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Question Paper Code	11521

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV/DEC 2022

Sixth Semester

Mechanical Engineering

ME8096 - GAS DYNAMICS AND JET PROPULSION

(Regulations 2017)

(Use of Gas Tables is permitted)

Duration: 3 Hours | Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks, K-Level, CO
1.	What is the basic difference between compressible and incompressible fluid flow?	*2,K1,CO1*
2.	Define M* and give the relation between M and M*.	*2,K1,CO2*
3.	Compare fanno flow and isothermal flow.	*2,K4,CO3*
4.	Give two practical examples where the fanno flow occurs.	*2,K3,CO3*
5.	Write Prandtl-Meyer relation and its significance.	*2,K3,CO4*
6.	What are the assumptions made in oblique shock?	*2,K1,CO4*
7.	How will you classify propulsive engines?	*2,K1,CO5*
8.	Define propulsive efficiency.	*2,K1,CO5*
9.	What are inhibitors?	*2,K1,CO6*
10.	List out the advantages of liquid propellant rockets over solid propellant rockets	*2,K1,CO6*

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

11.	a)	The Pressure, temperature and velocity of air at the entry of a diffuser are 0.7 bar, 345 K and 190 m/s respectively. The entry diameter of a diffuser is 15 cm and exit diameter is 35 cm. Determine the following. (i) Exit pressure (ii) Exit velocity (iii) Force exerted on the diffuser walls. Assuming isentropic flow and take $\gamma = 1.4$, C_p=1005 J/kgK.	*13,K3,CO1*
		OR	
	b)	Air enters the nozzle from a large reservoir at 0.7 bar and 300K. The cross sectional area of the throat is 1200cm^2 and test section mach number is 1.98. calculate the following for one dimensional isentropic	*13,K3,CO1*

flow
(i) Pressures, temperatures and velocities at the throat and test-sections.
(ii) Mass flow rate
(iii) Power required to drive the compressor
(iv) Area of cross section of the test section

12. a) Air is having Mach number 3 with total temperature 295°C and static pressure 0.5bar flows through a constant area duct adiabatically to another section where the Mach number is 1.5. Determine the amount of heat transfer and the change in Stagnation pressure. *13,K3,CO3*

OR

b) The Condition of a gas in combustion chamber at entry are $T_1 = 375$ K, $P_1 = 0.050$bar, $C_1 = 70$ m/s. The air – fuel ratio is 29 and the calorific value of the fuel is 42MJ/Kg. Calculate, *13,K3,CO3*
(i) Initial and final mach number
(ii) Final pressure, temperature and velocity
(iii) Gas Percentage of stagnation pressure loss
(iv) Maximum stagnation temperature
Take $\gamma = 1.4$ and $R = 0.287$ kJ/kgK.

13. a) A converging diverging nozzle has an exit to throat area ratio of 2. Air enters the nozzle with a stagnation pressure of 6.5 bars and a stagnation temperature of 93^0 C. The throat area is $6.25cm^2$. If there is a normal shock wave standing at the point where M=1.5, determine the pressure, temperature on either side of the plane of shock and the Mach number on the downstream side of the plane. *13,K3,CO4*

OR

b) An oblique waves occur at the leading edge of a symmetrical wedge. Air has a mach number of 2.1 and deflection angle of 15°.Determine strong and weak waves. *13,K3,CO4*
(i) Wave angle
(ii) Pressure ratio
(iii) Density ratio
(iv) Temperature ratio
(v) Downstream mach number

14. a) Explain the construction and working of a Ramjet engine. *13,K2,CO5*

OR

b) The flight speed of a turbojet is 800 km/h at 10,000 m altitude. The density of air at that altitude is $0.17kg/m^3$. The drag for the plane is 6.8KN. The propulsive efficiency of the jet is60%. Calculate the SFC, air-fuel ratio, jet velocity. Assume the calorific value of fuel is 45000 KJ/kg and overall efficiency of the turbojet plane is 18%. *13,K3,CO5*

15. a) Explain with a help of neat sketch the working of solid and liquid propellant rocket engine. *13,K2,CO6*

OR

b) A rocket has the following data *13,K3,CO6*
Propellant flow rate = 0.5 Kg/s
Nozzle exit diameter = 10cm
Nozzle exit pressure = 1.02bar
Ambient pressure = 1.013 bar
Thrust chamber pressure = 20 bar
Thrust = 7 KN
Determine: Effective jet velocity, actual jet velocity, specific impulse and specific propellant consumption. Recalculate the value of thrust and specific impulse for an altitude where ambient pressure is 10 bar.

PART - C (1 × 15 = 15 Marks)

16. a) Derive Prandtl- Meyer Relation. *15,K3,CO4*

OR

b) In a supersonic nozzle air expands from p_o = 24 bar and T_o = 1000 K to an exit pressure of 4.3 bar. If the exit area of the nozzle is 110 cm^2, Calculate the following: (i) Throat area, (ii) Pressure and Temperature at the throat, (iii) Temperature at exit, (iv) Mass Flow Rate, (v) Exit velocity as fraction of the maximum attainable velocity. *15,K3,CO2*