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

Question Paper Code: 59702

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

Elective

Mechanical Engineering

15UME902- GAS DYNAMICS AND JET PROPULSION

(Regulation 2015)

(Approved Gas Tables and Steam tables permitted)

Duration: Three Hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. In transonic flow Mach number is CO1- R

   (a) 0.8<M<1.2 (b) 0.8>M<1.2 (c) 0.8<M<1.5 (d) 0.9<M<1.2

2. In chocking condition at Fanno flow Mach number is CO1- R

   (a) 1 (b) >1 (c) Infinity (d) None of these

3. Fanno line flow in a constant area duct CO2- R

   (a) With friction and heat transfer but in the absence of work

   (b) With friction and heat transfer accompained by work

   (c) With frictional but in the absence of heat transfer or work

   (d) Without friction but accompained by heat transfer and work

4. In Rayleigh flow at subsonic Mach number heat addition CO2- R

   (a) Decreases the static pressure (b) Decreases the enthalpy

   (c) Increases the static pressure (d) Decreases the static temperature

5. Across a normal shock CO3- R

   (a) The pressure and temperature rise (b) The density and temperature decreases

   (c) The velocity and pressure increases (d) The enthalpy remains constant

6. If the disturbance is _____ amplitude shock waves are created. CO3- R

(a) equilibrium (b) finite

(c) infinite (d) non-equilibrium

7. Propulsion efficiency is defined as CO4- R

(a) Engine output and propulsive work

(b) Thrust power and heat released by combustion of fuel

(c) Propulsive work and heat released by combustion of fuel

(d) Thrust power and propulsive power

8. Jet engines are classified into _____ types. CO4- R

(a) 5 (b) 4 (c) 3 (d) 2

9. In rocket propulsion the oxygen from its combustion of fuel is taken from CO5- R

(a) Surrounding air (b) The rocket itself

(c) Compressed atmospheric air (d) Surrounding air and compressed atmospheric air

10. Hybrid rocket engines are also called as _____ propellant rocket engines CO5- R

(a) solid (b) liquid (c) solid & liquid (d) none of the mentioned

PART – B (5 x 2= 10Marks)

11. Define nozzle and diffuser CO1- R

12. List the three governing equation for fanno process. CO2- R

13. List some application of moving shock wave CO3-U

14. Define Propulsive efficiency and Overall efficiency CO4- R

15. Differentiate between monopropellant and bi-propellant CO5- R

PART – C (5 x 16= 80Marks)

16. (a) (i) Air (γ=1.4, R=287.43J/kg K) enters a straight axisymmetric duct at 300K, 3.45 bar and 150 m/sec and leaves it at 277K, 2.058 bar and 260 m/sec. The area of cross section at entry is 500cm^2 assuming adiabatic flow determine CO1 - App (8)

(1) stagnation temperature

(2) maximum velocity

(3) mass flow rate and

(4) area of cross section at exit.

		(ii) Air at 200Kpa flows at a velocity of 50 m/sec. Find the Mach number at a point where its density is 2.9kg/m^3.	CO1 - App	(8)
		Or		
	(b)	A conical air diffuser has entry and exit diameters of 15cm and 30 cm respectively. The pressure, temperature and velocity of air at entry are 0.69 bar, 340 K and 180 m/s respectively. Determine exit pressure and exit velocity. Assume isentropic flow, γ=1.4 and C_P=1.0 kJ/kgK.	CO1 - App	(16)
17.	(a)	The pressure, temperature, Mach number of the gas at exit are 2bar, 1200°C and 0.7 respectively. The ratio of stagnation temperature at exit to entry is 3.85. Calculate 1. Mach number, Pressure and temperature of the gas at entry 2. The heat supplied per kg of gas 3.The maximum heat supplied 4. Is it a heating or cooling process.	CO2 - App	(16)
		Or		
	(b)	A circular duct passes 8.25kg/s of air at exit mach number of 0.5. The entry pressure and temperature are 345kPa and 38°C respectively and the coefficient of friction is 0.005. If the mach number at entry is 0.15. Determine 1) Diameter and Length of the duct 2) Properties at exit 3) Stagnation pressure loss.	CO2 - App	(16)
18.	(a)	The upstream Mach number, pressure and temperature of normal shock wave are 2.4 bar, 2 bar and 270 K respectively. Calculate the Mach number, pressure, temperature and velocity of the gas for downstream of the shock. Check the calculated values with those given in the gas tables. Take γ=1.3, R=460J/KgK	CO3 - App	(16)
		Or		
	(b)	The conditions of a gas in a combuster at entry are P_1 = 0.343 bar, T_1 = 310K, C_1 = 60m/sec. Determine the Mach number, pressure, temperature and velocity at the exit if the increase in stagnation enthalpy of a gas between entry and exit is 1172.5KJ/kg. Take Cp = 1.005KJ/kgK and γ= 1.4.	CO3 - App	(16)

19.	(a)	Explain the construction and working principle of a turbojet engine with a neat sketch and state its advantages and disadvantages	CO4 - App	(16)
		Or		
	(b)	An aircraft flies at 960Kmph. One of its turbojet engines takes in 40 kg/s of air and expands the gases to the ambient pressure .The air –fuel ratio is 50 and the lower calorific value of the fuel is 43 MJ/Kg .For maximum thrust power determine (a)jet velocity (b) thrust (c) specific thrust (d) thrust power (e) propulsive, thermal and overall efficiencies and (f) TSFC	CO4 - U	(16)
20.	(a)	Explain the construction, working principle and operation of liquid propellant rocket engine with neat sketch and also state its advantages.	CO5 - U	(16)
		Or		
	(b)	Define the following terms used in rocket engine (i) Thrust (ii) Specific impulse (iii) Specific propellant consumption (iv) Thrust Coefficient	CO5 - U	(16)