U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

April 2024 Semester End Main Examinations

Programme: B.E. — **Semester: III**
Branch: Chemical Engineering — **Duration: 3 hrs.**
Course Code: 23CH3PCTD1 / 22CH3PCTD1 — **Max Marks: 100**
Course: Process Engineering Thermodynamics -I

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	***CO***	***PO***	**Marks**
1	a)	Define with examples i) Intensive and extensive properties ii) Enthalpy and iii) Work	*CO1*	*PO1*	**10**
	b)	Elucidate on scope of thermodynamics.	*CO1*	*PO1*	**05**
	c)	Explain the phase rule with examples.	*CO1*	*PO1*	**05**
		UNIT - II			
2	a)	Derive first law of thermodynamics for flow process.	*CO2*	*PO2*	**10**
	b)	Calculate changes in *U* and H in kJ for 1 kmol water, as it is vaporized at the constant temperature of 373 K and constant pressure of 101.3 kPa. The specific volumes of liquid and vapor at these conditions are 0.001 and 1.675 m^3/kmol respectively; 1030 kJ of heat is added to water for this change.	*CO2*	*PO2*	**10**
		OR			
3	a)	Explain reversible process with suitable example.	*CO2*	*PO2*	**10**
	b)	Steam at 1800 kPa and 673.15 K steadily enters a nozzle at a rate of 5 kg/s and leaves the nozzle at 1400 kPa with a velocity of 300 m/s. The inlet area of the nozzle is 0.02 m^2. Heat losses from the nozzle per unit mass of the steam are estimated to be 3.3 kJ/kg. Determine the exit temperature of the steam	*CO2*	*PO2*	**10**
		UNIT - III			
4	a)	Explain PVT behavior of fluids with PV & PT diagrams.	*CO3*	*PO2*	**10**
	b)	The *P-V-T* behavior of nitrogen is represented by the ideal gas equation $PV = nRT$, where n is the number of moles of the gas and R the ideal gas constant ($R = 8.314$ kJ/kmol K). The heat capacities of the gas are $C_v = 20.8$ and $C_p = 29.1$ kJ/kmol K. The gas initially at 10 bar and 280 K is undergoing a change of state to the final condition of 1 bar and 340 K. Determine the change in internal energy and the change in enthalpy.	*CO3*	*PO2*	**10**

			UNIT - IV			
	5	a)	Develop mathematical expression for change in internal energy, work done and heat for the following processes involving ideal gases. i) Isochoric Process ii) Isothermal process.	*CO4*	*PO2*	**10**
		b)	Carbon dioxide gas is sold commercially at 60 bar. The gas is leaking through the outlet valve slowly, so that its temperature may be assumed to be constant at the ambient temperature of 300K. i) Calculate the work done in the expansion of 10 kg of CO_2 gas from 60 bar to 1 bar. ii) If the temperature were constant at 290K, what would be the work done? iii) Find the changes in enthalpy in both the above cases.	*CO5*	*PO3*	**10**
			OR			
	6	a)	Derive an expression for work done in adiabatic process.	*CO5*	*PO3*	**10**
		b)	An ideal gas is undergoing a series of three operations: The gas is heated at constant volume from 300 K and 1 bar to a pressure of 2 bar. It is expanded in a reversible adiabatic process to a pressure of 1 bar. It is cooled at constant pressure of 1 bar to 300 K. Determine the heat and work effects for each step. Assume C_p = 29.3 kJ/kmol K.	*CO5*	*PO3*	**10**
			UNIT - V			
	7	a)	Derive an expression for Carnot engine efficiency.	*CO6*	*PO3*	**10**
		b)	Describe the second law of thermodynamics with the help of Kelvin-Planck's and Clausius statements. Write the relevant mathematical equations.	*CO6*	*PO3*	**10**

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