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10AE666

**Sixth Semester B.E. Degree Examination, June/July 2017**  
**Rockets and Missiles**

Time: 3 hrs.

Max. Marks:100

**Note: Answer any FIVE full questions, selecting atleast TWO questions from each part.**

**PART – A**

- 1
  - a. Show in a tree diagram about different classes of Chemical rocket propulsion. (08 Marks)
  - b. A spacecraft engine ejects mass at the rate of 30kg/s with an exhaust velocity of 3000m/s. The pressure at the nozzle exit is 0.8 KPa, and the exit area is 1.0 sqm. Calculate the thrust of the engine in vacuum. (08 Marks)
  - c. Define i) Specific Impulse ii) Effective Exhaust velocity. (04 Marks)
- 2
  - a. Determine the mass of the propellant required to send 4000 kg space craft from LEO to Mars in 0.7 years, mission requiring a velocity of 5.7km/s. Assume 4000 kg includes the propellant on board at the start of the burn. Also assume specific impulse of 300s. (08 Marks)
  - b. Sketch the pressure distribution in a convergent – divergent nozzle for different flow conditions, when the inlet pressure is the same, but the exit pressure changes. (06 Marks)
  - c. Write the equations of motion for a rocket flight in atmosphere. Draw a neat sketch and show the forces acting on the vehicle. (06 Marks)
- 3
  - a. Explain with the help of a neat diagram, Solid propellant rocket motor. Explain Progressive, Regressive and Neutral burning with sketches. (08 Marks)
  - b. Explain with the help of a diagram, pressure fed bi – propellant rocket engine. (08 Marks)
  - c. Name two commonly used : i) Mono – propellant ii) Bi – propellant liquid propellants. (04 Marks)
- 4
  - a. Draw and show in a simplified diagram the idealized process for selecting propulsion systems. (12 Marks)
  - b. List two advantages and disadvantages of : i) Liquid propellant rockets ii) solid propellant rockets. (08 Marks)

**PART – B**

- 5
  - a. Discuss Slender body theory at supersonic speeds, Stating the assumptions clearly. (10 Marks)
  - b. Sketch the flow field and pressure distribution over a single stage rocket at supersonic speed. (10 Marks)
- 6
  - a. Describe various types of aerodynamic control in a missile. (10 Marks)
  - b. Write the differential equations describing the missile dynamics in pitch plane. (10 Marks)
- 7
  - a. With the help of neat sketches, explain Thrust Vector Control by :  
 i) Gimbal or hinge ii) Flex Nozzle iii) Jet Vanes and iv) Secondary injection.  
 Explain merits and demerits of each system. (16 Marks)
  - b. Explain how TVC system is integrated with guidance and control system of a rocket. (04 Marks)
- 8
  - a. Explain five important types of tests performed before qualifying a rocket propulsion system for operations. (05 Marks)
  - b. Explain with the help of a sketch, vertical static test stand for a large liquid propellant thruster. (09 Marks)
  - c. List three importance physical quantities measured in rocket testing. (06 Marks)

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