MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institution of Manipal University

SECOND SEMESTER M.TECH (AEROSPACE ENGINEERING) END SEMESTER EXAMINATIONS, APRIL/MAY 2017

Reg. No.

SUBJECT: RENDEZVOUS AND DOCKING OF SPACECRAFT [ICE 5236]

Time: 3 Hours

MAX. MARKS: 50

5

3

2

Instructions to Candidates:

- ✤ Answer ALL the questions.
- ✤ Missing data may be suitably assumed.
- **1A.** With diagrams, explain the main phases of rendezvous mission.
- **1B.** Sketch the trajectory for following maneuvers:
 - i. Radial impulse transfer along V- bar
 - ii. Tangential impulse fly around maneuver
- **1C.** List any four differences between docking and berthing process.
- 2A. For the trajectory shown in FIG Q2A, obtain the equation of motion governing the 5 trajectory and calculate the total ΔV expenditure. CW equation without input forces are as follows:

$$\begin{aligned} x(t) &= \left(\frac{4\dot{x}_0}{\omega} - 6z_0\right)\sin(\omega\tau) - \frac{2\dot{z}_0}{\omega}\cos(\omega\tau) + (6\omega z_0 - 3\dot{x}_0)\tau + (x_0 + \frac{2\dot{z}_0}{\omega})y(t) \\ y(t) &= y_0\cos(\omega\tau) + \frac{\dot{y}_0}{\omega}\sin(\omega\tau) \\ z(t) &= \left(\frac{2\dot{x}_0}{\omega} - 3z_0\right)\cos(\omega\tau) + \frac{\dot{z}_0}{\omega}\sin(\omega\tau) + \left(4z_0 - \frac{2\dot{x}_0}{\omega}\right) \end{aligned}$$

- **2B.** Explain passive trajectory safety for Hohmann transfer and tangential boost **3** transfer.
- **2C.** Write about any two drivers and constraints for the definition of the diameter of the **2** approach and departure corridors.
- **3A.** Explain remote interaction with the automatic system in RVD/B. **4**
- **3B.** Briefly explain the approach strategy for -V bar docking port approach. Sketch **3** the trajectory.
- **3C.** Briefly explain the operation of scanning laser range finder **3**
- **4A.** With block diagram, discuss about the hierarchy of control system for RVD. What **5** are the tasks and functions of automatic onboard system during RVD/B mission?

- **4B.** Briefly explain the requirement of a mission and vehicle management system for **3** RVD/B mission.
- **4C.** What are the external events that must be synchronized with the final rendezvous **2** events for proper monitoring of the final approach and capture operation?
- 5A. Describe various steps in the docking process for a manned RVD mission 5
- **5B.** What are the major tasks of chaser control center and target control center during **5** the rendezvous mission?



