Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2022

Course: Gas Dynamics and Jet Propulsion **Semester: V**
Program: B. Tech ASE, B. Tech ASE+AVE **Time : 03 hrs.**
Course Code: ASEG 4014 **Max. Marks: 100**

Instructions: Make use of sketches/plots to elaborate your answer. Brief and to-the-point, answers are expected.
Assume suitable data if needed.
Gas Table allowed

SECTION A
(5Qx4M=20Marks)

Q. No.		Marks	CO
1	How does the molecular weight of a gas affects its speed of sound.	**4**	**CO1**
2	Discuss the turboshaft engine through TS plot.	**4**	**CO4**
3	Explain the condition of friction choking in fanno flow.	**4**	**CO2**
4	Discuss the technology challenges of future flight.	**4**	**C04**
5	Compare the merits and demerits of Propfan and Turbojet engine aircraft .	**4**	**CO4**
	SECTION B **(4Qx10M= 40 Marks)**		
6	Discuss the complete design aspects of Turbofan engine of an Ideal cycle.	**10**	**CO4**
7	Air is discharged from a reservoir at Po = 6.77 bar and To = 325 ^{0}C through a nozzle to an exit pressure of 0.96 bar . If the flow rate is 1 kg/s, find the throat area, pressure and velocity. Also find the exit area, exit temperature, and exit velocity.	**10**	**CO3**
8	Compute the thrust specific fuel consumption of a Ram jet engine under the given condition. Mach number= 2 Altitude =45,000 ft Ta = - 69.7^0 C Pa = 14.75 kPa Maximum Temperature = 2225 K Hydrocarbon fuel Qr = 43, 000 kJ/kg Assume constant properties of Υ and Cp , all process are Ideal no aerodynamics losses , no pressure loss.	**10**	**CO4**

9	A gas eneters a pipe line at a pressure and a temperature of 100 kPa and 400K with a Mach Number 2.0 . A normal shock is formed in the pipe at a location where Mach number has become equal to 1.5 . the flow passes the shock and continue till the end of the pipe where the Mach number is 1.0. if the diameter of the pipe is 300 mm and the mean friction coefficient is 0.003 , find 1. Distance from the entry to the location where shock is formed and the distance from the shock to the exit of the pipe. 2. Mass flow rate through the pipe. **OR** A gas (γ=1.3 and R = 0.46 KJ / Kg K) at a pressure of 70 Kpa and temperature of 295 K enters a combustion chamber at a velocity of 75 m / sec. The heat supplied in a combustion chamber is 1250 Kj / Kg .Determine the Mach number, pressure and temperature of gas at exit.	**10**	**CO2**
SECTION-C (2Qx20M=40 Marks)			
10	A single spool afterburning turbojet engine is powering a fighter airplane flying at Mach Number Ma = 2 at an altitude of 16,200 m where the temperutre is 216.6 K and the pressure is 10. 01 kPa. The inlet is of axisymmetric type and is fitted with spike having a deflection angle 12^0 . The air mass flow rate is 15 kg/s . the compressor has a pressure ratio of 5 and isentropic efficiency of 0.85. the pressure loss in the combustion chamber is 6 % and the heating value of fuel is 45,000 kJ/ kg. the burner efficiency is 0.96 and turbine inlet temperature 1200 K and its isentropic efficiency is 0.9. the maximum temperature in the afterburner is 2000 K. the pressure drop in the afterburner is 3 % and the afterburner efficiency is 0.9 . the nozzle efficiency is 0.96 calculate. 1. The stagnation pressure ratio of the diffuser and its isentropic efficiency 2. The thrust force.	**20**	**CO4,C05**
11	The condition of gas in a combustion chamber at entry are M_1=0.28, To_1=380 K, Po_1=4.9 bar. The heat supplied in the combustion chamber is 620 kJ/kg .Determine Mach number, pressure and temperature of the gas at exit and also determine the stagnation pressure loss during heating. Take γ = 1.3, cp=1.22 kJ/Kg K. **OR** Derive the expression for pressure ratio temperature ratio , velocity ratio, density ratio and stagnation pressure ratio for the fanno flow of perfect gas	**20**	**CO3**