(Pages : 4) **1553**

Reg. No. : ....

Name : ....

Seventh Semester B.Tech. Degree Examination, May 2012
(2008 Scheme)
08.703 : GAS DYNAMICS (M)

Time : 3 Hours Max. Marks : 100

Instruction : Use** of gas tables **permitted.

PART – A

Answer **all** questions. **(10×4=40 Marks)**

1. Draw the steady flow adiabatic ellipse and mark the ranges of incompressible, subsonic, supersonic and hypersonic flow. Explain.
2. State Karman's rules of supersonic flow.
3. What is impulse function ? How is it related to Mach number ?
4. What is Rayleigh flow ? What are the assumptions made in the analysis of Rayleigh flow ? Give an example.
5. Prove that maximum entropy point in a Rayleigh flow is at unity Mach number.
6. Sketch Fanno flow in p.v. and h-s diagrams and explain.
7. Explain the term shock strength. What are shocks of vanishing strength ?
8. Show that a normal shock is possible only in supersonic flow.
9. Sketch a kiel proble and explain its working
10. Explain the working principle of a hot wire anemometer.

P.T.O.

PART – B

Answer **one full** question from **each** Module. **(3×20=60 Marks)**

Module – I

11. a) Derive an expression for velocity of sound in a perfect gas. State assumptions clearly. **8**

b) A supersonic nozzle in a wind tunnel is to be designed to give an exit mach number of 2, with exit test section having an area of 0.1 m^2. Pressure and temperature at inlet of the nozzle is 5 bar and 450 k. respectively.

Find :

i) Throat area

ii) Pressure and temperature at throat

iii) Pressure, temperature at exit

iv) Mass flow rate

v) velocity of gas at throat and test sections. **12**

OR

12. a) Establish the following relation for I-D isentropic flow of a perfect gas. **8**

$$A/A^* = \frac{1}{M}\left(\frac{2}{r+1} + \frac{r+\cdot M^2}{r+1}\right)^{\frac{r+1}{2(r-1)}}$$

b) An air nozzle is to be designed for an exit mach number of 3.5. Conditions of the gas available in the reservoir are 800 kpa, 513 k. Estimate pressure, temperature, velocity of flow, area and Mach number at throat and exit if the mass flow rate through the nozzle is 12,600 kg/hr. **12**

Module – II

13. a) Derive expressions for ${T_2}/{T_1}$ and ${T_{o2}}/{T_{o1}}$ for a Rayleigh flow process in terms of r and M. 10

b) A convergent-divergent nozzle is provided with a pipe of constant cross section at its exit. The exit diameter of the nozzle and that of the pipe is 0.4 m. The mean coefficient of friction of the pipe is 0.0025. Stagnation pressure and temperature of air at the nozzle entry are 12 bar and book. The flow is isentropic in the nozzle. The mach numbers at the entry and exit of the pipe are 1.8 and 1.2 respectively. Determine :

i) Length of the pipe

ii) Diameter of nozzle throat

iii) Pressure and temperature at pipe exit

iv) Stagnation pressure loss in the pipe. 10

OR

14. a) Air at Po = 10 bar, To = 400 k supplied to a 50 mm ϕ pipe . Friction factor for the pipe is 0.002. If the mach number changes from 3 at entry to 1 at exit. Determine :

i) Length of pipe

ii) Mass flow rate

iii) Condition of gas at exit

iv) Stagnation pressure loss. 10

b) A combustion chamber in a gasturbine plant receives air at 350k, 0.55 bar and 80 m/s. The air-fuel ratio is 29 and calorific value of fuel is 42 mJ/kg. Taking r = 1.3 and R = 0.287 kJ/kg.K for the gas, determine :

i) Initial and final mach numbers

ii) Final pressure, temperature and velocity of gas

iii) Percentage stagnation pressure loss

iv) Maximum stagnation temperature attainable. 10

Module – III

15. a) Draw a neat sketch of an interferometer. How is it used to determine gas velocity and Mach number. **10**

b) The velocity of a normal shock moving into stagnant air (P=1.0 bar, T = 290k) is 500 m/s. If the area of cross section of the duet is constant, determine :

i) Pressure

ii) Temperature

iii) Velocity of air

iv) Stagnation temperature and

v) Mach no. imparted upstream of the wave front. **10**

OR

16. a) State and prove Prandtt-Mayer relation for a normal shock. **10**

b) The ratio of the exit to entry area of a subsonic diffuser is 4.0. The mach number of a jet of air approaching the diffuser is 2.2, with Po = 1.013 bar, T = 290 k. There is a standing normal shock wave just outside the diffuser entry. Flow in the diffuser is isentropic. Determine at the exit of the diffuser

i) Mach number

ii) Temperature

iii) Pressure

iv) Stagnation pressure loss between initial and final stages of the flow. **10**