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**Question Paper Code : 90074**

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Fifth Semester

Aeronautical Engineering

AE8504 – PROPULSION – II

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is the need of isolator in scramjet engine?
2. What is the need of supersonic combustion?
3. Define specific impulse.
4. What is nozzle-less propulsion?
5. Name some examples of solid propellant binders.
6. What do you mean by temperature sensitivity of solid propellant?
7. Name some propellants for reverse hybrid rocket
8. Define thrust coefficient.
9. What are subsystems found in electrical propulsion thruster?
10. What are the advantages of nuclear propulsion?

PART B — (5 × 13 = 65 marks)

11. (a) With a neat sketch explain the concept of fuel air mixing in parallel stream of scramjet combustor.

Or

- (b) Draw T-S diagram of scramjet engine. Derive expression for thermal efficiency of scramjet engine.

12. (a) How is chemical energy of the propellants utilized for propulsive power of a rocket vehicle? Classify chemical rockets and compare their performance along with application areas.

Or

(b) Explain in detail major components of a horizontal static test stand used in rocket test facilities.

13. (a) Explain why burning rate index of solid propellant should be less than unity? What are the important factors that govern the selection of solid propellant?

Or

(b) Explain salient features of a solid rocket motor with help of suitable diagram. Further explain relationship between (i) burning rate and temperature (ii) burning rate and chamber pressure.

14. (a) With a neat sketch explain the operation of liquid propellant rocket with a turbo pump feed system Draw a thrust time diagram obtained from static firing of a rocket unit marking all important events. Explain how total and specific impulse are obtained from the diagram.

Or

(b) Explain in detail various types of regression rate improvement methods for hybrid rocket fuels. Explain peculiar problems associated with cryogenic engines.

15. (a) Explain with neat sketch the working principle of nuclear propulsion and discuss its advantages and disadvantages. Also explain the design criteria for electrostatic thrusters regardless of the charged particle source.

Or

(b) Determine the flight characteristics of an electrical propulsion rocket for raising a low satellite orbit. Determine the propellant flow rate, total mass of the propellant, required electric power, mass before and after engine operation, incremental velocity and average acceleration of the vehicle. Data given specific impulse = 2000 sec thrust = 0.2 N, duration =  $2.42 \times 10^6$  sec pay load mass = 100kg, specific power = 100 W/kg, thruster efficiency = 0.5.

PART C — (1 × 15 = 15 marks)

16. (a) A ramjet engine propels an aircraft at a Mach 3.0 and at an altitude of 6160 m. The diameter of the inlet diffuser at entry is 40 cm and the calorific value of fuel is 43MJ/kg. The stagnation temperature at the nozzle entry is 1450 K. The properties of the combustion gases are same as those of air ( $\gamma=1.4, R=287 \text{ J/kg K}$ ). Determine: (i) Efficiency of ideal cycle, (ii) Flight speed (iii) Airflow rate, (iv) fuel—air ratio, (v) nozzle pressure ratio (vi) nozzle jet Mach no. (vii) Propulsive efficiency (viii) Thrust

Assume: Diffuser efficiency = 0.92; combustion efficiency = 0.97; Nozzle jet efficiency = 0.95; Stagnation pressure loss in the combustion chamber = 0.02  $P_{02}$

Or

- (b) A rocket nozzle has a throat area of 20 cm<sup>2</sup> and a combustion chamber pressure of 25 bar. If the specific impulse of the nozzle is 127 seconds and the weight flow rate is 45 N/s determine (i) thrust coefficient (ii) propellant weight flow coefficient (iii) specific propellant consumption and (iv) characteristics velocity.

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