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

Question Paper Code: 99702

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2022

Elective

Mechanical Engineering

19UME902 - Gas Dynamics and Jet propulsion

(Regulations 2019)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. In turbulent flow the fluid particles follows _____ path. CO1- U

   (a) smooth (b) continuous (c) irregular (d) uniform

2. For a Incompressible flow CO1- U

   (a) M<0.3 (b) M>0.3 (c) M=0.3 (d) M=0

3. Flow in a constant area duct with heat transfer is known as CO1- U

   (a) Fanno flow (b) Isothermal (c) Rayleigh flow (d) Isentropic flow

4. In Rayleigh flow entropy increases due to heat CO1- U

   (a) Addition (b) Deletion (c) None of these (d) All the above

5. The shock wave right angle to the flow is called CO1- U

   (a) Normal (b) Oblique (c)Expansion (d) Compression

6. Which of the following is weak shock wave? CO1- U

   (a) Normal (b) Expansion (c) Compression (d) both b and c

7. Pulse Jet Engine is also called as CO1- U

   (a) Turbo Jet (b) Flying Bomb (c)Turbo Fan (d) none of these

8. Air Breathing Engines is also called as CO1- U

   (a) Rocket Engine (b) Jet Engine (c)Petrol Engine (d) Diesel Engine

9. Liquid fuel consists of CO1- U

   (a) Refine petrol (b) liquid hydrogen (c) Hydrazine (d) None of the above

10. Hybrid propellant oxidizer used for CO1- U

(a) fluorine (b) nitrogen (c) both (a) & (b) (d) None of the above

PART – B (5 x 2= 10 Marks)

11. Define Mach angle and Mach wedge CO1- U

12. List the assumptions made in Rayleigh flow CO1- U

13. Define strength of shock wave. CO1- U

14. List the main parts of ramjet engine CO1- U

15. State the advantages of nuclear rocket engines. CO1- U

PART – C (5 x 16= 80 Marks)

16. (a) Air expands isentropically through the convergent nozzle from constant inlet conditions P_O = 4 bar, T_o= 550K, Exit area of nozzle is 1000cm^2. Determine the exit velocity and the mass flow rate for the following two cases at exit, M =1, M = 0.85. CO3- App (16)

Or

(b) The jet of a gas at 500K has a mach number of 1.2. Determine the following (i) local velocity of sound , (ii) Stagnation velocity of sound, (iii) Static enthalpy, (iv) maximum attainable velocity of jet γ=1.4 R = 469J/kgK CO3- App (16)

17. (a) The Mach number at the exit of a combustion chamber is 0.9. The ratio of stagnation temperature at exit and entry is 3.74. If the pressure and temperature of the gas at exit are 2.5 bar and 1000℃ respectively. Take γ=1.3,Cp=1.218KJ/KgK and determine (a) Mach number, pressure and temperature of the gas at entry (b) the heat supplied per kg of the gas (c) the maximum heat that can be supplied CO4- App (16)

Or

(b) The friction factor for a 50mm diameter steel pipe is 0.005. At inlet to the pipe the velocity is 70 m/s, temperature is 800C and the pressure is 10 bar. Find the temperature, pressure and Mach number at exit if the pipe is 25m long also determine the maximum possible length. CO4-App (16)

18.	(a)	An air jet at a Mach number of 2.1 is isentropically deflected by 10° in the clockwise direction. The initial pressure is 100kN/m2 and initial temperature is 98°C. Determine the final state of air after expansion	CO3- App	(16)
		Or		
	(b)	An oblique shock wave occurs at the leading edge of a symmetrical wedge. Air has a Mach number of 2.1 and deflection angle (δ) of 15°. Determine the following for strong and weak waves. 1. Wave angle 2. Pressure ratio 3. Density ratio 4. Temperature ratio 5. Downstream Mach number.	CO3- App	(16)
19.	(a)	Explain the working of turbo propeller engine with neat sketch	CO1- U	(16)
		Or		
	(b)	Explain the working of pulse jet with neat sketch	CO1- U	(16)
20.	(a)	Describe the types of liquid propellants and its important properties desired for rocket propulsion.	CO1- U	(16)
		Or		
	(b)	Explain the construction, working principle and operation of hybrid propellant rocket engines with neat sketch and also state its advantages.	CO1- U	(16)