



- Notes :
1. All questions carry marks as indicated.
 2. Solve Question 1 OR Questions No. 2.
 3. Solve Question 3 OR Questions No. 4.
 4. Solve Question 5 OR Questions No. 6.
 5. Solve Question 7 OR Questions No. 8.
 6. Solve Question 9 OR Questions No. 10.
 7. Solve Question 11 OR Questions No. 12.
 8. Due credit will be given to neatness and adequate dimensions.
 9. Assume suitable data whenever necessary.
 10. Diagrams and chemical equations should be given whenever necessary.
 11. Illustrate your answers whenever necessary with the help of neat sketches.
 12. Use of non programmable calculator is permitted.

1. A ramjet engine operates at $M=1.5$ at an altitude of 6500 m. The diameter of the inlet diffuser at entry is 50 cm and the stagnation temperature at the nozzle entry is 1600K. The calorific value of the fuel used is 40 MJ/Kg. The properties of the combustion gases are same as those of air ($\gamma=1.4$, $R=287$ J/Kg.k). The velocity of air at the diffuser exit is negligible. Calculate. **14**
- a) The efficiency of the ideal cycle.
 - b) Flight speed.
 - c) Air flow rate.
 - d) Diffuser pressure ratio.
 - e) Fuel-air ratio.
 - f) Nozzle pressure ratio.
 - g) Nozzle jet Mach number.
 - h) Propulsive efficiency.
 - i) And thrust.

Assume the following value $\eta_D = 0.90$, $\eta_B = 0.98$, $\eta_J = 0.96$, Stagnation pressure loss in the combustion chamber = $0.02 P_{02}$, $Z = 6500$ m the properties of air are

$$T_1 = 245.90K, P_1 = 0.440, q_1 = 314.50m/sec \rho_1 = 0.624kg/m^3$$

OR

2. a) Write a short notes on following operation in ramjet engine: **7**
- i) Subcritical.
 - ii) Critical.
 - iii) Supercritical.
- b) How the combustion will take place in ramjet engine, explain? **7**

3. a) Derive the ideal efficiency for Scramjet engine? 7
 b) Write a short notes on hypersonic propulsion? 6
- OR**
4. a) What is main difference between ramjet and scramjet engine? 6
 b) What are the advantages and disadvantages of scramjet engine? 7
5. a) What is the basic operating principle of rocket engines, explain? 6
 b) How many types of nozzle is their, explain with neat sketches? 7
- OR**
6. a) Define the following term. 6
 i) Specific impulse of a rocket.
 ii) Internal ballistics.
 b) What are the rocket performance considerations? 7
7. a) What do you mean by solid propellant, explain the chemical composition of it with suitable example? 7
 b) How we will select a solid Propellants, explain the selection criteria of it? 7
- OR**
8. a) What are the important hardware components of solid rocket engine? 7
 b) Explain the propellant grain design considerations for a rocket engine? 7
9. a) What are the selection criteria for liquid propellants? 6
 b) How to control thrust in liquid rocket engine? 7
- OR**
10. a) What are the limitations of hybrid rockets engine? 6
 b) What are the advantages of liquid rocket over solid rockets engine? 7
11. a) What do you mean by electric rocket propulsion? Explain. 7
 b) What are preliminary concepts in nozzle less propulsion? Explain. 6
- OR**
12. a) How Ion propulsion techniques work? 7
 b) What is working principle of nuclear rocket? 6
