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Reg. No. : .....

Name : .....

Seventh Semester B.Tech. Degree Examination, September 2020

(2013 Scheme)

13.703 : GAS DYNAMICS (M)

Time : 3 Hours Max. Marks : 100

PART – A

Answer **all** questions. Each question carries **2** marks

1. Explain Mach angle, Mach cone and sonic boom.
2. What do you mean by the stagnation speed of sound?
3. What do you mean by impulse Function? Bring out its relationship with Mach Number.
4. Write down the expression for stagnation to static ratios of temperature and pressures for 1-D isentropic flow.
5. Explain the over expansion and under expansion in nozzle flow.
6. Explain why the normal shock cannot occur in subsonic flows.
7. Locate the maximum entropy point in Fanno flow on h-s diagram.
8. Explain Oblique shocks.
9. Explain the concept of Adiabatic Recover factor in flow measurements
10. Explain the working of a Kiel probe.

(10 × 2 = 20 Marks)

P.T.O.

PART – B

Answer **any one full** question from **each** Module. Each question carries **20** marks.

Module – I

11. (a) Derive an expression for the reference Mach number [M*] in terms of the Mach number [M] of the flow. **10**

(b) The speed indicator of an aero plane whose speed meter is calibrated without considering the effect of compressibility on dynamic properties. The speed meter registers a speed of 1000 km/hour at an altitude of 5000 m. Determine the true speed of the aero plane. Also determine the stagnation properties registered at the nose of the pitot tube with the aero plane. Take T=-25°C and p=0.654 bar at 6000 m altitude. **10**

OR

12. (a) Derive the momentum equation using the control volume approach. **10**

(b) Nitrogen at a temperature of 350°C and a pressure of *5* bar is flowing through a duct with a velocity 250 m/s. Determine the Mach number of the flow. **10**

Module – II

13. (a) Derive an expression for the exit to throat area ratio of a converging diverging nozzle in terms of the exit Mach number of the flow. **10**

(b) Air enters a variable area duct at a temperature of 300 K, pressure of 0.4 bar and a velocity of 200 m/s. The area of cross section at the entry of the duct is 500 cm^2 and the exit area is 350 cm^2. Considering the flow to be isentropic, determine the mass flow rate through the duct and the properties at exit. Also determine the change in the impulse function. **10**

OR

14. (a) Derive the Prandtl- Meyer equation in connection with the normal shock. **10**

(b) A convergent - divergent nozzle has an exit to throat area ratio of 3.0. Air is entering directly from a combustion chamber at a pressure of 700 kN/m^2 and temperature of 90°C. Due to its operation at its off-design condition, a plane normal shock is seen to stand at a section where M=2. Determine the Mach Number, static pressure and static temperature at the exit of the nozzle if the throat area is 10 cm^2. Assume isentropic flow before and after the shock. **10**

Module – III

15. (a) Explain the changes happening in both the subsonic and supersonic Rayleigh flow until the limiting condition using the h-s diagram. Locate the maximum entropy and the maximum enthalpy point in Rayleigh flow on h-s diagram. **10**

(b) Air is passing at a rate of 8 kg/sec through an insulated circular pipe line. The entry pressure. temperature and Mach number of the air are 3 bar, 300 K and 0.15 respectively. The coefficient of friction of the pipe is 0.005 throughout. Determine, the diameter and length of the pipe if the exit Mach number is *0.5.* Also, determine the stagnation pressure loss due to the frictional losses and the pressure and temperature at the exit of the pipe. **10**

OR

16. (a) Explain the changes happening in both the subsonic and supersonic Fanno flow until the limiting condition using the h-s diagram. Locate the maximum entropy point in Fanno flow on h-s diagram. **10**

(b) Air enters a constant area pipe with velocity of 200 m/s, temperature of 100°C and pressure of 6 bar. If 220 kJ/kg of heat is added to the pipe for the entire length, find

(i) pressure at the exit,

(ii) Mach number of the air at the exit,

(iii) change in stagnation pressure and

(iv) the change in entropy of the air. **10**

Module – IV

17. (a) Explain the working of a Prandtl Pitot- static tube. Explain how it simultaneously measures the static and the stagnation pressure. **10**

(b) Explain the use of hot wire anemometer. Differentiate between the constant temperature and the constant current hot wire anemometers. **10**

OR

18. (a) What is the use of the wind tunnel? Explain how closed type wind tunnel differs from an open type wind tunnel using suitable diagrams. **10**

(b) Explain the working of a shock tube. **10**

(4 × 20 = 80 Marks)