AEROSPACE PROPULSION - II

VI Semester

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5AE25	PCC	3	0	0	3	30	70	100

COURSE OBJECTIVES:

The course is intended to build up necessary background for understanding the Aircraft and Rocket propulsion systems.

1. To learn the propulsion system performance information at various condition.
2. To understand the application of various propellant systems and their properties

UNIT-I BACKGROUND AND REQUIREMENTS

Introduction, Motion of bodies in space, parameters describing motion of bodies, frame of reference Impulse, force, universal law for gravitational force, motion in rotating frame of reference, pseudo- centrifugal force Orbits, orbit velocities, orbital period, geosynchronous and geostationary orbits, eccentricity and inclination, polar, sun-synchronous and other orbits Energy requirements for orbit, escape velocity, orbital and suborbital flight, state of weightlessness under free fall

UNIT-II ROCKET PRINCIPLE AND NOZZLES

ROCKET PRINCIPLE: Means of achieving orbit, Motion of a sled initially at rest Motion of giant squids, Rocket principle and Tsiolkovsky Rocket equation Mass ratio of rocket, desirable parameters to achieve high velocities, propulsive efficiency Performance parameters of a rocket, staging and clustering

NOZZLES: Rocket Nozzles:Expansion of gases from high pressure chamber, efflux velocity, classification, Performance losses in nozzles, Under-and Over- expansion nozzles (for very large pressure ratios),Performance loss in nozzles, mass flow rates and characteristic velocity role for interplanetary and deep space missions, Thrust developed by rocket , Net- and Gross- thrust, Thrust flow coefficient, vacuum and sea level specific impulse, efficiencies and thrust correction factor

UNIT-III CHEMICAL PROPELLANTS

Chemical propellants: Choice from considerations of molecular mass, specific heats, specific heat ratios, temperature and pressure Choice of chemical propellants: heats of formation, moles and mixture ratio; choice of mixture ratio, Calculation of heat of combustion, temperature, molecular mass and rocket performance parameters

UNIT-IV SOLID AND LIQUIDPROPELLANT ROCKETS

Solid propellant rockets: Introduction, classification Propellant grain configurations and its loading strategies: design of solid propellant rocket, Ignition of solid propellant rockets, ignition problems and solutions Characteristic burn times and action time. Liners, Insulators and inhibitors

LIQUIDPROPELLANT ROCKETS: Introduction to liquid propellant rockets, propellant feed systems, Gas Pressure feed system, Propellant properties, Liquid oxidizers and fuels

UNIT-V COMBUSTION INSTABILITY IN ROCKETS AND ELECTRICAL ROCKETS

COMBUSTION INSTABILITY IN ROCKETS: Combustion instability in rockets; illustration through examples, bulk and wave modes of instability, Modeling of bulk mode of instability in solid and liquid propellant rockets

ELECTRICAL ROCKETS

Introduction- electrical and magnetic fields, electro-thermal, arc-jet, electrostatic and electromagnetic thrusters

Text Books:

1. Ramamurthi, K., Rocket Propulsion, Macmillan (in press) 2009
2. Sutton, G. P. and Biblarj, O. Rocket propulsion elements, 7th Ed., New York: Wiley IntescicePulications, 2001.

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Reference Books:

1. Mechanics & Thermodynamics of Propulsion
2. M. Barrere, A. Jaumotte, B.J. Veubeke and J. Vanderkerckhove, Rocket Propulsion, Elsevier Publishing Company, Amsterdam, 1960 (remarks: no reference books available)

COURSE OUTCOMES:

1. Illustrate the basic concepts about planets and orbits
2. Determine rocket launching principles and concept of nozzles
3. Determine the selection criterion of various propellants.
4. Examine the configuration of propellants feeding.
5. illustrate the combustion instability in rockets and compare the principles of electrical rockets