Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April/May 2018

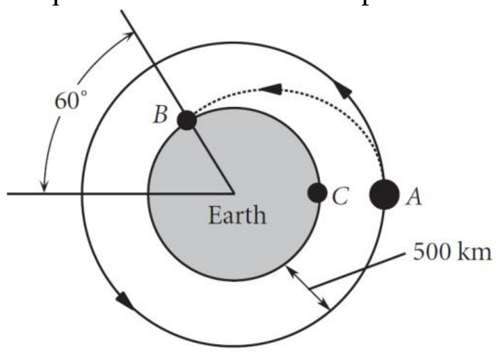
Course:	**Spacecraft Dynamics and Attitude Control**	**Semester:**	**VIII**
Program:	**B.Tech ASE**	**Maximum Marks:**	**100**
Time:	**03 hrs**		
Instruction:	**Assume Missing Data.**		

SECTION A

S. No.		Marks	CO
Q1	Define Following: 1. Precession 2. MEO 3. Epoch 4. Roche limit	**4**	**CO1**
Q2	Draw a well labelled diagram, illustrating six orbital parameters.	**4**	**CO1**
Q3	State and explain Kepler's three laws of planetary motion.	**4**	**CO3**
Q4	Differentiate between following: 1. Sidereal day and sinodic period 2. Eccentricity vector and apse line	**4**	**CO1**
Q5	Calculate orbital velocity and escape velocity of a circular LEO at 160 km.	**4**	**CO2**

SECTION B

S. No.		Marks	CO
Q6	Derive the expression for sphere of influence for a planet	**10**	**CO3**
Q7	Illustrate and explain following orbital maneuvers: 1. Hohmann transfer 2. Phasing maneuver 3. Apse line rotation 4. Plane change maneuver 5. One tangent burn OR Show that, for a given Δv, the change in specific energy is larger the faster the spacecraft is moving.	**10**	**CO4**
Q8	Derive the 'five term acceleration formula' for absolute acceleration of a particle in arbitrary motion. Identify the 'coriolis acceleration' in the final expression.	**10**	**CO2**

Q9	A spacecraft is in a 500 km altitude circular earth orbit. Neglecting the atmosphere, find the delta-v required at *A* in order to impact the earth at (a) point *B* (b) point *C*.  	**10**	**CO5**
	SECTION-C		
Q10	An earth satellite is in an orbit with perigee altitude z_p =400 km and an eccentricity e =0.6. Find (a) the perigee velocity, v_p (b) the apogee radius, r_a (c) the semimajor axis, a (d) the true-anomaly-averaged radius r_θ (e) the apogee velocity (f) the period of the orbit (g) the true anomaly when $r = r_\theta$ (h) the satellite speed when $r = r_\theta$ (i) the flight path angle γ when $r = r_\theta$ (j) the maximum flight path angle $\gamma_{\max}$ and the true anomaly at which it occurs.	**20**	**CO4**
Q11	At point *A* on its earth orbit, the radius, speed and flight path angle of a satellite are r_A =12,756 km, v_A =6.5992 km/s and γ_A =20◦. At point *B*, at which the true anomaly is 150◦, an impulsive maneuver causes $\Delta v_\perp$= +0.75820 km/s and Δv_r =0. a) What is the time of flight from *A* to *B*? b) What is the rotation of the apse line as a result of this maneuver? OR a) With a single delta-v maneuver, the earth orbit of a satellite is to be changed from a circle of radius 15,000 km to a coplanar ellipse with perigee altitude of 500 km and apogee radius of 22,000 km. Calculate the magnitude of the required delta-v and the change in the flight path angle $\Delta\gamma$. b) What is the minimum total delta-v if the orbit change is accomplished instead by a Hohmann transfer?	**20**	**CO5**