Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

SECOND SEMESTER M.TECH. (AEROSPACE ENGINEERING)

END SEMESTER EXAMINATIONS, APRIL - 2018

SUBJECT: SPACECRAFT ENGINEERING [ICE 5241]

Duration: 3 Hour Max. Marks:50

Instructions to Candidates:

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

1A Explain the different phases in the life cycle of spacecraft project. List the various project objectives and requirements of a spacecraft mission. 5

1B Write about the various environments (cause, effect and protection methods) experienced by the spacecraft during launch phase. 3

1C Derive the Tsiolkovsky equation which describes the motion of vehicles that follow the basic principle of a rocketry. 2

2A Consider a rocket engine in which the combustion chamber pressure and temperature are 30 atm and 3756 K, respectively. The area of the rocket nozzle exit is $15m^2$ and is designed so that the exit pressure exactly equals ambient pressure at a standard altitude of 25km. For the gas mixture, assume $\gamma = 1.18$ and the molecular weight is 20. At a standard altitude of 25km, calculate (a) specific impulse, (b) exit velocity, (c) mass flow, (d) thrust, and (e) throat area. 5

2B Explain the operation of a pressure-fed liquid propellant rocket engine. For which type of applications these engines are used. 3

2C A rocket using hydrogen – oxygen as fuel – oxidizer combination. Calculate the ratio of propellant mass to initial mass required to achieve a burnout velocity equal to escape velocity from the earth. 2

3A Explain any four torquers that can be used in attitude control of spacecraft. 4

3B What are the suitable stabilization technique(s) that can be used for following mission requirements (consider each mission requirement as different cases): 3

(i) Nadir Pointing (ii) Geosynchronous application (iii) Pointing accuracy of 0.1deg

3C Write about the importance of impact protection in spacecraft and briefly explain how this is incorporated in spacecraft structures. 3

4A	With diagram, explain the working of a radio isotope generator (RTG). What are the advantages and disadvantages of using RTG in spacecraft as a power source?	4
4B	What solar-array area is required to provide 1500 W, for the following conditions: Po = 276 mW/cell at 115^{o}C; packing factor = 732 cells/m^{2}; utilization factor = 0.97; assembly factor = 0.96; diode loss = 3%. Assume all other factors are unity.	3
4C	Briefly explain any two passive techniques for thermal control of spacecraft.	3
5A	Explain the operation of Marmon clampband and tape spring joint. What is the drawback of connecting booms using tape spring joint and how to overcome the same?	4
5B	Write about antenna radiation pattern and antenna gain.	3
5C	What are the various housekeeping data that are transferred in telemetry?	3

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