SPACE MECHANICS

PROFESSIONAL ELECTIVE - III

VII Semester

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5AE47	PCC	3	0	0	3	30	70	100

COURSE OBJECTIVES:

Upon completion of the course, students should be able to understand the following:

1. Know about the reference frames and coordinate system
2. Have knowledge about launching of the satellite
3. Know the basic idea about the interplanetary missions and the paths in which the space craft shall move
4. Basic idea of the ballistic trajectories
5. Acceleration using constant radial thrust acceleration
6. Know the general trajectory geometry
7. Understand the low-thrust trajectories

UNIT-I BASIC CONCEPTS AND THE GENERAL N-BODY PROBLEM

BASIC CONCEPTS: The solar system, Reference frames and coordinate systems, The celestial sphere, The ecliptic, Motion of vernal equinox, Sidereal time, Solar Time, Standard Time, The earth's atmosphere

THE GENERAL N-BODY PROBLEM: The many body problem, Lagrange-Jacobi identity. The circular restricted three-body problem, Libration points, Relative Motion in the N-body problem

UNIT-II THE TWO-BODY PROBLEM ANDTHE LAUNCHING OF A SATELLITE

THE TWO-BODY PROBLEM: Equations of motion-General characteristics of motion for different orbits-Relations between position and time for different orbits, Expansions in elliptic motion, Orbital Elements. Relation between orbital elements and position and velocity.

THE LAUNCHING OF A SATELLITE: Launch vehicle ascent trajectories, General aspects of satellite injection. Dependence of orbital parameters on in-plane injection parameters, Launch vehicle performances, Orbit deviations due to injection errors

UNIT-III PERTURBED SATELLITE ORBITS AND INTERPLANETARY TRAJECTORIES

PERTURBED SATELLITE ORBITS: Special and general perturbations- Cowell's Method, Encke's method. Method of variations of orbital elements, General perturbations approach

INTERPLANETARY TRAJECTORIES: Two-dimensional interplanetary trajectories, Fast interplanetary trajectories, Three dimensional interplanetary trajectories. Launch of interplanetary spacecraft. Trajectory about the target planet

UNIT-IV BALLISTIC MISSILE TRAJECTORIES

The boost phase, the ballistic phase, Trajectory geometry, optimal flights. Time offlight, Re-entry phase. The position of the impact point, Influence coefficients

UNIT-V LOW-THRUST TRAJECTORIES

Equations of Motion. Constant radial thrust acceleration, Constant tangential thrust(Characteristics of the motion>), Linearization of the equations of motion, Performance analysis.

Text Books:

1. William E. Wiesel (2010), *Spaceflight Dynamics*, 3rd edition, McGraw-Hill, New Delhi.
2. JJ Sellers," Understanding the Space", CEI publication.

Reference Books:

1. *Vladimir A. Chobotov (2002*), Orbital Mechanics, 3rd Edition, AIAA Education Series, USA.
2. *David A. Vellado (*2007), Fundamentals of Astrodynamics and Applications, 3rd Edition, Springer, Germany.
3. *J. W. Cornelisse* (1979), Rocket Propulsion and Spaceflight Dynamics, Pitman Publishing, London.

COURSE OUTCOMES:

This course uses lectures, assignments and home works to the students. The teaching methods include regular class work, Problem solving, technical quiz, and seminars to enable the students:

1. Should get the basic idea of reference frames and coordinate systems
2. Should know to solve General n-body problems
3. Should know to solve General 2-body problems
4. Ballistic missile trajectories
5. Planning of space missions
6. Planning of the simulation experiments
7. Low thrust and radial thrust acceleration
8. Have knowledge on special and general perturbations