U.S.N.										

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

Autonomous Institute Affiliated to VTU

October 2024 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Chemical Engineering **Duration: 3 hrs.**
Course Code: 23CH4PCHTR **Max Marks: 100**
Course: Process Heat Transfer

Instructions:
1. Answer any FIVE full questions, choosing one full question from each unit.
2. Use of Steam tables is permitted.
3. 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.

				CO	PO	Marks
			UNIT - I			
1	a)		What are the modes of heat transfer involved when a steel vessel containing water is heated using a gas stove? State the governing laws with equations.	*CO4*	*PO2*	**06**
	b)		Define thermal conductivity. Explain the constant and variable thermal conductivities of materials with equations.	*CO1*	*PO2*	**06**
	c)		Derive an equation to determine the rate of heat flow through a multilayered (three) slab. State the assumptions.	*CO3*	*PO3*	**08**
			UNIT – II			
2	a)		Differentiate between fin effectiveness and fin efficiency.	*CO2*	*PO2*	**04**
	b)		List the important properties of insulation materials with examples.	*CO2*	*PO2*	**06**
	c)		What is critical insulation thickness? Derive an equation to determine the critical thickness of insulation for a cylinder.	*CO2*	*PO2*	**10**
			OR			
3	a)		What are the practical applications of unsteady-state heat transfer? Explain with some examples.	*CO1*	*PO2*	**08**
	b)		Derive an equation to calculate the effectiveness of a fin whose end is insulated. State all the assumptions.	*CO2*	*PO2*	**12**
			UNIT - III			
4	a)		Write the Nusselt's equation with the units of each term. What is the application of this equation?	*CO3*	*PO3*	**04**
	b)		Compare and contrast between film-type and dropwise condensation.	*CO3*	*PO3*	**06**

		c)	An organic oil flowing at a rate of 1500 kg/h through the inner pipe of the double-pipe heat exchanger is heated from 40 °C to 85 °C. The heat is supplied by an inorganic oil, which enters the annular space at 225 °C and leaves at 95 °C. Determine the heat transfer area and the required flow rate of inorganic oil. Assume the oils are flowing counter-currently in the heat exchanger. Data: U = 450 W/m^2 K; C_p of organic oil = 2.34 kJ/kg K; and C_p of inorganic oil = 2.51 kJ/kg K.	***CO3***	***PO3***	**10**
			OR			
	5	a)	Explain different regimes of boiling heat transfer phenomena with a neat sketch.	***CO1***	***PO2***	**10**
		b)	Discuss the concept of LMTD and derive LMTD expression for counter-current heat exchangers. Write all the assumptions.	***CO1***	***PO2***	**10**
			UNIT - IV			
	6	a)	What is evaporation? Carry out enthalpy balance for a single-effect evaporator. List any four industries where evaporation is applied.	***CO1***	***PO2***	**08**
		b)	With a neat sketch, explain the methods of feeding multiple-effect evaporators.	***CO1***	***PO2***	**12**
			UNIT - V			
	7	a)	Discuss the following. i. Absorptivity ii. Reflectivity iii. Black body radiation iv. Grey body radiation	***CO4***	***PO2***	**04**
		b)	State and explain Kirchhoff's, Planck's, and Wien's displacement laws.	***CO4***	***PO2***	**06**
		c)	Find the heat transfer rate per unit area due to radiation between two infinitely long parallel planes. The first plane has an emissivity of 0.4 and is maintained at 473 K. The emissivity of the second plane is 0.2. It is maintained at 300 K. If a radiation shield having $\varepsilon = 0.5$ is interposed between the given planes, find the percentage reduction in heat transfer rate.	***CO4***	***PO2***	**10**

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