Name:

Enrolment No:

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

Course : Thermodynamics and Phase Behavior **Semester : III**
Program : B. Tech. (APE Upstream) **Time : 03 hrs.**
Course Code: MEPD 2007 **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

S. No.		Marks	CO
1.	Attempt the following: (a) Define open system and closed system (b) State zeroth law of thermodynamics (c) Give the relation between C_P and C_V (d) Define intensive and extensive properties with examples	**12 M**	**CO1**
2.	A gas in its ideal-gas state undergoes the following sequence of mechanically reversible processes in a closed system: (a) From an initial state of 70 ^oC and 1 bar, it is compressed adiabatically to 150 ^oC (b) It is then cooled from 150 to 70 ^oC at constant pressure (c) Finally, it expands isothermally to its original state. Calculate W, Q, ΔU^{ig}, and ΔH^{ig} for each of the three processes and for the entire cycle. Take C_V^{ig}=12.471, C_P^{ig}=20.785 J/mol.K.	**12 M**	**CO2**
3.	Describe the working principle of Throttling Colorimeter for measurement of quality of Steam with neat diagram	**12 M**	**CO3**
4.	Why is the Carnot cycle not a realistic model for a steam power plant? Explain	**12 M**	**CO4**
5.	Compare Otto and Diesel cycle based on working and performance.	**12 M**	**CO4**

SECTION-B

6.	a) Derive the law of conservation of energy using first law of thermodynamics for open system.1 b) 20 mol/s of air is compressed from 2 bar to 10 bar. The inlet temperature is 300K and at the outlet of the compressed air is 450K. The v1elocity at inlet and outlet of the compressor are 5 and 0.5 m/s. The compressor delivers power at 60 kJ/s. Assume	**10+10 M**	**CO2**

	that the enthalpy doesn't depend on pressure and C_P=1.5R, find the rate of heat transfer.		
7.	(a) Explain the phase change of a pure substance with P-V, P-T and P-V-T diagram. (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}, $V = 1.287$ $cm^3 \cdot g^{-1}$. 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.	**10+10 M**	**CO3**