

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

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

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

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

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

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NPTEL : Jet Aircraft Propulsion (Aerospace Engineering)

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

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

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

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NPTEL : Turbomachinery Aerodynamics (Aerospace Engineering)

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

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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

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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

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Lecture 11 - Axial Compressor Characteristics: Single stage, Multi stage and Multi spool Characteristics

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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

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NPTEL : Aero elasticity (Aerospace Engineering)

Co-ordinators : Prof. C. Venkatesan

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

Co-ordinators : Prof. Tapan K. Sengupta

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NPTEL : Introduction to Propulsion (Aerospace Engineering)

Co-ordinators : Dr. D.P. Mishra

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NPTEL : Jet and Rocket Propulsion (Aerospace Engineering)

Co-ordinators : Dr. A. Kushari

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- Lecture 5 - Where do these flows occur
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- Lecture 12 - Shocks and Expansion waves
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- Lecture 25 - Equilibrium chemically reacting gas mixture
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- Lecture 27 - Macrostates and Microstates and counting of microstates
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NPTEL : Acoustic Instabilities in Aerospace Propulsion (Aerospace Engineering)

Co-ordinators : Prof. R.I. Sujith

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Lecture 2 - Part I : Introduction to Acoustics Part II : Conservation Equations

Lecture 3 - Wave Equation and its Solution in Time Domain

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Lecture 6 - Standing Waves - 2

Lecture 7 - Power Flow and Acoustic Admittance

Lecture 8 - Impedance Tube Technique

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Lecture 10 - Admittance, Stability and Attenuation

Lecture 11 - Attenuation : Continued Sound Propagation Through Inhomogeneous Media - 1

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Lecture 14 - Multidimensional Acoustic Fields - 1

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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

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Lecture 21 - Active Control of Thermoacoustic Instability

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Lecture 23 - Galerkin Technique for Thermoacoustics

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Lecture 25 - Non linear analysis of Thermoacoustic Instability

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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

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Lecture 15 - Cycle Analysis - Turbojet V

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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

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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

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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

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Lecture 17 - Multi-Component Diffusion Equation

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Lecture 19 - Energy Equation

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- 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](#)

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

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NPTEL : Gas Dynamics (Aerospace Engineering)

Co-ordinators : Dr. T.M. Muruganandam

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NPTEL : Introduction to CFD (Aerospace Engineering)

Co-ordinators : Prof. M. Ramakrishna

- 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](#)

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[Lecture 34 - Multigrid method](#)

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Lecture 3 - Rotational Frame of Reference and Orbital Velocities

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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](#)

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Lecture 4 - Classical Control Overview - III

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Lecture 7 - Overview of Flight Dynamics - I

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Lecture 9 - Representation of Dynamical Systems - I

Lecture 10 - Representation of Dynamical Systems - II

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Lecture 13 - Review of Matrix Theory - II

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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

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Lecture 27 - Linear Quadratic Regulator (LQR) Design - 1

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Lecture 29 - Linear Control Design Techniques in Aircraft Control - I

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Lecture 12 - Linear Quadratic Regulator (LQR) - III

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Lecture 15 - Overview of Flight Dynamics - I

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