

## **AE6003 SPACE MECHANICS**

### DETAILED SYLLABUS

#### **OBJECTIVES:**

- To introduce concepts of satellite injection and satellite perturbations, trajectory computation for interplanetary travel and flight of ballistic missiles based on the fundamental concepts of orbital mechanics.

#### **UNIT I SPACE ENVIRONMENT**

Peculiarities of space environment and its description– effect of space environment on materials of spacecraft structure and astronauts- manned space missions – effect on satellite life time

#### **UNIT II BASIC CONCEPTS AND THE GENERAL N- BODY PROBLEM**

The solar system – reference frames and coordinate systems – terminology related to the celestial sphere and its associated concepts – Kepler’s laws of planetary motion and proof of the laws – Newton’s universal law of gravitation - the many body problem - Lagrange-Jacobi identity – the circular restricted three body problem – libration points – the general N-body problem – two body problem – relations between position and time.

#### **UNIT III SATELLITE INJECTION AND SATELLITE PERTURBATIONS**

General aspects of satellite injection – satellite orbit transfer – various cases – orbit deviations due to injection errors – special and general perturbations – Cowell’s method and Encke’s method – method of variations of orbital elements – general perturbations approach.

#### **UNIT IV INTERPLANETARY TRAJECTORIES**

Two-dimensional interplanetary trajectories – fast interplanetary trajectories – three dimensional interplanetary trajectories – launch of interplanetary spacecraft – trajectory estimation about the target planet – concept of sphere of influence – Lambert’s theorem

#### **UNIT V BALLISTIC MISSILE TRAJECTORIES**

Introduction to ballistic missile trajectories – boost phase – the ballistic phase – trajectory geometry – optimal flights – time of flight – re-entry phase – the position of impact point – influence coefficients.

#### **TEXT BOOKS:**

1. Cornelisse, J.W., “Rocket Propulsion and Space Dynamics”, J.W. Freeman & Co., Ltd, London, 1982
2. Parker, E.R., “Materials for Missiles and Spacecraft”, Mc. Graw Hill Book Co. Inc., 1982.

#### **REFERENCES:**

1. Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 5th Edition, 1993.