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Question Paper Code: 99702

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2024

Elective

Mechanical Engineering

19UME902 - GAS DYNAMICS AND JET PROPULSION

(Regulations 2019)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

- In transonic flow Mach number is CO1- U
(a) $0.8 < M < 1.2$ (b) $0.8 > M < 1.2$ (c) $0.8 < M < 1.5$ (d) $0.9 < M < 1.2$
- For a Incompressible flow CO1- U
(a) $M < 0.3$ (b) $M > 0.3$ (c) $M = 0.3$ (d) $M = 0$
- Flow in a constant area duct with heat transfer is known as CO1- U
(a) Fanno flow (b) Isothermal (c) Rayleigh flow (d) Isentropic flow
- In Rayleigh flow entropy increases due to heat CO1- U
(a) Addition (b) Deletion (c) None of these (d) All the above
- The shock wave right angle to the flow is called CO1- U
(a) Normal (b) Oblique (c) Expansion (d) Compression
- Which of the following is weak shock wave? CO1- U
(a) Normal (b) Expansion (c) Compression (d) both b and c
- Pulse Jet Engine is also called as CO1- U
(a) Turbo Jet (b) Flying Bomb (c) Turbo Fan (d) none of these
- Air Breathing Engines is also called as CO1- U
(a) Rocket Engine (b) Jet Engine (c) Petrol Engine (d) Diesel Engine

9. Liquid fuel consists of CO1- U
 (a) Refine petrol (b) liquid hydrogen (c) Hydrazine (d) None of these
10. Notation for hydrogen peroxide CO1- U
 (a) H₂O (b) O₂H (c) H₂O₂ (d) All the above

PART – B (5 x 2= 10 Marks)

11. List the use of Mach number? CO1- U
12. List the assumptions made in Rayleigh flow CO1- U
13. Define shock wave CO1- U
14. List the main parts of ramjet engine CO1- U
15. Classify the rocket engines based on source of energy employed. CO1- U

PART – C (5 x 16= 80 Marks)

16. (a) Determine (i) Velocity of sound at the stagnation conditions CO3- App (16)
 (ii) Maximum velocity of the jet (iii) Stagnation Enthalpy (iv) Crocco number An air jet ($R=287 \text{ J/kg K}$) at 400K has sonic velocity, $\gamma=1.3$.

Or

- (b) Air expands isentropically through the convergent nozzle from CO3- App (16)
 constant inlet conditions $P_0 = 4 \text{ bar}$, $T_0 = 550\text{K}$, Exit area of nozzle is 1000cm^2 . Determine the exit velocity and the mass flow rate for the following two cases at exit, $M = 1$, $M = 0.85$.

17. (a) The condition of a gas in a combustion chamber at entry are CO4- App (16)
 $T_1 = 375 \text{ K}$, $P_1 = 0.50 \text{ bar}$, $C_1 = 70 \text{ m/s}$. The air fuel ratio is 29 and the calorific value of the fuel is 42 MJ/kg. Calculate 1) Initial & final Mach number 2) Final pressure, temperature & velocity of the gas 3) % of stagnation pressure loss 4) Maximum stagnation temperature. Take $\gamma=1.4$, Gas constant = 0.287 KJ/kg K

Or

- (b) The friction factor for a 50mm diameter steel pipe is 0.005. At CO4-App (16)
 inlet to the pipe the velocity is 70 m/s, temperature is 800C and the pressure is 10 bar. Find the temperature, pressure and Mach number at exit if the pipe is 25m long also determine the maximum possible length.

18. (a) The upstream Mach number, pressure and temperature of normal shock wave are 2.4, 2 bar and 270 K respectively. Calculate the Mach number, pressure, temperature and velocity of the gas for downstream of the shock. Check the calculated values with those given in the gas tables. Take $\gamma=1.3$, $R=460\text{J/KgK}$ CO3- App (16)

Or

- (b) An oblique shock wave occurs at the leading edge of a symmetrical wedge. Air has a Mach number of 2.1 and deflection angle (δ) of 15° . Determine the following for strong and weak waves. 1. Wave angle 2. Pressure ratio 3. Density ratio 4. Temperature ratio 5. Downstream Mach number. CO3- App (16)

19. (a) Explain the working of ramjet engine with neat sketch CO1- U (16)

Or

- (b) Explain the working of pulse jet with neat sketch CO1- U (16)

20. (a) Explain the construction, working principle and operation of liquid propellant rocket engine with neat sketch and also state its advantages. CO1- U (16)

Or

- (b) Explain the construction, working principle and operation of solid propellant rocket engine with neat sketch and also state its advantages. CO1- U (16)

