Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2019

Course: Orbital Mechanics **Semester: VII**
Program: B. Tech ASE & ASE+AVE **Time 03 hrs.**
Course Code: ASEG 482 **Max. Marks: 100**

Instructions: Make use of *sketches/plots* to elaborate your answer. Brief and to the point, answers are expected.
The Question paper has three sections: Section A, B and C, Section B and C having internal choices.

SECTION A

S. No.	Questions	Marks	CO
Q 1	Calculate the velocity of an artificial satellite orbiting the Earth in a circular orbit at an altitude of 200 km above the Earth's surface.	**4**	**CO1**
Q 2	What is orbital velocity? Write some advantages of Low Earth orbit.	**4**	**CO2**
Q 3	Draw and explains the satellite attitude control system.	**4**	**CO4**
Q 4	Explain the various Attitude sensors.	**4**	**CO4**
Q 5	Plot the spacecraft trajectory on a velocity-altitude map	**4**	**CO3**

SECTION B

S. No.	Questions	Marks	CO
Q 6	A satellite is launch into Earth orbit, where its launch vehicle burns out at an altitude of **250 km**. At burnout condition, the satellite's velocity is **7,900 m/s** with the zenith angle equal to **89 degrees**. Calculate the semi-major axis of the orbit for the satellite. Discuss the various orbital elements.	**10**	**CO3**
Q 7	a) An artificial Earth satellite is in an elliptical orbit which brings it to an altitude of **250 km** at perigee and out to an altitude of **500 km** at apogee. Calculate the velocity of the satellite at both perigee and apogee. b) Radius of earth=$\mathbf{6.378 \times 10^8}$ **m**, g=**9.81** m/sec^2, height of satellite=$\mathbf{35.9 \times 10^6}$ m, $\mathbf{\theta = 10.5^o}$ to equator. How much velocity is required to make the orbit of satellite equatorial?	**05+05**	**CO2**
Q 8	A spacecraft is in a circular parking orbit with an altitude of **200 km**. Calculate the velocity change required to perform a Hohmann transfer to a circular orbit at geosynchronous altitude. Draw the trajectory of Hohmann transfer with suitable equations.	**10**	**CO3**

Q 9	The satellite open loop transfer function is $G(s) = \frac{K}{s(s^2+6s+10)}$ Sketch the root locus of the unity feedback system. (Or) The open loop transfer function of a unity feedback control system is given by $$G(s) = \frac{K}{(s+2)(s+4)(s^2+6s+25)}$$ State the stability of the closed loop system as a function of k .Determine the value of 'k', which will cause sustained oscillations in the closed loop systems. Where are the corresponding oscillating frequencies?	**10**	**CO4**
SECTION-C			
Q 10	A satellite is in a circular Earth orbit at an altitude of **400 km**. The satellite has a cylindrical shape **2 m** in diameter by **4 m** long and has a mass of **1,000 kg**. The satellite is traveling with its long axis perpendicular to the velocity vector and its drag coefficient is **2.67**. Calculate the perturbations due to atmospheric drag and estimate the satellite's lifetime	**20**	**CO2**
Q 11	a) A satellite is in an orbit with a semi-major axis of **7,500 km**, an inclination of **28.5** degrees, and an eccentricity of **0.1**. Calculate the J2 perturbations in longitude of the ascending node and argument of perigee. Also Discusses the orbital perturbation b) A satellite is in an orbit with a semi-major axis of **7,500** km and an eccentricity of **0.1** Calculate the length of its position vector, its flight-path angle, and its velocity when the satellite's true anomaly is **225** degrees. **(Or)** a) Three identical mass 'm' are located at corners of equilateral triangle and revolves in a circular orbit of radius 'R'. Calculate the velocity of each planet in an orbit and the total potential of the system? b) If satellite is revolving around earth in a circular orbit at a distance r from the center of earth. Find the extra energy that must be provided to the satellite to escape from earth's gravitational field?	**20**	**CO3**