

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER-VI EXAMINATION – WINTER 2025****Subject Code:2160503****Date:17-11-2025****Subject Name:Process Equipment Design -I****Time:02:30 PM TO 05:30 PM****Total Marks:70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

MARKS

- Q.1**
- | | | |
|-----|---|-----------|
| (a) | Explain in brief about the equivalent length of pipes and joints | 03 |
| (b) | Write a brief note on NPSH for centrifugal pumps | 04 |
| (c) | Give the functions of various parts of shell and tube heat exchanger. | 07 |

- Q.2**
- | | | |
|-----|--|-----------|
| (a) | Write a brief note on Fluid allocation in shell and tube heat exchanger. | 03 |
| (b) | How baffle cut and baffle spacing affect tube outside heat transfer coefficient. | 04 |
| (c) | Discuss in detail about criteria of selection between kettle type and thermosyphon reboiler. | 07 |

OR

- | | | |
|-----|---|-----------|
| (c) | Discuss how to find or fix the recirculation ratio in the following conditions: (i) $\Delta P_{av} \approx \Delta P_t$ (ii) $\Delta P_{av} > \Delta P_t$ (iii) $\Delta P_{av} < \Delta P_t$ | 07 |
|-----|---|-----------|

- Q.3**
- | | | |
|-----|--|-----------|
| (a) | Describe functions of down comer & mention types of down comers | 03 |
| (b) | Describe determination of minimum reflux ratio by McCabe-Thiele method. | 04 |
| (c) | Aqueous solution of ethanol contains 6% by mass ethanol. It is to be concentrated in the distillation column to 30% ethanol by mass. Open steam, saturated at 80kPa g pressure will be used for distillation column. Feed flow rate is 5000 kg/hr and it is saturated liquid at its bubble point. Residue should not contain more than 0.02 mass percent ethanol. Sparging steam flow is 0.2 kg per kg of feed. Calculate the number of theoretical stages required for desired production | 07 |

Equilibrium data for Ethanol –Water system

x	0.019	0.0721	0.0966	0.1238	0.1661
y	0.17	0.3891	0.4704	0.4704	0.5089

OR

- Q.3**
- | | | |
|-----|--|-----------|
| (a) | Define: 1) Light key 2) Heavy key 3) Adjacent key 4) Split Key | 03 |
| (b) | Discuss in brief the factors affecting selection of tray type | 04 |

- (c) A saturated liquid, consisting of phenol and cresols with some xylenols, is fractionated to give a top product of 95.3 mole % phenol. Metacresol is heavy key and phenol is light key component. Total condenser is used. The composition of the top product and phenols in the bottoms are given. Take $v = 1.71$ for solving min. reflux ratio by under **07**

Component	α_{av}	Feed mole %	Top Product mole %	Bottoms mole %
phenol	1.98	35	95.30	5.24
o-cresol	1.59	15	4.55	?
m-cresol	1.00	30	0.15	?
Xylenol(s)	0.59	20	-	?
Total		100	100.00	

- a) Complete the material balance over the still for feed flow rate of 100kmol/h
 b) Calculate the minimum reflux ratio by Underwoods method

- Q.4** (a) Describe effect of increase in reflux ratio on number of theoretical stages and utility requirement **03**
 (b) Draw falling film type absorber and explain its advantages and disadvantages over the adiabatic type packed tower **04**
 (c) Explain design procedure for Absorption tower for finding the height (Cornell's method) and diameter of column **07**

OR

- Q.4** (a) Discuss jet and downcomer flooding. **03**
 (b) Write a brief note on packings used for packed bed absorption. **04**
 (c) Discuss about the Liquid distributors, Liquid redistributors, Packing support and Hold-down plate for packed tower type absorber **07**

- Q.5** (a) How distribution coefficient affects liquid liquid extraction **03**
 (b) Classify industrially important extractors. **04**
 (c) Explain process design of settler **07**

OR

- Q.5** (a) How to decide optimum solvent amount based on number of theoretical stages for liquid liquid extraction. **03**
 (b) Discuss the desirable solvent properties for liquid-liquid extraction **04**
 (c) Discuss the steps for process design of counter current multistage extractor **07**
