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

Autonomous Institute Affiliated to VTU

September / October 2023 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Biotechnology **Duration: 3 hrs.**
Course Code: 22BT4PCHMT **Max Marks: 100**
Course: Heat and Mass Transfer

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)		A copper sphere is enclosed with 3 different materials of insulation. Develop an expression for heat transfer by conduction through the composite material assuming constant thermal conductivity.	*CO2*	*PO 1*	**10**
	b)		A tube having outside diameter 2 cm is maintained at a uniform temperature T_1 and is covered with an insulation k=0.2 W/mK to reduce heat loss. Heat is dissipated from the outer surface of insulation by natural convection with h=15 W/m^{2}K into an ambient air at T_0. Determine the critical thickness of insulation. Calculate the ratio of the heat loss from the tube with insulation to that without insulation for the radius of insulation 2 cm thicker than the critical radius.	*CO3*	*PO2*	**10**
			OR			
2	a)		Deduce the relation between overall and individual heat transfer coefficient based on the outside area.	*CO2*	*PO1*	**10**
	b)		Describe the construction and working of a 1-2 STHE with a neat labeled diagram.	*CO1*	*PO1*	**10**
			UNIT - II			
3	a)		Differentiate between film wise and drop wise condensation mechanisms with suitable diagrams.	*CO2*	*PO1*	**10**
	b)		A single effect evaporator operates at 13 kN/m^2. Estimate the heat transfer area required to concentrate 5000 kg/h of caustic soda solution from 10% to 40% solution. Saturated steam is available at 390K. The overall heat transfer coefficient may be considered as 1.25 kW/m^{2}K. The feed enters the evaporator at 300K. The boiling point elevation is 3.2^{0}F.The specific heats of feed and product are 3.768 kJ/kg and 3.14 kJ/kg, respectively. Data: Enthalpy of vapor =2376.108 kJ/kg; Enthalpy of liquid= 221.08 kJ/kg.	*CO3*	*PO2*	**10**

			UNIT - III			
	4	a)	Explain two-film theory of mass transfer across phase boundaries.	*CO2*	*PO1*	**10**
		b)	Discuss the following: i) Equimolar counter current diffusion ii) Measurement of diffusivity iii) Mass transfer coefficients iv) Fick's law of diffusion	*CO1*	*PO1*	**10**
			UNIT - IV			
	5	a)	With a neat sketch explain the flash distillation process. Using material balance and component balance, derive equations to determine the amount of distillate & bottom product.	*CO2*	*PO1*	**08**
		b)	A continuous fractionating column is to be designed to separate 30.000 kg/h of a mixture of 40 percent benzene and 60 percent toluene into an overhead product containing 97 percent benzene and a bottom product containing 98 percent toluene. These percentages are by weight. A reflux ratio of 3.5 mol to 1 mol of product is to be used. The molal latent heats of benzene and toluene are 7360 and 7960 cal/gmol, respectively. Benzene and toluene form an ideal system with a relative volatility of about 2.5; The feed has a boiling point of 95°C at a pressure of 1 atm. (a) Calculate the moles of overhead product and bottom product per hour. (b) Determine the number of ideal plates and the position of the feed plate, if the feed is liquid and at its boiling point.	*CO3*	*PO2*	**12**
			OR			
	6	a)	Explain the characteristics considered while selecting a solvent in extraction.	*CO1*	*PO1*	**08**
		b)	Describe the separation process by different types of aqueous two phase extraction with suitable examples.	*CO2*	*PO1*	**12**
			UNIT - V			
	7	a)	Discuss the reasons for using heat in a drier.	*CO1*	*PO1*	**4**
		b)	Explain the concept of supersaturation.	*CO1*	*PO1*	**6**
		c)	Elaborate on the various types of adsorption isotherms. What is the significance of these isotherms in adsorption?	*CO2*	*PO1*	**10**

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