ROLL NO: ……
NAME : …….

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION
(2013 Scheme)
13.703 GAS DYNAMICS (M)

Time: 3 Hours **Max. Marks: 100**

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PART-A

(***Answer all questions; each question carries 2 marks***)

1. Write the differences between system approach and control volume approach
2. Explain Law of conservation of mass for a system.
3. What do you mean by Impulse function?
4. Explain choking phenomenon in isentropic nozzle.
5. Discuss the concept of Normal shock.
6. Give the governing equations of Fanno flow.
7. Explain choking in Fanno flow.
8. What are the assumptions of Rayleigh flow?
9. Give the working of a hot wire anemometer.
10. Explain a pitot – static tube. **(10x2 = 20 marks)**

PART-B

(**Answer** ***any one question from each module; each carries 20marks***)

MODULE I

11. a) Derive the expression for velocity of sound.

    b) An air jet (γ = 1.4, R = 287 J/ kg K) at 400 K has sonic velocity. Determine:

    i. The velocity of sound at 400 K
    ii. The velocity of sound at stagnation condition
    iii. Maximum velocity of jet
    iv. Stagnation Enthalpy
    v. Crocco Number

OR

12. a) Explain Law of conservation of mass for a control Volume.

b) A supersonic fighter plane flies at an altitude of 4000 m. An observer on the ground hears the sonic boom 8 s after passing the plane over his head. Estimate the speed of the plane and the Mach number. Take the average temperature as 10^0C.

MODULE II

13. a) Derive the expression for mach number downstream of normal shock

b) A conical diffuser has entry and exit diameters as 15 cm and 30 cm respectively. The pressure, temperature and velocity of air at entry are 0.69 bar, 340 K and 180 m/s respectively.

- Determine exit pressure
- Exit velocity and
- Force exerted on diffuser walls. Assume $\gamma = 1.4$ and $C_p = 1$ kJ/ kg

OR

14. a) Derive an expression for ratio of impulse functions F & F* in Isentropic flow as a function of Mach numbers and ratio of specific heats.

b) A compression shock occurs in a divergent air flow passage. On the upstream side of the shock, the velocity of air is 400 m/s and the pressure and temperature are 0.2 MPa and 350 C respectively. Determine:

i. Mach number, Temperature, Pressure and air velocity on the downstream side of the shock.

ii. Change in entropy per unit mass of air as a result of shock.

MODULE III

15. a) Prove that Mach number is unity at the point of Max. Entropy on a Fanno line.

b) The conditions of a gas in a combustor at entry are: $P_1 = 0.343$ bar, $T_1 = 310$ K, $C_1 = 60$ m/s. Determine the Mach number, pressure, temperature and velocity at the exit if the increase in stagnation enthalpy of the gas between entry and exit is 1172.5 kJ/ kg. Take $C_p = 1.005$ kJ/ kg K, $\gamma = 1.4$

OR

16. a) Prove that Mach number is equal to $\frac{1}{\sqrt{\gamma}}$ at the point of Max. Enthalpy for a Rayleigh flow process.

b) The average friction factor for a 50 mm dia. Pipe is 0.004. The Mach number of air at a particular section in the pipe is 0.25. Determine the length of the pipe, if the flow ends at a Mach number of 0.49. Assume Fanno flow.

MODULE IV

17. a) Explain the different velocity measurement techniques of compressible flow.

b) Explain Schlieren technique.

OR

18. a) Explain the principle and working of a supersonic pitot – tube.

b) Explain the working of Kiel probe.

(4x20 = 80 marks)