SE- Sem-IV (B.Tech) R. 16/6/14.

SE - B.Tech. - IV (R).
Unit Operations - II (1)
UO - II

QP Code : NP-19889

(3 Hours) (30) **[Total Marks : 80**

N.B. : (1) Question No. 1 is **Compulsory.**
(2) Attempt any **three** questions from the remaining **five** questions.
(3) Assume **suitable** data if **necessary.**

1. (a) Explain different modes of heat transfer. 5
(b) Write a note on fouling factor. 5
(c) State and explain fick's law of diffusion. 5
(d) Draw and explain boiling point diagram in distillation. 5

2. (a) 88 mm O.D. pipe is insulated with a 50 mm thick insulation having mean thermal conductivity of 0.087 W/m.K and 30 mm thick insulation having mean thermal conductivity of 0.064 W/m.K If the temperature of the outer surface of pipe is 623K. and temperature of outer insulation is 313K. Calculate the heat loss per meter of the pipe. 10

(b) Derive an equation for LMTD. and apply the same for co-current and counter current flow patterns. 10

3. (a) With the help of dimensional analysis derive an equation for Nusselt's number in convection. 12

(b) What are radiation shields? Derive the equation $Q_{\text{with n shields}} = \frac{1}{(n+1)} Q_{\text{without shields.}}$ 8

4. (a) Calculate the loss of heat by radiation from a steel tube diameter 70 mm and 3 m long at a temperature of 500K. If the tube is located in a square brick conduit 0.3 m side at 300 K. Assume ε for steel as 0.79 and for brick conduit as 0.93. 6

(b) A mixture of 35 mole % A and 65 mole % B is to be separated in distillation column. The concentration of A in distillate is 93 mole % and 96% of all A is in distillate. The feed is half vapor. Reflux ratio is 4. The relative volatility is 2.5. How many equilibrium stages are required in each section of the column. What could be the minimum reflux ratio for such operation? 14

5. (a) Explain the construction and working of
(i) Double pipe heat exchanger
(ii) Shell and tube heat exchanger. 14
(b) Write a note on azeotropic distillation. 6

SE - BTech - IV (R)

UO - II

(2)

QP Code : **NP-19889**

6. In an apparatus for the absorption of SO_2 in water at one point in the column, the concentration of SO_2 in gas phase was 10% SO_2 by volume and was in contact with a liquid containing 0.4% SO_2 by weight. Pressure and temperature are at 1 atm and 323K respectively. The overall gas phase mass transfer coefficient is 7.36×10^{-10} kmol/m^{2}s (N/m^2) of the total resistance 45%. lies in gas phase and 55% line in liquid phase. **20**

The equilibrium data is as follows;

Kg SO_2/100 kg H_2O	0.2	0.3	0.5	0.7
Partial pressure of SO_2 mm Hg	29	46	83	119

(i) Estimate the film coefficient & overall m.t.c. based on liquid phase.

(ii) Estimate the molar flux based on film coefficient and overall mass transfer coefficient.
