discretization of Diffusion Equation for Cartesian orthogonal systems - I

Lecture 27 - Discretization of Diffusion Equation for Cartesian orthogonal systems - II

Lecture 28 - Calculation of Diffusivity

Lecture 29 - Discretization of Diffusion Equation for non-Cartesian orthogonal systems - I

Lecture 30 - Discretization of Diffusion Equation for non-orthogonal systems - I

Lecture 31 - Discretization of Diffusion Equation for non-orthogonal systems - II

[Lecture 32 - Discretization of Diffusion Equation for non-orthogonal systems - III](#)

[Lecture 33 - Gradient Calculation for Diffusion Equation - I](#)

[Lecture 34 - Gradient Calculation for Diffusion Equation - II](#)

[Lecture 35 - Gradient Calculation for Diffusion Equation - III](#)

[Lecture 36 - Properties of matrices - I](#)

[Lecture 37 - Properties of matrices - II](#)

[Lecture 38 - Error Analysis - I](#)

[Lecture 39 - Error Analysis - II](#)

[Lecture 40 - Error Analysis - III](#)

- Lecture 1 - Introduction to Engines
- 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
- Lecture 10 - Induction System (Continued...)
- Lecture 11 - Cooling System
- Lecture 12 - Exhaust System
- 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
- Lecture 18 - Fuel injection Systems (Continued...)
- Lecture 19 - Fuel System
- Lecture 20 - Ignition system
- Lecture 21 - Ignition system (Continued...)
- Lecture 22 - Ignition system (Lab session)
- Lecture 23 - Basics of propeller and maintenance
- Lecture 24 - Aircraft Reciprocating Engine Inspection - Part 1
- Lecture 25 - Aircraft Reciprocating Engine Inspection - Part 2
- Lecture 26 - Aircraft Reciprocating Engine Inspection - Part 3
- Lecture 27 - Checklist for Aircraft Reciprocating Engine Maintenance
- Lecture 28 - Aircraft Maintenance (Aircraft Performance Point of View)

Lecture 1 - Linear solvers - I

Lecture 2 - Linear solvers - II

Lecture 3 - Linear solvers - III

Lecture 4 - Linear solvers - IV

Lecture 5 - Linear solvers - V

Lecture 6 - Linear solvers - VI

Lecture 7 - Linear solvers - VII

Lecture 8 - Linear solvers - VIII

Lecture 9 - Convection term discretisation - I

Lecture 10 - Convection term discretisation - II

Lecture 11 - Convection term discretisation - III (Private)

Lecture 12 - Convection term discretisation - IV (Private)

Lecture 13 - Convection term discretisation - V (Private)

Lecture 14 - Convection term discretisation - VI (Private)

Lecture 15 - Convection term discretisation - VII (Private)

Lecture 16 - Convection term discretisation - VIII

Lecture 17 - Convection term discretisation - IX

Lecture 18 - High Resolution Schemes - I

Lecture 19 - High Resolution Schemes - II

Lecture 20 - High Resolution Schemes - III

Lecture 21 - High Resolution Schemes - IV

Lecture 22 - High Resolution Schemes - V

Lecture 23 - High Resolution Schemes - VI

Lecture 24 - High Resolution Schemes - VII

Lecture 25 - Temporal discretisation - I

Lecture 26 - Temporal discretisation - II

Lecture 27 - Temporal discretisation - III

Lecture 28 - Temporal discretisation - IV

Lecture 29 - Discretisation of the Source Term, Relaxation and Other Details - I

Lecture 30 - Discretisation of the Source Term, Relaxation and Other Details - II

Lecture 31 - Fluid Flow Computation: Incompressible Flows - I

[Lecture 32 - Fluid Flow Computation: Incompressible Flows - II](#)

[Lecture 33 - Fluid Flow Computation: Incompressible Flows - III](#)

[Lecture 34 - Fluid Flow Computation: Incompressible Flows - IV](#)

[Lecture 35 - Fluid Flow Computation: Incompressible Flows - V](#)

[Lecture 36 - Fluid Flow Computation: Incompressible Flows - VI](#)

[Lecture 37 - Fluid Flow Computation: Incompressible Flows - VII](#)

[Lecture 38 - Fluid Flow Computation: Incompressible Flows - VIII](#)

[Lecture 39 - Fluid Flow Computation: Compressible Flows - I](#)

[Lecture 40 - Some Advanced Topics - I](#)



Lecture 1 - Introduction

Lecture 2 - A Brief History of Rocket Propulsion and ISRO

Lecture 3 - Types of Rocket Engine

Lecture 4 - Fundamentals of Aero-thermodynamics

Lecture 5 - Control Volume Analysis and Governing Equations

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

Lecture 7 - Basics of Thermochemistry

Lecture 8 - Adiabatic Flame Temperature and Chemical Equilibrium

Lecture 9 - Ideal Rocket Engine, Thrust Equation and Performance Parameters

Lecture 10 - Performance Parameters of Rocket Engine

Lecture 11 - Performance Parameters of Rocket Engine (Continued...)

Lecture 12 - Ideal Nozzle

Lecture 13 - Rocket Nozzle

Lecture 14 - Convergent Nozzle

Lecture 15 - Convergent-Divergent Nozzle and Shock Reflection

Lecture 16 - Effect of Back Pressure and Thrust Coefficient

Lecture 17 - Thrust Coefficient

Lecture 18 - Characteristics Velocity, Combustion Efficiency and Thrust Effectiveness

Lecture 19 - Actual Rocket Nozzle Characteristics

Lecture 20 - Flight Performance of a Rocket Vehicle

Lecture 21 - Flight Performance of a Rocket Vehicle

Lecture 22 - Flight Trajectory of Single Stage Rocket Vehicle

Lecture 23 - Orbital Mechanics

Lecture 24 - Types of Orbits

Lecture 25 - Orbital and Escape Velocity

Lecture 26 - Interplanetary Transfer Path

Lecture 27 - Multi-staging Rocket

Lecture 28 - Chemical Propellants-Characteristics and Classification

Lecture 29 - Solid and Composite Propellants

Lecture 30 - Composite Propellants and it's Manufacturing

Lecture 31 - Classification of Liquid Propellants

Lecture 32 - Solid Propellant Rocket Engine

Lecture 33 - Propellant Burning Mechanism and Flame Structure

Lecture 34 - Composite Propellant Combustion

Lecture 35 - Regression Rate of Solid Propellant and Effect of Operating Parameters

Lecture 36 - Characteristics of Solid Propellants

Lecture 37 - Effect of Acceleration and Particle Size on Burning Rate

Lecture 38 - Erosive Burning, Effect of Propellant Temperature and Thermal Model

Lecture 39 - Chamber Pressure in Solid Propellant Rocket Engine

Lecture 40 - Types of Propellant Grains

Lecture 41 - Types of Solid Propellant Grains and Evolution of Burning Surface

Lecture 42 - Burning Stability and Ignition System in SPRE

Lecture 43 - Liquid Propellant Rocket Engine: Basic Configuration and Types

Lecture 44 - Injection System in LPRE

Lecture 45 - Atomization of Liquid Propellants

Lecture 46 - Types of Injection System in LPRE

Lecture 47 - Analysis of Impinging Atomizer

Lecture 48 - Injection Distributor and Combustion Process in LPRE

Lecture 49 - Variation of Gas Specific Volume and Combustion Chamber Geometry

Lecture 50 - Liquid Propellant Feed System in LPRE

Lecture 51 - Turbo-Pump Feed Configuration

Lecture 52 - Ignition System in LPRE

Lecture 53 - Cooling of Thrust Chamber and Nozzle of a Rocket Engine

Lecture 54 - Cooling System of Rocket Engine (Continued...)

Lecture 55 - Modes of Heat Transfer through combustion Chamber Wall and Nozzle Wall

Lecture 56 - Heat Transfer Analysis of Cooling System

Lecture 57 - Hybrid Propellant Rocket Engine

Lecture 58 - Regression Rate of Solid Fuel Grain in HPRE and Types of Port Configurations

Lecture 59 - Non-Chemical Rocket Engine

Lecture 60 - Electromagnetic Thruster, Nuclear and Solar Rocket Engine

Lecture 1 - Introduction to Design Algorithms: Flight Dynamics Point of View

Lecture 2 - Thrust Generation and Power Required

Lecture 3 - Lift and Drag for Infinite Wing

Lecture 4 - Lift and Drag for an Infinite Wing (Continued...)

Lecture 5 - Relation between Aerodynamic center and Center of Pressure

Lecture 6 - Aerodynamic Characteristics of Wing

Lecture 7 - Stability and Criteria for Longitudinal Static Stability

Lecture 8 - Numericals

Lecture 9 - Longitudinal Static Stability - Wing Contribution

Lecture 10 - Flight Demonstration of Flat Plate

Lecture 11 - Numericals (Continued...)

Lecture 12 - Example Problems for Wing alone Configuration

Lecture 13 - Wing-Tail Contribution and Neutral Point

Lecture 14 - Example problems of wing and tail combination

Lecture 15 - Example problems of wing and tail combination (Continued...)

Lecture 16 - Flight demonstration of same wing and tail combination

Lecture 17 - Matlab Tutorial

Lecture 18 - Trim Requirements of UAV

Lecture 19 - Example on performance analysis of UAV

Lecture 20 - Weight Estimation and wing Sizing with Example

Lecture 21 - Power Plant Selection with Example

Lecture 22 - Subroutine for takeoff performance (Powerplant selection)

Lecture 23 - Subroutine for Climb Performance (Powerplant Selection)

Lecture 24 - Subroutine for Weight Estimation

Lecture 25 - Subroutine for Planform Geometry Selection

Lecture 26 - Subroutine for Airfoil Selection

Lecture 1 - Introduction

Lecture 2 - Introduction (Continued...)

Lecture 3 - Introduction (Continued...)

Lecture 4 - Review of Fluid Mechanics

Lecture 5 - Review of Fluid Mechanics, Thermodynamics

Lecture 6 - Review of Compressible Flows

Lecture 7 - Review of Compressible Flows (Continued...)

Lecture 8 - Review of Compressible Flows (Continued...)

Lecture 9 - Review of Compressible Flows (Continued...)

Lecture 10 - Review of Compressible Flows (Continued...)

Lecture 11 - Introduction to gas turbine engines

Lecture 12 - Introduction to gas turbine engines (Continued...)

Lecture 13 - Introduction to gas turbine engines (Continued...)

Lecture 14 - Introduction to gas turbine engines (Continued...)

Lecture 15 - Introduction to gas turbine engines (Continued...)

Lecture 16 - Introduction to gas turbine engines (Continued...)

Lecture 17 - Introduction to gas turbine engines (Continued...)

Lecture 18 - Piston Engines and Propellers

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

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

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

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

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

Lecture 24 - Performance/cycle analysis: Pulsejet

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

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

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

Lecture 28 - Performance/cycle analysis: Turbojet

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

Lecture 30 - Performance/cycle analysis: Turbojet (Continued...), Turbofan

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

[Lecture 32 - Performance/cycle analysis: Turbofan \(Continued...\), Turboramjet](#)

[Lecture 33 - Performance/cycle analysis: Turboramjet \(Continued...\)](#)

[Lecture 34 - Performance/cycle analysis: Turboprop](#)

[Lecture 35 - Performance/cycle analysis: Turbohaft, and Propfan](#)

[Lecture 36 - Stationary components: intakes](#)

[Lecture 37 - Stationary components: combustors](#)

[Lecture 38 - Stationary components: nozzles, Industrial Gas Turbines](#)

[Lecture 39 - Introduction to turbomachinery: basic principles and equations](#)

[Lecture 40 - Centrifugal compressor](#)

[Lecture 41 - Centrifugal compressor \(Continued...\)](#)

[Lecture 42 - Centrifugal compressor \(Continued...\)](#)

[Lecture 43 - Centrifugal compressor \(Continued...\)](#)

[Lecture 44 - Centrifugal compressor \(Continued...\)](#)

[Lecture 45 - Centrifugal compressor \(Continued...\)](#)

[Lecture 46 - Centrifugal compressor \(Continued...\)](#)

[Lecture 47 - Axial compressor](#)

[Lecture 48 - Axial compressor \(Continued...\)](#)

[Lecture 49 - Axial compressor \(Continued...\)](#)

[Lecture 50 - Axial compressor \(Continued...\)](#)

[Lecture 51 - Axial compressor \(Continued...\)](#)

[Lecture 52 - Axial compressor \(Continued...\)](#)

[Lecture 53 - Axial compressor \(Continued...\)](#)

[Lecture 54 - Axial compressor \(Continued...\)](#)

[Lecture 55 - Axial turbine](#)

[Lecture 56 - Axial turbine \(Continued...\)](#)

[Lecture 57 - Axial turbine \(Continued...\)](#)

[Lecture 58 - Axial turbine \(Continued...\)](#)

[Lecture 59 - Axial turbine \(Continued...\)](#)

[Lecture 60 - Radial Flow Turbine, Module Matching](#)

Lecture 1 - Linear Algebra: Introduction

Lecture 2 - Linear Algebra: Introduction (Continued...)

