Name: **Enrolment No:**	UPES

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

Programme Name: B. Tech ASE+AVE | **Semester : VIII**
Course Name : Satellite System Engineering | **Time : 03 hrs**
Course Code : ELEG 408 | **Max. Marks : 100**
Nos. of page(s) : 02

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 have internal choices.**

SECTION A

S. No.		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**	**CO2**
Q 2	Explain the Polar orbit and Sun Synchronous orbit	**4**	**CO2**
Q 3	Draw and explain the spacecraft trajectory on a velocity-altitude map	**4**	**CO1**
Q 4	Calculate the eccentricity of the orbit for the satellite with the following parameters? Given: r_1 = 6,628,140 m v_1 = 7,900 m/s $\Upsilon = 89^o$	**4**	**CO3**
Q 5	Explain the Equivalent Isotropic Radiated Power	**4**	**CO5**

SECTION B

Q 6	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) Calculate the radius of orbit for an Earth satellite in a geosynchronous orbit, where the Earth's rotational period is 86,164.1 seconds.	**10**	**CO2**
Q 7	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	**10**	**CO4**

Q 8	a) The period of revolution of the earth about the sun is 365.256 days. The semimajor axis of the earth's orbit is $1.49527*10^{11}$ m. The Semimajor axis of the orbit of Mars is $2.2783*10^{11}$ m. Calculate the period of Mars. b) A satellite is moving around Earth with speed v in circular orbit of radius r,if orbit radius decreases by 1 % , then the velocity will be?	**10**	**CO1**
Q 9	A satellite link operating at 14 GHz has receiver feeder losses of 1.5 dB and a freespace loss of 207 dB. The atmospheric absorption loss is 0.5 dB and the antenna pointing loss is 0.5 dB. EIRP = 60 dbW, Gain of the Antenna is 50dB. Depolarization losses may be neglected. Calculate the Received power and total loss for clear sky conditions. (Or) a) A satellite downlink at 12 GHz operates with a transmit power of 6 W and an antenna gain of 48.2 dB. Calculate EIRP in dBW. b) Design the spacecraft active thermal control techniques.	**10**	**CO5**
SECTION-C			
Q 10	At the end of a rocket launch of a space vehicle from earth, the burnout velocity is 13km/s in a direction due south and 10^0 above the local horizontal. The burnout point is directly over the equator at an altitude of 400 mi above the sea level. Calculate the trajectory of the space vehicle.	**20**	**CO3**
Q 11	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. (Or) A satellite transfer function is $\mathbf{G(s)} = \frac{\boldsymbol{K}\,(\boldsymbol{s}^2+6\boldsymbol{s}+25)}{\boldsymbol{s}(\boldsymbol{s}+1)(\boldsymbol{s}+2)}$ 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**

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SECTION A

S. No.		**Marks**	**CO**
Q 1	Explain the Prograde and Retrograde Orbit	**4**	**CO1**
Q 2	Draw and explain the Argument of perigee	**4**	**CO2**
Q 3	For the Earth-Moon system, what is the Roche Limit if R = 6,378 km, ρM= 5.5 gm/cm3 and ρm= 2.5 gm/cm3?	**4**	**CO3**
Q 4	What is geosynchronous orbit? How it is different from Polar orbit?	**4**	**CO2**
Q 5	Explain the aerodynamic drag in Low earth orbit satellite	**4**	**CO4**

SECTION B

Q 6	A satellite link operating at 14 GHz has receiver feeder losses of 1.5 dB and a freespace loss of 207 dB. The atmospheric absorption loss is 0.5 dB and the antenna pointing loss is 0.5 dB. EIRP = 60 dbW, Gain of the Antenna is 50dB. Depolarization losses may be neglected. Calculate the Received power and total loss for clear sky conditions.	**10**	**CO5**
Q 7	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**
Q 8	Calculate the semi major axis of the orbit for the satellite which is launched into Earth orbit where its vehicle burns out at an altitude of 250km.at burnout the satellite's velocity is 7950 m/s with the zenith angle equal to 89 degrees.	**10**	**CO3**

Q 9	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) Calculate the radius of orbit for an Earth satellite in a geosynchronous orbit, where the Earth's rotational period is 86,164.1 seconds. (Or) a) 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 b) A satellite in earth orbit has s semi major axis of 6750 km and an eccentricity of 0.017. Calculate the satellite's altitude at both perigee and apogee.	**10**	**CO2**
SECTION-C			
Q 10	For given satellite system, construct the Bode plot (Magnitude and Phase) $$G(s) = \frac{10}{s(1+0.4s)(1+0.1s)}$$ To determine the a) Gain and phase crossover frequencies b) Gain and phase Margin c) Comments on the stability of the system	**20**	**CO4**
Q 11	At the end of a rocket launch of a space vehicle from earth, the burnout velocity is 13km/s in a direction due south and 10^0 above the local horizontal. The burnout point is directly over the equator at an altitude of 400 mi above the sea level. Calculate the trajectory of the space vehicle. (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**