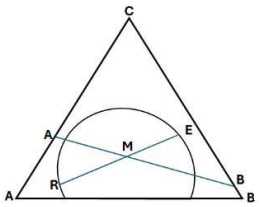
BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

CLASS: B.TECH. **SEMESTER: V/ADD**
BRANCH: CHEMICAL ENGINEERING **SESSION: MO/2025**
SUBJECT: CL301_MASS TRANSFER OPERATION- II
TIME: 2 HOURS **FULL MARKS: 25**

INSTRUCTIONS:

1. The total marks of the questions are 25.
2. Candidates attempt for all 25 marks.
3. Before attempting the question paper, be sure that you have got the correct question paper.
4. The missing data, if any, may be assumed suitably.
5. **Psychrometric chart and Graph paper** to be supplied to the candidates in the examination hall.

				CO	BL
Q1	(a)	Write down the significance of the plait point of triangular diagram for Liquid-liquid extraction process?	[2]	1	2
Q1	(b)	 A triangular diagram represented for a batch separation process is mixed with a solvent B to produce R and E. Substance A is the carrier liquid and C is the solute to be extracted. The amount of B and E are 1 kg and 1.2 kg. The length AM is 3.1 unit and AB is 8.5 unit. Calculate R/E.	[3]	1	3
Q2	(a)	Give a real-life example of Leaching process.	[1]	1	1
Q2	(b)	It was desired to extract A from feed containing 20 mole % A and 80 mole % B into ideal cross current stages using equal amount of pure solvent C in each stage. The component B & C are immiscible. 60 % of A is extracted in stage 1. The equilibrium medium is given by **y* = 1.5 x**, where x, is the moles of A per mole of B in raffinate phase and y* is the moles of A per mole of C in extract phase. Extract phase is in equilibrium with raffinate. Find the mole percent of A in raffinate from stage 2.	[4]	1	3
Q3	(a)	Determine the following psychrometric properties of moist air having dry bulb temperature of 50 °C and wet bulb temperature of 32.0 °C? (P = 1 atm) (**using Psychrometric chart**) a) % Humidity, b) Dew point, c) Humid volume, d) Humid heat and f) Enthalpy	[5]	2	3
Q4	(a)	Why are natural draft cooling towers in hyperbolic shape?	[2]	2	3
Q4	(b)	From the definition of wet bulb temperature, derive the expression of wet bulb depression.	[3]	2	3
Q5	(a)	It is planned to cool water from 43.3 °C to 29.4 °C in a packed counter current water-cooling tower using entering air at 29.4 °C with a wet bulb temperature of 23.9 °C. The water flow is 9700 kg/h.m^2 and the air flow is 6800 kg/h.m^2. The overall mass transfer coefficient is $K_Y^{/}a$ = 2500 kg/m^{3}h $(\Delta Y^{/})$. Calculate (a) minimum air rate that can be used and (b) tower height needed if air flow of 6800 kg/h.m^2 is used. Given: Height of transfer unit, $H_{toG} = \frac{G_S}{K_Y^{/}a}$. Tie lines are vertical. Enthalpies of saturated air-water vapor (Base temperature: 0 °C)	[5]	2	4

Temperature (°C)	$H^{/}$ (kJ / kg dry air)	$H_*^{/}$ (kJ / kg dry air)	Temperature (°C)	$H^{/}$ (kJ / kg dry air)	$H_*^{/}$ (kJ / kg dry air)
15.6		43.68	37.8	122.4	148.2
26.7		84.0	40.6	139.4	172.1
29.4	71.7	97.2	43.3	154.8	197.2
32.2	88.4	112.1	46.1		224.5
35.0	105.4	128.9	60.0		461.5

PTO

Psychrometric Chart: