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: Biotechnology **Duration: 3 hrs.**
Course Code: 23BT3ESPPC / 22BT3PCPPC **Max Marks: 100**
Course: Process Principles and Calculations

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)	2 grams of ninhydrin (molecular formula: $C_9H_6O_4$) is dissolved in 100 grams of water to prepare a ninhydrin stock solution in a biotechnology laboratory. Ninhydrin is commonly used in detection of amino acids. Express the composition of solution in i. Weight fraction and weight % and ii. Mole fraction and mole %		CO1	PO 1	**07**
	b)	A biotechnologist is interested to prepare 2.5L of a 0.250 M solution of potassium permanganate ($KMnO_4$). Calculate the mass of $KMnO_4$ needed to make the solution.		CO1	PO1	**05**
	c)	How can the following solutions be prepared? a. 47 ml of a 7%(w/v) solution of NaCl b. 200 ml of a 95% (v/v) solution of ethanol c. microliters of 20% SDS required to bring 1.5mL of solution to 0.5%		CO1	PO1	**08**
		UNIT - II				
2	a)	Demonstrate the following terms with necessary equations. i. The percentage humidity ii. The molal absolute humidity iii. The partial pressure of vapour in the sample iv. The relative humidity v. Dew point		CO1	PO1	**10**
	b)	Vapor mixture at 80^0C and 0.2 bar contains 20mol% toluene, 80mol% benzene. If the mixture is isothermally compressed at 80^0C, at what pressure the first condensate drop will be formed? What will be the composition of condensate drop? Data: V.P. of Benzene and Toluene at 80^0C is 1.013 bar and 0.381 bar respectively.		CO1	PO1	**10**
		OR				

	3	a)	The dry bulb temperature and wet bulb temperatures on a particular day in Bangalore to be 308 K and 299 K respectively. With the help of psychrometric chart, determine (i) absolute humidity, (ii) % RH, (iii) dew point.	*CO3*	*PO2*	**08**
		b)	Differentiate between Henrys law and Raoults law based on applications.	*CO1*	*PO1*	**04**
		c)	Consider the solution of methanol and water in a closed system. It is a homogeneous system. When this system is heated at elevated temperatures, it converts into vapour and liquid phases. Demonstrate the vapor liquid equilibrium of the process by increasing and decreasing temperatures, with neat T-x-y diagram.	*CO1*	*PO1*	**08**
			UNIT - III			
	4	a)	Fresh juice contains 15% solids and 85% water by weight and is to be concentrated to contain 40% solids by weight. In single evaporation system, it is found that the volatile constituents of juice escape with water leaving the concentrated juice with a flat taste. To overcome this problem, a part of the fresh juice bypasses the evaporator. The stream leaving the evaporator contains 55% solids. All percentages are given by mass. Calculate: a) the fraction of the juice that bypasses the evaporator b) the concentrated juice produced containing 40% solids / 100 kg of fresh juice fed to the process.	*CO2*	*PO2*	**10**
		b)	A distillation column separates a feed mixture containing 30% C_6H_6, 50% $C_6H_5CH_3$ and rest $C_6H_4C_2H_6$ on mole basis into an overhead fraction containing 95% C_6H_6, 4% $C_6H_5CH_3$ and rest $C_6H_4C_2H_6$ and bottom fraction containing 2% C_6H_6. On the basis of 1000 kmole of feed per hour, calculate i) Mass flow rate of the top fraction stream ii) Recovery of C_6H_6 in top stream and iii) % recovery of $C_6H_4C_2H_6$ in bottom stream.	*CO2*	*PO2*	**10**
			UNIT - IV			
	5	a)	Explain the terms, limiting and excess reactants with an examples.	*CO2*	*PO1*	**05**
		b)	In manufacture of chlorine, feed containing hydrochloric acid gas and air are fed to oxidizer. The product gases leaving the oxidizer are found to contain 13.2% HCl, 6.3 % O_2, 42.9% N_2, 30% Cl_2 and 7.6% H_2O (by weight). Calculate: i) % excess air used. ii) Composition by weight of gases entering the oxidizer. $4HCl+O_2 \longrightarrow 2Cl_2 + 2H_2O$	*CO2*	*PO2*	**10**
		c)	Explain proximate and ultimate analysis of coal.	*CO2*	*PO1*	**05**
			OR			

	6	a)	With a neat sketch, explain the concept and importance of bypass, recycle & purging operation in bioprocess industries.	*CO2*	*PO1*	**10**
		b)	The feed containing 60 mol% A, 30 mol% B and 10 mol% inerts enters a reactor.80 % of original A reacts according to the following reaction: $2A + B \rightarrow C$ Find the composition of the product stream on mole basis.	*CO2*	*PO2*	**10**
			UNIT - V			
	7	a)	Derive an equation for effect of temperature on standard heat of reaction.	*CO2*	*PO1*	**10**
		b)	Aerobic growth of a microorganism on ethanol is represented by the following overall stoichiometric reaction: $C_2H_5OH + aO_2 + bNH_3 \longrightarrow c(CH_{1.704}N_{0.149}O_{0.408}) + d\,CO_2 + eH_2O$ i) Determine the coefficients a, b, c, d and e where RQ = 0.66 ii) Calculate the biomass yield coefficients, $Y_{X/S}$, and Oxygen yield coefficients, $Y_{X/O2}$ (g dw cell/ g O_2)	*CO4*	*PO2*	**10**

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