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Reg. No. : .....

Name : .....

Seventh Semester B.Tech. Degree Examination, June 2018
(2008 Scheme)
08.703 : GAS DYNAMICS (M)

Time : 3 Hours Max. Marks : 100

Instructions : *Answer **all** questions from Part – **A** and **one full** question from **each** Module of Part – **B**. **Use** of gas tables **permitted**.*

PART – A

1. Express the stagnation enthalpy in terms of static enthalpy and velocity of flow.
2. Starting from the continuity equation derive the expression for the area variation in terms of mach number and velocity variation and hence obtain the shape (geometry) for both subsonic and supersonic nozzles and diffusers.
3. Explain mach cone and mach angle.
4. Differentiate between adiabatic flow and diabatic flow.
5. Explain the difference between fanno flow and isothermal flow.
6. Sketch the Rayleigh line on the T-S plane and explain the significance of it.
7. Write down the ratio of velocities between any two sections in terms of their mach numbers in a Fanno flow.
8. Explain how the pitot tube could be used to measure the Mach number in supersonic flow.
9. Prove that for a normal shock $Py/Px = (1 + kMx^2) / (1 + kMy^2)$, where k is the ratio of specific heats for air.
10. Discuss the occurrence of normal shock in a C-D nozzle. **(10×4=40 Marks)**

P.T.O.

PART – B

Module – I

11. Air is discharged from a reservoir at Po = 6.91 bar and To = 325°C, through a nozzle to an exit pressure of 0.98 bar. If the flow rate is 3600 kg/hour, determine for isentropic flow :

    1) area, pressure and velocity at throat

    2) area and Mach number at exit and

    3) maximum possible velocity.

12. A certain quantity of air at pressure 3.344 bar and temperature 627°C is flowing through C-D nozzle. The exit pressure is 1.05 bar. Determine the temperature, velocity and density of air at exit. Also determine the pressure, temperature, density and velocity of air at exit if the divergent portion is to act as diffuser. Assume isentropic flow in both cases.

Module – II

13. a) Air enters a constant area duct at $M_1 = 3$, $P_1 = 1$ atm and $T_1 = 300$ K. Inside the duct the heat added per unit mass is $q = 3 \times 10^5$ J/kg. Calculate the flow properties M_2, P_2, T_2, ρ_2, T_{02} and P_{02} at the exit. **10**

    b) Derive an expression for the maximum heat transfer in Rayleigh flow in terms of Mach Number. **10**

14. a) Air at an inlet temperature of 60°C flow with subsonic velocity through an insulated pipe having inside diameter of 50 mm and a length of 5 m. The pressure at the exit of the pipe is 101 kPa and the flow is choked at the end of the pipe. If the friction factor 4 f = 0.005, determine the inlet Mach number, the mass flow rate and the exit temperature. **10**

    b) Derive an expression for $\frac{4fL_{max}}{D}$ in terms of Mach Number in Fanno flow. **10**

Module – III

15. A convergent divergent nozzle is designed to expand air from a reservoir in which the pressure is 800 kPa and temperature is 40°C to give a mach no. at exit of 2.5. The thrust area is 25 cm^2. Find :

    i) mass flow rate,

    ii) exit area, and

    iii) when a normal shock appears at a section where the area is 40 cm^2 determine the pressure and temperature at exit.

16. Air flows adiabatically in a pipe. A normal shock wave is formed. The pressure and temperature of air before the shock are 150 kN/m^2 and 25°C respectively. The pressure just after the normal shock is 350 kN/cm^2. Calculate :

    i) Mach no. before shock.

    ii) Mach no. static temperature and velocity of air after the shock wave.

    iii) Increase in density of air.

    iv) Loss of stagnation pressure of air.

    v) Change in entropy. **(3×20=60 Marks)**