MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL

A Constituent Institution of Manipal University

SECOND SEMESTER M.TECH. (AEROSPACE ENGINEERING)
END SEMESTER EXAMINATIONS, JUNE 2017

SUBJECT: SPACECRAFT ENGINEERING [ICE 5241]

Time: 3 Hours   MAX. MARKS: 50

Instructions to Candidates:

❖ Answer **ALL** questions.

❖ Missing data may be suitably assumed.

1A.	Briefly explain the process of charged particle interactions in the radiation environment.	**4**
1B.	A rocket has the following data: propellant flow rate ($\dot{m}_p$) = 5 kg/s, nozzle exit diameter=10 cm, ambient pressure=1.03 bar, nozzle exit pressure=1.02 bar, thrust=7 kN. Determine the effective exhaust velocity, exit velocity, specific impulse, and specific propellant consumption. Recalculate the value of thrust and specific impulse for an altitude where the ambient pressure is 10 mbar.	**3**
1C.	Explain the importance of rocket staging and classify them.	**3**
2A.	Find the minimum time required for a spacecraft to perform a 90-deg tum about the axis with two thrusters if the spacecraft has the following characteristics: moment of inertia about the z-axis = 500 kg-m^2; moment arm = 1.8 m: thrust of each engine = 3.5 N.	**2**
2B.	Describe the types of chemical propulsion techniques used in spacecrafts.	**5**
2C.	Briefly explain the different types of disturbance torques affecting the attitude of a spacecraft.	**3**
3A.	Illustrate the operation of different types of actuators used in an ADCS.	**4**
3B.	Explain the different types of solar array configurations.	**3**
3C.	Discuss the properties that the material of a spacecraft structure should possess.	**3**
4A.	Design a NiCd battery system to provide an average eclipse load of 567 W at 28 V for a duration of 38 min and a battery-to-Ioad power loss of 3%. The required cycle life is 10,000 cycles at 25^{0}C. Use 20 A-h cells and provide battery-out capability.	**2**
4B.	Briefly explain the different types of active thermal control techniques.	**4**
4C.	Explain the heat transfer mechanisms in a spacecraft.	**4**
5A.	Derive the link-budget equation for a telecommunication system in a spacecraft.	**3**
5B.	Illustrate the operation of a telecommand subsystem with a block diagram.	**4**
5C.	Briefly explain some of the one-shot devices used in a spacecraft.	**3**

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