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

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

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

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

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

Lecture 8 - Linear Algebra: Orthogonal System, Projection, Determinant (Continued...)

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

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

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

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

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

Lecture 14 - ODE: Solution of Second Order Linear ODEs

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

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

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

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

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

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

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

Lecture 22 - PDE: Solution of Linear PDEs

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

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

Lecture 25 - Introduction to Numerical Methods, Mathematical Models, Errors

Lecture 26 - Errors, Numerical Differentiation, Stability

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

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

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

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

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

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Method, Gauss-Seidel

Lecture 32 - Extrapolation Method, Eigenvalue Problem, Jacobi Method, Householder's Method for Symmetric Matrices, Power Method, Inverse Power Method

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

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

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

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

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

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

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

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

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)



[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37](#)

[Lecture 38](#)

[Lecture 39](#)

[Lecture 40](#)

[Lecture 41](#)

[Lecture 42](#)

[Lecture 43](#)

[Lecture 44](#)

[Lecture 45](#)

[Lecture 46](#)

[Lecture 47](#)

[Lecture 48](#)

[Lecture 49](#)

[Lecture 50](#)

[Lecture 51](#)

[Lecture 52](#)

[Lecture 53](#)

[Lecture 54](#)

[Lecture 55](#)

[Lecture 56](#)

[Lecture 57](#)

[Lecture 58](#)

[Lecture 59](#)

[Lecture 60](#)

Lecture 1 - Introduction and Review of Thermodynamics

Lecture 2 - Review of Thermodynamics (Continued...)

Lecture 3 - Review of Thermodynamics (Continued...)

Lecture 4 - Review of Thermodynamics (Continued...)

Lecture 5 - One-dimensional gas dynamics

Lecture 6 - One-dimensional gas dynamics (Continued...)

Lecture 7 - One-dimensional gas dynamics (Continued...)

Lecture 8 - One-dimensional waves

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

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

Lecture 11 - Waves and Supersonic Flow

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

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

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

Lecture 15 - Shock Expansion Theory

Lecture 16 - Flow through ducts and channels

Lecture 17 - Flow in ducts

Lecture 18 - Flow in ducts (Continued...)

Lecture 19 - Adiabatic Flow in ducts with friction

Lecture 20 - Adiabatic flow in ducts with friction (Continued...)

Lecture 21 - Isothermal flow in ducts with friction

Lecture 22 - Flow in uniform duct with heating

Lecture 23 - Multi - dimensional flow problems

Lecture 24 - Multi - dimensional flow problems (Continued...)

Lecture 25 - Linearized flow problems

Lecture 26 - Linearized flow problems (Continued...)

Lecture 27 - Linearized flow problems (Continued...)

Lecture 28 - Linearized flow problems (Continued...)

Lecture 29 - Linearized flow problems (Continued...)

Lecture 30 - Linearized flow problems (Continued...)

Lecture 31 - Linearized flow problems (Continued...)

[Lecture 32 - Linearized Problems - Forces on Slender Bodies](#)

[Lecture 33 - Linearized Problems - Forces on Slender Bodies \(Continued...\)](#)

[Lecture 34 - Similarity Rules for High Speed Flows](#)

[Lecture 35 - Similarity Rules for High Speed Flows \(Continued...\)](#)

[Lecture 36 - Similarity Rules for High Speed Flows \(Continued...\)](#)

[Lecture 37 - Similarity Rules in Hypersonic Flow](#)

[Lecture 38 - Transonic Flow](#)

[Lecture 39 - Transonic Flow \(Continued...\)](#)

[Lecture 40 - Transonic Flow \(Continued...\)](#)

[Lecture 1 - Introduction to Space Flight Mechanics](#)

[Lecture 2 - Particle Kinematics](#)

[Lecture 3 - Particle Kinematics \(Continued...\)](#)

[Lecture 4 - Conic Section](#)

[Lecture 5 - Two Body Problem](#)

[Lecture 6 - Two Body Problem \(Continued...1\)](#)

[Lecture 7 - Two Body Problem \(Continued...2\)](#)

[Lecture 8 - Two Body Problem \(Continued...3\)](#)

[Lecture 9 - Two Body Problem \(Continued...4\)](#)

[Lecture 10 - Two Body Problem \(Continued...5\)](#)

[Lecture 11 - Two Body Problem \(Continued...6\)](#)

[Lecture 12 - Two Body Problem \(Continued...7\) & Three Body Problem](#)

[Lecture 13 - Three Body Problem \(Continued...1\)](#)

[Lecture 14 - Three Body Problem \(Continued...2\)](#)

[Lecture 15 - Three Body Problem \(Continued...3\)](#)

[Lecture 16 - Three Body Problem \(Continued...4\)](#)

[Lecture 17 - Three Body Problem \(Continued...5\)](#)

[Lecture 18 - Three Body Problem \(Continued...6\)](#)

[Lecture 19 - Three Body Problem \(Continued...7\)](#)

[Lecture 20 - Three Body Problem \(Continued...8\)](#)

[Lecture 21 - Trajectory Transfer](#)

[Lecture 22 - Trajectory Transfer \(Continued...1\)](#)

[Lecture 23 - Trajectory Transfer \(Continued...2\)](#)

[Lecture 24 - Trajectory Transfer \(Continued...3\)](#)

[Lecture 25 - Trajectory Transfer \(Continued...4\)](#)

[Lecture 26 - Trajectory Transfer \(Continued...5\)](#)

[Lecture 27 - Trajectory Transfer \(Continued...6\)](#)

[Lecture 28 - Trajectory Transfer \(Continued...7\)](#)

[Lecture 29 - Trajectory Transfer \(Continued...8\)](#)

[Lecture 30 - Trajectory Transfer \(Continued...9\)](#)

[Lecture 31 - Trajectory Transfer \(Continued...10\)](#)

[Lecture 32 - Trajectory Transfer \(Continued...11\) and Attitude Dynamics](#)

[Lecture 33 - Attitude Dynamics \(Continued...1\)](#)

[Lecture 34 - Attitude Dynamics \(Continued...2\)](#)

[Lecture 35 - Attitude Dynamics \(Continued...3\)](#)

[Lecture 36 - Attitude Dynamics \(Continued...4\)](#)

[Lecture 37 - Attitude Dynamics \(Continued...5\)](#)

[Lecture 38 - Attitude Dynamics \(Continued...6\)](#)

[Lecture 39 - Attitude Dynamics \(Continued...7\)](#)

[Lecture 40 - Attitude Dynamics \(Continued...8\)](#)

[Lecture 41 - Attitude Dynamics \(Continued...9\)](#)

[Lecture 42 - Propulsion](#)

[Lecture 43 - Propulsion \(Continued...1\)](#)

[Lecture 44 - Propulsion \(Continued...2\)](#)

[Lecture 45 - Propulsion \(Continued...3\)](#)

[Lecture 1 - Aircraft and Aerodynamic Forces and Moments](#)

[Lecture 2 - Aircraft and Aerodynamic Forces and Moments \(Continued...\)](#)

[Lecture 3 - Fluids and Forces in Fluids](#)

[Lecture 4 - Fluids and Forces in Fluids \(Continued...\)](#)

[Lecture 5 - Forces in Fluids](#)

[Lecture 6 - Forces in Fluids \(Continued...\)](#)

[Lecture 7 - Kinematics of fluid motion](#)

[Lecture 8 - Kinematics of fluid motion \(Continued...\)](#)

[Lecture 9 - Kinematics of fluid motion \(Continued... \)](#)

[Lecture 10 - Kinematics of fluid motion \(Continued...\)](#)

[Lecture 11 - Kinematics of fluid motion - Velocity with specified extension and vorticity](#)

[Lecture 12 - Kinematics of fluid motion - Velocity with specified extension and vorticity \(Continued...\)](#)

[Lecture 13 - Kinematics of fluid motion - Vorticity Distribution](#)

[Lecture 14 - Kinematics of fluid motion - Velocity without expansion and vorticity](#)

[Lecture 15 - Irrotational Solenoidal Flow in Multiply Connected region](#)

[Lecture 16 - Irrotational Solenoidal Flow in Multiply Connected region \(Continued...\)](#)

[Lecture 17 - Equations of Fluid Motion - Navier - Stokes Equation](#)

[Lecture 18 - Equations of Fluid Motion - Navier - Stokes Equation \(Continued...\)](#)

[Lecture 19 - Equations of Fluid Motion - Navier - Stokes Equation \(Continued...\)](#)

[Lecture 20 - Conservation of Energy and Energy Equation](#)

[Lecture 21 - Equations of Motions](#)

[Lecture 22 - Equations of Motion \(Continued...\)](#)

[Lecture 23 - Exact Solution for Simple Problems](#)

[Lecture 24 - Exact Solution for Simple Problems \(Continued...\)](#)

[Lecture 25 - Non-dimensional Form of the Equations and Possible Simplifications](#)

[Lecture 26 - High Reynolds Number Approximation](#)

[Lecture 27 - Conditions for Incompressibility](#)

[Lecture 28 - Potential Flow](#)

[Lecture 29 - Potential Flow - Combination of Basic Solutions](#)

[Lecture 30 - Potential Flow - Combination of Basic Solutions \(Continued...\)](#)

[Lecture 31 - Potential Flow - Combination of Basic Solutions \(Continued...\)](#)

[Lecture 32 - Potential Flow - Combination of Basic Solutions \(Continued...\) - Lifting Cylinder](#)

[Lecture 33 - Conformal Transformation](#)

[Lecture 34 - Conformal Transformation \(Continued...\)](#)

[Lecture 35 - Zhukovsky Transformation](#)

[Lecture 36 - Zhukovsky Transformation \(Continued...\)](#)

[Lecture 37 - Zhukovsky Transformation - Applications](#)

[Lecture 38 - Zhukovsky Transformation - Applications \(Continued...\)](#)

[Lecture 39 - Zhukovsky Transformation - Applications \(Continued...\)](#)

[Lecture 40 - Transformation](#)

[Lecture 41 - Transformation \(Continued...\)](#)

[Lecture 42 - Boundary - Layer Theory](#)

[Lecture 43 - Boundary - Layer Theory \(Continued...\)](#)

[Lecture 44 - Boundary - Layer Theory \(Continued...\)](#)

[Lecture 45 - Boundary - Layer Theory \(Continued...\)](#)

[Lecture 46 - Boundary - Layer Theory \(Continued...\)](#)

[Lecture 1 - Kinematics of Rotation](#)

[Lecture 2 - Kinematics of Rotation \(Continued...\)](#)

[Lecture 3 - Kinematics of Rotation \(Continued...\)](#)

[Lecture 4 - Kinematics of Rotation \(Continued...\)](#)

[Lecture 5 - Kinematics of Rotation \(Continued...\)](#)

[Lecture 6 - Kinematics of Rotation \(Continued...\)](#)

[Lecture 7 - Rotation](#)

[Lecture 8 - Rotation \(Continued...\)](#)

[Lecture 9 - Rotation \(Continued...\)](#)

[Lecture 10 - Rotation \(Continued...\)](#)

