A **Reg. No. :** | | | | | | | | | | |

Question Paper Code: 56901

B.E./B.Tech. DEGREE EXAMINATION, MAY 2018

Sixth Semester

Chemical Engineering

15UCH601 - MASS TRANSFER - II

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer All Questions

PART A - (10 x 1 = 10 Marks)

1. Absorption factor is defined as CO1- U

(a) mGL (b) mG/L (c) G/mL (d) L/mG

2. Absorption accompanied by heat evolution results in CO1- R

(a) increased solubility of gas in the liquid

(b) larger number of plates (than that required for isothermal absorption) for the same degree of separation

(c) increased capacity of the absorber

(d) none of the above

3. The relative volatility CO2- R

(a) is independent of pressure (b) decreases with increasing pressure

(c) increases with increasing pressure (d) increases with decreasing pressure

4. Raoults law is applicable to CO2- R

(a) ideal solutions (b) real solutions (c) all solutions (d) non-ideal gases

5. A solvent employed in a liquid-liquid extraction operation should preferably have CO3 R

(a) low viscosity and low interfacial tension (b) high viscosity and low interfacial tension

(c) low viscosity and high interfacial tension (d) high viscosity and high interfacial tension

6. At the plait point selectivity is CO3 R

(a) zero (b) 1 (c) 10 (d) infinity

7. For liquids of very small density difference, the most suitable extractor is CO4 R

(a) a mixer-settler unit (b) a rotating disc contactor

(c) a packed column extractor (d) a centrifugal extractor

8. In leaching operation, for constant under flow, y* / x is CO4 R

(a) greater than one (b) equal to one (c) less than one (d) equal to 0.5

9. Adsorption of a gas onto a solid can be conducted most efficiently at CO5 R

(a) high pressure and low temperature (b) low pressure and low temperature

(c) low pressure and high temperature (d) high pressure and high temperature

10. Which module is preferred for reverse osmosis operation? CO5 R

(a) Hollow fibre module (b) Plate and frame module

(c) Spiral wound module (d) No module is used

PART – B (5 x 2= 10Marks)

11. Give the importance of absorption factor. CO1- R

12. Draw the T-x,y diagram for constant pressure system CO2- U

13. Give the significance of "selectivity" in extraction. CO3- U

14. When heap leaching is preferred? CO4- R

15. Mention any two applications of adsorption process in process industries. CO5- R

PART – C (5 x 16= 80Marks)

16. (a) (i) Derive Kremser-Brown-Souders equation for the calculation of number of theoretical stages for absorption in a stagewise contact tower. CO1- App (8)

(ii) Discuss on what basis the choice of solvent was made in absorption. CO1- App (8)

Or

(b) An effluent gas containing 12% benzene is to be scrubbed in a packed column continuously, operating in counter-current manner at 43^{o}C and 1 atm pressure. The column is to be designed for treating 15 m^3 of entering gas per hour per square meter of the column cross section, such that the exit gas will contain 1% benzene. The solvent for scrubbing is mineral oil which will enter the top of the column at a rate of 28 kmol/hr.m^2 and a benzene content of 1%. Determine the height of the column assuming height of transfer unit to be 0.75 m. The equilibrium concentration at the operating conditions may be estimated as $y^* = 0.263\ x$. CO1- App (16)

17. (a) (i) Derive Rayleigh's equation for differential distillation. CO2- App (8)

(ii) A feed of 50 mole % hexane and 50 mole % octane is fed into a pipe still through a pressure reducing valve and then into a flash disengaging chamber. The vapor and liquid leaving the chamber are assumed to be in equilibrium. If the fraction of the feed converted to the vapor is 0.6. Find the compositions of the top and bottom products. the following table gives the equilibrium data for this system. CO2- App (8)

Mole fractions of hexane in liquid 'x'	1.00	0.69	0.40	0.192	0.045	0.00
Mole fractions of hexane in vapour 'y'	1.00	0.932	0.78	0.538	0.1775	0.00

Or

(b) A mixture of benzene and toluene containing 38 mole % of benzene is to be separated to give a product of 90 mole % of benzene at the top and bottom product with not more than 4 mole % of benzene. It is proposed to operate the unit with a reflux ratio of 3.0. Locate the feed plate and calculate number of plates. The feed enters the column at its boiling point. The vapour pressures of pure benzene and toluene are 1460 and 584 mm Hg respectively. Total pressure is 750 mm Hg. CO2- Ana (16)

18. (a) Nicotine in water solution containing 1% nicotine is to be extracted with kerosene at 20^{o}C. Kerosene and water are insoluble. Determine the percentage of extraction if 1000 kg of feed solution is extracted once with 1500 kg of solvent. What will be the extraction if three ideal stages are used with 50 kg. CO3- App (16)

X' kg nic/kg water	0.0010	0.0024	0.0050	0.00751	0.0099	0.020
Y' kg nic/ kg kerosene	0.00081	0.0019	0.0045	0.0068	0.0091	0.018

Or

(b) With neat sketch discuss the construction and working of Rotating Disc Contactor and Pulsed Column Extractor CO3- Ana (16)

19. (a) Explain the graphical method of determining the number of theoretical stages in a multistage counter-current leaching. CO4- U (16)

Or

(b) How leaching equipments are classified? Elaborate the methods/equipments you will adopt for the following cases:

(i) When there is a need to extract metallic compounds from low grade ore? CO4-Ana (4)

(ii) When there is a requirement for extracting oil from seeds? CO4- Ana (12)

20. (a) A solid adsorbent is used to remove the color impurities from an aqueous solution. The original value of color in an arbitrary scale is 48. It is required to reduce this value to 10% of its original value. Using the following data find the quantity of fresh adsorbent used for 1000 kg of a solution for CO5- U (16)

(i) Single stage

(ii) Two stage cross current operating with the intermediate color value of 24.

Equilibrium data:

kg adsorbent/kg solution	0	0.001	0.004	0.008	0.02	0.04
Equilibrium color	48	43	31.5	21.5	8.5	3.5

Or

(b) Briefly discuss about the basic principles and the commercial application of the following: CO5- U (16)

(i) Membrane separation process

(ii) Reverse osmosis

(iii) Electrodialysis