Introduction to Aerospace Propulsion - Video course

COURSE OUTLINE

Introduction to Propulsion :

The making of thrust to fly - science and history of propulsion; How the jet engines make thrust : conceptual basis; Jet engine : Turbo-jet, Turbo-fans, Turbo prop, Turbo-shaft.

Thermodynamic basis of Propulsion devices :

Basic concepts ; System-Boundary, Surroundings; State, Stable Equilibrium, State Co-ordinates and parameters, Extensive and Intensive Parameters; Energy interactions, Work and Heat transfers, Equilibrium, Quasistatic and Reversible process, Non-equilibrium and Irreversible Processes; Zeroeth Law and Temperature, First Law and Internal Energy; Second Law - Entropy and Absolute Temperature; Third Law and Absolute Entropy.

Thermodynamics of simple compressible systems, State postulate, Fundamental Representations, Thermodynamic Potentials; Jacobean and Legender Transformations - Maxwell's Equations, Derivation of thermodynamic properties. Applications: Closed and open systems, Polytropic processes, Cyclic process - Carnot's cycle; Gas and vapour power cycles; Mixtures of gases and vapours, One-D compressible flow, isentropic flow, flow with friction and heat transfer, supersonic flow and normal shock.

Piston –Prop Engines for Aircraft:

The Otto cycles; IC engines for aircraft application Reciprocating engine performance; Supercharging and Performance enhancement; Propeller fundamentals & Theories.

Ideal cycles for Jet Propulsion.

Introduction to Missiles, Rockets & Space Propulsion.

COURSE DETAIL

Lecture /Tutorial No.	Topic	(Instructor)
Lect-1	Course Intro & Historical development of flights.	(BR & AMP)
Lect-2	Early development of aircraft propulsive devices.	(BR)
Lect-3	Development of Jet propulsion for aircraft.	(BR)
Lect-4	Introduction to thermodynamics, Scope and method, Basic concepts: system, surroundings, property, intensive and extensive, state, equilibrium and state postulate, process, path and cycle.	(AMP)
Lect-5	Quasi-static processes, zeroth law of thermodynamics and temperature, concept of energy and its various forms, internal energy, enthalpy, specific heats at constant pressure and volume.	(AMP)
Lect-6	Work and heat transfers.	(AMP)

NP-TEL

NPTEL

http://nptel.iitm.ac.in

Aerospace Engineering

Additional Reading:

1. J.D.Mattingly, *Elements of Propulsion - Gas Turbines and Rockets,* 2006, AIAA Education series.
2. Ojha S K; *Flight Performance of Aircraft (4 & 5 Chapters)* , 1995, AIAA Ed Series.

Coordinators:

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Lect-7	Tutorial.	(AMP)
Lect-8	First law of thermodynamics for closed systems.	(AMP)
Lect-9	First law of thermodynamics for open systems/flow processes.	(AMP)
Lect-10	Second law of thermodynamics, heat engines, refrigerators and heat pumps, Kelvin-Planck and Clausius statement of second law of thermodynamics.	(AMP)
Lect-11	Reversible and irreversible processes, concept of entropy.	(AMP)
Lect-12	Tutorial.	(AMP)
Lect-12	Increase of entropy principle, third law of thermodynamics, absolute entropy, perpetual motion machines.	(AMP)
Lect-13	Carnot cycle, Carnot principle, thermodynamic temperature scale.	(AMP)
Lect-14	Exergy, availability and second law efficiency.	(AMP)
Lect-15	Tutorial.	(AMP)
Lect-16	Gas and vapour power cycles, Otto cycle, Diesel cycle, Dual cycle.	(AMP)
Lect-17	Rankine cycle, Brayton cycle, Stirling and Ericsson cycles.	(AMP)
Lect-18	Thermodynamic property relations, Jacobean and Legendre transformations, Maxwells' equations.	(AMP)
Lect-19	Tutorial.	(AMP)
Lect-20	Properties of gas and vapour mixtures.	(AMP)
Lect-21	One-dimensional compressible flows, isentropic flows.	(AMP)
Lect-22	Flows with friction and heat transfer, normal and oblique shocks.	(AMP)
Lect-23	Piston-prop engines : Otto cycles ; Ideal and Real cycles.	(BR)
Lect-24	IC Engines for aircraft application.	(BR)
Lect-25	Performance parameters of IC engines.	(BR)
Lect-26	Supercharging of aircraft IC engines.	(BR)
Lect-27	Tutorial.	(BR)
Lect-28	Propeller fundamentals.	(BR)
Lect-29	Propeller aerodynamic theories.	(BR)
Lect-30	Propeller aerodynamic theories.	(BR)
Lect-31	Tutorial.	(BR)
Lect-32	Ideal cycles for Jet engines.	(AMP)
Lect-33	Ideal cycles for variants of jet engines.	(AMP)
Lect-34	Tutorial.	(AMP)
Lect-35	Fundamentals of Ramjets and Pulsejets.	(BR)
Lect-36	Fundamentals of Rocket engines.	(BR)
Lect-38	Fundamentals of Missile engines.	(BR)
Lect-39	Various space vehicles and their engines.	(BR)
Lect-40	Closure of the lecture series : recap.	(BR & AMP)

References:

1. Nag, P.K. *Engineering Thermodynamics*, Tata McGraw Hill, 2008 (4^{th} ed).
2. Emmanuel G, *Advanced Classical Thermodynamics*, AIAA Ed. Series, 1987.
3. Kroes Michael J; Wild Thomas W; *Aircraft Powerplants;* 2010(7 Ed), Tata-Mcgraw-Hill.
4. Hill Philip, Peterson Carl, *Mechanics and Thermodynamics of Propulsion*, 1992, Addison Wesly.
5. Roy Bhaskar, *Aircraft Propulsion,* 2008, Elsevier (India).