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Total number of printed pages - 02

B.TECH
PCCH4303

5th Semester Regular / Back Examination 2016 - 17
PROCESS EQUIPMENT DESIGN

BRANCH : Chemical

Time : 3 Hours

Max Marks : 70

Question Code : Y437

Answer Question No.1 which is compulsory and any five from the rest.

The figures in the right hand margin indicate marks.

Assume suitable notations and any missing data wherever necessary.

Use of Steam Table, Data Table, and Process Equipment Design by MV Joshi book which are permitted. Answer all parts of a question at a place.

1. Answer the following questions : 2 x 10

- (a) Which materials are used for cladding and bonding for low cost materials?
- (b) What is flange joint and when it is used?
- (c) Calculate the minimum thickness required for pressure vessel for internal pressure of 10MPa, inner diameter of 1m, and permissible stress of 80MPa.
- (d) Which are the lower limit and upper limit for distillation operation in McCabe-Thiele diagram?
- (e) What is channeling and how to minimize it in a packed tower?
- (f) Draw different types of packing materials.
- (g) Define BWG and Schedule number.
- (h) Calculated U_D for $h_{i0} = 565 \text{ kcal/hr.m}^2.\text{K}$ and $h_o = 400 \text{ W/m}^2.\text{K}$, neglecting fouling factor.
- (i) Define steam economy.
- (j) Define BPR or BPE.

2. Design a storage vessel with column supported Roof.

Data:

Tank diameter	9.0 m
Tank height	11m
Sp. Gr. of liquid	0.85
Material	Carbon Steel (structural)
Permissible stress	142 N/mm ²
Density	7.7
Modulus of elasticity	2 × 10 ⁵ .

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3. A feed mixture containing 45mol% benzene and rest toluene is to be separated into an overhead product containing 95mol% benzene and a residue of 2mol% benzene at 1 std. atm. Feed is saturated vapor and is admitted at a desired rate to the column. A reflux ratio of 2.5 times of the minimum is to be used for 25 no. of actual trays to work. 7200 m³/hr of vapor from re-boiler at a velocity of 1m/sec is flowing upward inside the tower. Calculate the height and diameter of the distillation column. **10**

 4. A 2-2 heat exchanger is to supply hot water receiving heat from flue gas at 220°C and cooled to 200°C. 500 kg/sec of water at 300 K enters the tubes at a velocity of 5m/sec and leaves at 350 K. Gas inlet pressure may be taken as 1atm. Calculate the number of tubes, shell ID, and length of exchanger.
Data:Tubes: ID = 2.12cm, OD = 2.54cm, P_T = 3.175 cm (□), U_D = 1200 Kcal/hr.m².K, F_T = 0.98. **10**

 5. An evaporator is to be fed with 9000kg/hr solution containing 9% solute by wt. the feed at 40°C is to be concentrated to a solution of 49% solute by wt. Steam is available at 115°C. Overall heat transfer coefficient (U) is 2000 kcal/hr.m².°C. Evaporator is operated at a pressure of 460mmHg vacuum. BPR of 5°C cannot be neglected. Enthalpy of the feed and product stream can be taken as 95 and 85 kcal/kg respectively. For this purpose, 1.5 m length and 25mm OD tubes are used. Calculate the steam economy, number of tubes, height, and diameter of the horizontal tube evaporator. **10**

 6. Draw a neat diagram of distillation column (plate tower), showing all the necessary accessories. **10**

 7. Draw a neat diagram of 2-2, shell and tube heat exchanger (fixed head), showing all parts with specifications. **10**

 8. Draw a neat diagram of single effect vertical tube evaporator with specifications. **10**
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