BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: B. TECH **SEMESTER: Vth**
BRANCH: BIOENGINEERING & BIOTECHNOLOGY **SESSION: MO/25**

SUBJECT: BE303 MASS TRANSFER OPERATION

TIME:3 hour **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates

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			CO	BL
Q.1(a)	Define Roult's Law. Draw and describe the temperature concentration diagram at constant pressure.	[5]	1	3
(b)	Benzene is stored in a tank of diameter 10 m and open at top. A stagnant air film of 10 mm is covering the liquid beyond which benzene is absent. If the temperature is 25 °C, estimate the mass flux of benzene. Diffusivity is 0.02 m^2/h, P_t = 1 atm, R = 8314 J/(kmol.K), and $p_{A1} = 0.2\times10^5$ N/m^2	[5]	1	4
Q.2	A distillation column is used to separate methanol from water. The feed is a mixture that contains 70 mole % methanol. The overhead is 90 mole % methanol, and the bottom is 10 mole %. Consider a saturated liquid feed is provided; relative volatility is 3.32, and a reflux ratio twice the minimum is used. Calculate the number of theoretical plates, the minimum number of plates, and the feed plate location using graphical method.	[10]	2	5
Q.3(a)	In a ternary equilibrium diagram, indicate the point representing A = 40%, B = 30%, and C = 30%.	[5]	3	3
(b)	A clarified fermentation beer (H) containing 260 mg/L of antibiotic is to be extracted using butyl acetate (L). K = 57. We plan to use H = 450 L/h and L = 37 L/h to recover 90% antibiotics. How many stages are required for this separation?	[5]	3	5
Q.4(a)	What are the factors that influence leaching? Explain heap leaching with diagram.	[5]	4	2
Q.4(b)	In a pilot scale testing a vessel of 1 m^3 volume, a solute was leached from an inert solid. The water was saturated 75% in 10 sec. In a full scale unit, 500 kg of inert solid containing 28% w/w of soluble component is agitated with 100 m^3 of water. How long will it take for all the solute to dissolve? Assuming the same condition as pilot plant. Water is saturated with the solute at a concentration of 2.5 kg/m^3.	[5]	4	5
Q.5(a)	With a neat diagram, explain the Pervaporation method.	[5]	5	3
(b)	Write the advantages of using CO_2 for Super-critical fluid extraction. Briefly describe membrane distillation process.	[5]	5	3

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