b) A aircraft flies at a speed of 520 kmph at an altitude of 8000 m. The diameter of the propeller of an aircraft is 2.4 m and flight to jet speed ratio is 0.74. Find the following : (13)

i) The rate of air flow through the propeller.

ii) Thrust produced.

iii) Specific thrust.

iv) Specific impulse.

v) Thrust power.

15\. a) i) Explain with a neat sketch the working of a gas pressure feed system used in liquid propellent rocket engines. (8)

ii) Describe the important properties of liquid and solid propellants desired for rocket propulsion. (5)

(OR)

b) A rocket moves with a velocity of 10,000 km/hr with an effective exhaust velocity of 1400 m/s, the propellant flow rate is 5 kg/sec and the propellant mixture has a heating value of 6500 kJ/kg. Find (13)

1) Propulsion efficiency.

2) Engine power output

3) Thermal efficiency

4) Overall efficiency.

PART – C (1×15=15 Marks)

16\. a) Describe two practical situations where oblique shock waves are produced. How are strong and weak shocks generated and how it affects the flow ? (15)

(OR)

b) How is forward motion of an aircraft achieved by propeller action ? How does the aircraft lift off the ground ? Explain with help of illustrative sketches. (15)

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Reg. No. :

Question Paper Code : 41415

07/05/18 FN

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018

Sixth Semester

Mechanical Engineering

ME 6604 – GAS DYNAMICS AND JET PROPULSION

(Regulations 2013)

Time : Three Hours Maximum : 100 Marks

(Use of Approved Gas Table is Permitted)

Answer ALL questions.

PART – A (10×2=20 Marks)

1\. State the difference compressible fluid and incompressible fluid.

2\. A plane travels at a speed of 2400 km/h in an atmosphere of 5°C find the Mach Angle.

3\. State assumptions made to derive the equations for isothermal flow.

4\. What do you understand by chocking in Rayleigh flow ?

5\. Shock waves cannot be develop in subsonic flow ? State the reason.

6\. Define strength of a shock wave.

7\. Why after burners are used in turbojet engine ?

8\. What is "thrust augmentation" ?

9\. Compare solid and liquid propellant rockets.

10\. Give the important requirements of rocket engine fuels.

PART – B

(5×13=65 Marks)

11\. a) A conical diffuser has entry and exit diameters of 15 cm and 30 cm respectively. The pressure, temperature and velocity of air at entry are 0.69 bar, 340 K and 180 m/s respectively. Determine (13)

i) exit pressure

ii) the exit velocity and

iii) the force exerted on the diffuser walls assume the flow is isentropic, $\gamma = 1.4$ and Cp = 1.00 J/kg K.

(OR)

b) Air flows isentropically through a convergent-divergent nozzle. The inlet conditions are pressure 700 KN/m^2, temperature 320°C, velocity 50 m/s. The exit pressure is 105 KN/m^2 and the exit area is 6.25 cm^2. Calculate (13)

i) Mach number, temperature and velocity at exit

ii) Pressure, temperature and velocity at throat

iii) Mass flow rate

iv) Throat area.

12\. a) i) A circular duct passes 8.25 kg/s of air at an exit Mach number of 0.5. The entry pressure and temperature are 345 KPa and 38°C respectively and the co-efficient of friction is 0.005. If the Mach number at entry is 0.15. Determine, (8)

i) The diameter of the duct

ii) Length of the duct

iii) Pressure and temperature at exit and

iv) Stagnation pressure loss.

ii) Air flows through a pipe of 300 mm diameter. At inlet, temperature is 35°C, pressure is 0.6 bar and stagnation pressure is 12 bar. At a location 2 m downstream, the static pressure is 0.89 bar. Estimate the average friction coefficient between two section. (5)

(OR)

b) The condition of gas in a combustion chamber at entry are $M_1 = 0.28$, $T0_1 = 380$ K, $P0_1 = 4.9$ bar. The heat supplied in the combustion chamber is 620 kJ/kg. Determine Mach number, pressure and temperature of the gas at exit and also determine the stagnation pressure loss during heating. Take $\gamma = 1.3$ and Cp = 1.22 kJ/kg K. (13)

13\. a) Supersonic nozzle is provided with a constant diameter circular duct at its exit. The duct diameter is same as the nozzle diameter. Nozzle exit cross section is three times that of its throat. The entry conditions of the gas ($\gamma = 1.4$, R = 287 J/kg K) are P0 = 10 bar, T0 = 600 K. Calculate the static pressure. Mach number and velocity of the gas in duct. (13)

a) When the nozzle operates at its design condition.

b) When a normal shock occurs at its exit

c) When a normal shock occurs at a section in the diverging part where the area ratio, A/A* = 2.

(OR)

b) An aircraft flies at a Mach number of 1.1 at an altitude of 15,000 metres. The compression in its engine is partially achieved by a normal shock wave standing at the entry of the diffuser. Determine the following for downstream of the shock. (13)

1) Mach number

2) Temperature of the air

3) Pressure of the air

4) Stagnation pressure loss across the shock.

14\. a) i) Explain the principle of working of turbo jet engine and pulse jet engine. (8)

ii) A converging nozzle operating with air and inlet conditions of P = 4 kg/cm^2, T0 = 450°C and T = 400°C is expected to have an exit statics pressure of 2.5 kgf/cm^2 under ideal conditions. Estimate the exit temperature and Mach number, assuming a nozzle efficiency is 92% when the expansion takes place to the same back pressure. (5)

(OR)