

Reg. No. :

**Question Paper Code : 20077**

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2022.

Fifth Semester

Aeronautical Engineering

AE 8504 — PROPULSION — II

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Draw a neat and labeled diagram of ramjet engine.
2. What is ram effect and state how it is achieved in supersonic vehicles?
3. Define specific propellant consumption.
4. What are the various ignition methods employed in liquid propellant rocket engines?
5. What do you understand from term erosive burning?
6. What do you mean by motor case?
7. Name four fuels and oxidizers used in liquid rocket engines.
8. What are the technological challenges in operating hybrid rocket engines?
9. Why advanced propulsion systems are being tried beyond chemical propulsion systems?
10. What are the challenges in electric rocket propulsion systems?

PART B — (5 × 13 = 65 marks)

11. (a) (i) "The ramjet engines are more suitable for supersonic flights" —  
Substantiate the statement. Explain why ramjet engines are not  
ideal for hypersonic flights. (7)
- (ii) Discuss about the challenges of designing fuel injection systems for  
scramjet combustors and means to overcome the same. (6)

Or

- (b) Discuss the need for supersonic combustion and problems associated  
supersonic combustion in detail. Also explain construction features of any  
one type of supersonic combustor. (13)
12. (a) Discuss various performance parameters of rocket engine and types of  
nozzles employed in rocket engines. (13)

Or

- (b) Explain the following :
- (i) Nozzle-less propulsion (13)
- (ii) Pulse rocket motor. (13)
13. (a) Explain how T-burner and strand burner are used in determining  
ballistic properties of the solid propellants. (13)

Or

- (b) Discuss about causes of combustion instability and techniques to handle  
them in solid rocket motor. (13)
14. (a) Explain various fuel feed systems used in LRE in detail.

Or

- (b) (i) Explain the challenges of operation of cryogenic engines. (7)
- (ii) Explain combustion mechanism of hybrid rocket propulsion system.  
(6)
15. (a) Write notes on solar sail and nuclear rocket with necessary sketches. (13)

Or

- (b) Discuss about challenges of implementing advanced propulsion systems  
and current scenario of their use worldwide. (13)

PART C — (1 × 15 = 15 marks)

16. (a) A ramjet engine is to fly at a Mach number of 4 in an atmosphere where temperature is 223 K. At entrance to the burner, the Mach number of the flow is 0.3. Combustion in the burner (whose cross-sectional area is constant) may be represented approximately as heating of a perfect gas with constant specific heat ratio. At the exit from the burner, the temperature of the gas is 2462 K. Neglecting frictional effects in the burner and considering the flow to be one-dimensional throughout, estimate the Mach number of the gas leaving the burner. Determine also the stagnation pressure loss due to heating. (15)

Or

- (b) Using a propellant of molecular weight 15 and flame temperature 3300K, determine the rocket throat and exhaust areas required for a thrust of 500 kN and an ideal specific impulse of 300 s. Take the ambient pressure as 0.1 MPa and the specific heat ratio of the propellant as 1.4. How much thrust would this rocket develop if the ambient pressure were changed to 0.03 MPa? How much thrust would be developed by a rocket designed to expand to 0.03 MPa, if it had the same stagnation conditions, throat area and propellant? (15)