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**

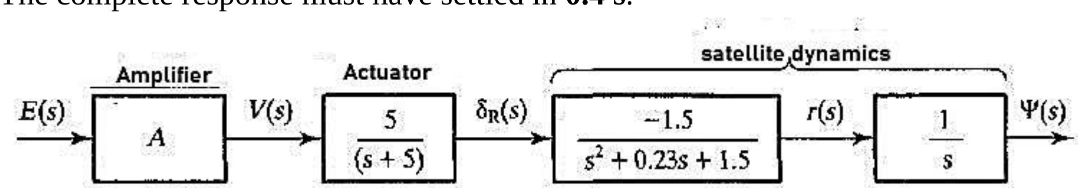
Instructions: Make use of *sketches/plots* to elaborate your answer. Brief and to the point, answers are expected.
The Question paper has three sections: Section A, B and C, Section B and C having internal choices.

SECTION A

S. No.	Questions	Marks	CO
Q 1	What is geosynchronous orbit? How it is different from Polar orbit?	**4**	**CO1**
Q 2	Define Prograde and Retrograde Orbit.	**4**	**CO2**
Q 3	Draw and explain the satellite attitudes control block diagram?	**4**	**CO4**
Q 4	List out the types of Reentry in details.	**4**	**CO3**
Q 5	Explain the Perturbations due to Non-Spherical Earth. Justify your answer.	**4**	**CO2**

SECTION B

S. No.	Questions	Marks	CO
Q 6	A satellite is in a circular parking orbit with an altitude of **200 km**. Using a one-tangent burn, it is to be transferred to geosynchronous altitude using a transfer ellipse with a semi-major axis of **30,000 km**. Calculate the total required velocity change and the time required to complete the transfer.	**10**	**CO3**
Q 7	a) The space shuttle is in an altitude of **250 km** in a circular orbit then calculates the period of the orbit and its speed. b) Radius of earth=**6.378×10^8 m**, g=**9.81** m/sec^2, height of satellite=**35.9×10^6** m, **$\theta=10.5^o$** to equator. How much velocity is required to make the orbit of satellite equatorial?	**05+05**	**CO2**
Q 8	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	**10**	**CO3**

Q 9	Define Kepler Laws? The period of revolution of the earth about the sun is **365.256** days. The semi-major axis of the earth's orbit is **1.49527*10^{11} m**. The Semi-major axis of the orbit of Mars is **2.2783*10^{11} m**. Calculate the period of Mars. **(Or)** At perigee , kinetic energy and potential energy can be written as (K.E)p and (P.E)p and $\lambda 1$ = (K.E)p (P.E)p , whereas at apogee: kinetic energy is (K.E)a potential energy is (P.E)a and $\lambda 2$ = (K.E)a (P.E)a , which of the following relation between $\lambda 1$ and $\lambda 2$ is true? Justify your answer.	**10**	**CO1**
SECTION-C			
Q 10	At the end of a rocket launch of a space vehicle, the burnout velocity is **9km/s** is a direction due north and **3^0** above the local horizontal. The altitude above the sea level is **500 mi**. The burnout point is located at the **27^0** parallel above the equator. Calculate and plot the trajectory of the space vehicle. Also, Derive the equation of the motion of the space vehicle.	**20**	**CO2**
Q 11	Design a closed loop system using linear state variable feedback for the open loop system shown in Figure 1. The desired dominant complex poles of the closed loop system must have a damping ratio of not less than **0.45**. In addition, in response to a unit step input the peak overshoot of the response of the closed loop system must not exceed **20** per cent and must not occur later than **0.15 s** after the step has been applied. The complete response must have settled in **0.4 s**.  **Figure (1)** (a) Draw a root locus diagram for the aircraft system of Figure 1. (b) If ***A* = 0.04** calculate the values of the poles of the system **(Or)** A satellite transfer function is $\mathbf{G(s)} = \frac{K\,(s^2+6s+25)}{s(s+1)(s+2)}$ i) Determine the value of K, which gives continuous oscillation and the frequency of oscillation. ii) Determine the value of K corresponding to a dominant closed loop pole with damping ratio **0.7** iii) Draw the root locus plot for unity feedback having forward path transfer function	**20**	**CO4**