Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

FIRST SEMESTER M.TECH. (AEROSPACE ENGINEERING.)

END SEMESTER EXAMINATIONS, DEC - 2017

SUBJECT: ORBITAL MECHANICS [ICE 5103]

Duration: 3 Hours Max. Marks:50

Instructions to Candidates:

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

1A	Obtain the expressions for the constants of the two-body motion.	3
1B	The elements of the Magellan mapping orbit about Venus are as follows: a = 10,424.1km, e = 0.39433. The mapping pass is started at a true anomaly of 280 deg. What are the altitude, flight path angle, velocity, and time since periapsis at this point?	4
1C	Explain various time systems used in orbit determination.	3
2A	Given the state vector, $\vec{r} = -6045\hat{I} - 3490\hat{J} + 2500\hat{K}\ (km)$, $\vec{v} = -3.457\hat{I} + 6.618\hat{J} + 2.533\hat{K}(\frac{km}{s})$. Find the orbital elements.	4
2B	Briefly explain how orbit determination is performed using optical sightings.	4
2C	State the Gauss problem and the steps involved in solving it.	2
3A	Illustrate the sensitivity analysis of Hohmann transfers with equations.	3
3B	Design a Hohmann transfer from a circular Mars orbit of radius 8000 km to a circular Mars orbit of radius 15,000 km.	3
3C	The Magellan approach hyperbola at Venus had the following elements: a = 17,110 km, e= 1.3690. The spacecraft was placed in a nearly polar, elliptical mapping orbit with the following elements: a = 10,424.1 km, e = 0.39433. If the two orbits were tangent at periapsis, what velocity change is required to establish the mapping orbit? Is it a velocity increase or decrease?	4
4A	Derive the expression for radius of sphere of influence.	3
4B	Estimate the total delta-v requirement for a Hohmann transfer from earth to Mercury, assuming a 150 km circular parking orbit at earth and a 150 km circular capture orbit at Mercury.	4
4C	What is the specific energy, specific momentum and type of the Earth orbit with Radius = 11,000km, Velocity = 10.280 km/s, Flight path angle = -40.1944 deg at a point ?	3
5A	Briefly explain the different types of synchronous orbit configurations.	3

5B Briefly explain the different types of perturbations with their expressions affecting the motion of a satellite. 4

5C Calculate nodal regression $\dot{\Omega}$ and apsidal rotation rate $\dot{\omega}$ for a satellite in a 400-km circular orbit at i = 60 deg inclination to the equator. What if i = 90 deg or i = 63.4 deg? 3

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