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

Question Paper Code: 59702

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2019

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. The Mach number at the entry of the nozzle is CO1- R

   (a) Less than 1 (b) Equal to 1 (c) Greater than 1 (d) Equal to 0

2. Identify the Mach number Formula CO1- R
   (c = fluid velocity, a = velocity of sound)

   (a) M = c/a (b) M= a/c (c) M=c*a (d) M = a - c

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

   (a) With friction but without heat transfer (b) Without friction but with heat transfer

   (c) With both friction and heat transfer (d) Without either friction or heat transfer

4. The locus of the state which satisfy the continuity and energy equation for a frictional flow is known as CO2- R

   (a) Fanno line (b)Rayleigh line (c) Eulers line (d) Bernoulli's Line

5. For oblique shock, the downstream Mach number CO3- R

   (a) Is always more than unity (b) Is always less than unity

   (c) May be less or more than unity (d) Can never be unity

6. In a normal shock in a gas, the CO3- R

(a) Upstream flow is supersonic

(b) Upstream flow is subsonic

(c) Down stream flow is sonic

(d) Both downstream flow and upstream flow are supersonic

7. A turbo-prop is preferred to turbo-jet because CO4- R

(a) It can fly at high elevations (b) It has high propulsive efficiency at high speeds

(c) It can fly at super sonic speeds (d) It has high power for take off

8. A jet engine has CO4- R

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

(c) Propeller on the top (d) No propeller

9. 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

10. Only rocket engines can be propelled to space because CO5- R

(a) They can generate very high thrus (b) These engines can work on several fuels

(c) They have high propulsion efficiency (d) They are not air-breathing engines

PART – B (5 x 2= 10 Marks)

11. Name the different regions of compressible fluid flow CO1- R

12. List the assumptions made for Fanno flow CO2- R

13. Define strength of shock wave CO3- R

14. Classify air breathing engines CO4- R

15. Name the few liquid propellants used in Rocket Engines CO5- R

PART – C (5 x 16= 80Marks)

16. (a) Air (cp = 1.05 kJ/kg K, γ = 1.38) at pressure 3 bar and temperature 500K flows with a velocity of 200 m/s in a 30cm diameter duct. Calculate
(i) mass flow rate
(ii) stagnation temperature
(iii) Mach Number
(iv) stagnation pressure. Assume the flow is compressible and incompressible respectively. CO1- App (16)

Or

(b) A supersonic diffuser diffuses air in an isentropic flow from a Mach number of 3 to Mach number of 1.5. The static conditions of air at inlet are 70 kPa and -7^{o}C. If the mass flow rate of air is 125 kg/s, determine CO1- App (16)

(i) Stagnation conditions

(ii) Area at throat and exit (iii) Static conditions of air at exit.

17. (a) Air is heated in a constant area duct from a Mach number of 0.2 to 0.8. The inlet stagnation conditions are 2 bar and 93^{o}C. Determine stagnation conditions of air at exit, the amount of heat transferred per unit flow and change in entropy. CO2- App (16)

Or

(b) A circular duct passes 8.25 kg/s of air at an exit Mach number of 0.5. The entry pressure and temperature are 3.5 bar and 38^{o}C respectively and co-efficient of friction is 0.005. If the Mach number at entry is 0.15, determine CO2- App (16)
(i) Diameter of the duct
(ii) Length of the duct
(iii) Pressure and temperature at exit
(iv) Stagnation pressure loss

18.	(a)	An oblique shockwave at an angle of 33^0 occurs at the leading edge of a symmetrical wedge. Air has a mach number of 2.1 , upstream temperature of 300k and upstream pressure of II bar. Determine downstream pressure, temperature and wedge angle.	CO3- App	(16)
		Or		
	(b)	The following data refer to compressible fluid flow in a convergent divergent nozzle. Throat area = 2.4 cm^2, Exit area = 5 cm^2, Stagnation pressure = 7 bar, Stagnation temperature = 100^oC. Normal shock occurs at a section where the cross section area is 3.4 cm^2. Taking the flow as isentropic flow before and after the shock. Determine (i) The properties of the fluid just after the shock (ii) Exit Mach number (iii) properties of the fluid at exit.	CO3- App	(16)
19.	(a)	Draw the neat sketch of turbo propeller and turbo jet engine and explain the working principle.	CO4- U	(16)
		Or		
	(b)	Draw the neat sketch of turbo form and with working principle.	CO4- U	(16)
20.	(a)	Explain the working principle of solid propellant rocket engine with neat sketch	CO5 U	(16)
		Or		
	(b)	Explain the construction and working of Hybrid Propellant Rocket Engine with neat illustration.	CO5 U	(16)