Name: **Enrolment No:**	

UPES

End Semester Examination, May 2024

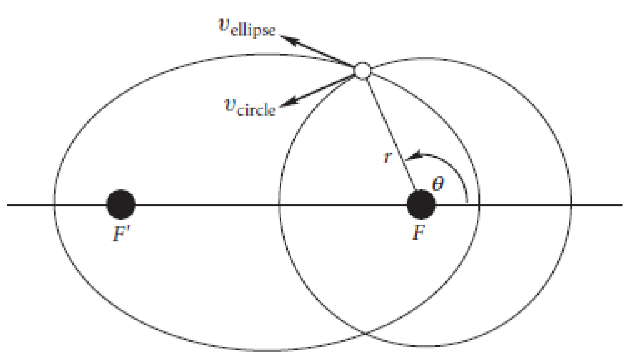
Course: Space Dynamics & Attitude Control **Semester: VI**
Program: B.Tech ASE **Time : 03 hrs.**
Course Code: ASEG4023P **Max. Marks: 100**

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	Explain the significance of inertial frames of reference in analyzing the motion of spacecraft. Provide examples illustrating the application of these frames in astrodynamics.	**4**	**CO1**
Q 2	Which method is more cost-effective for raising a satellite's orbit: with a plane change or without a plane change maneuver, and what are the reasons behind the choice?	**4**	**CO2**
Q 3	Explain the concept of a Hohmann transfer orbit and its role in interplanetary travel.	**4**	**CO2**
Q 4	Explain the concept of phasing maneuvers and their application in space missions.	**4**	**CO2**
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	An unmanned satellite orbits the earth with a perigee radius of 7000 km and an apogee radius of 70 000 km. Calculate (a) the eccentricity of the orbit; (b) the semimajor axis of the orbit (km); (c) the period of the orbit (hours); (d) the specific energy of the orbit (km^2/s^2); (e) the true anomaly at which the altitude is 1000 km (degrees); (f) v_r and $v_\perp$ at the points found in part (e) (km/s); (g) the speed at perigee and apogee (km/s).	**10**	**CO2**
Q 8	Assuming the orbits of earth and Mars are circular and coplanar, calculate. (a) the time required for a Hohmann transfer from earth to Mars, and (b) the initial position of Mars (α) in its orbit relative to earth for interception to occur. Radius of earth orbit=1.496×10^8 km. Radius of Mars orbit=2.279×10^8 km. $\mu_{sun}=1.327\times10^{11}$ km^3/s^2. **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 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.	**10**	**CO2**
Q 9	The space shuttle was launched on a 15-day mission. There were four orbits after injection, all of them at 39◦ inclination. Orbit 1: 302 by 296 km Orbit 2 (day 11): 291 by 259 km Orbit 3 (day 12): 259 km circular Orbit 4 (day 13): 255 by 194 km Calculate the total delta-v, which should be as small as possible, assuming Hohmann transfers.	**10**	**CO3**
SECTION-C **(2Qx20M=40 Marks)**			
Q 10	Explain the critical importance of attitude control systems in spacecraft operations, detailing the essential features necessary for their design. Analyze the solid propellant microthruster, including its components, functions, and applications in spacecraft attitude control.	**20**	**CO3**
Q 11	Analyze the concept of Lagrange Points in celestial mechanics, exploring their significance in gravitational equilibrium within the solar system. Evaluate the scientific objectives and experimental payloads of the Aditya L1 mission, emphasizing its contributions to advancing our understanding of solar phenomena and space weather **OR**	**20**	**CO3**

	Two spacecraft are in the same elliptical earth orbit with perigee radius 8000 km and apogee radius 13000 km. Spacecraft 1 is at perigee and spacecraft 2 is 30° ahead. Calculate the total delta-v required for spacecraft 1 to intercept and rendezvous with spacecraft 2 when spacecraft 2 has travelled 60°.		