[Lecture 11 - Rotational Kinematics](#)

[Lecture 12 - Rotational Kinematics \(Continued...\)](#)

[Lecture 13 - Rotational Kinematics \(Continued...\)](#)

[Lecture 14 - Rotational Kinematics \(Continued...\)](#)

[Lecture 15 - Rotational Dynamics \(Rigid Body Dynamics\)](#)

[Lecture 16 - Rotational Dynamics \(Rigid Body Dynamics\) \(Continued...\)](#)

[Lecture 17 - Rotational Dynamics \(Rigid Body Dynamics\) \(Continued...\)](#)

[Lecture 18 - Rigid Body Dynamics](#)

[Lecture 19 - Rigid Body Dynamics \(Continued...\)](#)

[Lecture 20 - Rigid Body Dynamics \(Continued...\)](#)

[Lecture 21 - Rigid Body Dynamics \(Continued...\)](#)

[Lecture 22 - Rigid Body Dynamics \(Continued...\)](#)

[Lecture 23 - Rigid Body Dynamics \(Continued...\)](#)

[Lecture 24 - Rigid Body Dynamics \(Continued...\)](#)

[Lecture 25 - Rigid Body Dynamics \(Continued...\)](#)

[Lecture 26 - Stability of Torque Free Rotation](#)

[Lecture 27 - Stability of Torque Free Rotation \(Continued...\)](#)

[Lecture 28 - Gravity-gradient Satellite](#)

[Lecture 29 - Gravity-gradient Satellite \(Continued...\)](#)

[Lecture 30 - Gravity-gradient Satellite \(Continued...\)](#)

[Lecture 31 - Gravity-gradient Satellite \(Continued...\)](#)



- [Lecture 32 - Gravity-gradient Satellite \(Continued...\)](#)
- [Lecture 33 - Gravity-gradient Satellite \(Continued...\)](#)
- [Lecture 34 - Gravity-gradient Satellite \(Continued...\)](#)
- [Lecture 35 - Gravity-gradient Satellite \(Continued...\)](#)
- [Lecture 36 - Gravity-gradient Satellite \(Continued...\)](#)
- [Lecture 37 - Gravity-gradient Satellite \(Continued...\)](#)
- [Lecture 38 - Spin Stabilization](#)
- [Lecture 39 - Spin Stabilization \(Continued...\)](#)
- [Lecture 40 - Spin Stabilization \(Continued...\)](#)
- [Lecture 41 - Spin Stabilization \(Continued...\)](#)
- [Lecture 42 - Spin Stabilization \(Continued...\)](#)
- [Lecture 43 - Control Moment Gyroscope](#)
- [Lecture 44 - Control Moment Gyroscope \(Continued...\)](#)
- [Lecture 45 - Gyroscope/Top Motion](#)
- [Lecture 46 - Gyroscope/Top Motion \(Continued...\)](#)
- [Lecture 47 - Gyroscopic Motion](#)
- [Lecture 48 - Gyroscopic Motion \(Continued...\)](#)
- [Lecture 49 - Reaction Wheel/Gyrost](#)
- [Lecture 50 - Reaction Wheel/Gyrost \(Continued...\)](#)
- [Lecture 51 - Gyrost](#)
- [Lecture 52 - Gyrost \(Continued...\)](#)
- [Lecture 53 - Gyrost \(Continued...\)](#)
- [Lecture 54 - Gyrost \(Continued...\)](#)
- [Lecture 55 - Control Moment Gyro](#)
- [Lecture 56 - Control Moment Gyro \(Continued...\)](#)
- [Lecture 57 - Control Moment Gyro \(Continued...\)](#)
- [Lecture 58 - Control Moment Gyro \(Continued...\)](#)
- [Lecture 59 - Satellite Dynamics with Control Moment Gyro](#)
- [Lecture 60 - Satellite Dynamics with Control Moment Gyro \(Continued...\)](#)
- [Lecture 61 - Satellite Dynamics with Control Moment Gyro \(Continued...\)](#)
- [Lecture 62 - Simplified Control Gyro for Satellite Attitude Control](#)
- [Lecture 63 - Satellite Attitude Control using Magnetic Torquer](#)
- [Lecture 64 - Satellite Attitude Control using Magnetic Torquer \(Continued...\)](#)

[Lecture 65 - Satellite Attitude Control using Magnetic Torquer \(Continued...\)](#)

[Lecture 66 - Satellite Attitude Control using Magnetic Torquer \(Continued...\)](#)

[Lecture 67 - Satellite Attitude Control using Magnetic Torquer \(Continued...\)](#)

[Lecture 68 - Satellite Attitude Control using Lorentz Force](#)

[Lecture 69 - Satellite Attitude Control using Thruster](#)

[Lecture 70 - Atmospheric Drag on the Satellite](#)

[Lecture 71 - Atmospheric Force and Moment on the Satellite](#)

[Lecture 72 - Atmospheric Force and Moment on the Satellite \(Continued...\)](#)

[Lecture 73 - Solar Radiation Force and Moment on the Satellite](#)

Lecture 1 - Introduction

Lecture 2 - Undamped Free Vibration

Lecture 3 - Damped Free Vibration

Lecture 4 - Damped Free Vibration (Continued...)

Lecture 5 - Damped Free Vibration (Continued...)

Lecture 6 - Force Vibration

Lecture 7 - Harmonic Loading

Lecture 8 - Harmonic Loading (Continued...)

Lecture 9 - Harmonic Loading (Continued...)

Lecture 10 - Harmonic Loading (Continued...)

Lecture 11 - Impulse Load and Arbitrary Load

Lecture 12 - Impulse Load and Arbitrary Load (Continued...)

Lecture 13 - MDOF, 2-Dof System

Lecture 14 - Normal Mode of Vib

Lecture 15 - Natural Frequency and Mode Shapes

Lecture 16 - Mode Shapes of MDOF

Lecture 17 - Mode Shapes and Free Vibration Response of MDOF

Lecture 18 - Example on MDOF

Lecture 19 - Example on MDOF (Continued...)

Lecture 20 - Modal Expansion Theorem, Generalized Coordinate

Lecture 21 - Examples on Modal Analysis

Lecture 22 - Damping

Lecture 23 - Rigid Body Modes

Lecture 24 - Numerical Time Integration

Lecture 25 - Continuous System

Lecture 26 - Axial Vibration of Bar

Lecture 27 - Axial Vibration of Bar (Continued...)

Lecture 28 - Bending Vibration in Beam

Lecture 29 - Bending Vibration in Beam (Continued...)

Lecture 30 - Bending Vibration in Beam (Continued...)

Lecture 31 - Modal Analysis

[Lecture 32 - Modal Analysis \(Continued...\)](#)

[Lecture 33 - Modal Analysis of Continuous System](#)

[Lecture 34 - Modal Analysis of Continuous System \(Continued...\)](#)

[Lecture 35 - Approximate Method](#)

[Lecture 36 - Approximate Methods \(Continued...\)](#)

[Lecture 37 - Collocation Method](#)

[Lecture 38 - Analytical Methods](#)

[Lecture 39 - Analytical Methods \(Continued...\)](#)

[Lecture 40 - Analytical Methods \(Continued...\)](#)

[Lecture 1 - Conic Section](#)

[Lecture 2 - Conic Section \(Continued...\)](#)

[Lecture 3 - Conic Section \(Continued...\)](#)

[Lecture 4 - Central Force Motion](#)

[Lecture 5 - Gravitational Central Force Motion](#)

[Lecture 6 - Gravitational Central Force Motion \(Continued...\)](#)

[Lecture 7 - Gravitational Central Force Motion \(Continued...\)](#)

[Lecture 8 - 2-Body Problem](#)

[Lecture 9 - 2-Particle System Motion Under Mutual Gravitational Attraction](#)

[Lecture 10 - 2-Particle Body Problem](#)

[Lecture 11 - 2-Particle Body System](#)

[Lecture 12 - Classical Orbital Elements / Parameters](#)

[Lecture 13 - Classical Orbital Elements / Parameters \(Continued...\)](#)

[Lecture 14 - Classical Orbital Elements / Parameters \(Continued...\)](#)

[Lecture 15 - Classical Orbital Elements and Its Inverse Problems](#)

[Lecture 16 - Inverse Problem of Orbit Determination \(Classical Orbital Elements\)](#)

[Lecture 17 - Problem Solving on 2-Body Problem Related to Orbit and Orbital Elements](#)

[Lecture 18 - Problem Related to Orbital Elements](#)

[Lecture 19 - Kepler's Equation / Kepler's Problem](#)

[Lecture 20 - Kepler's Problem \(Continued...\)](#)

[Lecture 21 - Kepler's Problem \(Continued...\)](#)

[Lecture 22 - Kepler's Equation](#)

[Lecture 23 - Kepler's Equation \(Continued...\)](#)

[Lecture 24 - Kepler's Equation \(Continued...\)](#)

[Lecture 25 - Kepler's Equation \(Continued...\)](#)

[Lecture 26 - Kepler's Equation \(Continued...\)](#)

[Lecture 27 - Kepler's Equation \(Continued...\)](#)

[Lecture 28 - Kepler's Equation \(Continued...\)](#)

[Lecture 29 - 3-Body Problem](#)

[Lecture 30 - 3-Body Problem \(Continued...\)](#)

[Lecture 31 - 3-Body Problem \(Continued...\)](#)

- [Lecture 32 - 3-Body Problem \(Continued...\)](#)
- [Lecture 33 - 3-Body Problem \(Continued...\)](#)
- [Lecture 34 - Restricted 3-Body Problem](#)
- [Lecture 35 - Restricted 3-Body Problem \(Continued...\)](#)
- [Lecture 36 - Restricted 3-Body Problem \(Continued...\)](#)
- [Lecture 37 - Restricted 3-Body Problem \(Continued...\)](#)
- [Lecture 38 - Restricted 3-Body Problem \(Continued...\)](#)
- [Lecture 39 - Restricted 3-Body Problem \(Continued...\)](#)
- [Lecture 40 - Restricted 3-Body Problem \(Continued...\)](#)
- [Lecture 41 - Restricted 3-Body Problem \(Continued...\)](#)
- [Lecture 42 - Restricted 3-Body Problem \(Continued...\)](#)
- [Lecture 43 - Restricted 3-Body Problem \(Continued...\)](#)
- [Lecture 44 - Restricted 3-Body Problem \(Continued...\)](#)
- [Lecture 45 - Restricted 3-Body Problem \(Continued...\)](#)
- [Lecture 46 - Restricted 3-Body Problem \(Continued...\)](#)
- [Lecture 47 - General Perturbation Theory](#)
- [Lecture 48 - General Perturbation Theory \(Continued...\)](#)
- [Lecture 49 - General Perturbation Theory \(Continued...\)](#)
- [Lecture 50 - General Perturbation Theory \(Continued...\)](#)
- [Lecture 51 - General Perturbation Theory \(Continued...\)](#)
- [Lecture 52 - General Orbit Perturbation Theory](#)
- [Lecture 53 - General Orbit Perturbation Theory \(Continued...\)](#)
- [Lecture 54 - General Orbit Perturbation Theory \(Continued...\)](#)
- [Lecture 55 - General Orbit Perturbation Theory \(Continued...\)](#)
- [Lecture 56 - General Orbit Perturbation Theory \(Continued...\)](#)
- [Lecture 57 - General Orbit Perturbation Theory \(Continued...\)](#)
- [Lecture 58 - General Orbit Perturbation Theory \(Continued...\)](#)
- [Lecture 59 - General Orbit Perturbation Theory \(Continued...\)](#)
- [Lecture 60 - General Orbit Perturbation Theory \(Continued...\)](#)
- [Lecture 61 - General Orbit Perturbation Theory \(Continued...\)](#)
- [Lecture 62 - General Orbit Perturbation Theory \(Continued...\)](#)
- [Lecture 63 - General Orbit Perturbation Theory \(Continued...\)](#)
- [Lecture 64 - General Orbit Perturbation Theory \(Continued...\)](#)

