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

Fifth Semester

Mechanical Engineering

ME 1303 — GAS DYNAMICS AND JET PROPULSION

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define: Impulsive function
2. What is the value of M* for air if the fluid velocity 416 m/s at - 60°C?
3. Show an adiabatic expansion process through nozzle on TS coordinates.
4. What is the necessity to study the flow through variable area of duct at isentropic flow condition?
5. Define Fanno flow.
6. Give examples of Raleigh flow.
7. What is the strength of shock wave?
8. List the properties which are increase, decrease and remains constant across the normal shock wave?
9. What are the limitations of jet engine?
10. What are the desirable properties of liquid propellant?

PART B — (5 × 16 = 80 marks)

11. (a) Explain the effect of Mach number on compressibility and obtain the equation at $\gamma = 1.4$. (16)

Or

(b) A carbon dioxide jet at 473 K has sonic velocity. Determine velocity of sound in the jet, stagnation temperature and stagnation enthalpy of the jet, stagnation velocity of sound, stagnation to static pressure ratio, maximum velocity of the jet and Croco number. Take $\gamma = 1.237$, R= 189J/kgK for carbon dioxide. (16)

12. (a) Discuss about types of nozzle and diffuser with the flow characteristics. (16)

Or

(b) A certain quantity of air at a pressure of 3.344 bar and temperature of 672°C is flowing through CD nozzle. The exit pressure is 1 bar. Determine the temperature, velocity and density of air at exit. Also determine the pressure, temperature, velocity of air at exit if the divergent portion is act as diffuser. Assume isentropic flow in both cases. (16)

13. (a) Derive the expression for pressure ratio, temperature ratio, density ratio, velocity ratio for Fanno flow of perfect gas. (16)

Or

(b) The pressure, temperature and velocity of gas in a combustion chamber at entry are 0.343 bar, 310 K and 60 m/s respectively. 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 the ratio of the sp.heat for air as 1.4 and $C_p = 1.005$ kJ/kgK. (16)

14. (a) Derive the Prandtl-Meyar relation for a shock wave in a nozzle. (16)

Or

(b) A compression shock occurs in a divergent flow passage. On the upstream side of the shock the velocity of air is 400 m/s and the pressure and temperature are at 2 bar and 35°C respectively. Determine Mach number on the downstream side of the shock wave, the air velocity on the downstream side and the change in entropy per unit mass of air as a result of shock. Take $\gamma = 1.4$. (16)

15. (a) Explain with a neat sketch the principle of operation of a ramjet engine and state its advantages and disadvantages. (16)

Or

(b) Explain with a neat sketch the principle of operation of a liquid propellant rocket and state its advantages and disadvantages. (16)