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

Total number of printed pages – 2

B. Tech

PCCH 4303

Fifth Semester (Back/Special) Examination – 2013

PROCESS EQUIPMENT DESIGN

BRANCH : CHEM

QUESTION CODE : D 282

Full Marks – 70

Time : 3 Hours

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

The figures in the right-hand margin indicate marks.

Assume suitable notations and any missing data wherever necessary.

1. Answer the following questions : 2×10

   (a) Define distillation operation.

   (b) What are the necessary accessories which should beaccompanied with the distillation column ?

   (c) Define relative volatility.

   (d) How to calculate the thickness of pressure vessel ?

   (e) When conical heads are used ?

   (f) Cold fluid heated from 35 to 48°C with the help of hot fluid which is in at 78°C and out at 56°C. Calculate the LMTD assuming counter flow.

   (g) What is fouling factor in heat exchanger ?

   (h) Define BPR or BPE.

   (i) Define steam economy.

   (j) What is the advantage of square pitch over triangular pitch ?

2. (a) Design a storage vessel with column supported roof. 15

   Data :

Tank diameter	8 m
Tank height	6 m
Sp. Gr. of liquid	1.0
Material	Carbon Steel (structural)
Permissible stress	$142 N/mm^2$
Density	7.7
Modulus of elasticity	2×10^5.

   (b) Draw a neat diagram of storage vessel. 10

P.T.O.

3. (a) A methanol(CH_3OH)-water(H_2O) solution containing 40 mol% methanol is to be continuously rectified at 1 std. atm. at a rate of 6000 kg/hr to provide a distillate containing 96 mol%methanol and a residue containing 2.0 mol% methanol. The feed is supplied at its boiling point. The distillate is to be totally condensed to a liquid and the reflux returned at the bubble point. A reflux ratio of 3.5will be used. Relative volatility of 2.6 can be taken for the system. Vapor velocity can be taken as 1m/sec. Calculate the height and diameter of distillation column by assuming necessary data on operational point of view. Also calculate the number of actual tray required assuming 80% overall efficiency. 15

(b) Draw a neat sketch of bubble cap tray distillation columnwith specifications. 10

4. (a) The two liquids are flowing in a double pipe heat exchanger both at a rate of 1800 kg/hr. The inner pipe of heat exchanger has inner diameter 25 mm and the thickness of wall is 1.25 mm. The inner pipe made up of copper having thermal conductivity (K) 328 kcal/hr.m.°C. The outer pipe of heat exchanger has an internal diameter of 50 mm. For simplicity; assume that both liquids have physical properties comparable with that of water. The liquid in the inner tube is being cooled from 70°C to 55°C at the expense of the liquid flowing in the outer tube which is entering at 20°C. Individual heat transfer coefficients for inner and outer sides of inner tube are 5013 and 1311 kcal/hr.m^2. °C respectively. Calculate the length of the heat exchanger required if the liquids are flowing in a counter current manner. 15

(b) Draw a neat sketch of double pipe heat exchangerwith specifications. 10

5. (a) An evaporator is to be fed with 5000kg/hr solution containing 10% solute by wt. the feed at 40°C is to be concentrated to a solution of 40% solute by wt. Steam is available at 120°C. Overall heat transfer coefficient U is 1800 kcal/hr.m^2.°C.Evaporator is operated at a pressure of 300 mmHg vacuum. BPR of 10°C cannot be neglected. Enthalpy of the feed and product stream can be taken as 90 and 80 kcal/kg respectively.For this purpose, 1.5 m length and 25 mm OD tubes are used. Calculate the steam economy, no. of tubes, height, and diameter of the horizontal tube evaporator. 15

(b) Draw a neat sketch of horizontal tube evaporator with specifications. 10