U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

July 2023 Semester End Main Examinations

Program: B.E. — **Semester: VI**
Branch: Chemical Engineering — **Duration: 3 hrs.**
Course Code: 19CH6DCPED / 16CH7DCPED — **Max Marks: 100**
Course: Process Equipment Design — **Date: 05.07.2023**

Instructions: 1. Answer any one full question, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of Perry's Chemical Engineering handbook, IS 4503 and IS 2825 code books are allowed.
4. Use of psychometric chart and other data sheets are allowed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT – I	*CO*	*PO*	Marks
1		Design a horizontal condenser to condense 9500 kg/h of methanol vapor, which is slightly above the atmospheric pressure. Water is flowing inside the tube at a velocity of 1.5 m/s, with inlet and outlet temperature of 25°C and 43°C, respectively. Tubes of following characteristics are available: 1" OD, 2.6 mm thickness, and 4 m long on triangular pitch.			
	a)	State the data source and determine physical properties of fluids.	*CO1* *CO2*	*PO2* *PO4*	**15**
	b)	Calculate the heat load and the mass flow rate of water.	*CO3*	*PO3*	**10**
	c)	Estimate the heat transfer coefficient and suggest a suitable configuration of horizontal condenser Report shell diameter	*CO3*	*PO3*	**35**
	d)	Estimate pressure drop on tube side and shell side. State inference relating to design specifications.	*CO4* *CO5*	*PO12* *PO8*	**20**
	e)	Draw to scale, the sectional elevation of the condenser with dimensions and parts list.	*CO6*	*PO3*	**20**

			UNIT – II			
	2		A bubble cap distillation column is required to separate 200 kmol/h of feed solution with benzene – toluene mixture containing 40% benzene. It is required to get an overhead product containing 98% benzene. The feed to the column is at its bubble point. A reflux ratio of 3.5 is to be used to design the column. Use tray spacing of 300 mm. The equilibrium data for benzene-toluene mixture is as given below. Assume the tray efficiency as 70%. Bottom product contains 2% benzene.			

x	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
y	0	0.2	0.38	0.5	0.63	0.71	0.78	0.85	0.91	0.96	1.0

		a)	Carry out material balance and determine the unknown flow rates of distillate and the residue streams.	*CO1* *CO2*	*PO2* *PO4*	**05**
		b)	Determine the number of theoretical plates and actual plates and locate the feed plate.	*CO2*	*PO4*	**15**
		c)	Calculate the height of the distillation column.	*CO3*	*PO3*	**05**
		d)	Calculate the diameter of the column with respect to either enriching or stripping zone, assuming operating velocity is 60% of flooding velocity.	*CO3*	*PO3*	**30**
		e)	Design the plate with all the details.	*CO4*	*PO12*	**10**
		f)	Calculate the diameter of nozzles for feed, distillate, and residue pipelines.	*CO4* *CO5*	*PO12* *PO8*	**15**
		g)	Draw the front sectional view of the column with design details.	*CO6*	*PO3*	**20**

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