GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2022

Subject Code:2160503   **Date:03/06/2022**

Subject Name:Process Equipment Design -I

Time:10:30 AM TO 01:30 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

Q.1	**(a)**	Define: i) Heavy Key component ii) Light Key component iii) Distributed Components.	03
	(b)	Discuss the five standard locations of pressure taps in orifice meter.	04
	(c)	Explain general design procedure for shell & tube heat exchanger.	07
Q.2	**(a)**	Define: Equivalent length, schedule Number and NPSH.	03
	(b)	State falling film absorber advantages and disadvantages over the adiabatic type packed tower.	04
	(c)	Explain the method of selection of operating pressure in distillation column.	07

OR

(c) A saturated liquid consisting of phenol and cresols with some xylenols, is fractioned to give a top product of 95.3 mole % phenol. Metacresol is heavy key and phenol is light key component. Total condenser is used.   **07**

Component	Relative Volatility (α_{avg})	Feed mole %	Top Product Mole %	Bottom product mole %
Phenol	1.98	35	95.3	5.24
o-Cresol	1.59	15	4.55	?
m-Cresol	1.00	30	0.15	?
Xyenols	0.59	20	--	?
		100	100.00	

The compositions of the top product and of the phenol in the bottom are given:(i) Complete the material balance over the still for a feed rate of 100 kmol/hr.(ii) Calculate the minimum reflux ratio by Underwood's method.

Q.3	**(a)**	Discuss about liquid distributor and redistributors.	03
	(b)	Explain the factors affecting the fluid allocation in Heat exchanger.	04
	(c)	Discuss in detail about criteria of selection between kettle type and thermosyphon reboiler.	07

OR

Q.3	**(a)**	Determine the minimum reflux ratio for the binary distillation at standard atmospheric pressure based on the following data: Feed = 100 kmol/hr, mole fraction of benzene= 0.4 and rest toluene. Feed is saturated liquid and mole fraction of benzene in distillate = 0.99, Mole fraction of benzene in residue required = 0.02, α_{avg} = 2.25.	03
	(b)	Explain in brief tinkers flow model for shell and tube heat exchanger.	04
	(c)	Discuss the criteria of selection among the different types of the equipment used as absorbers or scrubbers.	07
Q.4	**(a)**	Explain random and regular packing used for packed bed absorption.	03
	(b)	Discuss criteria of selection between horizontal condenser and vertical condenser.	04

(c) Explain design procedure for absorption tower for finding the height (Cornell's method) and diameter of column.   07

OR

Q.4 (a) State the advantages of U tube & floating head heat exchanger over fixed tube heat exchanger.   03

(b) Discuss jet and downcomer flooding with neat sketch.   04

(c) Benzene at 38°C is pumped through the system at a rate 9.09 m³/hr with the help of a centrifugal pump. The reservoir is at atmospheric pressure. Pressure at the end of discharge line is 345 kPa g. The discharge head is 3.05 meter, and the pump suction head is 1.22 meter above the level of liquid in reservoir. The friction loss in suction line is 3.45 kPa and that in discharge line is 37.9 kPa. The mechanical efficiency of the pump is 0.6. The density of benzene is 865 kg/m³ and its vapor pressure at 37.8 °C is 26.2 kPa. Calculate (i) (NPSH)ₐ and (ii) Power required by Centrifugal pump.   07

Q.5 (a) Estimate the optimum pipe diameter for a flow of dry chlorine gas of 10,000 kg/hr at 6 atm a and 20 °C through carbon steel pipe.   03

(b) Explain the properties of the solvent need to be consider while selecting suitable solvent for extraction operation.   04

(c) Discuss the steps for process design of counter current multistage extractor.   07

OR

Q.5 (a) State the industrial applications of Liquid-Liquid Extraction.   03

(b) Discuss factors affecting the selection of types of trays in the distillation column.   04

(c) Explain in brief the design steps for the process design of horizontal settler.   07

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