B.TECH SEM – VIII (2007 COURSE) (CHEMICAL ENGG.) : SUMMER - 2018

SUBJECT: PROCESS EQUIPMENT DESIGN

Day: **Saturday** Time: **02.30 PM TO 05.30 PM**

Date: **09/06/2018** **S-2018-2852** Max. Marks: 80

N.B.

1) Q. No. **1** and Q. No. **5** are **COMPULSORY**. Out of the remaining attempt **ANY TWO** questions.
2) Answers the two sections should be written in **SEPARATE** answer books.
3) Use pf electronic non-programmable calculator is allowed.
4) Assume suitable data if necessary.

SECTION - I

Q.1 a) Explain the significance of: **(05)**
i) baffles ii) Tie rod iii) Tube shell
iv) Number of passes in shell and tube H. E.

b) Write important consideration of expression for designing a CSTR. **(05)**

c) What are different types of H.E.? Explain any one in detail. **(04)**

Q.2 Extractor out let at 89^0 C to be cooled to 35^0 C with help of available cold water at 28^0 C with flow rate and 17860 kg/hr. properties of Extractor out let fluid **(13)**
Sp. Qr. = 0.785, viscosity = 0.49×10^3 N s/m
K = 0.096 W/mk, Cp = 1.4 kJ/kg K.
Tubes available with 1.d. = 16 mm Thickness = 2 mm and the length of tube 12 f. Assuming 1 -2 SATHE, with triangular pitch
Estimate overall Heat Transfer coefficient take U = 500W/m^2k.

Q.3 a) How do you find diameter of shaft based on twisty moment and bending moment. **(05)**

b) Explain the various types of agitators in detail with neat sketch. **(08)**

Q.4 Design a chemical reaction vessel with following data **(13)**
Vessel shell internal diameter = 1200 mm
Jacket shell internal diameter= 1325 mm
Jacket on straight side only with jacket length = 1000mm
Design pressure shell = 0.4 N/mm^2
Design pressure jacket = 0.45 N/mm^2
Design temperature shell and jacket = 150^0C
J= 0.85
Corrosion allowance shell= 1.5 mm, Jacket = 2 mm
Allowable stress, Shell and head = 120 N/mm^2, Jacket = 95 N/mm^2
Modulus of elasticity = 1.7×10^5N/mm^2
Poisson's ratio = 0.3
Assume factor B to be 13000.

SECTION - II

Q.5 **a)** Explain the absorber in detail with neat sketch. **(05)**

b) Discuss the factor to be considered in plate hydraulic design. **(05)**

c) Write a short note on Reflux drum. **(04)**

Q.6 **a)** How do you design decanter for L-L separation. **(07)**

b) What steps are involved in finding diameter and height of cyclone separator? **(06)**

Q.7 Design distillation column for feed of 50 kmol/hr containing 48 % benzene and rest toluene. It is desired to have 99.5 % benzene in top and 0.05 % benzene in bottom product. Relative volatility is 2.5. Feed can be considered at bubble point temperature. Find our number of plates with plate by plate calculations. Assume constant liquid and vapor flowrate on each plate. **(13)**

Q.8 **a)** 4% by volume of ethanol vapor to be removed from ethanol air mixture with the help of water at 80,000 kg/hr. flow rate of ethanol air mixture is 5200 kg/hr. Equilibrium relation Y=30X **(08)**

$$Y = \frac{moles\ of\ ethanol}{moles\ of\ air}$$

$$X = \frac{moles\ of\ ethanol}{moles\ of\ water}$$

If the height is 410 cm, estimate the height of transfer unit.

b) Comment on design of absorption column **(05)**

* * * * *