Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
(GIET University)

B. Tech (Sixth Semester - Regular) Examinations, April 2026

23BCHPC36001 - Process Equipment Design

(Chemical Engineering)

Time: 3 hrs Maximum: 60 Marks

Answer ALL questions

(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

Q.1. Answer ***ALL*** questions		CO #	Blooms Level
a.	Name different types of trays used in distillation columns.	CO2	K1
b.	What is flooding in packed towers?	CO1	K1
c.	What are major equipments in chemical industries?	CO1	K1
d.	What are the advantages of multiple-effect evaporators over single-effect evaporators?	CO5	K1
e.	Differentiate between fixed roof and floating roof tanks.	CO6	K1

PART – B **(10 x 5 = 50 Marks)**

Answer ***ALL*** the questions		Marks	CO #	Blooms Level
2. a.	A benzene–toluene mixture with 45 wt% benzene is fed at 3500 kg/hr to a distillation column operating at 1 atm. The distillate contains 90 wt% benzene and the bottoms contain 5 wt% benzene. Feed is saturated liquid. Reflux ratio is twice the minimum. Vapour velocity is 1 m/s. Tray efficiency is 70%. Calculate Number of actual plates, Column height & Tower diameter.	10	CO2	K3
	(OR)			
b.	An ethanol–water mixture containing 55 wt% ethanol is fed at 6000 kg/hr to a tray column at 1 atm. The distillate contains 94 wt% ethanol and the bottom contains 3 wt% ethanol. Feed is saturated vapour. Reflux ratio is 1.8 times minimum. Vapour velocity is 1 m/s. Tray efficiency is 60%. Calculate Number of actual plates, Column height & Tower diameter.	10	CO2	K3
3.a.	A packed column is used to absorb SO_2 from gas. The inlet gas contains 24% SO_2 at 165 kmol/hr. The outlet gas contains 2% SO_2 and liquid contains 16% SO_2. Mass transfer coefficient is 142 kmol/hr·m². Equilibrium relation: y=1.9x. Calculate Packing height.	10	CO3	K1
	(OR)			
b.	A packed tower is used to absorb NH_3 from coke oven gas. The inlet gas contains 22% ammonia at 160 kmol/hr. The outlet gas contains 2% ammonia and liquid contains 16% ammonia. The mass transfer coefficient is 135 kmol/hr·m². Equilibrium relation: y=2.5x. Calculate the height of packing.	10	CO3	K3
4.a.	A 1–2 shell and tube heat exchanger heats water using hot oil from 210°C to 150°C. Water flow rate is 400 kg/s entering at 300 K and leaving at 360 K. Tube velocity is 4 m/s. The Data are given as: ID = 2 cm, OD = 2.5 cm, P_T = 3 cm	10	CO4	K3

(Square Pitch), U_d=1000 kcal/hr·m², F_T=0.95. Calculate Number of tubes, shell diameter, and length.

(OR)

b.	A vertical evaporator is required to concentrate 5500 kg/hr of 9% NaOH solution to 28%. Steam at 1.8 kg/cm² is used, and vapor space pressure is 400 mm Hg. Overall heat transfer coefficient is 2700 kcal/hr·m²·°C, and boiling point elevation is 10°C. Feed and product enthalpies are 88 kcal/kg and 76 kcal/kg. Tubes: 50 mm OD (45 mm ID), 1.5 m length, 80 mm square pitch. Calculate: Heat transfer area, number of tubes, and steam requirement.	10	CO4	K3
5.a.	Design a cylindrical storage vessel with a column-supported roof. Data: • Diameter = 25 m • Height = 18 m • Specific gravity = 0.92 • Material = Mild steel • Permissible stress = 150 N/mm² • Density = 7.8 g/cm³ • Modulus of elasticity = 2×10^5 N/mm²	10	CO6	K3

(OR)

b.	Design a vertical storage tank with column-supported roof. Data: • Diameter = 20 m • Height = 16 m • Specific gravity = 0.95 • Material = Structural steel • Permissible stress = 145 N/mm² • Density = 7.85 g/cm³ • Modulus of elasticity = 2×10^5 N/mm²	10	CO6	K3
6.a.	Sketch and label a backward feed multiple-effect evaporator and identify its major accessories.	5	CO5	K2
b.	Draw a neat diagram of double heat exchanger showing all the important components in series.	5	CO5	K2

(OR)

c.	Draw a neat diagram of Continuous flow reactor and neat label.	5	CO5	K2
d.	Draw a neat diagram of rotary dryer and neat label.	5	CO5	K2

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