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**Question Paper Code : 51859**

**B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016**

**Sixth Semester**

**Mechanical Engineering**

**ME 2351/ME 64/10122 ME 602 – GAS DYNAMICS AND JET PROPULSION**

**(Regulations 2008/2010)**

**(Common to PTME 2351/10122 ME 602 – Gas Dynamics and Jet Propulsion for B.E. (Part-Time) Fifth Semester – Mechanical Engineering – Regulations 2009/2010)**

**Time : Three Hours** **Maximum : 100 Marks**

**Use of Gas Tables is permitted**

**Answer ALL questions.**

**PART – A (10 × 2 = 20 Marks)**

1. Define Stagnation State.
2. How do you classify the flow based on the Mach number ?
3. What is 'Fanno Flow' ? Give some examples.
4. Show three Fanno curves on the h-s coordinates at three mass flow densities.
5. What is the use of Prandtl-Meyer relation ?
6. Write the equation which relates the static pressure ratio and Mach number in normal shock wave. Also briefly explain their relationship.
7. Define Strength of a Shock Wave.
8. What is Monopropellants ? Give some examples.
9. List out the good properties of Liquid propellants.
10. Define specific impulse of rocket.

## PART – B (5 × 16 = 80 Marks)

11. (a) Air at 40 °C flows from a large reservoir (tank) through a converging nozzle at 40 mm throat diameter. The air pressure in the tank is 150 kPa. The discharge pressure is 95 kPa. Find the discharge and maximum possible discharge.

**OR**

(b) An ideal gas flows into a convergent nozzle at a pressure of 865 kPa and temperature of 280 °C and negligible velocity. The gas is discharged into a reservoir where pressure can be varied. The exit area is 500 $mm^2$ for gas assume $\gamma = 1.3$ and cp = 1172 J/kg.K. Determine exit pressure, mass flow rate when exit temperature is 225 °C. The mass flow rate and exit temperature when exit pressure is 210 kPa. Comment on your results.

12. (a) Air is flowing into an insulated duct with a velocity of 150 m/s. The temperature and pressure at the inlet are 280 °C and 28 bar respectively. Find the temperature at a section in the duct where the pressure is 15.7 bar. If the duct diameter is 15 cm and the friction factor is 0.005, find the distance between the two sections.

**OR**

(b) Air flows through a constant area duct with inlet temperature of 20 °C and inlet Mach number of 0.5. What is the possible exit stagnation temperature ? It is desired to transfer heat such that at exit of the duct the stagnation temperature is 1180 K. For this condition what must be the limiting inlet mach number ? Neglect friction.

13. (a) Derive the Prandtl-Meyer Relations.

**OR**

(b) An air plane having a diffuser designed for subsonic flight has the normal shock attached to the edge of the diffuser when the plane is flying at a certain mach number. If at the exit of its diffuser the Mach number is 0.3, what must be the flight Mach number assuming isentropic diffusion behind the shock ? The area at inlet is 0.29 m and that at exit is 0.44 m.

14. (a) Describe the working of a ramjet engine with help of neat sketch. What is the effect of flight Mach number on its efficiency ?

**OR**

(b) A turbo jet has a speed of 750 km/h while flying at an altitude of 10000 m. The propulsive efficiency of the jet is 50% and the overall efficiency of the turbine plant is 16%. The density of the air at 10000 m altitude is 0.173 kg $m^3$. The drag on the plane is 6250 N. Calorific value of the fuel is 48000 kJ/Kg. Calculate

(i) Absolute velocity of the jet

(ii) Diameter of the jet and

(iii) Power output of the unit in kW.

15. (a) Explain the working principle of 'Hybrid Propellant Engine' with help of neat sketch. Mention its merits, demerits.

**OR**

(b) A rocket flies at 10,000 kmph with an effective exhaust jet velocity of 1500 m/s and the propellant flow rate of 4.5 kg/s. If the head of reaction of the propellant is 5800 kJ/kg of propellant mixture. Determine

(1) Propulsion Efficiency and Propulsion Power

(2) Engine Output

(3) Thermal Efficiency

(4) Overall Efficiency

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