

2023-24
B.TECH. (AUTUMN SEMESTER) EXAMINATION
CHEMICAL ENGINEERING
PROCESS ENGINEERING AND PLANT DESIGN
CHC4190

Maximum Marks: 60

Credits: 04

Duration: Two Hours

Answer all the questions.

Assume suitable data if missing.

Notations used have their usual meaning.

Q.No.	Question	M.M.
1(a)	(a) How are the chemical products classified? Draw the differences and similarities between them.	[3+2] [CO-1]
	(b) <u>Figure-1</u> shows a task sequence for producing 'dry solid powder' from wet solids in an air stream. Wet solids are to be grounded, heated, the water removed, the solids settled out as a finely divided powder. Suggest a suitable equipment flowsheet .	

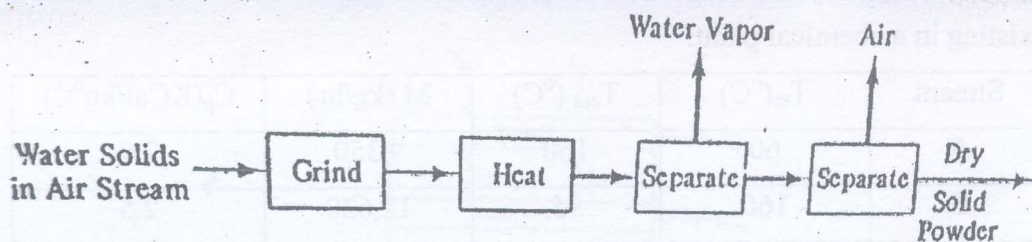


Figure 1: Task sequence for producing dry solids

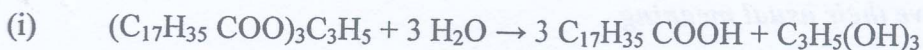
- 1(b) A stream of hydrocarbon consisting of methane (b.p = -161°C), benzene (80°C), toluene (110°C) and orthoxylene (144°C) with a composition of 50,10, 10 and 30 percent respectively is to be separated. What sequence of boiling point
- [05]
[CO-1]
1&2]

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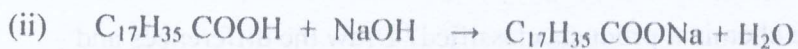
exploitation will probably lead to meet economic separation?

- 1(c) Soaps are the Sodium or Potassium salts of various fatty acids, chiefly Oleic, stearic, palmitic, lauric and myristic acids. [05]
[CO-1]

For the production of soap following reactions are carried out in Hydrolyser and Mixer-neutralizer respectively:



Glyceryl stearate Stearic acid glycerine



Stearic acid caustic soda Sodium stearate soap

If glyceryl stearate costs Rs.15.5/Kg and caustic soda Rs.70.7/Kg and if byproduct glycerine can be sold for Rs160.94/Kg. What is the lower bound on the sales price of sodium stearate soap?

OR

- 1' Synthesize a heat integration network for the following four process streams [15]
existing in a chemical plant: [CO-1]

Stream	T _{in} (°C)	T _{out} (°C)	M (kg/hr)	C _p (KCal/kg°C)
A	60	160	9,350	2.9
B	160	95	12,620	2.5
C	115	260	10,530	2.1
D	250	140	11,530	3.3

Steam utility is available at 120°C, 175°C and 285°C. Cooling water is available at 25°C and Brine is available -1°C.

Also, write all the Heuristics concerning Heat Exchange Network (HEN).

- 2(a) .An initial information flow structure of some system is given in figure2 : [09]
(a) What is an information flow structure? Write down its significance. [CO-2]

contd.... 3.

- (b) Obtain the precedence order of calculation by applying second design variable selection algorithm.

