Fifth Semester B.Tech Degree Examination, Nov/Dec 2015

(2013 scheme)

Branch: Aeronautical Engineering

13.502: GAS DYNAMICS

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

Instructions*: 1) Answer all questions from Part – A and four full questions from Part – B.*

2) Choosing not more than one question from each Module from Part – B.

3) Gas table is permitted

PART-A

1. Define: Acoustic Velocity.

2. What is meant by Mach Cone?

3. Explain about control volume and control mass.

4. What is meant by chocking in isentropic flow?

5. Write the Fanno relation for a perfect gas.

6. Write short notes on thermal chocking.

7. Explain how to represent the strength of a shock wave.

8. Explain about the working principle of Schlieren System.

9. What is compressibility correction factor?

10. What is Rayleigh Pitot tube?

(10X2=20)

PART-B

MODULE-I

11. (a) Define Conservation of Momentum and derive momentum equation for infinitesimal element moving with flow. (20)

(or)

(b) (i) Derive an expression for effect of Mach number on compressibility and explain with compressibility plot. (12)

(ii) Derive adiabatic energy equation to represent various flow regions on steady flow.(8)

MODULE-II

12. (a) A conical diffuser has entry and exit diameters of 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:

(i) the exit pressure (6)

(ii) the exit velocity (6)

(iii) the force exerted on the diffuser walls. (8)

Assume isentropic flow, $\gamma = 1.4$, $c_p = 1.00$ kJ/kg.K.

(or)

(b) A gas ($\gamma = 1.3$, R = 0.287 kJ/kg.K) at $p_1 = 1.0$ bar, $T_1 = 400$ K enters a 30 cm diameter duct at a Mach number of 2.0. A normal shock occurs at a Mach number of 1.5 and the exit mach number is 1.0. If the mean value of the friction factor is 0.003 determine:

(i) length of the duct upstream and downstream of the shock wave,

(ii) mass flow rate of the gas,

(iii) change of entropy upstream of the shock, across the shock and downstream of the shock. (20)

MODULE-III

13. (a) (i) Derive equations for stagnation temperature, change of entropy and heat transfer for Rayleigh flow. (14)

(ii) Explain about maximum heat transfer on a Rayleigh flow with neat plot. (6)

(or)

(b) (i) State and derive the fundamental relation between the gas velocities before and after the normal shock using Prandtl-Meyer relation. (10)

(ii) With neat sketch explain about moving shock waves in detail. (10)

MODULE-IV

14. (a) Explain with neat sketch about shadowgraph flow visualization system used in wind tunnels. (20)

(or)

(b) (i) Explain the principle, construction, working and types of hot wire anemometer with neat sketch. (14)

(ii) Write short notes on temperature recovery factor (6)

(4X20=80)