

B.: (1) Question No.1 is compulsory.

(2) Attempt any **Three** out of remaining questions.

(3) Assume any suitable data if necessary and indicate it clearly.

(4) Draw neat sketches wherever required.

(5) Answer to the sub-questions of an individual question should be grouped and written together i.e. one below the other.

Answer the following subquestions briefly.

(20)

- (a) What are the basic functions of process engineer in process industries?
- (b) Write different types of heating and cooling utilities with their recommended temperature ranges.
- (c) Draw control strategies for distillation column.
- (d) Design heuristics related with recycle of some reactant and purification of feed.

Given the following feed stream at 10 atm and temperature 310 K.

(20)

Component (k)	Flowrate (gmol/s)	Vapour Pressure (mm Hg)
n-butane	100	2588
Di-ethyl ether	5	824
n-butanol	2	14.3
Water	1	46.3

(a) Design an absorber to recover 90% of the ether in the liquid stream, find theoretical number of trays, flow rate of liquid and vapour and its composition.

(b) How would you increase water composition in vapour phase?

3. (a) Discuss the common features and develop the PPS for following processes: (14)

(i) Nitration (ii) Sulphonation

(b) Differentiate between batch and continuous process. (06)

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The Heat Exchanger network system design is to be done for the following process where two streams are being heated and two streams are being cooled. (20)

FCp (KW/°C)	T _{in} (°C)	T _{out} (°C)
3	180	60
1	150	30
2	20	135
5	80	140

Where, F = mass/molar flow rate of stream; Cp = Specific heat of stream; T_{in} = Inlet Temperature of stream; T_{out} = Outlet Temperature of stream.

The minimum temperature approach limit, $\Delta T_{\min} = 10^\circ\text{C}$

Then,

- (i) Draw the cascade diagram and find out the minimum heating and cooling load for the above system.
 - (ii) Define the concept of pinch temperature and find out the pinch temperature for the above system.
- (a) What is layer of protective analysis (LOPA) and what are major steps to be followed in LOPA ? Explain with one example. (10)
 - (b) Explain the concept of fire triangle and give importance of fire safety in a process industry. (10)

Explain with suitable example the importance of following factors in selection of process: (20)

- (i) Economic analysis
 - (ii) Environmental foot prints
 - (iii) Safety aspects
 - (iv) Controlability
 - (v) Flexibility.
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