BE - Chemical - Sem - VII

Process Engg.

Q.P. Code : 814000

VII

Total Marks: 80

(3 Hours)

19/5/17

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 in one below the other.

Q.1. Answer the following questions briefly and exactly (each sub-question below carry equal marks) (20)

1. In design of absorption column, what is the significance of the absorption factor?
2. In a binary continuous distillation, what will happen if the relative volatility is one
3. For a reactor if V is the volume and $\dot{q}$ is the volumetric flow rate then how the residence time is calculated?
4. What is HAZOP
5. Why batch processes are more suitable for manufacturing seasonal products?
6. In case of distillation column, the slope of the feed line is defined as $(-q)/(1-q)$. Its value is $-\frac{1}{3}$. Then what is the % of vapour in the feed?
7. In a multistage compressor, what do you mean by compression ratio and what can be the maximum compression ratio?
8. What is the meaning of TLV related to the concentration of a toxic gas in case of toxic gas release in a plant?
9. How degree of freedom is calculated while designing control structure for a particular process/operation?
10. What are the various nitrating agents used in nitration process?

Q.2. Find the work to compress 15 gmol/sec of an ideal gas at 298 K from an initial pressure (P_0) of 100 kPa to final pressure (P_N) of 1500 kPa using staged compression. Also find the outlet temperature of gas from each compressor. R= 8.314 J/gmol K and γ=1.4 (20)

Determine the cost of a compressor (excluding intercooler) in year 2016 considering the following data.

S_0=100 hp, C_0= Rs.1.15×10^6, α=0.77, UF = 3.12, F_d=1, MF = 3.11

For centrifugal compressor with electric motor, motor and compressor efficiency is 90 % and 80% respectively.

TURN OVER

Q.3. (a) Discuss the common features of nitration process and develop the preliminary process system (PPS) block diagram for the manufacture of nitrobenzene. (10)

(b) Draw and explain the control loop of the Reflux in a distillation column (Only drawing a loop without explanation carries zero mark). (05)

(c) Write short note on event tree analysis of accidents. (05)

Q.4. (a) In a plant there are four streams. We have to exchange heat amongst these four streams using a heat exchanger network. For this find out minimum heating load, minimum cooling load & pinch temperatures of the hot and the cold stream. Also define concept of pinch temperature. Assume $\Delta T_{min} = 10°C$. Data for process stream as follows: (15)

Streams	FCp (kW/°C)	Tin (°C)	Tout (°C)
Hot	3	180	60
Hot	1	150	30
Cold	2	20	135
Cold	5	80	140

(b) Discuss the applications of the following utilities: (i) Nitrogen (ii) Vacuum (05)

Q.5. 90 % acetone from air-acetone vapour mixture is to be recovered by using absorption using water as a solvent at 300 K and 10 bar. The feed entering bottom of column consists of 10 moles of air and 1 mole of acetone. (20)

Calculate

a) Required flow rate of solvent

b) Number of stages

c) Composition of leaving vapour and liquid from absorption column.

Antoine constant data:

Component	A	B	C
Acetone	14.6513	2940.46	- 35.93
Water	18.3036	3816.44	- 46.13

Q.6. (a) In a particular process, the feed stream to the reactor is being heated by exchanging heat with hot reactor effluent. The objective is to maintain the constant temperature of feed to the reactor in order to maintain the conversion at desired level. Draw a simple block diagram to show this and further draw and explain the most appropriate control strategy to achieve the said objectiv (10)

(b) Discuss in detail the guidelines to be followed while deciding whether the process should be carried out in batch wise or continuous fashion? (10)