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Question Paper Code: 49702

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2018

Elective

Mechanical Engineering

14UME902 - GAS DYNAMICS AND JET PROPULSION

(Regulation 2014)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

- The flow in which the fluid characteristics do not change with respect to time
 - Continuous flow
 - One dimensional flow
 - Two dimensional flow
 - Steady flow
- Subsonic Converging passage of nozzle may be acted as
 - Subsonic diffuser
 - Sonic throat
 - Supersonic diffuser
 - Hypersonic diffuser
- The value of mach number of air at the maximum point of Rayleigh flow is
 - 0.5
 - 0.25
 - 0.75
 - 1
- The value of mach number of air at the maximum point of Rayleigh flow is
 - 0.5
 - 0.25
 - 0.75
 - 1
- The stagnation pressure across normal shock may
 - increase
 - decrease
 - remains constant
 - increase or decrease
- Shock can be develop in a _____ flow.
 - supersonic
 - subsonic
 - sonic
 - none of these

7. Propulsive efficiency is defined as the ratio of
- (a) Thrust power and fuel energy (b) Engine output and propulsive power
- (c) Propulsive power and fuel input (d) Thrust power and propulsive power
8. In jet engines, for the efficient production of large power, fuel is burnt in an atmosphere of
- (a) Vacuum (b) Atmospheric air
- (c) Compressed air (d) Oxygen alone
9. Characteristic velocity is the ratio of
- (a) Thrust coefficient to effective jet velocity
- (b) Effective jet velocity to thrust coefficient
- (c) Effective jet velocity to friction coefficient
- (d) Stagnation velocity of sound to thrust coefficient
10. Characteristic velocity is the ratio of
- (a) thrust coefficient to effective jet velocity
- (b) effective jet velocity to thrust coefficient
- (c) effective jet velocity to friction coefficient
- (d) stagnation velocity of sound to thrust coefficient

PART - B (5 x 2 = 10 Marks)

11. Find the acoustic velocity of sound when the temperature of the medium is 300K
12. Give two practical examples where the Fanno flow occurs.
13. Define oblique shock where it occurs.
14. List the different types of jet engines.
15. Name some oxidizer uses in rockets.

PART - C (5 x 16 = 80 Marks)

16. (a) A conical diffuser has entry diameter 20 cm. The Mach number, temperature and pressure are 0.6, 120 kN/m² and 340 K. The Mach number at exist is 0.2. For one dimensional isentropic flow, calculate: (i) Pressure, temp and velocity at exist (ii) Mass flow rate, and exit diameter, and (iii) Change in impulse function. (16)

Or

- (b) A conical diffuser has entry diameter 20 cm. The Mach number, temperature and pressure are 0.6, 120 kN/m² and 340 K. The Mach number at exit is 0.2. For one dimensional isentropic flow, calculate: (i) Pressure, temp and velocity at exit (ii) Mass flow rate, and exit diameter, and (iii) Change in impulse function. (16)

17. (a) A long pipe of 25.4mm diameter has a mean co-efficient of friction of 0.003. Air enters the pipe at a mach number of 2.5, stagnation temperature 310 K and static Pressure 0.507 bar. Determine for a section at which the mach number reaches 1.2, (a) Static Pressure and Temperature (b) Stagnation Pressure and Temperature. (c) Velocity of air (d) Distance of this section from the inlet (e) Mass flow rate of air. (16)

Or

- (b) A gas ($\gamma = 1.3$ and $R = 0.46$ kJ/kg K) at a pressure of 70 kPa and temperature of 295 K enters a combustion chamber at a velocity of 75 m/s. The heat supplied in a combustion chamber is 1250 kJ/kg. Determine, the Mach number, pressure and temperature of gas at exit. (16)
18. (a) An Aircraft flies at a Mach number of 1.1 at an altitude of 15,000 meters. 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: (i) Mach number (ii) Temperature of the air (iii) Pressure of the air (iv) Stagnation pressure loss across the shock. (16)

Or

- (b) Air having a Mach number 3.0, approaches a symmetrical wedge having a wedge angle of 30°. The pressure and temperature of the air are 1 bar and 27°C. Find the Mach number and velocity of flow downstream of the shock wave, assuming that a weak oblique shock is formed. Also, find the pressure, density, temperature and stagnation pressure downstream of the shock wave. (16)
19. (a) Illustrate the working of ramjet engine and depict the various thermodynamic processes occurring in it on $h-s$ diagram. Write down its main advantages and disadvantages. (16)

Or

- (b) An aircraft flies at 960kmph. One of its turbo jet engines takes in 40kg/s of air and expands the gases to the ambient pressure. The air-fuel ratio is 50 and the over calorific value of the fuel is 43MJ/kg. For maximum thrust power determine
- a) Jet velocity b)Thrust c)Specific thrust
- d) Thrust power e) Propulsive, thermal and overall efficiency (16)

20. (a) A rocket nozzle has a throat area of 18cm^2 and combustor pressure of 25bar.If the specific impulse is 127.42sec and the rate of flow of propellant is 44.145N/s, determine the thrust coefficient, propellant weight flow coefficient, specific propellant consumption and characteristic velocity. (16)

Or

- (b) (i) Describe with the aid of neat sketches the two arrangements of solid propellant grains employed for restricted and unrestricted burning. (10)
- (ii) List out any three important applications of rocket propulsion. (6)
