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# MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

*(A constituent unit of MAHE, Manipal)*

**SECOND SEMESTER M.TECH. (AEROSPACE ENGG.)**

**END SEMESTER DEGREE EXAMINATION, APRIL/MAY - 2019**

**SUBJECT: SPACECRAFT ENGINEERING [ICE 5241]**

TIME: 3 HOURS MAX. MARKS: 50

**Instructions to candidates :*Answer ALL questions and missing data may be suitably assumed.***

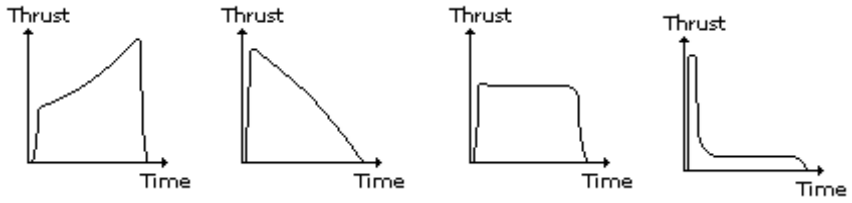
1A Explain in detail the environmental effects on materials used and humans in a spacecraft mission.

1B List the phases in a spacecraft mission development. What are the objectives and steps involved in each phase?

1C Comment on the statement, "*The selection of ascent trajectory is governed by the desire to minimize thrust losses, drag losses, gravity losses and steering losses subject to the operational constraints*".

(4+3+3)

2A Sketch the solid propellant grain configurations for obtaining the following thrust profiles – Fig (Q2A):




(a) (b) (c) (d)

FIG (Q2A)

2B With diagram, explain rocket staging in detail and derive the expression for final change in velocity attained for a two stage rocket. What are the advantages of rocket staging.

2C A rocket engine uses hydrogen – oxygen as fuel – oxidizer combination. The combustion chamber pressure and temperature are 25 atm and 3517 K, respectively. The area of the rocket nozzle exit is $0.1m^2$ and the area of exit is designed so that the exit pressure exactly equals ambient pressure at a standard altitude of 30km. For the gas mixture, assume $\gamma = 1.22$ and the molecular weight is 16. At a standard altitude of 30km, calculate (a) specific impulse, (b) thrust, (c) area of the exit, and (d) flow Mach number at exit.

(2+3+5)

3A Write about one axis attitude maneuver for a spacecraft and derive the expression for propellant mass required for this type of maneuver.

3B What are the different sources of heat that affect the thermal equilibrium of a spacecraft? Also, obtain

the expression for equilibrium temperature and write a note on effect of absorption and emission factor on thermal equilibrium.

3C With proper diagram, explain in detail the attitude control system design cycle for a spacecraft.

(3+3+4)

4A List the design requirements for various mechanisms used in spacecraft.

4B What are the various parameters that are tested during the analysis of spacecraft structure?

4C Explain the operation of following components in a power management, distribution and control unit:

(i) Array regulator

(ii) Battery management

(iii)Power control and distribution

(2+3+5)

5A Write about various types of basic telecommands used in a spacecraft mission. List the various housekeeping data that are transferred in telemetry.

5B Explain the operation of a transponder system used in communication payload.

5C With diagram, explain the system context of a TM/TC data handling system. What are the major functions of an on-board data handling mechanism (OBDH) system?

(3+3+4)

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