Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

SECOND SEMESTER M.TECH. (AEROSPACE ENGINEERING)

END SEMESTER EXAMINATIONS, JUNE- 2018

SUBJECT: RENDEZVOUS AND DOCKING OF SPACECRAFT [ICE-5236]

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. Explain the factors increasing the complexity of a rendezvous and docking process. **3**

1B. Illustrate how orbit corrections are performed in case of impulsive maneuvers with equations and diagrams. **4**

1C. Illustrate the motion of a chaser with equations for a transfer by continuous x-thrust employing CW equations given below: **3**

$$x(t) = \left(\frac{4\dot{x}_0}{\omega} - 6z_0\right)\sin(\omega t) - \frac{2\dot{z}_0}{\omega}\cos(\omega t) + (6\omega z_0 - 3\dot{x}_0)t + \left(x_0 + \frac{2\dot{z}_0}{\omega}\right) + \cdots + \frac{2}{\omega^2}\gamma_z(\omega t - \sin(\omega t)) + \gamma_x\left(\frac{4}{\omega^2}(1-\cos(\omega t)) - \frac{3}{2}t^2\right)$$

$$y(t) = y_0\cos(\omega t) + \frac{\dot{y}_0}{\omega}\sin(\omega t) + \frac{\gamma_y}{\omega^2}(1-\cos(\omega t))$$

$$z(t) = \left(\frac{2\dot{x}_0}{\omega} - 3z_0\right)\cos(\omega t) + \frac{\dot{z}_0}{\omega}\sin(\omega t) + \left(4z_0 - \frac{2\dot{x}_0}{\omega}\right) + \cdots + \frac{2}{\omega^2}\gamma_x(\sin(\omega t) - \omega t) + \frac{\gamma_z}{\omega^2}(1-\cos(\omega t))$$

2A. Describe the deviations observed in the trajectory due to thrust errors with equations. **4**

2B. Briefly explain the types of failures that occur in passively safe trajectories during a tangential thrust transfer along V-bar. **3**

2C. Discuss the launch and phasing constraints during a rendezvous and docking mission. **3**

3A. Explain the approach rules defined by the target. **3**

3B. Illustrate the function of a closed-loop controlled spacecraft with a block diagram. **4**

3C. With a flowchart, explain how failure detection is performed for the guidance function in a GNC system. **3**

4A. Illustrate the functional principle of relative GPS with a block diagram. **3**

4B.	Illustrate the working principle of a camera rendezvous sensor with a block diagram.	**4**
4C.	Briefly explain the steps involved in a berthing process after successful rendezvous of the chaser with the target.	**3**
5A.	Classify different types of docking/berthing mechanisms.	**4**
5B.	With a block diagram, explain the general space and ground system setup in a rendezvous mission.	**3**
5C.	Explain the verification stages in the development life-cycle of a rendezvous and docking mission.	**3**

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