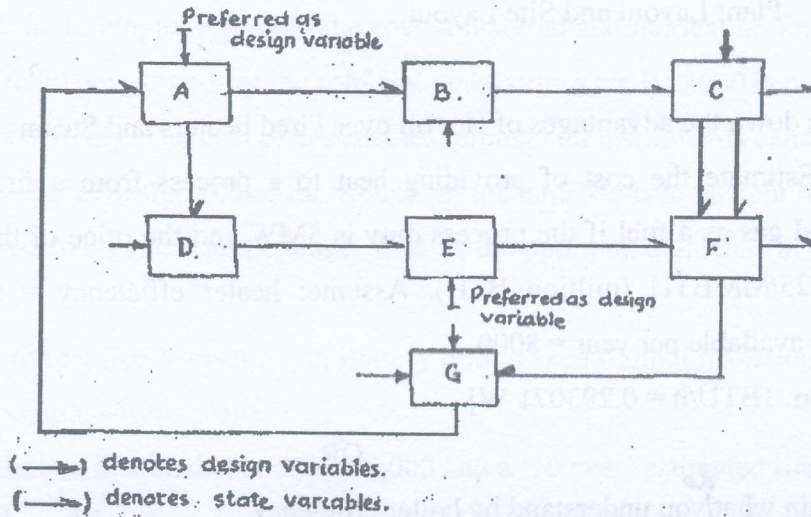


Figure 2: Information flow structure

OR

- 2'(a) For an N-equilibrium stage cascade with heat addition (shown in figure-3), [09]
determines the degrees of freedom and gives a suitable set of design variables. [CO-2]

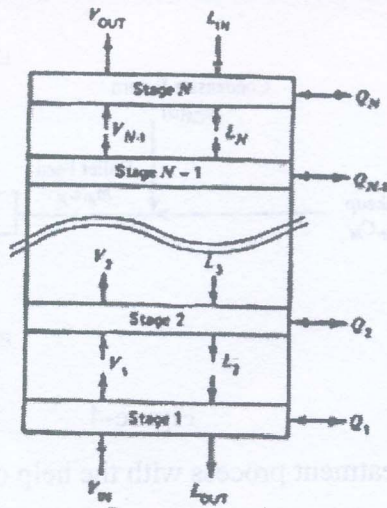


Figure -3: N-equilibrium stage cascade

contd... 4.

- 2(b) Explain the following: [06]
(i) Grouped Layout and Flow Layout [CO-2]
(ii) Modular construction
(iii) Plant Layout and Site Layout

- 3(a) Write down the advantages of Hot oil over Fired heaters and Steam [06]
Estimate the cost of providing heat to a process from a fired heater using [CO-3]
natural gas as a fuel if the process duty is 5MW and the price of the natural gas is
INR125/MMBTU (million BTU). Assume: heater efficiency = 85%, operating
hours available per year = 8000.
[Given: 1BTU/h = 0.293071 W]

OR

- 3'(a) Explain what ^{do} you understand by boiler efficiency. [06]
A small package fire-tube boiler has makeup water that contains 500 ppm [CO-3]
dissolved solids. The steam system operates with 50% condensate return. Estimate
the blowdown rate. Assume that the maximum limit for the TDS is 4500 ppm.
Assume that there are no solids in the evaporation or the condensate return. Refer to
figure-4 below:

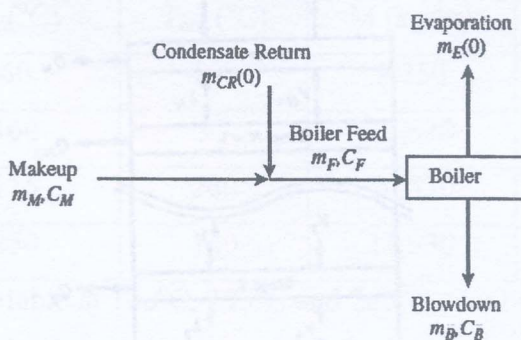


Figure-4

- 3(b) Explain boiler water treatment process with the help of process flowsheet. [09]
[CO-3]
4(a) In a desalination plant, an evaporator of area 200 m² was purchased in 1996 at a cost [04]
\$ 3, 00,000. In 2002, another evaporator of area 50 m² was added. What was the [CO-4]
cost of second evaporator (in \$)? Assume that the cost of evaporator scales as

contd...5.

(capacity)^{0.54}. The Marshall and Swift Index was 1048.5 in 1996 and 1116.9 in 2002.

