Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VIII - EXAMINATION – SUMMER 2014

Subject Code: 180103 **Date: 03-06-2014**

Subject Name: Space Dynamics

Time:10:30 am to 01:00 pm **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) Determine the mass of the space dynamics student if the force of attraction between earth and the student is 684 N. **03**

Q.2 **(a)** Write a short note on Escape Velocity. **07**

(b) A 250 kg rocket moving rapidly outward from the earth has a speed of 5.7 km/s when its engine shuts off 200 km above earth's surface. **07**

(a) Assuming negligible air drag, find the rocket's velocity when it is 1000 km above earth's surface.

(b) What maximum height above earth's surface is reached by the rocket?

OR

(b) Explain Hohmann transfer ellipse. **07**

Q.3 **(a)** Explain mechanics of Circular orbit. Also list important points for the same. **07**

(b) A satellite is launched from a circular equatorial parking orbit at an altitude of 150 km into a coplanar circular synchronous orbit by using a Hohmann transfer ellipse. Assume a homogeneous spherical earth with a radius of 6370 km. Determine the velocity increments for entering the transfer ellipse and for achieving the synchronous orbit at 42,000 km altitude. **07**

OR

Q.3 **(a)** Write a short note on Elliptic Orbits. **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 3° above the local horizontal. The altitude above sea level is 805 km. The burnout point is located at 27° degree above the equator. Calculate the trajectory of the space vehicle. **07**

Q.4 **(a)** (i) Classify Space Vehicles. **03**

(ii) With neat sketches explain primary phases of space mission. **04**

(b) Derive Orbit equation. **07**

OR

Q.4 **(a)** (i) 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. What would be the required speed at the top of an arc of radius 1500 meters? **04**

(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. **03**

Q.4 **(b)** Write a short note on Kepler's third law in detail. **07**

Q.5 **(a)** Derive general equation of motion for a vehicle entering the atmosphere. **07**

(b) Explain different types of entry paths. **07**

OR

Q.5 **(a)** Explain Entry heating. Also obtain an equation for aerodynamic heating rate. **07**

(b) Write a short note on Deep Space. **07**

Given Data:

Radius of earth = 6370 km

$G = 6.67\times10^{-11}$ Nm^2/kg^2

Mass of earth = 5.98×10^{24} kg

****