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Reg. No. : .....

Name : .....

Seventh Semester B.Tech. Degree Examination, June 2019

(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. Sketch on T-S plane isentropic and actual expansion of compressible fluid and give the expression for nozzle efficiency.
2. Deduce the expression for impulse function.
3. Explain the difference between flow and non flow work.
4. What is the effect of Mach number on compressibility?
5. Sketch the Fanno line as h-s and h-p diagrams and explain how these lines are constructed.
6. Distinguish between Rayleigh flow and Fanno flow.
7. How do the flow properties change in Rayleigh flow?
8. Under what condition a compression wave changes into a shock wave.
9. State two practical situations where oblique shock waves are produced.
10. Write the change across normal shock for Mach number and Static pressure.

(10 × 4 = 40 Marks)

P.T.O.

PART – B

Module – I

11. (a) Carbon-dioxide expands isentropically through a nozzle from a pressure of 3.2 bar to 1.0 bar. If the initial temperature is 475°K determine the final temperature, the enthalpy drop and the change in internal energy.

(b) A conical air diffuser has an intake area of 0.11 m^2 and an exit area of 0.44 m^2. Air enters the diffuser with a static pressure of 0.18 MPa, static temperature of 37°C and velocity of 267 mis. Calculate

(i) the mass flow rate of air through the diffuser,

(ii) the Mach number, static temperature and static pressure of the air leaving diffuser and

(iii) the net thrust acting upon the diffuser due to diffusion.

12. (a) Derive the expression for the area expansion ratio of nozzles.

(b) A Freon-turbine has to use a maximum flow rate of 5 kg/s of Freon employing a ring of convergent nozzles of total exit area of cross-section of 100 cm^2. The pressure in the nozzle entry space is 20 x 10^5 N/m^2. Taking Cp = 0.845 kJ/kg, y = 1.2. Calculate stagnation temperature, static pressure and temperature at the nozzle exit, and Mach number at the nozzle exit.

Module – II

13. Air is flowing into an insulated duct with a velocity of 150 m/s. The temperature and pressure at the inlet are 280°C and 28 bar respectively. Find the temperature at a section in the duct where the pressure is 15.7 bar. If the duct diameter is 15 cm and the friction factor is 0.005, find the distance between the two sections.

14. Air flows through a constant area duct with inlet temperature of 20°C and inlet Mach number of 0.5. What is the possible exit stagnation temperature? it is desired to transfer heat such that at exit of the duct the stagnation temperature is 1180 K. For this condition what must be the limiting inlet Mach number? Neglect friction

Module – III

15. A convergent divergent nozzle is designed to expand air from a reservoir in which the pressure is 700 kPa and temperature is 5°C and the nozzle inlet Mach number is 0.2. The nozzle throat area is 46 cm^2 and the exit area is 230 cm^2. A normal shock appears at a section where the area is 175 cm^2. Find the exit pressure and temperature. Also find the increase in entropy across the shock.

16. (a) Deduce the Hugoniot equation for shock heating and explain the same on p – v plane. Also give the advantage of shock heating.

(b) Explain why normal shock wave causes supersonic flow to jump to subsonic flow. Substantiate your answer with governing equations, relevant reasons and using T-s diagram.

(3 × 20 = 60 Marks)