S.E - IV Sem - Biotech. 10/6/16

2016 Unit operation - II

(28) SE/IV/CBGS/BT/UO-II

Q.P. Code : 568700

(3 Hours) **Max. Marks: 80**

Note:

1. Question **No. 1 is compulsory.**
2. Attempt **any three** questions from remaining **five** questions.
3. Assume suitable data wherever necessary.

Q.1 a) Mention important requirements of insulating materials and describe optimum insulation thickness. 5

b) Explain in brief the process of diffusion in bioprocess. 5

c) Calculate the rate of heat transfer by radiation from an unlagged steam pipe, 50 mm, O.D. at 393 K to air at 293 K. (Assume e=0.9) 5

d) What are the significances of Nusselt Number & Prandtl Number in convective heat transfer transfer? 5

Q.2 a) Derive the expression for heat transfer through furnace wall made up of three different materials in series. 10

c) Explain in detail forward and backward multiple effect evaporators 10

Q.3 a) A mixture of benzene and toluene containing 40 % benzene and 60 % toluene is to be separated in a fractionating column to give a product (distillate) containing 96 % benzene and a bottom product containing 95 % toluene. The feed is a mixture of two third vapour and one third liquid. Find the number of theoretical stages required if reflux ratio of 1.5 times the minimum is used and if relative volatility is 2.5. 15

b) Write a note on bubble cap tray tower. 5

Q.4 a) Draw a neat sketch of fixed tube sheet shell and tube heat exchanger and label its parts. 5

b) Compare drop wise condensation and film wise condensation. 5

c) Derive the equation of relative volatility for binary system to generate vapor – liquid equilibrium data. Explain vapour liquid equilibrium curve for Benzene Toluene system. 10

Q.5 a) A steam pipe 115 mm outside diameter is covered with two layers of different materials. The first layer is 50 mm thick and has a thermal conductivity of 0.062 W/(m.K). The second layer is 30 mm thick and has a thermal conductivity of 0.872 W/(m.K). outside surface temperature of the steam pipe is 508 K and that of the outer surface of the lagging is 311 K. calculate the heat loss per meter length of the pipe and the temperature between the two layers of insulation 10

b) Hot oil at a rate of 1.2 kg/s [Cp = 2083 J/(kg.K)] flows through a double pipe heat exchanger. It enters at 633 K and leaves at 573 K. the cold fluid enters at 303 K and leaves at 400 K. if the overall heat transfer coefficient is 500 W/(m^2.K), calculate the heat transfer area for i) parallel flow and ii) countercurrent flow. 10

Q.6 a) Write short note on the following theories of diffusion mass transfer 10

i) Film theory ii) Penetration theory

b) Describe in brief various methods for measuring K_La. 10
