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: Biotechnology **Duration: 3 hrs.**
Course Code: 23BT4PCHMT **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.

				CO	*PO*	Marks
			UNIT - I			
1	a)		Deduce the relation between individual and overall heat transfer coefficients based on outside area.	*CO2*	*PO 1*	**10**
	b)		Derive an expression for heat transfer by conduction through multilayer cylinder. State all assumptions made.	*CO2*	*PO 1*	**10**
			OR			
2	a)		Illustrate the construction and working of a 1-2 shell and tube heat exchanger with neat labelled diagram. Indicate advantages of the same.	*CO2*	*PO1*	**10**
	b)		Crude oil flows at a rate of 1000 Kg/h through the inside pipe of a DPHE and is heated from 300°C to 900°C.The heat is supplied by kerosene initially at 2000 °C flowing through the annular space. If the temperature of approach is 100°C, determine the heat transfer area for cocurrent flow and kerosene flow rate. Cp for crude oil =0.5 Kcal/Kg°C, Cp for kerosene =0.6Kcal/Kg°C and Uo=400Kcal/h.m^2. °C	*CO* 3	*PO2*	**10**
			UNIT – II			
3	a)		Illustrate the construction and working of a short tube vertical evaporator with neat labelled sketch.	*CO2*	*PO1*	**10**
	b)		A single effect evaporator is used to concentrate 30,000Kg/h of a 10% solution of a caustic soda to 50% concentration. Heating medium is dry and saturated steam at 120 °C. The vapour space pressure is 0.2 Mpa(absolute). The evaporator is working at reduced pressure such that the boiling point is 323 K. Compute the steam consumption, steam economy and heat transfer area if the following data is available. Feed temperature =35°C Latent heat of condensation of steam =2202 KJ/Kg Latent heat of vaporization of water at the vapour space pressure =2383KJ/Kg $(Cp)_{feed}$ =3.98 KJ/Kg°C $(Cp)_{product}$=0.75KJ/Kg°C Overall heat transfer coefficient, Uo=2900 W/m^2 °C	*CO* 3	*PO2*	**10**

			UNIT - III			
	4	a)	Illustrate the two film theory for mass transfer with a neat figure. Derive equation for overall mass transfer coefficient and brief controlling film concept.	*CO2*	*PO1*	**10**
		b)	In an oxygen-nitrogen gas mixture at 101.325 kpa and 298 K,the concentration of oxygen at two phases 4 mm apart are 15% and 25% by volume respectively. Compute the flux of diffusion of oxygen for the case where (i) nitrogen is non-diffusing (ii) there is equimolar counter diffusion of the two given gases,Diffusivity of oxygen in nitrogen is $1.81x10^{-5}m^2/s$.	*CO3*	*PO 2*	**10**
			UNIT – IV			
	5	a)	Derive Rayleigh equation which is applicable to differential or simple distillation. Brief the working principle of simple distillation.	*CO2*	*PO 1*	**08**
		b)	A continuous fractionating column is to be designed to separate 30,000 kg/h of a mixture of 40% benzene and 60% toluene into overhead product containing 97% benzene and a bottom product containing 98% toluene. These percentages are by weight. A reflux ratio of 3.5 mol to 1 mol of product 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 and pressure of 1 atm. a) Compute 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 at its boiling point.	*CO3*	*PO 2*	**12**
			OR			
	6	a)	With a neat sketch illustrate the flash distillation process. Using material balance and component balance, derive equations to determine the amount of distillate and bottom product.	*CO2*	*PO 1*	**10**
		b)	Explain aqueous two phase extraction and its steps. Give its applications.	*CO2*	*PO 1*	**10**
			UNIT - V			
	7	a)	What are the methods of supersaturation for crystallization to start? Explain the process of nucleation and crystal growth in crystallization.	*CO1*		**10**
		b)	Discuss various types of adsorption isotherms with relevant graphs and equations. Describe ion-exchange process with any one applications.	*CO2*	*PO 1*	**10**

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