- [Lecture 65 - General Orbit Perturbation Theory \(Continued...\)](#)
- [Lecture 66 - General Orbit Perturbation Theory \(Continued...\)](#)
- [Lecture 67 - General Orbit Perturbation Theory \(Continued...\)](#)
- [Lecture 68 - Orbit Determination](#)
- [Lecture 69 - Orbit Determination \(Continued...\)](#)
- [Lecture 70 - Orbit Determination \(Continued...\)](#)
- [Lecture 71 - Orbit Determination \(Continued...\)](#)
- [Lecture 72 - Transformation from Celestial to Earth Fixed Reference Frame](#)
- [Lecture 73 - Time](#)
- [Lecture 74 - Time \(Continued...\)](#)
- [Lecture 75 - Orbit Determination](#)
- [Lecture 76 - Orbit Determination \(Continued...\)](#)
- [Lecture 77 - Orbit Determination \(Continued...\)](#)
- [Lecture 78 - Orbit Determination \(Continued...\)](#)
- [Lecture 79 - Trajectory Transfer](#)
- [Lecture 80 - Trajectory Transfer \(Continued...\)](#)
- [Lecture 81 - Trajectory Transfer \(Continued...\)](#)
- [Lecture 82 - Trajectory Transfer \(Continued...\)](#)
- [Lecture 83 - Trajectory Transfer \(Continued...\)](#)
- [Lecture 84 - Trajectory Transfer \(Continued...\)](#)
- [Lecture 85 - Trajectory Transfer \(Continued...\)](#)
- [Lecture 86 - Trajectory Transfer \(Continued...\)](#)
- [Lecture 87 - Interplanetary Transfer](#)
- [Lecture 88 - Interplanetary Transfer \(Continued...\)](#)
- [Lecture 89 - Interplanetary Transfer \(Continued...\)](#)
- [Lecture 90 - Patched Conic Section Method for Interplanetary Transfer](#)
- [Lecture 91 - Interplanetary Mission](#)
- [Lecture 92 - Interplanetary Mission \(Continued...\)](#)
- [Lecture 93 - Interception in Coplanar Orbit](#)
- [Lecture 94 - Interception in Coplanar Orbit \(Continued...\)](#)
- [Lecture 95 - Interception in non-coplanar Orbit](#)
- [Lecture 96 - Interception in non-coplanar Orbit \(Continued...\)](#)
- [Lecture 97 - Interception in non-coplanar Orbit \(Continued...\)](#)

[Lecture 98 - Non Coplanar Transfer](#)

[Lecture 99 - Sphere of Influence](#)



- Lecture 1 - Introduction
- Lecture 2 - Introduction (Continued...)
- Lecture 3 - Introduction (Continued...)
- Lecture 4 - Load Encountered by a Typical Aircraft
- Lecture 5 - Conceptual Structural Details of a Typical Aircraft
- Lecture 6 - Airworthiness of An Aircraft
- Lecture 7 - Aerodynamic Loads and Load Factors
- Lecture 8 - Loads From A Symmetric Manoeuvre Of An Aircraft
- Lecture 9 - Shear and Moment on Wing An Aircraft
- Lecture 10 - Distribution Of Load On The Fuselage
- Lecture 11 - Unit Load Analysis Of Fuselage
- Lecture 12 - Truss System
- Lecture 13 - Truss System (Continued...)
- Lecture 14 - Space Structures
- Lecture 15 - Space Structures (Continued...)
- Lecture 16 - Wing Truss System
- Lecture 17 - Introduction to Energy Methods
- Lecture 18 - Dummy and Unit Load Method
- Lecture 19 - Dummy and Unit Load Method - Examples
- Lecture 20 - Castigliano's Theorems
- Lecture 21 - Rayleigh - Ritz Method
- Lecture 22 - Statically Indeterminate Structures
- Lecture 23 - Theory of Elasticity - Stress
- Lecture 24 - Theory of Elasticity - Equilibrium
- Lecture 25 - Stress Transformation and Principal Stress
- Lecture 26 - Theory of Elasticity - Principal Stress Boundary Condition
- Lecture 27 - Shear Stresses
- Lecture 28 - Introduction of Strain
- Lecture 29 - Introduction of strain - Equations of compatibility
- Lecture 30 - Formulation of Elasticity Problems
- Lecture 31 - Inverse Method of Solution

[Lecture 32 - Semi-Inverse Method of Solution](#)

[Lecture 33 - Equilibrium Equation in Polar Coordinate System](#)

[Lecture 34 - Compatibility Condition in Polar Coordinate System](#)

[Lecture 35 - Effects of Circular Hole on Stress Distributions in a Plate](#)

[Lecture 36 - Effects of Circular Hole on Stress Distributions in a Plate](#)

[Lecture 37 - Effects of Circular Hole on Stress Distributions in a Plate](#)

[Lecture 38 - Theory of Elasticity - Torsion Problems](#)

[Lecture 39 - Theory of Elasticity - Torsion Problems \(Continued...\)](#)

[Lecture 40 - Torsion of an Elliptical Bar](#)

[Lecture 41 - Membrane Analogy for Torsion Problem](#)

[Lecture 42 - Membrane Analogy for Torsion Problem \(Continued...\)](#)

[Lecture 1 - Brief Overview of CFD](#)

[Lecture 2 - Governing Equations of Fluid Flow](#)

[Lecture 3 - Governing Equations of Fluid Flow \(Continued...\)](#)

[Lecture 4 - Classification of PDEs](#)

[Lecture 5 - Classification of PDEs \(Continued...\)](#)

[Lecture 6 - Methods for Approximate Solution of PDEs](#)

[Lecture 7 - Finite Difference Method](#)

[Lecture 8 - Methods for Approximate Solution of PDEs \(Continued...\)](#)

[Lecture 9 - Methods for Approximate Solution of PDEs \(Continued...\)](#)

[Lecture 10 - Methods for Approximate Solution of PDEs \(Continued...\)](#)

[Lecture 11 - Methods for Approximate Solution of PDEs \(Continued...\)](#)

[Lecture 12 - Taylor Table Approach for Constructing Finite Difference Schemes](#)

[Lecture 13 - Taylor Table Approach for Constructing Finite Difference Schemes \(Continued...\)](#)

[Lecture 14 - Taylor Table Approach for Constructing Finite Difference Schemes \(Continued...\)](#)

[Lecture 15 - Taylor Table Approach for Constructing Finite Difference Schemes \(Continued...\)](#)

[Lecture 16 - Taylor Table Approach for Constructing Finite Difference Schemes \(Continued...\)](#)

[Lecture 17 - Numerical Solution of Steady State Heat Conduction \(Elliptic PDE\)](#)

[Lecture 18 - Numerical Solution of Steady State Heat Conduction \(Elliptic PDE\) \(Continued...\)](#)

[Lecture 19 - Numerical Solution of Steady State Heat Conduction \(Elliptic PDE\) \(Continued...\)](#)

[Lecture 20 - Numerical Solution of Steady State Heat Conduction \(Elliptic PDE\) \(Continued...\)](#)

[Lecture 21 - Numerical Solution of Steady State Heat Conduction \(Elliptic PDE\) \(Continued...\)](#)

[Lecture 22 - Numerical Solution of Unsteady Heat Conduction \(Parabolic PDE\)](#)

[Lecture 23 - Numerical Solution of Unsteady Heat Conduction \(Parabolic PDE\) \(Continued...\)](#)

[Lecture 24 - Numerical Solution of Unsteady Heat Conduction \(Parabolic PDE\) \(Continued...\)](#)

[Lecture 25 - Numerical Solution of Unsteady Heat Conduction \(Parabolic PDE\) \(Continued...\)](#)

[Lecture 26 - Numerical Solution of Unsteady Heat Conduction \(Parabolic PDE\) \(Continued...\)](#)

[Lecture 27 - Numerical Solution of Linear Wave Equation \(Hyperbolic PDE\)](#)

[Lecture 28 - Numerical Solution of Linear Wave Equation \(Hyperbolic PDE\) \(Continued...\)](#)

[Lecture 29 - Numerical Solution of Linear Wave Equation \(Hyperbolic PDE\) \(Continued...\)](#)

[Lecture 30 - Numerical Solution of Linear Wave Equation \(Hyperbolic PDE\) \(Continued...\)](#)

[Lecture 31 - Numerical Solution of Linear Wave Equation \(Hyperbolic PDE\) \(Continued...\)](#)

- [Lecture 32 - Numerical Solution of Linear Wave Equation \(Hyperbolic PDE\) \(Continued...\)](#)
- [Lecture 33 - Numerical Solution of One Dimensional Convection - Diffusion Equation](#)
- [Lecture 34 - Numerical Solution of One Dimensional Convection - Diffusion Equation \(Continued...\)](#)
- [Lecture 35 - Numerical Solution of One Dimensional Convection - Diffusion Equation \(Continued...\)](#)
- [Lecture 36 - Numerical Solution of One Dimensional Convection - Diffusion Equation \(Continued...\)](#)
- [Lecture 37 - Numerical Solution of One Dimensional Convection - Diffusion Equation \(Continued...\)](#)
- [Lecture 38 - Numerical Solution of One Dimensional Convection - Diffusion Equation \(Continued...\)](#)
- [Lecture 39 - Numerical Solution of Two Dimensional Incompressible Navier Stokes Equations](#)
- [Lecture 40 - Numerical Solution of Two Dimensional Incompressible Navier Stokes Equations \(Continued...\)](#)
- [Lecture 41 - Numerical Solution of Two Dimensional Incompressible Navier Stokes Equations \(Continued...\)](#)
- [Lecture 42 - Numerical Solution of Two Dimensional Incompressible Navier Stokes Equations \(Continued...\)](#)
- [Lecture 43 - Numerical Solution of Two Dimensional Incompressible Navier Stokes Equations \(Continued...\)](#)
- [Lecture 44 - Numerical Solution of Two Dimensional Incompressible Navier Stokes Equations \(Continued...\)](#)
- [Lecture 45 - Numerical Solution of One Dimensional Euler Equation for Shock Tube Problem](#)
- [Lecture 46 - Numerical Solution of One Dimensional Euler Equation for Shock Tube Problem \(Continued...\)](#)
- [Lecture 47 - Numerical Solution of One Dimensional Euler Equation for Shock Tube Problem \(Continued...\)](#)
- [Lecture 48 - Numerical Solution of One Dimensional Euler Equation for Shock Tube Problem \(Continued...\)](#)
- [Lecture 49 - Numerical Solution of One Dimensional Euler Equation for Shock Tube Problem \(Continued...\)](#)
- [Lecture 50 - Basics of Interface Capturing Methods for Applications in Multiphase Flow](#)
- [Lecture 51 - Basics of Interface Capturing Methods for Application in Multiphase Flow \(Continued...\)](#)
- [Lecture 52 - Basics of Interface Capturing Methods for Application in Multiphase Flow \(Continued...\)](#)
- [Lecture 53 - Basics of Interface Capturing Methods for Application in Multiphase Flow \(Continued...\)](#)
- [Lecture 54 - Basics of Interface Capturing Methods for Application in Multiphase Flow \(Continued...\)](#)
- [Lecture 55 - Basics of Turbulence Modeling](#)
- [Lecture 56 - Basics of Turbulence Modeling \(Continued...\)](#)
- [Lecture 57 - Basics of Turbulence Modeling \(Continued...\)](#)
- [Lecture 58 - Basics of Turbulence Modeling \(Continued...\)](#)
- [Lecture 59 - Basics of Turbulence Modeling \(Continued...\)](#)
- [Lecture 60 - Basics of Turbulence Modeling \(Continued...\)](#)
- [Lecture 61 - Structured and Unstructured Grid Generation](#)
- [Lecture 62 - Structured and Unstructured Grid Generation \(Continued...\)](#)
- [Lecture 63 - Structured and Unstructured Grid Generation \(Continued...\)](#)
- [Lecture 64 - Structured and Unstructured Grid Generation \(Continued...\)](#)



