

(3 Hours)

Total Marks: 80

- N.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.

Q.1. Answer the following sub-questions in brief:

- (a) Write basic functions of process engineer in process industries. (05)
 (b) Discuss major utilities used in process industries and their applications (05)
 (c) Explain degree of freedom analysis to check feasibility of control structure and thumb rules to be followed while designing control structure for system (05)
 (d) Write design heuristics related to separation system for process. (05)

Q.2. (a) What is event tree analysis (ETA) and what are major steps to be followed in ETA? Explain with one example. (10)

- (b) With the help of suitable formulae, explain the following terms used during cost estimation of process equipments: (10)
 (i) MPF (ii) Base cost (iii) Module Factor (iv) Bare module cost (v) Update Factor

Q.3. (a) The process system involves two hot and two cold streams whose data is given below. Then evaluate the amount of minimum utility (hot as well cold) required as well pinch temperature for this system. Use $\Delta T_{\min} = 10^\circ\text{C}$ (15)

MCp (Heat Capacity Flow rate) (KW/°C)	T _{in} (°C)	T _{out} (°C)
100	250	120
400	200	100
300	90	150
600	130	190

- (b) Define pinch temperature and explain the effect of ΔT_{\min} on pinch temperature. (05)

- Q.4. The vapor feed to an absorber consists of 95 gmol/s of n-butane, 10 gmol/s of ether, 3 gmol/s of n-butanol and 2 gmol/s of water. The feed is at 7600 mm Hg and 300 K. It is desired to recover 80% of ether from this feed stream using water as solvent. The vapor pressures of n-butane, ether, n-butanol and water at 300 K are 2590 mm Hg, 820 mm Hg, 15 mm Hg and 45 mm Hg respectively. Then calculate: (20)
- (i) Required flow rate of solvent
 - (ii) Required number of theoretical stages in absorber
 - (iii) The component flow rate in vapor and liquid stream leaving an absorber
- Q.5. (a) Discuss about the process to manufacture Nitrobenzene from Benzene and Mixed acid, with the help of following points: Brief process description; Common features of process; PPS for the process (12)
- (b) Explain in detail the algorithm (write the various equations) for sizing of distillation column. (08)
- Q.6. Write the short notes on:
- (a) Characteristics of Batch process (05)
 - (b) Design heuristics for Recycle structure in process flow sheet (05)
 - (c) Common features of chlorination process (05)
 - (d) Characteristics of PFD (05)
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