

and after the shock.

- 7 a) Explain the phenomenon of frictional choking. (3)
- b) A convergent-divergent nozzle is provided with a pipe of constant cross section at its exit. The exit diameter of nozzle and that of pipe is 40 cm. The mean coefficient of friction for the pipe is 0.0025. Stagnation pressure and temperature of air at the nozzle entry are 12 bar and 600 K. The flow is isentropic in the nozzle and adiabatic in the pipe. The Mach number at the entry and exit of the pipe are 1.8 and 1.0 respectively. Determine i) length of pipe, ii) diameter of the nozzle throat and iii) pressure and temperature at the pipe exit. (7)
- 8 a) Differentiate between Fanno flow and Isothermal flow. What is the limit for continuous subsonic isothermal flow through a constant area duct. (4)
- b) A circular duct passes 8.25 kg/s of air at an exit Mach number of 0.5. The entry pressure and temperature are 3.45 bar and 38°C respectively and the mean coefficient of friction 0.005. If the Mach number at the entry is 0.15, determine i) diameter of the duct, ii) length of duct, iii) pressure and temperature at exit and iv) stagnation pressure loss. (6)

PART C

Answer any four full questions, each carries 10 marks.

- 9 A combustion chamber in a gas-turbine plant receives air at 300 K, 55 kPa and 60 m/s. The fuel air ratio is 29 and the calorific value of the fuel is 42MJ/kg. Assuming $\gamma=1.4$, $R=0.287$ kJ/kg K for the gas, determine (i) Mach numbers at inlet and exit. (ii) pressure, temperature and velocity of the gas at exit of combustion chamber. (iii) percentage loss in stagnation pressure. (10)
- 10 Air-fuel mixture enters a combustion chamber with a initial velocity of 150m/s, pressure of 4 bar and temperature of 410K. The mach number at the exit of the combustion chamber is 0.8. Taking $\gamma=1.3$, $C_p=1.144$ kJ/kgK and calorific value of fuel = 43 MJ/kg, find (i) entry Mach no. (ii) exit temperature and pressure (iii)stagnation pressure loss and (iv) air-fuel ratio required. (10)
- 11 Derive an expression for the maximum possible Heat addition (Q_{max}) in terms of Mach number, gamma and temperature for a Rayleigh flow. Explain the phenomenon of thermal choking. (10)
- 12 a) With the help of neat sketch explain the working of a shock tube. (4)
- b) With a neat sketch show the working of a Open type and Closed type wind tunnel clearly labelling the different parts (6)

- 13 a) Draw the bridge circuit of a constant current hot wire anemometer and explain the working principle. (4)
- b) With a neat sketch show the working principle of Shadowgraph and Schlieren techniques (6)
- 14 a) Draw the bridge circuit of a constant temperature hot wire anemometer and explain the working principle. (4)
- b) What is the advantage of using a Kiel probe over a Pitot tube. How is the yaw sensitivity of the Kiel probe compared to the Pitot tube. (6)