- Lecture 1 - Introduction on Aerodynamics-its relevance and applications
- Lecture 2 - Atmosphere
- Lecture 3 - Flow velocity, pressure, skin friction
- Lecture 4 - Generation of aerodynamic forces and moments on an aircraft
- Lecture 5 - Generation of aerodynamic forces and moments on an aircraft (Continued...)
- Lecture 6 - Generation of aerodynamic forces and moments on an aircraft (Continued...)
- Lecture 7 - Eulerian and Lagrangian perspectives of flow: Fluid element trajectories
- Lecture 8 - Fluid element trajectories, Angular velocity, and vorticity
- Lecture 9 - Irrotational and Rotational flow, Strain of a fluid element, Gradient
- Lecture 10 - Line Surface and Volume Integrals, Circulation, Velocity
- Lecture 11 - Conservation equations of mass, momentum and energy
- Lecture 12 - Conservation equations of momentum and energy
- Lecture 13 - Inviscid and viscous flows
- Lecture 14 - Inviscid and viscous flows (Continued...)
- Lecture 15 - Bernoulli's equation and its applications
- Lecture 16 - Bernoulli's equation applications; Potential flow; Boundary layer flow
- Lecture 17 - Boundary layer flow
- Lecture 18 - Boundary Layer (Continued...) and Laminar and turbulent flow
- Lecture 19 - Airfoil Geometry, forces and moments acting on an airfoil
- Lecture 20 - Pressure distribution on an airfoil, Airfoil nomenclature and characteristics
- Lecture 21 - Airfoil characteristics; Aerodynamic center; Some more elementary flows
- Lecture 22 - Elementary flows- Doublet and Point Vortex; Vortex sheet
- Lecture 23 - Kutta condition; Kelvin's circulation theorem; Introduction to thin airfoil theory
- Lecture 24 - Results of thin airfoil theory for symmetric
- Lecture 25 - Multi element airfoils, Laminar and turbulent
- Lecture 26 - Finite wing geometry and flow features
- Lecture 27 - Biot Savart Law; Prandtl's lifting line theory
- Lecture 28 - Prandtl lifting theory for finite wings
- Lecture 29 - Finite wing aerodynamics; Delta wing aerodynamics
- Lecture 30 - Delta wing aerodynamics; Unsteady aerodynamics
- Lecture 31 - Fundamentals of high speed flows

- Lecture 32 - Velocity potential equation and its application; Finite Waves
- Lecture 33 - Normal shocks
- Lecture 34 - Normal shocks, Mach waves and oblique shocks
- Lecture 35 - Oblique shock; Prandtl Meyer expansion
- Lecture 36 - Shock expansion theory; Flow through converging diverging nozzle
- Lecture 37 - Flow through converging diverging nozzle under different back pressure
- Lecture 38 - Preliminary concepts of hypersonic flow; Shock tube
- Lecture 39 - Computing aerodynamic flows - trying to connect with the theory
- Lecture 40 - Computing aerodynamic flows - trying to connect with the theory (Continued...)
- Lecture 41 - Some more on flow physics; The different steps involved in flow computations
- Lecture 42 - An introduction to Panel Method
- Lecture 43 - Panel method and Vortex Lattice Method
- Lecture 44 - Mathematical classification of PDEs and their physical behavior
- Lecture 45 - Basics of grid and discretization of governing PDEs
- Lecture 46 - Different aspects of numerical schemes
- Lecture 47 - Basics of Euler Equation
- Lecture 48 - Basics of Compressible Navier Stokes Equations
- Lecture 49 - Wind tunnel-an experimental tool in aerodynamics; Types of wind tunnels
- Lecture 50 - Wind Tunnel design basics - Subsonic Wind Tunnels
- Lecture 51 - Wind Tunnel design basics - Subsonic wind tunnels (Continued...)
- Lecture 52 - Wind Tunnel design basics - Supersonic wind tunnels
- Lecture 53 - Continuous closed circuit supersonic wind tunnel
- Lecture 54 - Scaling of wind tunnel models; Safety issues in wind tunnel handling
- Lecture 55 - Flow visualization techniques
- Lecture 56 - Schlieren and Shadowgraph techniques
- Lecture 57 - Measurement of Pressure using mechanical instruments
- Lecture 58 - Rayleigh Pitot tube; Drag measurement using wake survey and direct weighing method
- Lecture 59 - Mechanical balance
- Lecture 60 - Electronic transducers
- Lecture 61 - Wheatstone bridge circuits for force and moment measurement
- Lecture 62 - Strain gauge based balances; Electronic pressure gauges
- Lecture 63 - Absolute-Gauge-Differential pressure sensors; Data Acquisition System
- Lecture 64 - Measurement error and uncertainty

[Lecture 65 - Velocity measurement using Particle Image Velocimetry](#)

[Lecture 66 - Velocity measurement using Particle Image Velocimetry \(Continued...\)](#)

[Lecture 67 - Particle image velocimetry \(Continued...\)](#)

[Lecture 68 - How wind tunnel and associated instrumentation are used](#)

[Lecture 69 - Quick recapitulation of course content and closure](#)



[Lecture 1 - Introduction](#)

[Lecture 2 - Introduction \(Continued...\)](#)

[Lecture 3 - Introduction \(Continued...\)](#)

[Lecture 4 - Introduction \(Continued...\)](#)

[Lecture 5 - Introduction \(Continued...\)](#)

[Lecture 6 - Introduction \(Continued...\)](#)

[Lecture 7 - Stage Configurations and Parameters](#)

[Lecture 8 - Stage Configurations and Parameters \(Continued...\)](#)

[Lecture 9 - Stage Configurations and Parameters \(Continued...\)](#)

[Lecture 10 - Stage Configurations and Parameters \(Continued...\)](#)

[Lecture 11 - Stage Configurations and Parameters \(Continued...\)](#)

[Lecture 12 - Stage Configurations and Parameters \(Continued...\)](#)

[Lecture 13 - Stage Configurations and Parameters \(Continued...\)](#)

[Lecture 14 - Stage Configurations and Parameters \(Continued...\)](#)

[Lecture 15 - Stage Configurations and Parameters \(Continued...\)](#)

[Lecture 16 - Design Concepts](#)

[Lecture 17 - Design Concepts \(Continued...\)](#)

[Lecture 18 - Design Concepts \(Continued...\)](#)

[Lecture 19 - Design Concepts \(Continued...\)](#)

[Lecture 20 - Design Concepts \(Continued...\)](#)

[Lecture 21 - Design Concepts \(Continued...\)](#)

[Lecture 22 - Design Concepts \(Continued...\)](#)

[Lecture 23 - Cascade Aerodynamics](#)

[Lecture 24 - Cascade Aerodynamics \(Continued...\)](#)

[Lecture 25 - Cascade Aerodynamics \(Continued...\)](#)

[Lecture 26 - Cascade Aerodynamics \(Continued...\)](#)

[Lecture 27 - Cascade Aerodynamics \(Continued...\)](#)

[Lecture 28 - Selection of Design Parameters](#)

[Lecture 29 - Selection of Design Parameters \(Continued...\)](#)

[Lecture 30 - Selection of Design Parameters \(Continued...\)](#)

[Lecture 31 - Selection of Design Parameters \(Continued...\)](#)

- [Lecture 32 - Selection of Design Parameters \(Continued...\)](#)
- [Lecture 33 - Design Strategies](#)
- [Lecture 34 - Design Strategies \(Continued...\)](#)
- [Lecture 35 - Design Strategies \(Continued...\)](#)
- [Lecture 36 - Design Strategies \(Continued...\)](#)
- [Lecture 37 - Design of Low Speed Compressor](#)
- [Lecture 38 - Design of Low Speed Compressor \(Continued...\)](#)
- [Lecture 39 - Design of Low Speed Compressor \(Continued...\)](#)
- [Lecture 40 - Design of Low Speed Compressor \(Continued...\)](#)
- [Lecture 41 - Design of Low Speed Compressor \(Continued...\)](#)
- [Lecture 42 - Design of Low Speed Compressor \(Continued...\)](#)
- [Lecture 43 - Design of Low Speed Contra rotating Fan](#)
- [Lecture 44 - Design of Low Speed Contra rotating Fan \(Continued...\)](#)
- [Lecture 45 - Design of Low Speed Contra rotating Fan \(Continued...\)](#)
- [Lecture 46 - Design of Low Speed Contra rotating Fan \(Continued...\)](#)
- [Lecture 47 - Design of Low Speed Contra rotating Fan \(Continued...\)](#)
- [Lecture 48 - Design of Low Speed Contra rotating Fan \(Continued...\)](#)
- [Lecture 49 - Transonic Compressors](#)
- [Lecture 50 - Transonic Compressors \(Continued...\)](#)
- [Lecture 51 - Transonic Compressors \(Continued...\)](#)
- [Lecture 52 - Transonic Compressors \(Continued...\)](#)
- [Lecture 53 - Transonic Compressors \(Continued...\)](#)
- [Lecture 54 - Design of Transonic Compressor](#)
- [Lecture 55 - Design of Transonic Compressor \(Continued...\)](#)
- [Lecture 56 - Design of Transonic Compressor \(Continued...\)](#)
- [Lecture 57 - Design of Transonic Compressor \(Continued...\)](#)
- [Lecture 58 - Design of Transonic Compressor \(Continued...\)](#)
- [Lecture 59 - Design of Transonic Compressor \(Continued...\)](#)
- [Lecture 60 - Design of Industrial fan](#)
- [Lecture 61 - Design of Industrial fan \(Continued...\)](#)
- [Lecture 62 - Design of Industrial fan \(Continued...\)](#)
- [Lecture 63 - Design of Industrial fan \(Continued...\)](#)
- [Lecture 64 - Design of Industrial fan \(Continued...\)](#)

[Lecture 65 - CFD application to Design and Performance assessment](#)

[Lecture 66 - CFD application to Design and Performance assessment \(Continued...\)](#)

[Lecture 67 - CFD application to Design and Performance assessment \(Continued...\)](#)

[Lecture 68 - CFD application to Design and Performance assessment \(Continued...\)](#)

[Lecture 69 - CFD application to Design and Performance assessment \(Continued...\)](#)

[Lecture 1 - Introduction to Smart Structures \(Continued...\)](#)

[Lecture 2 - Introduction to Smart Structures \(Continued...\)](#)

[Lecture 3 - Introduction to Smart Structures \(Continued...\)](#)

[Lecture 4 - Introduction to Piezoelectric Materials](#)

[Lecture 5 - Introduction to Piezoelectric Materials \(Continued...\)](#)

[Lecture 6 - Mathematical Preliminaries](#)

[Lecture 7 - 3D Constitutive Modeling of Piezoelectric Materials - 1](#)

[Lecture 8 - 3D Constitutive Modeling of Piezoelectric Materials - 2](#)

[Lecture 9 - 3D Constitutive Modeling of Piezoelectric Materials - 3](#)

[Lecture 10 - 3D Constitutive Modeling of Piezoelectric Materials - 4](#)

[Lecture 11 - Piezoelectric Sensors and Actuators](#)

[Lecture 12 - Numerical Problems and Solutions](#)

[Lecture 13 - Induced Strain Actuation - Static Analysis](#)

[Lecture 14 - Induced Strain Actuation - Static Analysis \(Continued...\)](#)

[Lecture 15 - Induced Strain Actuation - Static Analysis](#)

[Lecture 16 - Induced Strain Actuation - Static Analysis \(Continued...\)](#)

[Lecture 17 - Induced Strain Actuation - Static Analysis \(Continued...\)](#)

[Lecture 18 - Induced Strain Actuation - Static Analysis - Numerical Examples](#)

[Lecture 19 - Introduction to Energy Principles for Structural Analysis](#)

[Lecture 20 - Introduction to Energy Principles for Structural Analysis \(Continued...\)](#)

[Lecture 21 - Static Analysis of beam for Induced Strain Actuation using Energy Principles](#)

[Lecture 22 - Static Analysis of beam for Induced Strain Actuation using Energy Principles \(Continued...\)](#)

[Lecture 23 - Static Analysis of beam for Induced Strain Actuation using Energy Principles \(Continued...\)](#)

[Lecture 24 - Static Analysis of beam for Induced strain Actuation using Energy Principles Numerical](#)

