ROCKET AND MISSILES

PROFESSIONAL ELECTIVE - V

VIII Semester

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5AE54	PCC	3	0	0	3	30	70	100

COURSE OBJECTIVES:

This course is to develop and understand the aerodynamics of rocket and missile, major propellants used in rocket, trajectory and launching systems

1. Illustrate Fundamentals of rocket and missile systems, functions and disciplines.
2. Demonstrate full spectrum of rocket systems, application and technologies.
3. Classify technologies of guided systems used in missile.
4. Explain Fundamentals and applications of solid, liquid and hybrid rocket systems.
5. Distinguish between systems built as weapons and those built for commerce.

UNIT-I ROCKET PROPELLANT SYSTEMS

SOLID PROPELLANT ROCKET SYSTEMS: Ignition system in rockets, Types of igniters, Igniter design considerations, Combustion system of solid rockets.

LIQUID PROPELLANT ROCKET SYSTEMS: Design consideration of liquid rocket combustion chamber, injector, propellant feed lines, valves, propellant tank outlet and helium pressurized and turbine feed systems, Propellant slosh, Propellant hammer, Geysering effect in cryogenic rocket engines

UNIT-II AERODYNAMICS OF ROCKETS AND MISSILES

Classification of missiles, general aerodynamic design considerations, Airframe components of rockets and missiles and aerodynamic characteristics, Forces acting on a missile while passing through atmosphere, Method of describing aerodynamic forces and moments, Drag estimation, Body upwash and downwash in missiles, free flight dispersion and structural design considerations

UNIT-III TWO-DIMENSIONAL ROCKET MOTION IN VACUUM & MULTI-STAGE ROCKET

TWO-DIMENSIONAL ROCKET MOTION IN VACUUM: Equations of motion, Rocket Motion in free space (Tsiokovsky‘s equation, Rocket Parameters, Burnout range), Rocket Motion in a homogeneous gravitational field (Vertical flight).

MULTI-STAGE ROCKET: Nomenclature of the multi-stage rocket, Ideal Velocity of the multi-stage rocket, Vertical ascent in a homogeneous gravitational field and in vacuum (Burnout velocity- Culmination altitude- Vertical ascent of a two-stage rocket).

UNIT-IV ATTITUDE CONTROL OF ROCKETS AND MISSILES

ATTITUDE CONTROL OF ROCKETS AND MISSILES: Rocket thrust vector control, Methods of thrust vector control, Thrust magnitude control, Thrust Termination.

SEPARATION SYSTEMS FOR ROCKETS AND MISSILES: Stage separation dynamics, Separation and aerodynamics launching problems.

UNIT-V MATERIALS FOR ROCKETS AND MISSILES

Criteria for Selection of materials for rockets and missiles, Choice of materials at cryogenic temperatures, extremely high temperatures. Requirement of materials for thermal protection and pressure vessels.

Text Books:

1. Martin J. L. Turner (2008), Rocket and Spacecraft Propulsion principles, practice and new developments, 3rd edition, Springer, USA.
2. Sutton G.P. (2010), Rocket Propulsion Elements, John Wiley / BSP Books, USA.
3. Cornelissse J. W. (1980), Rocket Propulsion and Space Dynamics, Pitman Publishing, London.

Reference Books:

1. S. S. Chin (1982), Missile Configuration Design, McGraw- Hill, New Delhi.
2. Bong Wie (2008), Space Vehicle Dynamics and Control, AIAA Educational Series, USA.
3. Earl R Parker (1998), Materials for Missiles and Spacecraft, McGraw Hill, New Delhi

COURSE OUTCOMES:

At the end of the course the student should be able to:

1. Interpret new technology for staging of rockets and missiles.
2. Develop methods for altitude control.
3. Identify material for nozzle of rockets and missiles.
4. Analyse the missile guidance system.
5. Determine 2-D motion rocket equation