Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VIII • EXAMINATION – SUMMER • 2015

Subject Code: 180103 **Date: 11/05/2015**

Subject Name: Space Dynamics

Time: 10.30am-01.00pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Explain Newton's Law of Gravitation in detail.	**07**
	(b)	(i) Explain Gravitational Potential Energy.	**04**
		(ii) Is there gravity in space? Yes or No? Explain.	**03**
Q.2	**(a)**	Explain different types of entry paths.	**07**
	(b)	(i) What is Zero Potential Energy configuration?	**03**
		(ii) It is possible to simulate "weightless" conditions by flying a plane in an arc such that the centripetal acceleration exactly cancels the acceleration due to gravity. Such a plane was used by NASA while training astronauts. What would be the required speed at the top of an arc of radius 1000 m?	**04**
		OR	
	(b)	Write a short note on Elliptic Orbits.	**07**
Q.3	**(a)**	Explain mechanics of Circular orbit. Also list important points for the same.	**07**
	(b)	At the end of a rocket launch of a space vehicle, the burnout velocity is 9 km/s in a direction due north and 3º above the local horizontal. The altitude above sea level is 805 km. The burnout point is located at 27º degree above the equator. Calculate the trajectory of the space vehicle.	**07**
		OR	
Q.3	**(a)**	Explain Hohmann transfer ellipse with velocity increments required to achieve the mission.	**07**
	(b)	A satellite is launched from a circular equatorial parking orbit at an altitude of 160 km into a coplanar circular synchronous orbit by using a Hohmann transfer ellipse. Assume a homogeneous spherical earth with a radius of 6400 km. Determine the velocity increments for entering the transfer ellipse and for achieving the synchronous orbit at 42,000 km altitude.	**07**
Q.4	**(a)**	Derive Orbit equation.	**07**
	(b)	Using Orbit equation derive equation for eccentricity in terms of the difference between K.E & P.E. Also derive formula to calculate circular velocity and parabolic velocity.	**07**
		OR	
Q.4	**(a)**	Write a short note on The Two body problem.	**07**
Q.4	**(b)**	Write a short note on Escape Velocity. Also calculate escape velocity for earth and sun.	**07**
Q.5	**(a)**	Explain Kepler's laws in detail.	**07**

	(b)	i.	Explain different types of entry paths.	**05**
		ii.	The period of revolution of the earth about the sun is 365.256 days. The semi major axis of earth's orbit is 1.49527×10^{11} m. In turn, the semi major axis of the orbit of Mars is 2.2783×10^{11} m. Calculate the period of Mars.	**02**

OR

Q.5	**(a)**	Derive general equation of motion for a vehicle entering the atmosphere. Based on ballistic parameter plot the entry trajectory on a velocity altitude map.	**07**
	(b)	Explain Entry heating. Also obtain an equation for aerodynamic heating rate.	**07**

<u>Given Data:</u>

Radius of earth = 6370 km **$G = 6.67\times10^{-11}$ Nm^2/kg^2**

Mass of earth = 5.98×10^{24} kg **Mass of earth = 1.99×10^{30} kg**

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