

PARUL UNIVERSITY
FACULTY OF ENGINEERING & TECHNOLOGY
B.Tech. Summer 2022 - 23 Examination

Semester: 4
Subject Code: 203103253
Subject Name: Mass Transfer-I

Date: 22-03-2023
Time: 02:00pm to 04:30pm
Total Marks: 60

Instructions:

1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

Q.1 Objective Type Questions - (Fill in the blanks, one word answer, MCQ-not more than Five in case of MCQ) (All are compulsory) (Each of one mark) **(15)**

1. Define molar flux?
2. What is mass average and molar average velocity?
3. Define relative volatility.
4. What is the degree of freedom of distillation operation for binary component?
5. Define Schmidt number with formula?
6. Total reflux in a distillation operation requires minimum
 (a) reboiler load (b) number of plates (c) condenser load (d) all (a), (b) and (c)
7. In batch distillation with constant reflux, overhead product composition _____ with time.
 (a) increases (b) decreases (c) does not vary (d) may increase on decrease, depends on the system.
8. The mass diffusivity, the thermal diffusivity and the eddy momentum diffusivity are same for,
 $N_{Pr} = N_{Sc} =$ _____
 (a) 1 (b) 0.5 (c) 10 (d) 0
9. According to Lewis and Whitman theory, the departure from concentration equilibrium at the Interphase is due to
 a) Low mass transfer rates b) High mass transfer rates
 c) Moderate mass transfer rate d) None of the mentioned
10. Diffusion of components between the phases at equilibrium is
 a) Zero b) Infinity c) Changes continuously d) Diffusion never occurs
11. What is the dimension of the Schmidt number?
 a) Newton b) Meter c) Celsius d) It is a dimensional quantity
12. For what kind of mixtures $D_{AB}=D_{BA}$ holds?
 a) Ideal b) Real c) For both real and ideal d) This relation is never true.
13. Consider a steady-state condition; the concentration at any point in the equipment never changes with time. (True/False)
14. For minimum reflux ratio the number of trays becomes infinite. (True/False)
15. If the reflux is total, minimum stages are used. (True/False)

Q.2 Answer the following questions. (Attempt any three) **(15)**

- A) Explain mass, heat and momentum transfer analogies.
- B) Explain Fick's law in brief and prove $D_{AB} = D_{BA}$
- C) Define absorption factor A and Stripping factor S.
- D) Define: 1) Total reflux ratio 2) Minimum reflux ratio 3) boil up ratio

Q.3 A) Discuss interphase mass transfer. Explain in detail about Overall and individual mass transfer coefficients. Also derive interrelationship between these. **(07)**

- B) Explain selection criteria for choice of solvent for absorption.** **(08)**

OR

- B) State various theories of mass transfer co-efficient and discuss film theory at length. Also derive its equation** **(08)**

- Q.4** A). A mixture of benzene and toluene containing 60 moles% benzene is to be separated to give a product of 95 mole% benzene and bottom product containing 10 moles% benzene. The feed enters a column at its bubble point. It is proposed to operate the column with reflux ratio of 2.5. Calculate number of theoretical plates needed by McCabe-Thiele method and position of feed plate. The vapor liquid equilibrium data are given as below: **(07)**

X	0	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Y	0	0.13	0.21	0.375	0.5	0.6	0.7	0.77	0.83	0.9	0.95	1.0

OR

- A) Discuss batch distillation and derive Rayleigh equation for a binary mixture. **(07)**
- B) Deduce an equation for molar flux for diffusion of component A through non-diffusing component B in case of steady state molecular diffusion for liquid phase. **(08)**