[Lecture 25 - Dynamic Analysis of Beam for Induced Strain Actuation Using Energy Principle](#)

[Lecture 26 - Dynamic Analysis of Beam for Induced Strain Actuation Using \(Continued...\)](#)

[Lecture 27 - Energy Harvesting and Vibration Control](#)

[Lecture 28 - Energy Harvesting and Vibration Control \(Continued...\)](#)

[Lecture 29 - Solution of Coupled Linear Ordinary Differential Equations](#)

[Lecture 30 - Introduction to Fibre Reinforced Plastic Composites](#)

[Lecture 31 - Constitutive Relation of Unidirectional FRP Composite Ply](#)

- [Lecture 32 - Constitutive Relation of Unidirectional FRP Composite Ply \(Continued...\)](#)
- [Lecture 33 - Constitutive Relation of Unidirectional FRP Composite Ply \(Continued...\)](#)
- [Lecture 34 - Mechanics of FRP Composite Laminate Numerical Examples](#)
- [Lecture 35 - Mechanics of FRP Composite Laminate Numerical Examples \(Continued...\)](#)
- [Lecture 36 - Analysis of composite laminate with piezoelectric patches \(Continued...\)](#)
- [Lecture 37 - Analysis of composite laminate with piezoelectric patches \(Continued...\)](#)
- [Lecture 38 - Analysis of composite laminate with piezoelectric patches \(Continued...\)](#)
- [Lecture 39 - Analysis of composite laminate with piezoelectric patches \(Continued...\)](#)
- [Lecture 40 - Analysis of composite laminate with piezoelectric patches - computer programming](#)
- [Lecture 41 - Introduction to Shape Memory Alloys](#)
- [Lecture 42 - Temperature and Stress Dependent Phase Transformation Modeling](#)
- [Lecture 43 - Temperature and Stress Dependent Phase Transformation Modeling \(Continued...\)](#)
- [Lecture 44 - Stress-strain Curve at Low Temperature, Pseudo elasticity Two Way Shape Memory Effect](#)
- [Lecture 45 - Constitutive Relations of Shape Memory Alloys](#)
- [Lecture 46 - Constitutive Relations of Shape Memory Alloys \(Continued...\)](#)
- [Lecture 47 - Constitutive Relations of Shape Memory Alloys \(Continued...\)](#)
- [Lecture 48 - Constitutive Relations of Shape Memory Alloys \(Continued...\)](#)
- [Lecture 49 - Constitutive Relations of Shape Memory Alloys \(Continued...\)](#)
- [Lecture 50 - Finite Element Formulation of Euler - Bernoulli Beam](#)
- [Lecture 51 - Finite Element Formulation of Euler - Bernoulli Beam \(Continued...\)](#)
- [Lecture 52 - Analysis of a Beam with Shape Memory Alloy Wire](#)
- [Lecture 53 - Analysis of a Beam with Shape Memory Alloy Wire \(Continued...\)](#)
- [Lecture 54 - Introduction to Electro and Magneto Rheological Fluids](#)
- [Lecture 55 - Analysis of Electro and Magneto Rheological Fluid Flow](#)
- [Lecture 56 - Analysis of Electro and Magneto Rheological Fluid Flow \(Continued...\)](#)
- [Lecture 57 - Analysis of Electro and Magneto Rheological Fluid Flow \(Continued...\)](#)
- [Lecture 58 - Analysis of Electro and Magneto Rheological Fluid Flow \(Continued...\)](#)
- [Lecture 59 - Analysis of Electro and Magneto Rheological Fluid Flow](#)
- [Lecture 60 - 60 Analysis of Electro and Magneto Rheological Fluid Flow \(Continued...\)](#)
- [Lecture 61 - Analysis of Electro and Magneto Rheological Fluid Flow \(Continued...\)](#)
- [Lecture 62 - Analysis of a Beam with ER/MR Fluid Layer](#)

Lecture 1 - Introduction

Lecture 2 - Introduction (Continued...)

Lecture 3 - Introduction (Continued...)

Lecture 4 - Introduction (Continued...)

Lecture 5 - Introduction (Continued...)

Lecture 6 - Introduction (Continued...)

Lecture 7 - Component Performance

Lecture 8 - Component Performance (Continued...)

Lecture 9 - Component Performance (Continued...)

Lecture 10 - Component Performance (Continued...)

Lecture 11 - Component Performance (Continued...)

Lecture 12 - Turbojet Engine - I

Lecture 13 - Turbojet Engine - I (Continued...)

Lecture 14 - Turbojet Engine - I (Continued...)

Lecture 15 - Turbojet Engine - I (Continued...)

Lecture 16 - Turbojet Engine - I (Continued...)

Lecture 17 - Turbojet Engine - I (Continued...)

Lecture 18 - Turbojet Engine - II

Lecture 19 - Turbojet Engine - II (Continued...)

Lecture 20 - Turbojet Engine - II (Continued...)

Lecture 21 - Turbojet Engine - II (Continued...)

Lecture 22 - Turbojet Engine - II (Continued...)

Lecture 23 - Turbofan Engine - I

Lecture 24 - Turbofan Engine - I (Continued...)

Lecture 25 - Turbofan Engine - I (Continued...)

Lecture 26 - Turbofan Engine - I (Continued...)

Lecture 27 - Turbofan Engine - I (Continued...)

Lecture 28 - Turbofan Engine - II

Lecture 29 - Turbofan Engine - II (Continued...)

Lecture 30 - Turbofan Engine - II (Continued...)

Lecture 31 - Turbofan Engine - II (Continued...)

- [Lecture 32 - Turbofan Engine - II \(Continued...\)](#)
- [Lecture 33 - Turbofan Engine - III](#)
- [Lecture 34 - Turbofan Engine - III \(Continued...\)](#)
- [Lecture 35 - Turbofan Engine - III \(Continued...\)](#)
- [Lecture 36 - Turbofan Engine - III \(Continued...\)](#)
- [Lecture 37 - Turbofan Engine - III \(Continued...\)](#)
- [Lecture 38 - Turbofan Engine - IV](#)
- [Lecture 39 - Turbofan Engine - IV \(Continued...\)](#)
- [Lecture 40 - Turbofan Engine - IV \(Continued...\)](#)
- [Lecture 41 - Turbofan Engine - IV \(Continued...\)](#)
- [Lecture 42 - Turbofan Engine - IV \(Continued...\)](#)
- [Lecture 43 - Turbofan Engine - IV \(Continued...\)](#)
- [Lecture 44 - Recent Advances in Turbofan Engines](#)
- [Lecture 45 - Recent Advances in Turbofan Engines \(Continued...\)](#)
- [Lecture 46 - Recent Advances in Turbofan Engines \(Continued...\)](#)
- [Lecture 47 - Recent Advances in Turbofan Engines \(Continued...\)](#)
- [Lecture 48 - Recent Advances in Turbofan Engines \(Continued...\)](#)
- [Lecture 49 - Recent Advances in Turbofan Engines \(Continued...\)](#)
- [Lecture 50 - Turboprop Engine](#)
- [Lecture 51 - Turboprop Engine \(Continued...\)](#)
- [Lecture 52 - Turboprop Engine \(Continued...\)](#)
- [Lecture 53 - Turboprop Engine \(Continued...\)](#)
- [Lecture 54 - Turboprop Engine \(Continued...\)](#)
- [Lecture 55 - Turboshift Engine](#)
- [Lecture 56 - Turboshift Engine \(Continued...\)](#)
- [Lecture 57 - Turboshift Engine \(Continued...\)](#)
- [Lecture 58 - Turboshift Engine \(Continued...\)](#)
- [Lecture 59 - Turboshift Engine \(Continued...\)](#)
- [Lecture 60 - Component Matching and Testing](#)
- [Lecture 61 - Component Matching and Testing \(Continued...\)](#)
- [Lecture 62 - Component Matching and Testing \(Continued...\)](#)
- [Lecture 63 - Component Matching and Testing \(Continued...\)](#)
- [Lecture 64 - Aircraft Engine Testing](#)





- Lecture 1 - Basic Principle of Rocket
- Lecture 2 - Basic Principle of Rocket (Continued...)
- Lecture 3 - Performance Parameters
- Lecture 4 - Performance Parameters (Continued...)
- Lecture 5 - Performance Parameters (Example problems)
- Lecture 6 - Solid Propellant Rocket - Brief Description
- Lecture 7 - Solid Propellants - Introduction
- Lecture 8 - Solid Propellants - Selection Criteria
- Lecture 9 - Solid Propellants - Selection Criteria (Continued...)
- Lecture 10 - Solid Propellants - Selection Criteria (Continued...)
- Lecture 11 - Propellants Ingredients (Continued...) and Classification of Solid Propellants
- Lecture 12 - Tutorial Problems
- Lecture 13 - Combustion of Solid Propellants - Introduction
- Lecture 14 - Combustion of Double-Base Propellants
- Lecture 15 - Combustion of Double-Base Propellants (Continued...)
- Lecture 16 - Combustion of Double-Base Propellants (Continued...)
- Lecture 17 - Evaluation of Burn Rate of DB Propellants
- Lecture 18 - Evaluation of Burn Rate of DB Propellants (Continued...)
- Lecture 19 - Combustion of Composite Propellants - Introduction
- Lecture 20 - Combustion of Composite Propellants (Continued...)
- Lecture 21 - Evaluation of Burn Rate of Composite Propellants
- Lecture 22 - Effect of Various Parameters on Burn Rate of Composite Propellants
- Lecture 23 - Effect of Transients, Vehicle Acceleration, Binder, Catalysts on Burning Rate of CP
- Lecture 24 - Effect of Catalysts on Burning Rate of CP (Continued...)
- Lecture 25 - Combustion of Nitro mine Composite Propellants
- Lecture 26 - Combustion of CMDB Propellants
- Lecture 27 - Choice of Pressure Index (n); Tutorial Problems
- Lecture 28 - Metal Combustion Classification-Introduction
- Lecture 29 - Metal Combustion Classification (Continued...)
- Lecture 30 - Metal Combustion Classification (Continued...)
- Lecture 31 - Metal Particle Combustion Regimes

[Lecture 32 - Metal Particle Combustion Regimes \(Continued...\)](#)

[Lecture 33 - Combustion Times for Diffusion and Kinetic Controlled Regimes](#)

[Lecture 34 - Ignition and Combustion of Boron Particle](#)

[Lecture 35 - Ignition and Combustion of Boron Particle \(Continued...\)](#)

[Lecture 36 - Ignition and Combustion of Aluminum Particle,Recent Future Developments on Metal Fuels](#)

[Lecture 37 - Erosive Burning in Solid Propellant Rockets - Introduction](#)

[Lecture 38 - Methods for Determination of Erosive Function](#)

[Lecture 39 - Methods for Determination of Erosive Function \(Continued...\)](#)

[Lecture 40 - Erosive Burning Theories](#)

Lecture 1 - Introduction to Aerospace Structures

Lecture 2 - Introduction to Aerospace Structures

Lecture 3 - Recap of Theory of Elasticity

Lecture 4 - Torsion of Circular Cross-Section Shaft

Lecture 5 - Torsion of Non-Circular Cross-Section Shaft

Lecture 6 - Torsion of Non-Circular Cross-Section Shaft

Lecture 7 - Torsion of Non-Circular Cross-Section Shaft

Lecture 8 - Torsion of Non-Circular Cross-Section Shaft

Lecture 9 - Membrane Analogy

Lecture 10 - Membrane Analogy

Lecture 11 - Torsion of Thin-Walled Cross-Section

Lecture 12 - Torsion of Thin-Walled Cross-Section

Lecture 13 - Torsion of Thin-Walled Closed Cross-Section

Lecture 14 - Torsion of Thin-Walled Closed Cross-Section

Lecture 15 - Torsion of Thin-Walled Closed Cross-Section

Lecture 16 - Bi-directional Bending

Lecture 17 - Bi-directional Bending

Lecture 18 - Bi-directional Bending

Lecture 19 - Deflection in Bi-directional Bending

Lecture 20 - Deflection in Bi-directional Bending

Lecture 21 - Shear Stresses due to Shear Forces

Lecture 22 - Shear Stresses due to Shear Forces

Lecture 23 - Shear Stresses due to Shear Forces

Lecture 24 - Shear Center

Lecture 25 - Shear Center

Lecture 26 - Shear Flow in Thin-walled Closed Cross-Section due to Shear Force

Lecture 27 - Shear Flow in Thin-walled Closed Cross-Section due to Shear Force

Lecture 28 - Shear Flow in Thin-walled Closed Cross-Section due to Shear Force

Lecture 29 - Shear Flow in Thin-walled Closed Cross-Section due to Shear Force

Lecture 30 - Skin-Stringer Idealization

Lecture 31 - Skin-Stringer Idealization

[Lecture 32 - Skin-Stringer Idealization](#)

