A **Reg. No. :** | | | | | | | | | | |

Question Paper Code: 59702

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

Elective

Mechanical Engineering

15UME902- GAS DYNAMICS AND JET PROPULSION

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. In Sonic flow Mach number is CO1- R

(a) M=0 (b) M<1 (c) M=1 (d) M>1

2. The function of Diffuser is CO1- R

(a) Increase the pressure (b) Increase the velocity

(c) decrease the pressure (d) None of these

3. For Rayleigh flow which one is correct. CO2- R

(a) $T_{01} = T_{02}$ (b) $P_{01} = P_{02}$ (c) $P_1^* = P_2^*$ (d) None of these

4. Flow in a constant area duct with friction without heat transfer is known as CO2- R

(a) Fanno flow (b) Rayleigh flow (c) Both A & B (d) None of these

5. In Normal shock wave Upstream Mach number is CO3- R

(a) M=0 (b) M=1 (c) M<1 (d) M>1

6. Across a Normal shock CO3- R

(a) the entropy remains constant (b) the pressure and temperature rise

(c) the velocity and pressure decrease (d) the density and temperature decrease

7. The principle of jet propulsion is CO4- R

(a) Newton's first law (b) Newton's third law

(c) Zeroth law of thermodynamics (d) None of these

8. A jet engine has CO4- R

(a) propeller in front (b) propeller at back

(c) propeller on the top (d) no propeller

9. What is the unit for Specific impluse? CO5- R

(a) W (b) Kg (c) Sec (d) Kg / S

10. A rocket engine uses _____ for the combustion of its fuel. CO5- R

(a) its own oxygen (b) compressed atmospheric air

(c) surrounding air (d) none of these

PART – B (5 x 2= 10Marks)

11. Define Mach cone. CO1- R
12. Write the practical examples for Rayleigh flow. CO2- U
13. Differentiate oblique and normal shocks. CO3- R
14. Define Propulsive efficiency? CO4- R
15. What are bi-propellants? Give two examples. CO5 R

PART – C (5 x 16= 80Marks)

16. (a) Air flows adiabatically through a pipe with a constant area. At point 1 the stagnation pressure is 0.35 Mpa and the mach number is 0.4. Further downstream the stagnation pressure is found to be 0.25 Mpa. What is the mach number at the second point for subsonic flow. CO1- Ana (16)

Or

(b) In an isentropic flow diffuser the inlet area is $0.15m^2$.At the inlet velocity 240 m/s,static temperature 300K and static pressure 0.7bar.Air leaves the diffuser with a velocity of 120 m/s.Calculate at the exit the mass flow rate,stagnation pressure,stagnation temperature,exit area and change in entropy across the diffuser. CO1- App (16)

17. (a) A combustion chamber in a gas turbine plant receives air at 350 K, 0.55 bar and 75m/s The air fuel ratio is 29 and the calorific value of the fuel is 41.87 MJ/kg. Taking $\gamma = 1.4$ R = 0.287 KJ/kg K for the gas, determine the following CO2- App (16)

(i) Initial and final Mach number

(ii) Final pressure, temperature and velocity of the gas

(iii) Stagnation pressure loss in the combustion chamber

(iv)The maximum stagnation temperature

Or

(b) Air enters 20mm diameter, 11m long pipe at a Mach number of 0.24. Pressure of 2 bar and temperature of 300K If the friction factor is 0.003. Determine the following CO2- App (16)

(i)Mass flow rate

(ii) Exit pressure

(iii) Exit temperature

(iv) Exit Mach number

18. (a) A Mach-2 aircraft engine employes a subsonic inlet diffuser of area ratio 3. A normal shock is formed just upstream of the diffuser inlet. The free-stream conditions of upstream of the diffuser are $P_0 = 0.10$ bar, T= 300K, determine CO3- App (16)

Mach number, pressure and temperature at the diffuser exit

Or

(b) Starting from the energy equation for flow through a normal shock obtain the following relation.($M_x^* . M_y^* = 1$) CO3- U (16)

19. (a) Describe the principle of operation of a turbofan engine with neat sketch and state its advantages and disadvantages. CO4- U (16)

Or

(b) An aircraft flies at a speed of 520 kmph at an altitude of 8000m. The diameter of the propeller of an aircraft is 2.4 m and flight to jet speed ratio is 0.74 Find the following: CO4- App (16)

(i) The rate of air flow through the propeller

(ii) Thrust produced

(iii) Specific thrust

(iv) Specific impulse

(v) Thrust power.

20. (a) (i) What are the properties of liquid propellants? CO5- U (10)

(ii) State the applications of rocket engines. CO5- U (6)

Or

(b) A rocket nozzle has a throat area of 18 cm^2 and combustion chamber pressure 2.5 MPa If the specific impulse is 127.42 secs and weight flow rate 44.145 N/sec. determine CO5- App (16)

(i) the thrust co-efficient

(ii) Propellant weight flow co-efficient

(iii) specific propellant consumption

(iv) the characteristic velocity