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18AS61

Sixth Semester B.E. Degree Examination, July/August 2022 Missiles and Launch Vehicles

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Describe the layout of a Military missile and explain the different components of it. (08 Marks)
- b. Rocket projectile has following characteristics:
 - i) Initial mass 200kg.
 - ii) Mass after rocket operation 130kg.
 - iii) Payload, non-propulsive structure 110kg.
 - iv) Rocket operation duration 3.0sec.
 - v) Average specific impulse of propellant 240sec.
 Determine:
 - i) Vehicle Mass ratio
 - ii) Propellant mass fraction
 - iii) Propellant flow rate
 - iv) Thrust to weight ratio
 - v) Acceleration of vehicle
 - vi) Effective exhaust velocity. (12 Marks)

OR

- 2 a. Define the following:
 - i) Specific impulse
 - ii) Total impulse
 - iii) Specific propellant consumption
 - iv) Mass Ratio. (08 Marks)
- b. With a neat sketch, explain mission profile of a launch vehicle. (12 Marks)

Module-2

- 3 a. Define propellant grain and explain the desirable properties of propellant grain. (08 Marks)
- b. With necessary sketch, explain the types of nozzles used in a solid rocket motor. (12 Marks)

OR

- 4 a. Describe regarding the pressure feed system and turbo pump feed system of liquid rocket propulsion. (12 Marks)
- b. With necessary sketch describe the different types of injection system used in liquid rocket propulsion. (08 Marks)

Module-3

- 5 a. Identify the forces and moment acting on a missile while passing through atmosphere and explain it with help of a neat sketch. (10 Marks)
- b. Define rocket dispersion and its types. Explain regarding the factors which influence dispersion. (10 Marks)

OR

- 6 a. Derive the equations for longitudinal and lateral moments acting on a missile with necessary sketch. (10 Marks)
 b. With a neat sketch, explain the design consideration of a re-entry vehicle. (10 Marks)

Module-4

- 7 a. Derive the equation for finding range during absence of gravity under a constant thrust case. (08 Marks)
 b. With neat sketch, explain different TVC mechanisms. (12 Marks)

OR

- 8 a. A 4 stage rocket is used to put up a satellite of 40kg mass in a Low Earth Orbit (LEO). The approximate values of mass of propellant, mass of structure and jet velocity for each stage is are given below.

Stage	I	II	III	IV
Mass of propellant (kg)	9000	3500	1700	260
Structural mass (kg)	1500	550	250	40
Jet velocity (M/S)	2200	2400	2500	2750

Determine:

- i) The payload mass fraction of total rocket.
 ii) The structural mass fraction of each stage.
 iii) The ideal ΔV provided by each stage and total ΔV .
 iv) If first stage fires for period of 50 seconds and mass flow rate is constant, what will be acceleration of rocket at take off? (12 Marks)
- b. Explain briefly:
 i) Stage separation within atmosphere.
 ii) Stage separation out of atmosphere. (08 Marks)

Module-5

- 9 a. Describe regarding criteria for selection of materials for a rocket and missile. (10 Marks)
 b. How does ablative material handle the high temperature generated in rockets and missiles? Explain the application of ablative materials in parts of rockets and missiles. (10 Marks)

OR

- 10 a. Explain vertical static test stand for a large liquid propellant thruster with necessary sketch. (12 Marks)
 b. Describe regarding post accidental procedure and steps to respond in emergency during rocket testing. (08 Marks)

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