4(b) A vertical cylindrical tank with a flat roof and bottom is to be constructed for storing 150 m³ of ethylene glycol. The cost of material and fabrication for the tank wall is Rs 6000 per m² and for the roof and tank bottom are Rs 2000 and Rs 4000 per m², respectively. The cost of accessories, piping and instruments can be taken as 10% of the cost of wall. 10% of the volume of the tank needs to be kept free as vapour space above the liquid storage. What is the optimum diameter (in m) for the tank? [05] [CO-4]

4(c) Define the terms: Break-even point, Battery limit, Fixed Capital Investment, depreciation, grass-roots plant. [4+2] [CO-4]

A pump has an installed cost of Rs 40,000 and a '10 year' estimated life. The salvage value of the pump is zero at the end of 10 years. Determine the asset (or book) value of pump, by double declining method, at the end of six years.

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2023-24
B.TECH. (WINTER) EXAMINATION
CHEMICAL ENGINEERING
CHEMICAL PROCESS INDUSTRIES-II
CHC-4200

Maximum Marks: 60

Credits: 03

Duration: Two Hours

Answer all the questions.

Assume suitable data if missing.

Notations used have their usual meaning.

Q. No.	Question	M.M.
1(a)	Discuss important applications of Acetone. OR	[04] [CO1]
1'(a)	Briefly mention the important properties of Aniline.	[04] [CO1]
1 (b)	List various processes for the production of Methanol Explain briefly about catalytic hydrogenation of CO OR	[08] [CO2]
1'(b)	Explain the manufacturing process of Acetone with the help of process flow diagram along with chemical reactions and process conditions	[08] [CO3]
1 (c)	Discuss safety and hazard aspects of Ethylene Oxide. OR	[03] [CO4]
1'(c)	Discuss safety and hazard aspects of Nitrobenzene	[03] [CO4]
2(a)	List different types of paper. Explain briefly about any four of them? OR	[04] [CO1]
2'(a)	List important optical and thermal properties of paper.	[04] [CO1]
2(b)	Discuss important properties and applications of rubber. OR	[05] [CO1]
2'(b)	What are advantages and disadvantages of natural and synthetic fibre.	[05] [CO1]
2(c)	Explain the manufacturing process of LDPE with the help of process flow diagram OR	[06] [CO1]
2'(c)	Explain the manufacturing process of PVC with the help of process flow diagram	[06] [CO1]

Contd... 2.

- 3(a)** What are different raw materials used in the production of synthetic detergent? [05] [CO3]
- 3(b)** What are important industrial solvents for extracting vegetable oil? Explain the factors which affect the process of solvent extraction. [06] [CO4]
- 3(b)** What are the steps involved in the continuous hydrolysis of oil to manufacture soap? [04] [CO3]
- 4(a)** What is crude oil? How crude oil is classified? Discuss different characterization criteria? [06] [CO1]
- 4(b)** Mention different refinery products. Explain briefly about any three of them [09] [CO4]

(PAPER CODE:6501)

2023-24
B.TECH.(ODD SEMESTER)EXAMINATION
CHEMICAL ENGINEERING
PETROLEUM PROCESSING (CHE-4430)

Maximum Marks: 60

Credits: 04

Duration: Two Hours

Answer all the questions.

Q.No.	Question	M.M.
Q1	Explain briefly and attempt all of the following: (a) API gravity and its Significance (b) Characterization factor and its Significance (c) ASTM distillation and its significance (d) Aniline Point and its Significance (e) Cetane number and its Significance	[3×5]
Q2	Draw the schematic diagram of the Top tray reflux, pump around reflux and pump back reflux. Explain its operation and importance during distillation.	[15]
	(CO-1) OR (CO-2)	
Q2'	Discuss the difference between Physical and Chemical Impurities and how they can be removed. Draw the flowsheet of the lead Doctrine treatment for Gasoline. Discuss the process and its significance.	[15]
Q3	Draw the process flow diagram of the Hydro cracking unit. Please explain the process diagram and its significance.	[15]
	(CO-2) OR (CO-3)	
Q3'	Draw the flowsheet of the delayed coking process. Discuss the process and its significance.	[15]
	(CO-3)	
Q4	Draw the process flowsheet sulphuric acid alkylation processes. Explain the process diagram and its significance.	[15]
	(CO-4)	