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**Question Paper Code : X 67624**

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020  
Fifth Semester  
Mechanical Engineering  
ME 1303 – GAS DYNAMICS AND JET PROPULSION  
(Regulations 2008)

Time : Three Hours

Maximum : 100 Marks

Answer ALL questions

PART – A

(10×2=20 Marks)

1. Define Impulsive function.
2. What is the value of  $M^*$  for air if the fluid velocity 416 m/s at  $-60^\circ\text{C}$  ?
3. Draw the T.S. and H.S. diagrams of Nozzle.
4. What are the effect of friction in flow through Nozzle ?
5. Give two practical examples for Fanno flow and Rayleigh flow analysis.
6. Give the assumptions that are used in the analysis of Rayleigh flow process.
7. Give the expression for  $T_y/T_x$  across the normal shock.
8. What is meant by wave angle ?
9. Name four jet engine used for jet propulsion.
10. Why is pulse jet engine not used in commercial aircraft ?



## PART – B

(5×16=80 Marks)

11. a) Explain the effect of Mach number on compressibility and obtain the equation at  $\gamma = 1.4$ . (16)

(OR)

- b) A carbon dioxide jet at 473 K has sonic velocity. Determine velocity of sound in the jet. Stagnation temperature and stagnation enthalpy of the jet. Stagnation velocity of sound. Stagnation to static pressure ratio, maximum velocity of the jet and Croco number. Take  $\gamma = 1.237$ ,  $R = 189\text{J/kgK}$  for carbon dioxide. (16)
12. a) Air enters the nozzle from a large reservoir at 7 bar and  $320^\circ\text{C}$ . The exit pressure of nozzle is 0.94 bar and mass flow rate is 3500 kg/h. Calculate the following for isentropic flow
- i) Throat area (2)
  - ii) Throat pressure (2)
  - iii) Throat velocity (3)
  - iv) Exit area (3)
  - v) Exit Mach number (3)
  - vi) Maximum velocity. (3)

(OR)

- b) Air enters an isentropic diffuser with a mach number of 3.6 and is decelerated to a Mach number of 2. The diffuser passes a flow of 15 kg/s. The initial static pressure and temperature of the air are 1.05 bar and  $40^\circ\text{C}$ . Assuming  $\gamma = 1.4$ . Calculate (i) Inlet area, total pressure and total temperature at inlet (ii) Exit area, total pressure, total temperature and static pressure at exit. (8+8)
13. a) In the frictionless flow of air though at 100 mm diameter duct, 1.42 kg/s enters at a temperature of  $52^\circ\text{C}$  and an absolute pressure of 60 kPa. Determine the amount of heat that must be added to choke the flow, and the fluid properties at the choked state. (16)

(OR)

- b) A circular duct passes 8.25 kg/s of air at an exit mach number of 0.5. The entry pressure and temperature are 345 kPa and 311 K respectively. The average friction factor is 0.02. If the Mach number at entry is 0.15 determine (i) The diameter of the duct, (ii) length of the duct, (iii) pressure and temperature at the exit of duct and (iv) stagnation pressure loss. (4×4)
14. a) i) An air jet at a Mach Number of 2.1 is isentropically deflected by  $10^\circ$  in the clockwise direction. The initial pressure is  $100\text{ kN/m}^2$  and initial temperature is  $98^\circ\text{C}$ . Determine the final state of air after expansion. (12)
- ii) What are the assumptions used for oblique shock flow ? (4)

(OR)



b) i) Show that strength of shock wave is proportional to  $\left[ \frac{\rho_y}{\rho_x} - 1 \right]$ . (10)

ii) The state of the gas  $\left[ \gamma = 1.3 \text{ and } R = 0.469 \frac{\text{kJ}}{\text{kgk}} \right]$  upstream of a normal shock wave is given by the following data :  $M_x = 2.5$ ,  $P_x = 2 \text{ bar}$ ,  $T_x = 275 \text{ K}$ . Calculate the mach number, pressure, temperature of the gas downstream of the shock. (6)

15. a) A turbojet engine operates at an altitude of 11 km and a mach number of 0.82. The data for a engine is given below

Stagnation temperature at the turbine inlet = 1220 k

Stagnation temperature rise through the compressor = 170 k

Calorific value of the fuel = 42 MJ/kg

Compressor efficiency = 0.75

Combustion chamber efficiency = 0.97

Turbine efficiency = 0.83

Exhaust nozzle efficiency = 0.96

Specific impulse = 20 seconds.

Determine :

i) Air fuel ratio (3)

ii) Compressor pressure ratio (3)

iii) Turbine pressure ratio (3)

iv) Exhaust nozzle pressure ratio (3)

v) Mach number of exhaust gas. (4)

(OR)

b) Briefly explain Ram jet and pulse jet engine ? With advantage and Disadvantage. (16)

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