Registration No. : | | | | | | | | | | |

Total number of printed pages – 3

B. Tech

PCCH 4303

Fifth Semester Regular Examination – 2014

PROCESS EQUIPMENT DESIGN

BRANCH : CHEM

QUESTION CODE : H 161

Full Marks – 70

Time : 3 Hours

*Answer Group - A which is compulsory, any **three** from Group-B and any **two** from Group - C.*

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 – M V Joshi book which are permitted.

Group – A

1. Answer the following questions : 2 ×10

   (a) What are the different types of feed employed in continuous fractionation ?

   (b) Define channeling in packed tower.

   (c) Name different packing materials.

   (d) Define TEMA.

   (e) Define BWG and Schedule number.

   (f) Define equivalent diameter for triangular pitch for shell side heat transfer coefficient calculation.

   (g) Differentiate between UC and UD.

   (h) Why the down-take area is provided in calendria type evaporators ?

   (i) Why temperature correction factor (FT) is used in STHE ?

   (j) Name the joints used in manufacturing the equipments.

P.T.O.

Group – B

2. An evaporator is to be fed with 4850 kg/hr solution containing 7.7 % solute by wt. The feed at 30 °C is to be concentrated to a solution of 45% solute by wt. Steam is available at an absolute pressure of 2.5 atm. Overall heat transfer coefficient U is 1800 kcal/hr.m^2.°C. Evaporator is operated at a pressure of 380 mmHg vacuum. BPR of 8°C cannot be neglected. Tubes of 25 mm OD and 1.2 m long are used. Assuming other necessary data, design a vertical tube evaporator. 10

3. Design a storage vessel with column supported roof. 10

Data :

Tank diameter	19 m
Tank height	18 m
Sp. Gr. of liquid	1
Material	Carbon Steel (structural)
Permissible stress	142 N/mm^2
Density	5.8
Modulus of elasticity	2×10^5.

4. A methanol (CH_3OH)/water(H_2O) solution containing 50% methanol at 27°C is to be continuously rectified at 1 std. atm. pressure at a rate of 5000 kg/hr to provide a distillate containing 95% methanol and a residue containing 4.0% methanol (all % by vol.). The feed consists of equal amount of liquid and vapour. The distillate is to be partially condensed and the reflux returned at the bubble point. A reflux ratio of 3.0 will be used. Relative volatility of 2.7 can be taken for the system. Vapour velocity is 1.1 m/sec. 60 cm tray spacing is to be used. Overall efficiency is 90%. Find the height, diameter, and number of actual plates of the column. 10

5. A 1-2 heat exchanger is to supply hot water receiving heat from flue gas at 420 K. 1000 kg/hr of water at 300 K enters the tubes at a velocity of 5m/sec and leaves at 325 K. Gas inlet pressure may be taken as 1 atm. Calculate the number of tubes, shell ID, and the length of exchanger. 10

Data :

For flue gas (at average temperature) :

Mol.wt.	:	29
Specific heat (C_p)	:	0.25 kcal/kg.K
Thermal conductivity (K)	:	0.027 kcal/hr.m.K
Viscosity (μ)	:	0.021 cP

For water (at average temperature) :

Specific heat (C_p)	:	1.0 kcal/kg K
Thermal conductivity (K)	:	0.539 kcal/hr.m.K
Viscosity (μ)	:	0.75 cP

For heat exchanger tubes :

ID = 2.12 cm, OD = 2.54 cm, P_T = 3.175 cm (Δ), R_D = 0.0006.

Group – C

6. Draw a neat sketch of Vertical tube evaporator with all specifications. 10
7. Draw a neat sketch of 2-2 shell and tube heat exchanger with all specifications. 10
8. Draw a packed tower for counter flow arrangement with all the specification for absorption operation. 10