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Question Paper Code: 31971

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

Elective

Mechanical Engineering

01UME902 - GAS DYNAMICS AND JET PROPULSION

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

(Standard gas tables are permitted)

PART A - (10 x 2 = 20 Marks)

1. What do you understand by stagnation temperature and stagnation pressure?
2. Define characteristic Mach number and write the relation between the local and characteristic mach number.
3. List the assumptions followed in Fanno flow.
4. Define isothermal flow with friction. Give the applications.
5. What is meant by strength of shock wave?
6. Differentiate between normal and oblique shock.
7. What is the principle of ram effect.
8. What is meant by thrust augmentation?
9. What are the types of liquid propellants used in rocket engines?
10. Name few advantages of liquid propellant rockets over solid propellant rockets.

PART - B (5 x 16 = 80 Marks)

11. (a) From the basic principles derive the relationship between compressibility of the fluid in terms Mach number. (16)

Or

(b) A subsonic diffuser operating under isentropic conditions has inlet area of 0.15 m^2. The inlet conditions are C_1 = 240 *m/s*, T_1 = 300 *K* and P_1 = 70 *kPa*. The velocity leaving the diffuser is 120 *m/s*. Analyse and determine the

(i) Mass flow rate

(ii) Exit stagnation pressure and temperature

(iii) Static pressure at exit

(iv) Change in entropy

(v) Maximum velocity

(vi) Crocco number (16)

12. (a) Air is flowing through an insulated duct. The inlet Mach number is 0.25. The friction factor 4 f = 0.01. Assuming the diameter of duct as 150 *cm*. Analyze and obtain,

(i) The length of pipe would give a 10% loss in stagnation pressure and Mach number at this section,

(ii) The percentage of stagnation pressure loss from inlet to a section at which the Mach number is 0.8

(iii) The maximum length of pipe to reach chocking condition (16)

Or

(b) Air having Mach number 3 with total temperature 295^oC and static pressure 0.5 *bar* flows through a constant area duct diabatically to another section where the Mach number is 1.5. Evaluate for air:

(i) The amount of heat transferred

(ii) Maximum heat transferred

(iii) Stagnation pressure loss

(iv) Critical state properties. (16)

13. (a) Apply the energy equation for a flow through normal shock and evaluate the Prandtl-Meyer relations. (16)

Or

(b) Use the data $P_0 = 1$ *bar*, $T = 280$ *K* and $M = 2$ for a jet of air at the entry of diffuser. The exit to entry area ratio is 4. If the normal shock stands just outside the entry of the diffuser, find the following at the exit

(i) Mach number, pressure and temperature

(ii) Stagnation pressure loss across the shock. (16)

14. (a) With the aid of neat sketch, explain the working and construction of:

(i) Ramjet engine

(ii) Pulsejet engine (16)

Or

(b) An air craft takes 45 *kg/s* of air at 950 *km/h.* The fuel supplied is with calorific value of fuel is 42 *MJ/kg* and with air fuel ratio of 50. For the maximum thrust, find the

(i) Jet velocity (ii) Specific Thrust (iii) Thrust power

(iv) TSFC (v) Overall efficiency (16)

15. (a) The specific impulse of a rocket is 125*s* and the flow rate of propellant is 44 *kg/s*. The nozzle throat area is 18 cm^2 and the pressure in the combustion chamber is 25 *bar*. Analyse and determine:

(i) The thrust coefficient

(ii) Propellant flow coefficient

(iii) Specific propellant consumption

(iv) Characteristic velocity (16)

Or

(b) (i) Explain the construction and operation of a liquid propellant rocket engine with neat sketch. (10)

(ii) What are the properties of good propellants? (6)

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