[Lecture 33 - Skin-Stringer Idealization](#)

[Lecture 34 - Skin-Stringer Idealization](#)

[Lecture 35 - Skin-Stringer Idealization](#)

[Lecture 36 - Buckling of Column](#)

[Lecture 37 - Buckling of Column](#)

[Lecture 38 - Buckling of Column with Initial Imperfection](#)

[Lecture 39 - Buckling of Column with Different Boundary Conditions](#)

[Lecture 40 - Buckling of Column with Different Boundary Conditions](#)

- Lecture 1 - Introduction to supersonic and hypersonic flows
- Lecture 2 - Introduction to supersonic and hypersonic flows (Continued...)
- Lecture 3 - Characteristics of these two flow regimes
- Lecture 4 - Characteristics of these two flow regimes (Continued...)
- Lecture 5 - Where do these flows occur
- Lecture 6 - Basic Concepts and Governing Equations of Compressible Flow
- Lecture 7 - Basic Concepts and Governing Equations of Compressible Flow (Continued...)
- Lecture 8 - Basic Concepts and Governing Equations of Compressible Flow (Continued...)
- Lecture 9 - Basic Concepts and Governing Equations of Compressible Flow (Continued...)
- Lecture 10 - Basic Concepts and Governing Equations of Compressible Flow (Continued...)
- Lecture 11 - Brief introduction to waves
- Lecture 12 - Shocks and Expansion waves
- Lecture 13 - Shock and expansion wave relations in the high Mach number limit
- Lecture 14 - Revisiting Waves, Conservation Equations and Shocks
- Lecture 15 - More on shock and expansion wave relations
- Lecture 16 - Introduction to viscous compressible flow
- Lecture 17 - Introduction to viscous compressible flow - boundary layer equations
- Lecture 18 - Compressible Boundary Layer Equations (Continued...)
- Lecture 19 - Compressible Boundary Layer Equations (Continued...)
- Lecture 20 - Compressible Boundary Layer Equations - aerodynamic heating and drag
- Lecture 21 - Introduction to High Temperature Gas Dynamics
- Lecture 22 - Introduction to High Temperature Gas Dynamics (Continued...)
- Lecture 23 - Introduction to High Temperature Gas Dynamics (Continued...)
- Lecture 24 - Thermodynamics and chemistry of high temperature gases
- Lecture 25 - Equilibrium chemically reacting gas mixture
- Lecture 26 - Introduction to Statistical Thermodynamics
- Lecture 27 - Macrostates and Microstates and counting of microstates
- Lecture 28 - Most probable macrostate - Boltzmann Distribution
- Lecture 29 - Partition function and its role in finding thermodynamic properties of a single
- Lecture 30 - Equilibrium composition of high temperature air
- Lecture 31 - Introduction to Hypersonic Non Equilibrium Flows

[Lecture 32 - Basics of Kinetic Theory of Gases](#)

[Lecture 33 - Kinetic Theory of Gases \(Continued...\)](#)

[Lecture 34 - Vibrational Nonequilibrium](#)

[Lecture 35 - Chemical Nonequilibrium](#)

[Lecture 36 - Inviscid High Temperature Equilibrium Flow](#)

[Lecture 37 - Inviscid High Temperature Equilibrium Flow \(Continued...\)](#)

[Lecture 38 - Governing equations of Inviscid High Temperature Equilibrium Flow](#)

[Lecture 39 - Inviscid High Temperature Equilibrium Flow-normal and oblique shock](#)

[Lecture 40 - Inviscid High Temperature Equilibrium Flow-flow through CD nozzle](#)

[Lecture 41 - Inviscid High Temperature Non Equilibrium Flow - Introduction](#)

[Lecture 42 - Inviscid High Temperature Non Equilibrium Flow - Introduction \(Continued...\)](#)

[Lecture 43 - Inviscid High Temperature Non Equilibrium Flow - Governing Equations](#)

[Lecture 44 - Inviscid High Temperature Non Equilibrium Flow - frozen, equilibrium](#)

[Lecture 45 - Inviscid High Temperature Non Equilibrium Flow - shocks, nozzle flow](#)

[Lecture 46 - Viscous High Temperature Flows - Introduction](#)

[Lecture 47 - Viscous High Temperature Flows - Introduction \(Continued...\)](#)

[Lecture 48 - Transport properties and Governing Equations of Viscous High Temperature Flows](#)

[Lecture 49 - Governing Equations of Viscous High Temperature Flows, Boundary layer Equations](#)

[Lecture 50 - Introduction to radiative heat transfer, computational results on viscous](#)

[Lecture 51 - Recapitulating the basics of high speed aerodynamics from an application perspective](#)

[Lecture 52 - Recapitulating the basics of high speed aerodynamics from an application perspective](#)

[Lecture 53 - Supersonic and Hypersonic Shock Interactions](#)

[Lecture 54 - Supersonic and hypersonic shock interactions \(Continued...\); Hypersonic Flight](#)

[Lecture 55 - Hypersonic Flight Trajectories \(Continued...\), Basics of wave rider, Recapitulation](#)

[Lecture 56 - Reference Temperature Method; Brief discussion on boundary layer transition](#)

[Lecture 57 - Recapitulation of the Reference Temperature Method; Governing equations](#)

[Lecture 58 - Some numerical simulations on shock diffraction, shock wave boundary](#)

[Lecture 59 - High speed intakes; scramjet engines; other applications of shock waves](#)

[Lecture 60 - Other applications of shock waves - astrophysical flows, a quick](#)

- Lecture 1 - Introduction to Thermoacoustic Instabilities
- Lecture 2 - Part I : Introduction to Acoustics Part II : Conservation Equations
- Lecture 3 - Wave Equation and its Solution in Time Domain
- Lecture 4 - Part I : Harmonic Waves Part II : Acoustic Energy Corollory
- Lecture 5 - Standing Waves - 1
- Lecture 6 - Standing Waves - 2
- Lecture 7 - Power Flow and Acoustic Admittance
- Lecture 8 - Impedance Tube Technique
- Lecture 9 - Admittance and Standing Waves
- Lecture 10 - Admittance, Stability and Attenuation
- Lecture 11 - Attenuation : Continued Sound Propagation Through Inhomogeneous Media - 1
- Lecture 12 - Sound Propagation Through Inhomogeneous Media - 2
- Lecture 13 - Sound Propagation Through Inhomogeneous Media - 3
- Lecture 14 - Multidimensional Acoustic Fields - 1
- Lecture 15 - Multidimensional Acoustic Fields - 2
- Lecture 16 - Interaction between Sound and Combustion
- Lecture 17 - Reference Books Derivation of Rayleigh Criteria
- Lecture 18 - Effect of Heat release on the Acoustic Field
- Lecture 19 - Modal Analysis of Thermoacoustic Instability - 1
- Lecture 20 - Modal Analysis of Thermoacoustic Instability - 2
- Lecture 21 - Active Control of Thermoacoustic Instability
- Lecture 22 - Toy model for a Rijke tube in Time Domain
- Lecture 23 - Galerkin Technique for Thermoacoustics
- Lecture 24 - Evolution Equation for Thermoacoustics
- Lecture 25 - Non linear analysis of Thermoacoustic Instability
- Lecture 26 - Non-normality, Transient Growth and Triggering Instability - 1
- Lecture 27 - Non-normality, Transient Growth and Triggering Instability - 2
- Lecture 28 - Non-normality, Transient Growth and Triggering Instability - 3
- Lecture 29 - Bifurcations
- Lecture 30 - Premixed Flame Acoustic Interaction - 1
- Lecture 31 - Premixed Flame Acoustic Interaction - 2

[Lecture 32 - Combustion instability due to Equivalence Ratio Fluctuation](#)

[Lecture 33 - Role of Hydrodynamic Instabilities - 1](#)

[Lecture 34 - Role of Hydrodynamic Instabilities - 2](#)

[Lecture 35 - Role of Hydrodynamic Instabilities - 3](#)

[Lecture 36 - Active Control of Thermoacoustic Instability Revisited](#)

[Lecture 37 - Solid Propellant Combustion Instability - 1](#)

[Lecture 38 - Solid Propellant Combustion Instability - 2](#)

[Lecture 39 - Response of a Diffusion Flame to Acoustic Oscillations - 1](#)

[Lecture 40 - Response of a Diffusion Flame to Acoustic Oscillations - 2](#)

[Lecture 41 - Response of a Diffusion Flame to Acoustic Oscillations - 3](#)



Lecture 1 - Introduction

Lecture 2 - Air breathing Engines - Turbojet I

Lecture 3 - Air breathing Engines - Turbojet II

Lecture 4 - Air breathing Engines - Turboprop & Turbofan

Lecture 5 - Air breathing Engines - Ramjet & Scramjet

Lecture 6 - Non-air breathing Engines I

Lecture 7 - Non-air breathing Engines II

Lecture 8 - General Performance Parameters I

Lecture 9 - General Performance Parameters II

Lecture 10 - Cycle Analysis - Ramjet

Lecture 11 - Cycle Analysis - Turbojet I

Lecture 12 - Cycle Analysis - Turbojet II

Lecture 13 - Cycle Analysis - Turbojet III

Lecture 14 - Cycle Analysis - Turbojet IV

Lecture 15 - Cycle Analysis - Turbojet V

Lecture 16 - Cycle Analysis - Turbojet VI

Lecture 17 - Cycle Analysis - Turbofan

Lecture 18 - Rocket Nozzles - 1D Analysis I

Lecture 19 - Rocket Nozzles - 1D Analysis II

Lecture 20 - Rocket Nozzles - 1D Analysis III

Lecture 21 - Rocket Nozzles - Real Effects I

Lecture 22 - Rocket Nozzles - Real Effects II

Lecture 23 - Rocket Nozzles - Thrust Vectoring

Lecture 24 - Solid Rockets - Propellants

Lecture 25 - Solid Rockets - Burn rate

Lecture 26 - Solid Rockets - Performance

Lecture 27 - Solid Rockets - Grain

Lecture 28 - Solid Rockets - Ignition, Quenching

Lecture 29 - Solid Rockets - Igniter, Depressurization

Lecture 30 - Propellant Combustion - Combustion Modelling

Lecture 31 - Liquid Rocket - Propellants

[Lecture 32 - Liquid Rocket - Nozzle Cooling I](#)

[Lecture 33 - Liquid Rocket - Nozzle Cooling II](#)

[Lecture 34 - Liquid Rocket - Nozzle Cooling III](#)

[Lecture 35 - Liquid Rocket - Pressure fed system](#)

[Lecture 36 - Liquid Rocket - Pump fed system](#)

[Lecture 37 - Liquid Rocket - Pumps](#)

[Lecture 38 - Liquid Rocket - Fuel Injection](#)

[Lecture 39 - Hybrid Rocket - Basics](#)

[Lecture 40 - Hybrid Rocket Performance](#)

[Lecture 41 - Hybrid Rocket Combustion](#)

[Lecture 42 - Chemical Equilibrium Analyser - SP 273](#)

Lecture 1 - Introduction

Lecture 2 - Chemical Reactions, Heats of Reaction and Formation

Lecture 3 - Sensible Enthalpy and Adiabatic Flame Temperature

Lecture 4 - Dissociation of Products, Role of Pressure

Lecture 5 - Numerical Calculation of Adiabatic Flame Temperature, Chemical Kinetics 1

