Course code	Course Name	L-T-P - Credits	Year of Introduction
AO402	ROCKETRY AND SPACE MECHANICS	3-0-0-3	2016

Prerequisite : Nil

Course Objectives

- To introduce solar system and basic concepts of orbital mechanics with particular emphasis on interplanetary trajectories
- To know rocketry and missile systems

Syllabus

Description of solar system-Newton's Law of Universal gravitation -Principle of operation of rocket motor -Boat-tailing in missiles –multi staging of rocket vehicles

Expected outcome

The students will get

i. knowledge about solar system and orbital mechanism
ii. awareness about the rocketry and missile systems

Text Books:

1. G.P. Sutton, "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edition, 1986.
2. J.W. Cornelisse, "Rocket Propulsion and Space Dynamics", J.W. Freeman & Co., Ltd., London, 1982

References:

1. Van de Kamp, "Elements of astromechanics", Pitman Publishing Co., Ltd., London, 1980.
2. E.R. Parker, "Materials for Missiles and Spacecraft", McGraw-Hill Book Co., Inc., 1982.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	The Solar System – References Frames and Coordinate Systems	1	15%
	The Celestial Sphere– The Ecliptic – Motion of Vernal Equinox	1	
	Sidereal Time – Solar Time – Standard Time –The Earth's Atmosphere	2	
	Galilean transformation Keplers Law, Newton Law of gravitation.	2	
II	Estimation of orbital and escape velocity - The many body Problem – Lagrange Jacobian Identity	2	15%
	The Circular Restricted Three Body Problem	2	
	Liberation Points- Relative Motion in the N-body Problem Two – Body Problem	2	
	Satellite Orbits – Relations between Position and Time – Orbital Elements.	4	
FIRST INTERNAL EXAMINATION			

III	Principle of operation of rocket motor - thrust equation	2	15%
	one dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields	1	
	Description of vertical, inclined and gravity turn trajectories determinations of range and altitude	3	
	simple approximations to burnout velocity	1	
IV	Description of various loads experienced by a rocket passing through atmosphere	2	15%
	drag estimation – wave drag, skin friction drag, form drag and base pressure drag	2	
	Boat-tailing in missiles –performance at various altitudes	2	
SECOND INTERNAL EXAMINATION			
V	Need for multi staging of rocket vehicle	1	20%
	multistage vehicle optimization	1	
	Stage separation dynamics and separation techniques	1	
	Aerodynamic and jet control methods of rocket vehicles - SITVC.	2	
VI	Basics of rocket nozzles – principle	2	20%
	Conical and bell shaped nozzles	1	
	Adapted nozzles	1	
	Rocket dispersion – launching problems.	2	
END SEMESTER EXAM			

Question Paper Pattern

Maximum marks: 100 Exam duration: 3 hours

The question paper shall consist of three parts

Part A
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.