Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, December 2023

Course: Space Dynamics & Orbital Mechanics **Semester: VII**
Program: B.Tech ASE/ ASE+AVE **Time : 03 hrs.**
Course Code: ASEG4017 **Max. Marks: 100**

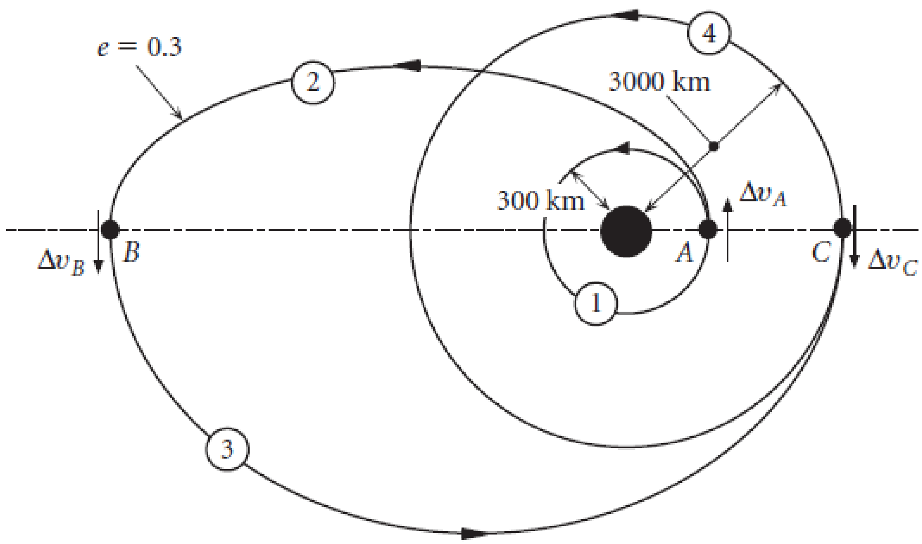
Instructions: a) All questions are compulsory.
b) Assume any suitable value for the missing data

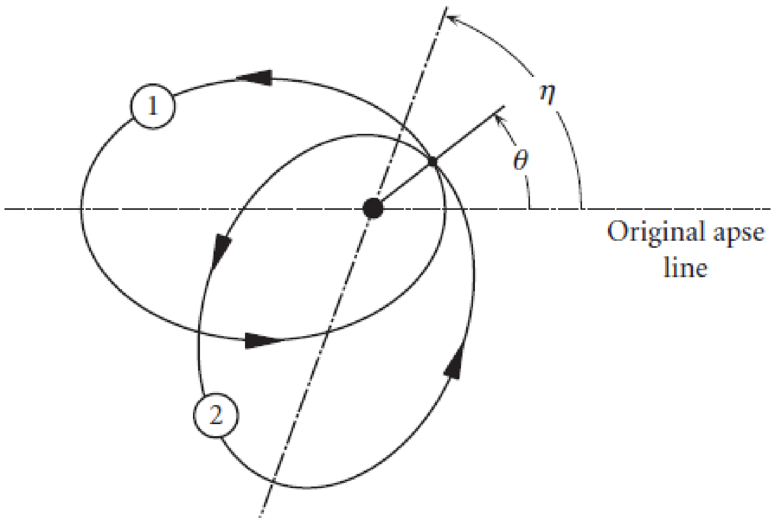
SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	How do Kepler's laws apply to the motion of natural satellites, such as the Moon?	**4**	**CO1**
Q 2	Define Prograde and Retrograde Orbit.	**4**	**CO1**
Q 3	Explain the concept of a Hohmann transfer orbit and its role in interplanetary travel.	**4**	**CO3**
Q 4	What are J2 perturbations in Earth's orbit, and how do they affect satellite orbits over time?	**4**	**CO3**
Q 5	Explain the principles of orbital rendezvous and docking procedures for spacecraft in different types of orbits.	**4**	**CO2**

SECTION B
(4Qx10M= 40 Marks)

Q 6	Determine the true anomaly θ of the point(s) on an elliptical orbit at which the speed equals the speed of a circular orbit with the same radius.	**10**	**CO2**
Q 7	The altitude of a satellite in an elliptical orbit around the earth is 1600 km at apogee and 600 km at perigee. Determine (a) the eccentricity of the orbit; (b) the orbital speeds at perigee and apogee; (c) the period of the orbit.	**10**	**CO2**
Q 8	A spacecraft is in a 300 km circular earth orbit. Calculate (a) the total delta-v required for a Hohmann transfer to a 3000 km coplanar circular earth orbit, and (b) the transfer orbit time. **OR** A spacecraft *S* is in a geocentric hyperbolic trajectory with a perigee radius of 7000 km and a perigee speed of $1.3v_{esc}$. At perigee, the spacecraft releases	**10**	**CO1** **Or** **CO3**

	a projectile *B* with a speed of 7.1 km/s parallel to the spacecraft's velocity. How far *d* from the earth's surface is *S* at the instant *B* impacts the earth? Neglect the atmosphere.		
Q 9	An earth satellite has a perigee altitude of 1270 km and a perigee speed of 9 km/s. It is required to change its orbital eccentricity to 0.4, without rotating the apse line, by a delta-v maneuver at $\theta = 100^\circ$. Calculate the magnitude of the required $\Delta \mathbf{v}$ and the change in flight path angle $\Delta\gamma$.	**10**	**CO4**
SECTION-C **(2Qx20M=40 Marks)**			
Q 10	A). A spacecraft is in a 300 km circular earth orbit. Calculate (i) the total delta-v required for the bi-elliptical transfer to a 3000 km altitude coplanar circular orbit shown, and (ii) the total transfer time. 	**10**	**CO3**
	B). A satellite is in elliptical orbit 1. Calculate the true anomaly θ (relative to the apse line of orbit 1) of an impulsive maneuver which rotates the apse line at an angle η counterclockwise but leaves the eccentricity and the angular momentum unchanged.	**10**	**CO4**

			
Q 11	CHANDRAYAAN 3 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** A spacecraft is in a 300 km circular parking orbit. It is desired to increase the altitude to 600 km and change the inclination by 20°. Find the total delta-v required if. (a) the plane change is made after insertion into the 600 km orbit (so that there are a total of three delta-v burns). (b) the plane change and insertion into the 600 km orbit are accomplished simultaneously (so that the total number of delta-v burns is two). (c) the plane change is made upon departing the lower orbit (so that the total number of delta-v burns is two).	**20**	**CO4**