

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

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

Lecture 15 - Exergy, availability and second law efficiency

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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

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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
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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
- 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
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- Lecture 19 - Axial Flow Turbines: Introduction to Turbines Aerothermodynamics
- Lecture 20 - Axial Flow Turbines: Turbine Blade 2D (Cascade) Analysis
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- Lecture 22 - Axial Flow Turbines: Blade and Axial Flow Passages, Exit Flow Matching with Nozzle
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- Lecture 25 - 3D Flow in Turbine: 3D Flow Theories, Free Vortex Theories etc.
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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 18 - Evaluation of Burn Rate of DB Propellants (Continued...)

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- 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
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- 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

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

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

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

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[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](#)

NPTEL : Acoustic Instabilities in Aerospace Propulsion (Aerospace Engineering)

Co-ordinators : Prof. R.I. Sujith

- 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 Corollary
- 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](#)

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[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

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[Lecture 32 - Bunsen Burner 1](#)

[Lecture 33 - Bunsen Burner 2](#)

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[Lecture 36 - Ignition](#)

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

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

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[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

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NPTEL : Introduction to CFD (Aerospace Engineering)

Co-ordinators : Prof. M. Ramakrishna

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

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

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

[Lecture 34 - Multigrid method](#)

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

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

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

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

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

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Lecture 2 - Motion in Space

Lecture 3 - Rotational Frame of Reference and Orbital Velocities

Lecture 4 - Velocity Requirements

Lecture 5 - Theory of rocket propulsion

Lecture 6 - Rocket Equation and Staging of Rockets

Lecture 7 - Review of Rocket Principles: Propulsion Efficiency

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

Lecture 9 - Theory of Nozzles

Lecture 10 - Nozzle Shape

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

Lecture 12 - Characteristic Velocity and Thrust Coefficient

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

Lecture 14 - Unconventional Nozzles and Problems in Nozzles

Lecture 15 - Criterion for Choice of Chemical Propellants

Lecture 16 - Choice of Fuel-Rich Propellants

Lecture 17 - Performance Prediction Analysis

Lecture 18 - Factors Influencing Choice of Chemical Propellants

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

Lecture 20 - Introduction to Solid Propellant Rockets

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

Lecture 22 - Design Aspects of Solid Propellant Rockets

Lecture 23 - Burning Surface Area of Solid Propellant Grains

Lecture 24 - Ignition of Solid Propellant Rockets

Lecture 25 - Review of Solid Propellant Rockets

Lecture 26 - Feed Systems for Liquid Propellant Rockets

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

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

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

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

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

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

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

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

[Lecture 35 - Electrical Thrusters](#)

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

Lecture 1 - Introduction and Motivation for Advanced Control Design

Lecture 2 - Classical Control Overview - I

Lecture 3 - Classical Control Overview - II

Lecture 4 - Classical Control Overview - III

Lecture 5 - Classical Control Overview - IV

Lecture 6 - Basic Principles of Atmospheric Flight Mechanics

Lecture 7 - Overview of Flight Dynamics - I

Lecture 8 - Overview of Flight Dynamics - II

Lecture 9 - Representation of Dynamical Systems - I

Lecture 10 - Representation of Dynamical Systems - II

Lecture 11 - Representation of Dynamical Systems - III

Lecture 12 - Review of Matrix Theory - I

Lecture 13 - Review of Matrix Theory - II

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