Lecture 6 - Chemical Kinetics 2

Lecture 7 - Equilibrium Reactions, Global Kinetics, Order of Reaction

Lecture 8 - Reduced Chemistry, Steady State Approximation

Lecture 9 - Steady State Approximation, Partial Equilibrium Approximation

Lecture 10 - Partial Equilibrium Approximation, Chemical Explosions

Lecture 11 - Combining Chemical and Thermal Processes 1

Lecture 12 - Combining Chemical and Thermal Processes 2

Lecture 13 - Combining Chemical and Thermal Processes 3

Lecture 14 - Combining Chemical and Thermal Processes 4

Lecture 15 - Mass and Molar Diffusion, Fick's Law

Lecture 16 - Conservation Equations for Multi-Component Mixtures

Lecture 17 - Multi-Component Diffusion Equation

Lecture 18 - Multi-Component Momentum Equation

Lecture 19 - Energy Equation

Lecture 20 - One Dimensional Steady Flow

Lecture 21 - Schvab-Zeldovich Formulation 1

Lecture 22 - Schvab-Zeldovich Formulation 2

Lecture 23 - Rankine-Hugoniot Relations 1

Lecture 24 - Rankine-Hugoniot Relations 2

Lecture 25 - Rankine-Hugoniot Relations 3

Lecture 26 - Velocity, Temperature and Entropy Variation along Hugoniot Curve

Lecture 27 - Laminar Premixed Flames

Lecture 28 - Laminar Premixed Flames - Corrections

Lecture 29 - Laminar Premixed Flames - Rigorous Analysis 1

Lecture 30 - Laminar Premixed Flames - Rigorous Analysis 2

Lecture 31 - Flame Speed Dependencies, G-Equation

[Lecture 32 - Bunsen Burner 1](#)

[Lecture 33 - Bunsen Burner 2](#)

[Lecture 34 - Flame Stabilisation 1](#)

[Lecture 35 - Flame Stabilisation 2](#)

[Lecture 36 - Ignition](#)

[Lecture 37 - Burke-Schumann Problem 1](#)

[Lecture 38 - Burke-Schumann Problem 2](#)

[Lecture 39 - Burke-Schumann Problem 3](#)

[Lecture 40 - Flame Structure](#)

[Lecture 41 - Mixture Fraction Formulation 1](#)

[Lecture 42 - Mixture Fraction Formulation 2](#)

[Lecture 43 - Droplet Burning 1](#)

[Lecture 44 - Droplet Burning 2](#)

[Lecture 45 - Spray Combustion 1](#)

[Lecture 46 - Spray Combustion 2](#)

[Lecture 47 - Turbulent Combustion 1](#)

[Lecture 48 - Turbulent Combustion 2](#)

[Lecture 49 - Combustion Instabilities](#)

[Lecture 50 - Detonations](#)

[Lecture 51 - Detonation Wave - ZND Structure](#)

- Lecture 1 - Earth Atmosphere, Aircraft components, Aircraft nomenclature
- Lecture 2 - Basic aerodynamics
- Lecture 3 - Equilibrium and stability
- Lecture 4 - Static vs dynamic stability
- Lecture 5 - Criterion for stability, Wing contribution
- Lecture 6 - Horizontal tail contribution
- 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
- Lecture 12 - Elevator
- 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
- Lecture 24 - Derivation of Angular Motion Equations
- Lecture 25 - Description of various forces and moments
- Lecture 26 - Nonlinearities and Associated Aircraft Behavior
- Lecture 27 - Small perturbation method, Linearization of equations
- Lecture 28 - Aerodynamic force and Moment Derivatives
- Lecture 29 - Contribution of Aircraft components to Aerodynamic Derivatives
- Lecture 30 - Linear Model and Aircraft Dynamics Modes
- Lecture 31 - Short Period, Phugoid (Lanchester's formulation)

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

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

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

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

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

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

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

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

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

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

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

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

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37](#)

[Lecture 38](#)

[Lecture 39](#)

[Lecture 40](#)

[Lecture 41](#)

[Lecture 42](#)

[Lecture 43](#)

[Lecture 44](#)

[Lecture 45](#)

[Lecture 46](#)

[Lecture 47](#)

[Lecture 48](#)

[Lecture 49](#)

[Lecture 50](#)

[Lecture 51](#)

[Lecture 52](#)

[Lecture 53](#)

[Lecture 54](#)



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

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

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

[Lecture 34 - Multigrid method](#)

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

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

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

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

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

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 Nozzles

Lecture 14 - Unconventional Nozzles and Problems in Nozzles

Lecture 15 - Criterion for Choice of Chemical Propellants

Lecture 16 - Choice of Fuel-Rich Propellants

Lecture 17 - Performance Prediction Analysis

Lecture 18 - Factors Influencing Choice of Chemical Propellants

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

Lecture 20 - Introduction to Solid Propellant Rockets

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

Lecture 22 - Design Aspects of Solid Propellant Rockets

Lecture 23 - Burning Surface Area of Solid Propellant Grains

Lecture 24 - Ignition of Solid Propellant Rockets

Lecture 25 - Review of Solid Propellant Rockets

Lecture 26 - Feed Systems for Liquid Propellant Rockets

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

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

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

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

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

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

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

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

[Lecture 35 - Electrical Thrusters](#)

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

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

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

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

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

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

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

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

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

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

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

Lecture 1 - Introduction, Motivation and Overview

Lecture 2 - Overview of SS Approach and Matrix Theory

Lecture 3 - Review of Numerical Methods

Lecture 4 - An Overview of Static Optimization - I

Lecture 5 - An Overview of Static Optimization - II

Lecture 6 - Review of Calculus of Variations - I

Lecture 7 - Review of Calculus of Variations - II

Lecture 8 - Optimal Control Formulation Using Calculus of Variations

Lecture 9 - Classical Numerical Methods to Solve Optimal Control Problems

Lecture 10 - Linear Quadratic Regulator (LQR) - I

Lecture 11 - Linear Quadratic Regulator (LQR) - II

Lecture 12 - Linear Quadratic Regulator (LQR) - III

Lecture 13 - Linear Quadratic Regulator (LQR) - III

Lecture 14 - Discrete-time Optimal Control

Lecture 15 - Overview of Flight Dynamics - I

Lecture 16 - Overview of Flight Dynamics - II

Lecture 17 - Overview of Flight Dynamics - III

Lecture 18 - Linear Optimal Missile Guidance using LQR

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

Lecture 20 - Dynamic Programming

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

Lecture 22 - Transcription Method to Solve Optimal Control Problems

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

Lecture 24 - MPSP for Optimal Missile Guidance

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

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

Lecture 27 - Review of Probability Theory and Random Variables

Lecture 28 - Kalman Filter Design - I

Lecture 29 - Kalman Filter Design - II

Lecture 30 - Kalman Filter Design - III

Lecture 31 - Integrated Estimation, Guidance & Control - I

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

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

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

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

[Lecture 36 - Constrained Optimal Control - III](#)

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

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

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

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



Lecture 1 - Introduction

Lecture 2 - Chemical Equilibrium - I

Lecture 3 - Chemical Equilibrium - II

Lecture 4 - Chemical Kinetics - I

Lecture 5 - Chemical Kinetics - II

Lecture 6 - Chemical Kinetics - III

Lecture 7 - Chemical Kinetics - IV

Lecture 8 - Oxidation Mechanism of Fuels - I

Lecture 9 - Oxidation Mechanism of Fuels - II

Lecture 10 - Oxidation Mechanism of Fuels - III

Lecture 11 - Oxidation Mechanism of Fuels - IV

Lecture 12 - Transport Phenomena

Lecture 13 - Governing Equations - I

Lecture 14 - Governing Equations - II

Lecture 15 - Governing Equations - III

Lecture 16 - Governing Equations - IV

Lecture 17 - Governing Equations - V

Lecture 18 - Laminar Non-Premixed Flames - I

Lecture 19 - Laminar Non-Premixed Flames - II

Lecture 20 - Laminar Non-Premixed Flames - III

Lecture 21 - Laminar Non-Premixed Flames - IV

Lecture 22 - Laminar Premixed Flames - I

Lecture 23 - Laminar Premixed Flames - II

Lecture 24 - Laminar Premixed Flames - III

Lecture 25 - Laminar Premixed Flames - IV

Lecture 26 - Laminar Premixed Flames - V

Lecture 27 - Laminar Premixed Flames - VI

Lecture 28 - Laminar Premixed Flames - VII

Lecture 29 - Limit Phenomena - I

Lecture 30 - Limit Phenomena - II

Lecture 31 - Introduction to turbulent flows

[Lecture 32 - Non-reacting turbulent flows - I](#)

[Lecture 33 - Non-reacting turbulent flows - II](#)

[Lecture 34 - Reacting turbulent flows - III](#)

[Lecture 35 - Reacting turbulent flows - IV](#)

[Lecture 36 - Reacting turbulent flows - V](#)

[Lecture 37 - Reacting turbulent flows - VI](#)

[Lecture 38 - Reacting turbulent flows - VII](#)

[Lecture 39 - Turbulent Non-Premixed Flames - I](#)

[Lecture 40 - Turbulent Non-Premixed Flames - II](#)

[Lecture 41 - Turbulent Non-Premixed Flames - III](#)

[Lecture 42 - Turbulent Premixed Flames - I](#)

[Lecture 43 - Turbulent Premixed Flames - II](#)

[Lecture 44 - Turbulent Premixed Flames - III](#)

[Lecture 45 - Turbulent Premixed Flames - IV](#)

[Lecture 46 - Turbulent Premixed Flames - V](#)

[Lecture 47 - Turbulent Premixed Flames - VI](#)

[Lecture 48 - Aero Gas Turbine Combustors - I](#)

[Lecture 49 - Aero Gas Turbine Combustors - II](#)

[Lecture 50 - Aero Gas Turbine Combustors - III](#)

[Lecture 51 - Aero Gas Turbine Combustors - IV](#)

[Lecture 52 - Aero Gas Turbine Combustors - V](#)

[Lecture 53 - Flame Stabilization and Blow off - I](#)

[Lecture 54 - Flame Stabilization and Blow off - II](#)

[Lecture 55 - Flame Stabilization and Blow off - III](#)

[Lecture 56 - Flame Stabilization and Blow off - IV](#)

[Lecture 57 - Flame Stabilization and Blow off - V](#)

[Lecture 58 - Combustion in Scramjets - I](#)

[Lecture 59 - Combustion in Scramjets - II](#)

[Lecture 60 - Combustion in Scramjets - III](#)

[Lecture 61 - Combustion in Scramjets - IV](#)

[Lecture 62 - Review](#)

Lecture 1 - Introduction

Lecture 2 - Flow Regimes

Lecture 3 - Thermodynamics - 1

Lecture 4 - Thermodynamics - 2

Lecture 5 - Thermodynamics - Numerical

Lecture 6 - Flow equations - Integral Form

Lecture 7 - Flow equations - Differential Form

Lecture 8 - Quasi-1D Assumption

Lecture 9 - Speed of Sound

Lecture 10 - Speed of Sound - Numerical

Lecture 11 - Stagnation properties

Lecture 12 - Pitot tube

Lecture 13 - Sonic/Star properties

Lecture 14 - Numerical

Lecture 15 - Normal Shock - I

Lecture 16 - Normal Shock - II-a

Lecture 17 - Normal Shock - II-b

Lecture 18 - Normal Shock - III

Lecture 19 - Normal Shock - IV

Lecture 20 - Normal Shock - Numerical

Lecture 21 - The Shock Tube

Lecture 22 - Waves of infinitesimal Amplitude

Lecture 23 - Waves of finite amplitude

Lecture 24 - Shock Tube Relations

Lecture 25 - Unsteady Flows - Numerical

Lecture 26 - Oblique Shock Waves

Lecture 27 - Expansion waves

Lecture 28 - Shock Expansion Method

Lecture 29 - Shock Reflection

Lecture 30 - Oblique Shock and Expansion waves - Numerical

Lecture 31 - Varying Area Duct Flows - I

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