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Question Paper Code : 41047

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Sixth Semester

Mechanical Engineering

080120037 — GAS DYNAMICS AND JET PROPULSION

(Regulation 2008)

Time : Three hours Maximum : 100 marks

(Use of Gas Tables is permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Name the different regions of compressible fluid flow.

2. Define zone of action and zone of silence.

3. Differentiate between adiabatic flow and diabatic flow.

4. What is chocked flow through a nozzle?

5. What are the assumptions made for Rayleigh flow?

6. Give the fanno flow in h – s diagram show various Mach number regions and write the fanno flow equation.

7. Define compression and rarefaction shocks? Is the latter possible.

8. What are the assumptions made for oblique shock wave?

9. Define specific impulse.

10. What is scram jet?

PART B — (5 × 16 = 80 marks)

11. (a) Air (γ = 1.4, R = 287 J/kg K) enters a straight axis symmetric duct at 300K, 3.45 bar and 150 m/s and leaves it at 277K, 2.058 bar and 260 m/s. The area of cross section at entry is 500 cm^2. Assuming adiabatic flow determine (i) Stagnation temperature (ii) Maximum velocity (iii) Mass flow rate (iv) Area of cross section at exit. (16)

Or

(b) (i) In settling chamber air is maintained at a temperature of 400K and a pressure of 6 bar. Calculate the following (1) stagnation enthalpy (2) Stagnation velocity of sound (3) Maximum velocity (4) Critical velocity of fluid (5) Critical velocity of sound. (10)

(ii) Show that $P_0/P = (1 + (\gamma - 1/2)\,M^2)^{\gamma/\gamma-1}$. (6)

12\. (a) An air nozzle is to be designed for an exit Mach number of 3.5. The stagnation conditions for the isentropic flow are 800 kpa and 240°C.Estimate pressure, temperature, velocity and area at throat and exit for a mass flow rate of 3.5 kg/s. (16)

Or

(b) A conical air diffuser has an inlet diameter of 40cm and an exit diameter of 80cm. Air enters the diffuser with a static pressure of 200 kpa, static temperature of 37° C and velocity of 265 m/s. Calculate (i) Mass flow rate (ii) Properties at exit. (16)

13\. (a) A combustion chamber in a gas turbine plant receives air at 350K.0.55 bar and 75m/s. The air fuel ratio is 29 and the calorific value of the fuel is 41.87 MJ/kg. Taking $\gamma = 1.4$, $R = 0.287$ kJ/kg K for the gas. Determine (i) Initial and final Mach number (ii) Final pressure, temperature and velocity of the gas (iii) Stagnation pressure loss in the combustion chamber (iv) The maximum stagnation temperature attainable. (16)

Or

(b) A long pipe of 25.4 mm diameter has a mean co-efficient friction of 0.003.Air enters the pipe at a Mach number of 2.5, stagnation temperature of 310 K and static pressure of 0.507 bar. Determine for a section at which mach number reaches 1.2 (i) static pressure and static temperature (ii) stagnation pressure and temperature (iii) velocity of air (iv) distance of this section from inlet and (v) mass flow rate, Assume the flow is isothermal. (16)

14\. (a) Air flows adiabatically in a pipe. A normal shock wave is formed. The pressure and temperature of air before the shock are 150 k N/m^2 and 25°C respectively. The pressure just after the normal shock is 350 kN/m^2. Calculate (i) Mach number before the shock (ii) Mach number, static temperature and velocity of air after the shock wave (iii) Increase in density of air (iv) Loss of stagnation pressure of air (v) Change in entropy. (16)

Or

(b) A jet of air approaches a symmetrical wedge of a Mach number of 2.4 and wave angle of 60°. Determine the following (i) Deflection angle (ii) Pressure ratio (iii) Temperature ratio (iv) Final Mach number. (16)

15. (a) Explain with neat sketches the principle of operation of (i) Turbofan engine (ii) Turbojet engine. (16)

Or

(b) An aircraft takes 45kg/s of air from the atmosphere and flies at a speed of 950 kmph. The air fuel ratio is 50 and the calorific value of the fuel is 42 MJ/kg. For maximum thrust power, find:(i) Jet velocity (ii) Thrust (iii) Specific thrust (iv) Thrust power (v) Propulsive efficiency (vi) Thermal efficiency (vii) Overall efficiency (viii) Thrust specific fuel consumption. (16)