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Name.....

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**SIXTH SEMESTER B.TECH. (ENGINEERING) DEGREE (2014 SCHEME) EXAMINATION, APRIL 2017**

Mechanical Engineering

ME 14 601—GAS DYNAMICS AND JET PROPULSION

Time : Three Hours

Maximum : 100 Marks

## Part A

*Answer any* **eight** *questions.*
*Each question carries* 5 *marks.*

1. Derive area ratio as a function of Mach number for one dimensional isentropic flow.
2. State the necessary conditions for a normal shock to occur in compressible flow ? What are the properties changes across a normal shock ?
3. Air approaches a symmetrical wedge (angle of deflection $\delta = 15'$) at a Mach number of 2. Consider strong waves conditions. Determine the wave angle.
4. Differentiate Fanno flow and Rayleigh flow ? Give details about chocking in Fanno flow.
5. Write the equations to calculate propulsion efficiency and thermal efficiency of an aircraft.
6. Classify the rocket engines based on source of energy employed. What is IWR ?
7. What is Rayleigh line and Fanno line?
8. Define strength of shock wave ? What are the applications of moving shock wave ?
9. What is thrust (or) drag and write about Thrust Specific Fuel Consumption (TSFC) ?
10. Depict the important properties of liquid and solid propellants desired for rocket propulsion.

($8 \times 5 = 40$ marks)

## Part B

11. (a) Air is discharged from a reservoir at $p_0 = 6.91$ bar and $t_0 = 325°C$ through a nozzle to an exit pressure of 0.98 bar. If the flow rate is 3600 Kg./hr. determine throat area, pressure and velocity at the throat, exit Mach number. Consider flow is isentropic.

*Or*

(b) Air ($C_p = 1.05$ KJ/Kg–K, $\gamma = 1.38$) at $P_1 = 3 \times 105$ N/m$^2$ and $T_1 = 500\ k$ flows with a velocity of 200 m/s in a 0.3 m. diameter duct. Calculate : Mass flow rate. Stagnation temperature, Mach number values for the compressible flow and Incompressible flow.

Turn over

12. (a) Derive the equation for Mach number of upstream and downstream of the normal shock wave.

*Or*

(b) A gas ($\gamma - 1.3$) at $P_1 = 345$ mbar. $T_1 = 350$ K and $M_1 = 1.5$ is to be isentropically expanded to 138 mbar. Determine : (i) Deflection angle ; (ii) Final Mach number ; and (iii) Temperature of the gas.

13. (a) Air having Mach number 3 with total temperature 295°C and static pressure 0.5 bar flows through a constant area duct adiabatically to another section where the mach number is 1.5. Determine the amount of heat transfer and change in stagnation pressure.

*Or*

(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 co-efficient of friction is 0.005. If the Mach number at entry is 0.15, determine the diameter of the duct, length of the duct, pressure, temperature at the exit and stagnation pressure loss.

14. (a) Explain the principle of operation of a turbojet engine and state its advantages and disadvantages.

*Or*

(b) Explain briefly about the propellant feed system of a liquid propellant rocket engine with suitable schematic sketches.

(4 × 15 = 60 marks)