(Pages : 3)

B – 3444

Reg. No. : ....

Name : ....

Seventh Semester B.Tech. Degree Examination, December 2016
(2013 Scheme)
13.703 : GAS DYNAMICS (M)

Time : 3 Hours Max. Marks : 100

Instruction : *Gas Tables are* ***allowed****.*

PART – A

Answer **all** questions in Part **A**, which is **compulsory, each** carries **2** marks.

1. Write down the four basic equations which satisfy the points before and after the shock wave.

2. Differentiate between steep and nonsteep compression waves.

3. Bring out the concept of continuum.

4. Sketch a Kiel probe.

5. Explain the phenomenon of cloud formation when a fighter plane crosses the barrier of sound.

6. Write note on temperature recovery factor.

7. Heat addition to a gas may cool the gas. Explain with proper h-s diagram.

8. An aircraft flies at M = 0.8 at an altitude where the pressure and temperature are 44 Kpa and – 15° C respectively. Determine the isentropic stagnation pressure and temperature recorded on the aircraft.

9. Explain the effect of increase in duct length in Fanno flow.

10. With suitable examples explain the system and control volume approach.

(10×2=20 Marks)

P.T.O.

PART – B

Answer **four** questions in Part **B**, choosing **one** question from **each** Module. **Each** question carries **20** marks.

Module – I

11. a) Derive an expression for the sonic velocity in a medium in terms of the ratio of specific heat and difference of specific heat of the medium. **10**

b) Derive $\frac{dA}{A} = \left(\frac{dp}{\rho c^2}\right)(1 - M^2)$ for one dimensional isentropic flow. **10**

OR

12. a) Derive the law of conservation of mass as applicable to control volume. State all the assumptions. **12**

b) Explain the following : Mach angle and Mach cone, zone of action, zone of silence with the help of neat sketch. **8**

Module – II

13. a) Air flows through a frictionless adiabatic convergent-divergent nozzle. The air stagnation pressure and temperature are 7 bar and 500 K respectively. The divergent portion of the nozzle has an area ratio of $A_{exit}/A_{throat} = 11.91$. A normal shock wave stand in the divergent portion of the nozzle where the Mach number is 3.0. Determine the Mach number and the static pressure and temperature at the nozzle exit plane. **10**

b) Show that A/A^* is a function of Mach number in one dimensional isentropic flow. **10**

OR

14. a) Derive an expression for mass flow parameter in the following form

$$\frac{m\sqrt{T_0}}{A^* p_0} = \left(\frac{\gamma}{R}\right)^{1/2} \left(\frac{2}{\gamma+1}\right)^{(\gamma+1)/2(\gamma-1)}$$ **10**

b) A converging diverging nozzle is designed to operate with an exit Mach number of 1.75. The nozzle is supplied from an air reservoir at 68 bar. Assuming one dimensional flow calculate :

a) Maximum back pressure to choke the nozzle

b) Range of back pressure over which a normal shock will appear in the nozzle

c) Back pressure for the nozzle to be perfectly expanded to the design Mach number

d) Range of back pressure for supersonic flow at the nozzle exit plane. **10**

Module – III

15. a) Atmospheric air at a pressure of 1.01325×10^5 N/m^2 and temperature of 300 K is drawn through a frictionless bell-mouth entrance into a 3 m long tube having 0.05 m diameter. The average friction coefficient is 0.005 for the tube. The system is perfectly insulated. a) Find the maximum mass flow rate and the range of back pressures that will produce this flow. b) What is the exit pressure required to produce 90% of the maximum mass flow rate and what will be the stagnation pressure and the velocity at the exit for that mass flow rate ? 12

b) Derive an expression for the change in entropy for a Fanno flow. With the help of second law explain the direction of process. 8

OR

16. A gaseous mixture of air and fuel enters a ramjet combustion chamber with a velocity of 73.15 m/s at astaitc pressure and temperature of 0.5516 bar and 333.3 K. The heat of reaction Δ H of the fuel air mixture is 1395.5 kJ/kg. Assuming that the working fluid has the same thermodynamic properties as air before and after combustion and that the friction is negligible and the cross-sectional area of the combustion chamber is constant calculate :

a) The stagnation temperature after combustion

b) Mach number after combustion

c) Final static temperature

d) The loss in stagnation pressure due to heat addition

e) Entropy change

f) The final velocity of the combustion mixture

g) The maximum heat of reaction for which the flow with the specified initial conditions can be maintained. 20

Module – IV

17. Explain three different optical instruments employed in compressible flow to study the density variation in the flow field. 20

OR

18. a) Explain the working principle of a closed circuit supersonic wind tunnel with a neat sketch indicating all the relevant components. Why the design of diffuser throat area is made larger than the nozzle throat area in supersonic tunnels ? 10

b) Explain the different temperature measurements employed in supersonic flow. 10