Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2023

Course : Thermodynamics and Phase Behavior **Semester : III**
Program : B. Tech. (APE Upstream) **Time : 03 hrs.**
Course Code: MEPD 2005 **Max. Marks : 100**

Instructions:
✓ Attempt **all** questions from **Section-A** (each carrying 12 marks), **Section-B** (each carrying 20 marks). Assume suitable data wherever necessary. The notations used here have the usual meanings.

Section A (Attempt all questions)

S. No.		Marks	CO
1.	Attempt the following: (a) Define intensive and extensive property. (b) Write the statement of first law of thermodynamics. (c) Prove that $C_P - C_V = R$ for an ideal gas (d) State and define different thermodynamic systems.	**12 M**	**CO1**
2.	A slow chemical reaction takes place in a fluid at the constant pressure of 0.1 MPa. The fluid is surrounded by a perfect heat insulator during the reaction which begins at state 1 and ends at state 2. The insulation is then removed and 105 kJ of heat flow to the surroundings as the fluid goes to state 3. The following data are observed for the fluid at states 1, 2 and 3. State 1 v (m^3) t (°C) 1 0.003 20 2 0.3 370 3 0.06 20 For the fluid system, estimate E_2 and E_3, if $E_1 = 0$	**12 M**	**CO2**
3.	Develop an expression for work done in isochoric process and polytropic process	**12 M**	**CO1**
4.	Explain the working principle of Throttling Colorimeter for measurement of quality of Steam with neat diagram	**12 M**	**CO3**
5.	A blower handles 10 mol/s of air at 20 ^oC and consumes a power of 15 kW. The inlet and outlet velocities of air are 50 m/s and 100 m/s, respectively. Estimate the exit air temperature, assuming adiabatic conditions. Take C_P of air is 1.005 kJ/kg-K.	**12 M**	**CO2**
	Section B (Attempt all questions)		
6.	(a) Explain the phase change of a pure substance with P-V, P-T and V-T diagram.	**10+10 M**	**CO3**

	(b) For liquid acetone at 20°C and 1 bar, $\beta = 1.487 \times 10^{-3}$ °C^{-1}, $k = 62 \times 10^{-6}$ bar^{-1}, $V = 1.287$ cm^3·g^{-1}. For acetone, find: i) The value of $(\partial P / \partial T)_V$ at 20°C and 1 bar. ii) The pressure after heating at constant V from 20°C and 1 bar to 30°C. iii) The volume change when T and P go from 20°C and 1 bar to 0°C and 10 bar.		
7.	Describe Otto cycle in detail and derive an expression for the efficiency of an otto cycle. Also explain which cycle is most efficient among Otto and Diesel cycles for same compression ratio and heat rejection.	**20 M**	**CO4**