Question Paper Code : 31047

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2013.

Sixth Semester

Mechanical Engineering

080120037 – GAS DYNAMICS AND JET PROPULSION

(Regulation 2008)

Time : Three hours Maximum : 100 marks

(Use of approved gas tables permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write the energy equation in differential form.

2. Draw the mach cone and indicate various zones.

3. Draw the p/p_0 along the length of a convergent divergent device when it functions as nozzle.

4. Define impulse function and its significance.

5. Differentiate between Fanno and Rayleigh flow.

6. For constant area fanno flow how limiting length for the pipe is determined?.

7. How the properties changes across the normal shock?

8. Give the expression for P_y/P_x in terms of mach number across normal shock.

9. Define thrust and propulsive efficiency of a jet propulsion system.

10. What is monopropellant? Give examples.

PART B — (5 × 16 = 80 marks)

11. (a) (i) An air jet at 400 K has sonic velocity. Determine (12)

(1) velocity of sound at 400 K

(2) velocity of sound at stagnation condition

(3) maximum velocity of jet

(4) stagnation enthalpy and

(5) crocco number

(ii) Explain what is meant by stagnation properties of fluid and supersonic flow. (4)

Or

(b) What is the effect of mach number on compressibility? Derive the relation between pressure coefficient and mach number. (16)

12. (a) (i) A gas is isentropically expanded from 10 bar, 525°C in a nozzle to a pressure of 7.0 bar. If the rate of flow of gas is 1.5 kg/sec. Determine (12)

(1) pressure velocity and temperature at the nozzle throat and exit

(2) maximum possible velocity attainable by the gas and

(3) type of nozzle and its throat area.

Take r= 1.5 and R= 0.464 kJ/KgK.

(ii) Distinguish between the nozzle and diffusers. (4)

Or

(b) (i) Starting from adiabatic energy equation derive the following for a one- dimensional isentropic flow in an axisymmetric duct., (12)

$dA/A = [(dp/\rho c^2)(1 - M^2)]$

(ii) Explain the chocking condition with example. (4)

13. (a) Air is flowing in an insulated duct with friction coefficient f= 0.002. At inlet, velocity of air is 130 m/s, pressure is 250 kPa, and temperature is 400 K. Determine the following: (16)

(i) Length of the pipe required so a to give 20% drop in stagnation pressure.

(ii) Properties of air at a section 3.5 m from inlet, and

(iii) Maximum pipe length.

Or

(b) Air enters a constant area pipe with velocity 150 m/s, temperature 60° C and pressure 0.5 MN/m^2. If 180 kJ/kg of heat is added to the pipe, find

(i) the final pressure

(ii) the final mach number and

(iii) the change in stagnation pressure and entropy. (16)

14. (a) An Aircraft flies at an mach number of 1.2 at an altitude of 16000 meters when p=103 m bar and T=216.55 K . The compression in its engine is partly achieved by a normal shock wave standing at the entry of the diffuser. Determine immediately downstream of the shock (16)

(i) Mach Number

(ii) Temperature of air

(iii) Pressure of air and

(iv) Stagnation pressure loss across the shock.

Or

(b) A normal shock occurs in the diverging section of C-D nozzle . The throat area equal to (1/2 × exit area). Static pressure at exit is 0.4 times the stagnation pressure at the entry. The flow is throughout isentropic except through the shock. Determine (16)

(i) the mach number M_x and M_y

(ii) the static pressure

(iii) the area of cross section of the nozzle at the section of the nozzle where the normal shock occurs.

15. (a) A turbojet engine flying at a speed of 900 Km/hr is fitted with a CD nozzle having an exit diameter 500 mm and area ratio 2. The exit from the turbine of the engine is 300 Kpa and 500 K.Find the thrust developed by the engine if the ambient pressure at altitude is 20 Kpa. Assume proportion of the exhaust gas to be same as that of air. Fuel-air ratio for the engine is 0.02167. (16)

Or

(b) With neat sketch explain the following (16)

(i) Pulse jet engine

(ii) Ram jet engine

(iii) Turbo prop engine

(iv) After burning in turbojet engine.
