Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – SUMMER 2024

Subject Code: 3170502 Date:28-05-2024

Subject Name: Process Equipment Design

Time:02:30 PM TO 05:00 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)**	Discuss the criteria for fluid allocation in shell & tube heat exchanger.	**03**
	(b)	Discuss the five standard locations of pressure taps in orifice meter.	**04**
	(c)	Hexane at 37.8 °C is pumped through the system at a rate of 9.09 m^3/hr. The tank is at atmospheric pressure. Pressure at the end of discharge line is 345 kPa g. The discharge head is 3.05 m and the suction lift is 1.22 m above the level of liquid in the tank. The friction loss in suction line is 3.45 kPa and that in the discharge line is 37.9 kPa. The mechanical efficiency of the pump is 0.6. The density of hexane is 659 kg/m^3 and its vapor pressure at 37.8 °C is 33.71 kPa. Calculate (i) (NPSH)A and (ii) Power required by the centrifugal pump.	**07**
Q.2	**(a)**	Define: Weeping, Entrainment, Coning in distillation column	**03**
	(b)	Define NPSH and write short note with giving importance for pump design.	**04**
	(c)	Discuss about the Liquid distributors, Liquid redistributors, Packing support and Hold-down plate for packed tower type absorber.	**07**
		OR	
	(c)	Discuss the criteria of selection among the different types of the equipment used as absorbers or scrubbers.	**07**
Q.3	**(a)**	What is jet flooding and downcomer flooding?	**03**
	(b)	Discuss advantage and disadvantage of Plate Heat Exchanger (PHE) over shell and tube heat exchanger.	**04**
	(c)	In vertical thermosyphon reboiler recirculation ratio is fixed by trial and error method. Discuss with figure and equations if applicable, 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**
		OR	
Q.3	**(a)**	List types of expansion joints. Why expansion joint is provided in fixed tube sheet heat exchanger?	**03**
	(b)	State the advantages and disadvantages of Vacuum Distillation.	**04**
	(c)	Discuss the criteria of selection among the different types of trays used in tray tower.	**07**

Q.4 **(a)** What is the function of downcomer? Discuss the different types of downcomers used in distillation column. **03**

(b) Explain Tinker's flow model with a neat diagram. **04**

(c) A saturated liquid, consisting of phenol and cresol 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. The composition of the top product and of the phenol in the bottom is given. (i) Complete the material balance over the still for a feed rate of 100 kmol/h and (ii) Calculate the minimum reflux ratio by Underwood's method. **07**

Component	α_{av}	Feed, mole %	Top product, mole %	Bottom product, mole %
Phenol	1.98	35	95.30	5.24
o-Cresol	1.59	15	4.55	?
m-Cresol	1.00	30	0.15	?
Xylenols	0.59	20	--	?

OR

Q.4 **(a)** How baffle cut and baffle spacing affect tube outside heat transfer coefficient? **03**

(b) Discuss in brief Random and Regular packing. **04**

(c) Discuss step wise design procedure for shell and tube heat exchanger without phase change. **07**

Q.5 **(a)** Define Radiography, Joint Efficiency and Design temperature. **03**

(b) Discuss different types of Agitators. **04**

(c) Discuss the design steps of vertical cylindrical pressure vessel and head subjected to internal pressure. **07**

OR

Q.5 **(a)** Define Internal design pressure, Design stress and External design pressure. **03**

(b) States different types of head with selection criteria. **04**

(c) Discuss different types of equipments and explain different static equipments. **07**