

SIXTH SEMESTER B.TECH DEGREE EXAMINATION

(Model Question)

(2013 scheme)

13.601 MASS TRANSFER OPERATIONS I

Maximum-100 marks

Time 3 hours

Part A

*Answer **all** questions. Each question carries 2 marks.*

- 1) Write Fick's law of diffusion and explain the terms.
- 2) State Colburn analogy between heat, mass and momentum transfer and define the dimensionless groups involved
- 3) Write the significance of absorption and stripping factor
- 4) Define wet bulb depression and how it is related to psychrometric ratio
- 5) Distinguish between humidification and dehumidification
- 6) Define absolute humidity and dew point.
- 7) List the factors which affect the zone of unsaturated drying
- 8) Explain $\propto L$ law of crystal growth
- 9) Describe Meir's super saturation theory
- 10) Distinguish between bound and unbound moisture. (10 x2 = 20 marks)

Part B

*Answer **one full** question from each module. Each question carries 20 marks*

Module-1

- 11) a) derive the equation to calculate the molar flux under steady state diffusion through a stagnant gas
- b) Describe the salient features of the penetration theory of mass transfer.

OR

12) Chloroform vapor is diffusing from the surface of the liquid contained in a capillary in to ambient air at 298K and 101.3kPa. The diffusivity of chloroform in air at this condition is $9.5 \times 10^{-6} \text{m}^2/\text{s}$. The vapor pressure of chloroform at 298K is 30Kpa. If the length of diffusion path is 70mm from the surface of the liquid, estimate the rate of steady state diffusion in $\text{Kmol}/\text{m}^2\text{s}$. Also estimate the mole fraction of chloroform halfway along the length of the diffusion path.

Module-II

- 13) a. Compare packed c columns versus plate columns for gas absorption
b. Derive kremser equation and describe its applications

OR

14) It is decide to absorb 95% of acetone from an acetone air mixture containing 2 percent (mole) acetone in a counter current packed tower. The gas flow rate is 4000 Kg/hm^2 pure water is used the solvent at a rate of 7000 Kg/hm^2 . The equilibrium solubility of acetone in water is given by $y^* = 2.53 x$ where x and y are the mole fractions of acetone in the liquid and gas phases respectively. The heights of individual transfer units are 0.32 m and 0.53 m respectively for the liquid phases. Assume dilute solutions and calculate the height of the tower

Module-III

15) Describe with a neat s sketch the types of cooling towers used in process industries.

- (b) Derive Lewis relation and explain its significance

OR

16) Air at a temperature of 30°C and a pressure of 100KPa has a relative humidity of 80%.

- a) Calculate the molar humidity of air
b) Calculate molar humidity of air if its is reduced to 15°C and its pressure is increased to 200KPa, condensing out some water
c) Calculate the weight of water condensed from 100m³ of original wet air in cooling to 15°C and compressing to 200KPa.

Module-IV

17) It takes 9 hours for a porous solid to reduce the moisture content from 45 to 10% when dried in a batch dryer under constant drying conditions. The critical moisture content was found to be 25% and the equilibrium moisture 3%. All moisture contents are on dry basis. Assuming that the rate of drying during the falling rate period is proportional to the free moisture content, how long should it take to dry a sample of the same solid from 35 to 5% under the same drying conditions

OR

18. a) Explain Rast law of crystal growth

b) 200Kg of 15% and 100Kg of 5% solution of Na_2SO_4 by weight are mixed in crystallizer and crystallization takes place. If 50Kg of $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ crystals are formed compute the composition of mother liquor

HANDOUT: CLARIFYING AND PROBING QUESTIONS

Name: _____

“Asking a good question can be valuable in and of itself, irrespective of the answer. It communicates your respect for the other person.”

- Adapted from the Iowa Peace Institute Message

Clarifying Questions are simple questions of fact. They clarify the dilemma and provide the nuts and bolts so that the participants can ask good probing questions and provide useful feedback.

Examples of Clarifying Questions:

- Is this what you said...?
- What resources were used for the project?
- Did I hear you say...?
- Did I understand you when you said...?
- What criteria did you use to...?
- What's another way you might...?
- Did I hear you correctly when you said...?
- Did I paraphrase what you said correctly?

Probing Questions are intended to help the presenter think more deeply about the issue at hand.

Examples of Probing Questions:

- Why do you think this is the case?
- What do you think would happen if...?
- What sort of impact do you think...?
- How did you decide...?
- How did you determine...?
- How did you conclude...?
- What is the connection between... and...?
- What if the opposite were true? Then what?

Using both clarifying and probing questions facilitates effective deliberation. It is helpful for the teacher to model using these types of questions since students may not have experience with them.

Optional Practice Activity: Form two lines (A and B) of students facing each other so that everyone has another person standing directly across from her/him to partner with. Make a statement such as: *Cell phones are better than land phones*. Allow a short amount of time for the student pairs to “huddle” and come up with one related clarifying question and one related probing question. Pick one of the pairs to share their questions. If their questions were truly clarifying and probing in nature, congratulate them and allow them to return to their seats. If they were not, recognize that more practice is needed and have them remain in the line. Proceed in this way, offering additional statements to which clarifying and probing questions can be formed, until all (pairs of) students are successfully returned to their seats.