Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

V SEMESTER B.TECH. (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2018

SUBJECT: ORBITAL MECHANICS [AAE 4012]

REVISED CREDIT SYSTEM
(28/11/2018)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A.	Analyze vis-viva equation in detail with necessary equations and explanations.	**2**
1B.	Prove that the acceleration of center of mass of a two body system is zero	**3**
1C.	Derive and analyze Kepler's first law from fundamentals.	**5**
2A.	What do you mean by "mean motion" in an orbit? How it is calculated?	**2**
2B.	Explain the process of orbit projection in detail.	**3**
2C.	Calculate the orbital elements eccentricity, specific angular momentum and inclination for a geocentric satellite whose position and velocity state vectors are $\mathbf{r} = 2615\,\mathbf{i} + 15881\,\mathbf{j} + 3980\,\mathbf{k}$ and $\mathbf{v} = -2.7\,\mathbf{i} + 0.8\,\mathbf{j} + 5\,\mathbf{k}$	**5**
3A.	Explain the significance of phasing maneuvers with necessary diagrams.	**2**
3B.	Explain the procedure for accomplishing Hohmann transfer between two co-axial elliptical orbits.	**3**
3C.	A spacecraft is in a 300 km circular earth orbit. The eccentricity of first transfer ellipse is 0.3. Calculate (a) the total delta-v required for the bi-elliptic transfer to a 3000 km altitude coplanar circular orbit and (b) the total transfer time.	**5**
4A.	Examine the term "sphere of influence" in detail.	**2**
4B.	What do you mean by patched conics method? Examine its significance with necessary diagrams.	**3**

4C. A spacecraft is launched on a mission to Mars starting from a 300 km circular parking orbit. Calculate (a) the delta-v required and (b) the amount of propellant required as a percentage of the spacecraft mass before the delta-v burn, assuming a specific impulse of 300 seconds. The gravitational parameters for sun is 1.327 x 10^{11} km^3/s^2. The radius of earth and mars are 149.6 x 10^{11} km and 227.9 x 10^{11} km respectively. **5**

5A. What do you mean by orbital perturbations? Analyze its various categories. **2**

5B. Analyze the effects of earths oblateness on satellite orbits. **3**

5C. Analyze any one debris mitigation technique in detail with all necessary diagrams and explanations. **5**