Name: **Enrolment No:**	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2022

Course: Space Dynamics & Orbital Mechanics **Semester: VII**
Program: B.Tech ASE/ ASE+AVE **Time : 03 hrs.**
Course Code: ASEG4012 **Max. Marks: 100**

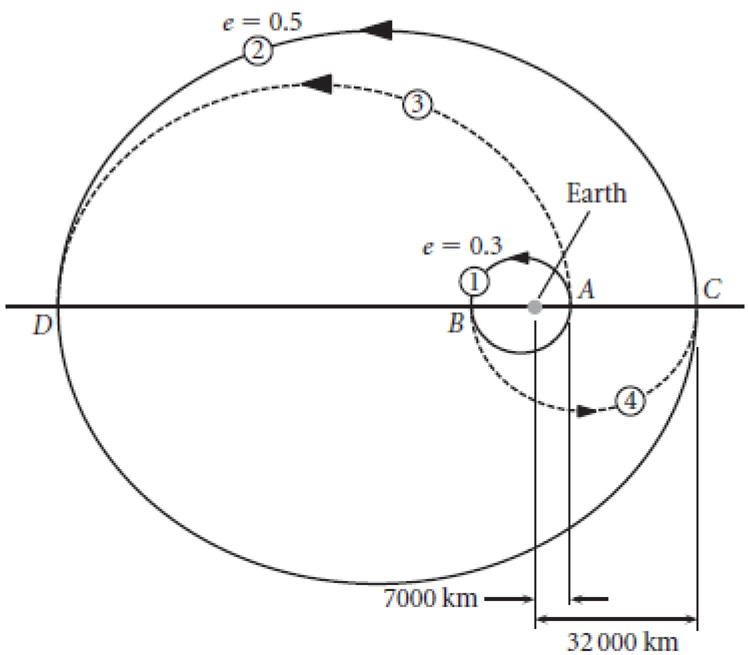
Instructions: a) All questions are compulsory.
b) Assume any suitable value for the missing data
c) For man-made earth satellites use μ = 398 600 km^2/s^2. R_E = 6378 km

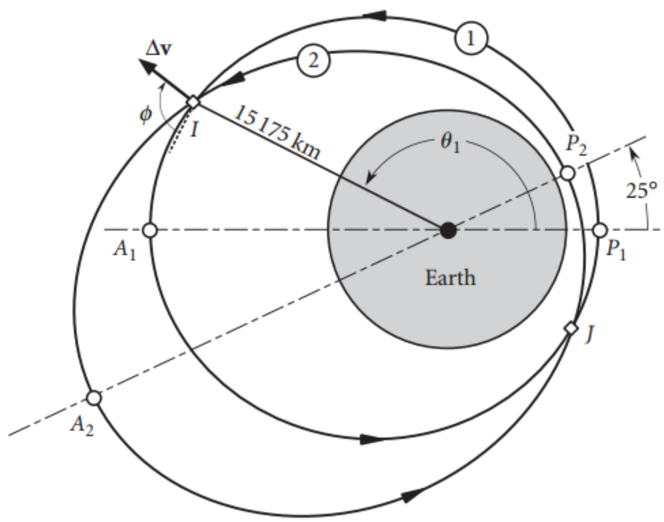
SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	What kind of orbits are preferred for GPS satellites? How it is different from polar orbit?	**4**	**CO1**
Q 2	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 3	Explain the Perturbations due to Non-Spherical Earth. Justify your answer.	**4**	**CO2**
Q 4	What are the objectives of Chandrayaan-2 mission by ISRO? Explain the key learnings from the mission.	**4**	**CO3**
Q 5	Draw and explains the satellite attitude control system.	**4**	**CO4**

SECTION B
(4Qx10M= 40 Marks)

Q 6	A hyperbolic earth departure trajectory has a perigee altitude of 300 km and a perigee speed of 15 km/s. (a) Calculate the hyperbolic excess speed (km/s) (b) Find the radius (km) when the true anomaly is 100° (c) Find v_r and $v_\perp$ (km/s) when the true anomaly is 100°.	**10**	**CO2**
Q 7	A rocket launched from the surface of the earth has a speed of 8.85 km/s when powered flight ends at an altitude of 550 km. The flight path angle at this time is 6°. Determine (a) the eccentricity of the trajectory; (b) the period of the orbit.	**10**	**CO2**
Q 8	For the earth-moon system, find the distance of the $L1$, $L2$ and $L3$ Lagrange points from the center of mass of the sun–earth system **OR**	**10**	**CO3**

	A satellite is in a circular earth orbit of altitude 400 km. Determine the new perigee and apogee altitudes if the satellite on-board engine (a) increases the speed of the satellite in the flight direction by 240 m/s. (b) gives the satellite a radial (outward) component of velocity of 240 m/s.		
Q 9	Two geocentric elliptical orbits have common apse lines and their perigees are on the same side of the earth. The first orbit has a perigee radius of r_p =7000 km and e =0.3, whereas for the second orbit r_p =32 000 km and e =0.5 (a) Find the minimum total delta-v and the time of flight for a transfer from the perigee of the inner orbit to the apogee of the outer orbit. (b) Do part (a) for a transfer from the apogee of the inner orbit to the perigee of the outer orbit. 	**10**	**CO3**
	SECTION-C **(2Qx20M=40 Marks)**		
Q 10	a). 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**
	b). 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.	**10**	**CO2**

Q 11	Mars Orbiter Mission (MOM) is the cynosure of many of the technological breakthroughs achieved by Indian Space Research Organization (ISRO) in the Space domain. Explain the objectives of the mission, launch vehicle, scientific payloads, achievements, awards, and tracking locations. **OR** An earth satellite is in an 8000 km by 16 000 km radius orbit (orbit 1 of Figure). Calculate the delta-v and the true anomaly θ_1 required to obtain a 7000 km by 21 000 km radius orbit (orbit 2) whose apse line is rotated 25◦ counterclockwise. Indicate the orientation φ of $\Delta\mathbf{v}$ to the local horizon.  	**20**	**CO4**