U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: V**

Branch: Aerospace Engineering **Duration: 3 hrs.**

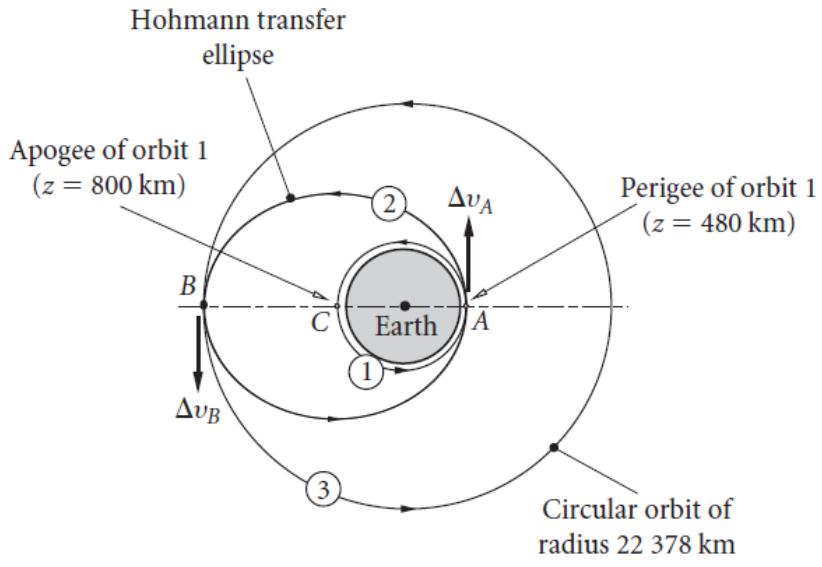
Course Code: 23AS5PESPM **Max Marks: 100**

Course: Space Mechanics

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - I	CO	PO	Marks
1	a)		State and prove transport theorem.	CO1	PO2	**10**
	b)		Define central force field. Describe three major characteristics of the central force field.	CO1	PO1	**10**
			OR			
2	a)		What do you understand by inertial frame and non-inertial frame? Newton's laws of motions are applied to which frame of reference. What is a body-fixed frame? State whether it is an inertial or non-inertial frame.	CO1	PO1	**10**
	b)		Derive the procedure of transformation of displacement vector from a fixed coordinate to a rotating coordinate system.	CO1	PO2	**10**
			UNIT - II			
3	a)		Write down Newton's law of gravitation. Describe the equation of motion of one body with respect to another under the mutual gravitational attraction.	CO2	PO2	**10**
	b)		Show that, angular momentum associated with a body, moving relative to another body under mutual gravitational attraction, is constant.	CO2	PO2	**10**
			OR			
4	a)		Show that, for elliptic orbit, (i) $l = a(1 - e^2)$ (ii) $b = a\sqrt{1 - e^2}$ (iii) $l = \frac{b^2}{a}$ (iv) $l = \frac{h^2}{\mu}$	CO2	PO2	**20**

			Where, l= semi-latus rectum, a= semi-major axis, b=semi-minor axis, e= eccentricity, h= specific angular momentum, μ= Gravitational parameter.			
			UNIT - III			
	5	a)	Why trajectory transfer is required. Describe different types of trajectory transfer.	CO3	PO1	**10**
		b)	Show that for the same amount of velocity change, maximum energy is obtained only for the Hohmann transfer.	CO3	PO2	**10**
			OR			
	6	a)	A spacecraft is in a 480 km by 800 km earth orbit (orbit 1 in Figure 1). Find (a) the Δv required at perigee A to place the spacecraft in a 480 km by 16 000 km transfer orbit (orbit 2); and (b) the Δv (apogee kick) required at B of the transfer orbit to establish a circular orbit of 16 000 km altitude (orbit 3). Gravitational parameter, μ=398 600 km3/s^2 and Radius of Earth, R_E =6378 km.  **Figure 1**	CO3	PO2	**20**
			UNIT - IV			
	7	a)	What do you understand by the stability of anybody? What are the different types of stabilities that a body undergoes?	CO4	PO1	**10**
		b)	What is torque-free motion? Derive the expression for absolute angular velocity ω along the three principal body axes considering rotational symmetry.	CO4	PO2	**10**
			OR			

	8	a)	Describe with a neat diagram the working principle of the Gyroscope. How the Gyroscope is useful in controlling the satellite attitude.	CO4	PO1	**10**
		b)	What is the difference between translation motion and rotational motion? Write down the equations used to describe the translation and rotational equations.	CO4	PO2	**10**
			UNIT - V			
	9	a)	Describe the rocket thrust equation. Comment on rocket performance based on the thrust equation.	CO5	PO2	**10**
		b)	(i) Write a short note on the despinning of satellites. (ii) Demonstrate attitude drift of space vehicles.	CO5	PO1	**10**
			OR			
	10	a)	Briefly describe any five types of rocket and space propulsion systems.	CO5	PO1	**10**
		b)	Draw free-body diagram of a rocket showing the various forces acting on it and derive an expression for downward range distance and altitude taking into account the curvature of the Earth.	CO5	PO2	**10**

****