Register Number :

Name of the Candidate :

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DIPLOMA EXAMINATION, 2010

(PETROLEUM REFINING ENGINEERING)

(PAPER - I)

110. DISTILLATION

December] [Time : 3 Hours

Maximum : 100 Marks

Answer any FIVE questions.
All questions carry equal marks.

1. Explain extractive distillation with a neat flow chart. Give suitable example. What are the requirements of a satisfactory solvent ?

2. A continuous fractionating column operating at 1 bar pressure is to be designed to separate 15,000 kg/hr of solution of benzene and toluene, containing 0·40 mass fraction benzene, into an overhead product containing 0·97 mass fraction benzene and a bottom

Turn Over

product containing 0·98 mass fraction toluene. A reflux ratio of 3·50 kg of reflux per kg of product is to be used. The feed will be liquid at its boiling point and the reflux will be returned to the column at 40°C.

(a) Determine the quantity of top and bottom products

and (b) Calculate the condenser duty and the rate of heat input in the reboiler.

The following enthalpy may be used :

The enthalpy of the feed = 164·50 kJ/kg.

The enthaply of vapour leaving the top of the column = 519 kJ/kg.

The enthaply of the distillate = 64·20 kJ/kg

and the enthalpy of the bottoms = 194 kJ/kg.

Calculate the number of theoretical trays required analytically by performing tray-to-tray calculations for a feed composition of 50 mole% mvc. Both the reflux and feed are saturated liquids at their bubble points. Constant relative volatility of $\alpha = 2$ describes the VLE of the binary system. Assume equimolal over flow.

10. Write briefly on the following :

(a) Total reflux.

(b) Minimum reflux.

(c) Optimum reflux.

(d) Reflux ratio.

(e) Raliegh equation.

3. What is azeotrope ? What is the minimum boiling and maximum boiling azeotrope ? Discuss the various factors to be considered in designing column for the separation of azeotropes.

4. Explain the following :

   (a) Steam distillation. (10)

   (b) Simple distillation. (10)

5. Write short notes on the following :

   (a) Prediction of binary V-L-E data consistency test.

   (b) ASTM or Englar distillation.

   (c) Equilibrium flash vaporization.

6. Derive an equation for the operating lines for the enriching and stripping section for the McCabe Thiele method and discuss the effect of feed conditions in this method.

7. (a) Enumerate the steps involved in the design of packed tower for distillation. (12)

   (b) Give a detailed account of the factors limiting capacity and the factors influencing efficiency. (8)

8. A solution of methanol and ethanol are substantially ideal. Compute the vapour liquid equilibrium data for this system at one atmosphere pressure and plot *x-y* and *t-x-y* diagrams. The vapour pressure and temperature relationship are given below :

   $\log P_{MeOH}$ (mmHg) =

   $[7{\cdot}849 - \{1473{\cdot}11/(230 + t^{o}C\}]$

   $\log P_{EtOH}$ (mmHg) =

   $[8{\cdot}045 - \{1544{\cdot}30/ (223 + t^{o}C\}]$.

   The boiling point of methanol and ethanol at atmospheric pressure are 64·65°C and 89·25°C respectively.

9. 250 k.mol/h of saturated liquid feed of a binary mixture is fed to a distillation column fitted with a partial reboiler and a reflux condenser. The feed is split into distillate containing 98% mole more volatile component (mvc) and bottoms product contains 2% mvc.