

AEROSPACE PROPULSION

CourseCode		Year		Semester	
Course Category	HONORS	Branch	ME	Course Type	Theory
Credits	3	L – T – P	3 – 0 – 0	Pre-requisites	Thermodynamics, Gas Dynamics & Jet Propulsion, Fluid Mechanics
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

Course Outcomes: Upon successful completion of the course, the student will be able to

	Statement	Skill	BTL	Units
CO1	Understand basic concepts of Air Breathing and Non Air breathing Engines	Understand	L2	1,2,3,4,5
CO2	Apply thermodynamics of aircraft jet engine, rocket motors and calculate the performance measures, such as thrust and specific fuel consumption in terms of design requirement.	Apply	L3	2,3,4
CO3	Analyze the internal mechanisms of gas turbine engine and rocket engine components and understand the factors that limit the practical performance of thrust chambers, and nozzles	Analyze	L4	1,3,5

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1					2					2	3	1
CO2	3	1					2					2	3	1
CO3	3	2					2					2	3	1

Syllabus

UNIT	Contents	Mapped COs
I	Introduction: Classification of power plants - Methods of aircraft propulsion – Propulsive efficiency – Specific fuel consumption - Thrust and power- Factors affecting thrust and power. Illustration of working of Gas turbine engine - Characteristics of turboprop, turbofan and turbojet, Ram jet, Scram jet – Methods of Thrust augmentation.	CO1, CO3
II	Introduction to rocket propulsion: Classification and applications of rockets – Reaction principle – Thrust equation – Classification of rockets based on propellants used – solid, liquid and hybrid – Comparison of these engines with special reference to rocket performance – electric propulsion – classification- electro thermal – electro static – electromagnetic thrusters- geometries of Ion thrusters- beam/plume characteristics – hall thrusters.	CO1, CO2

	Fundamentals and Definitions – Thrust, Exhaust Velocity, Energy and efficiencies, multiple propulsion systems, typical performance values, variable thrust and simple problems.	
III	Liquid Propellant rocket engine: Types of propellants, propellant tanks, propellant feed systems, gas pressure feed systems, tank pressurization, turbopump feed system, rocket engines for maneuvering and orbit adjustments. Introduction to Cryogenic Engines. Liquid Propellants: propellant properties, liquid oxidizers, liquid fuels, liquid monopropellants, gaseous propellant, safety and environment concern. Combustion process and instability.	CO1, CO2, CO3
IV	Solid Propellant Rocket engine: Basic relations and propellant burning rate, performance issues, propellant grain and grain configuration, propellant grain stress and strain, altitude control and side maneuver's with solid propellant rocket motors Solid Propellants: Classification, propellant characteristics, hazards, propellant ingredients, other propellant categories	CO1, CO2
V	Nozzle Theory and Thermodynamics Relations: review of thermodynamics relations, ideal rocket propulsion systems, isentropic flow through nozzles, nozzle configuration, real nozzles, nozzle alignment, over expanded, under expanded nozzles and optimum expansion in nozzles Thrust Chambers: Injectors, flow characteristics, factors influencing injection behavior, heat transfer analysis, starting and ignition, life of thrust chambers, random variable thrust, sample thrust chamber design analysis, Thrust Vector Control with single nozzle and multiple nozzles. Integration with vehicle.	CO1, CO3

Learning Resources

Text books

1. Rocket Propulsion Elements G. P. Sutton Wiley India Pvt Ltd 7th Edition, 2010
2. Gas Turbine Theory Cohen, H. Rogers, G.F.C. and Saravanamuttoo H.I.H DORLING KINDERSLEY 5th edition, 2002

Reference books

1. Introduction to Rocket Propulsion James R Church of Care 2018
2. Rocket and Spacecraft Propulsion Martin J I Turner Springer Third Edition
3. Aerothermodynamics of gas turbines and rocket propulsion G.C. Oates AIAA Education Series Third Edition
4. Mechanics and Thermodynamics of Propulsion Hill, P.G. and Peterson, C.R Pearson 2nd edition, 2009

E- Resources & other digital material

1. https://onlinecourses.nptel.ac.in/noc22_ae03/preview
2. https://onlinecourses.nptel.ac.in/noc22_me33/preview