CAP S.E-IV Sem - Biotech

Unit Operation - II S.E/IV/CBGS/BT/Dec-15

QP Code : 5544

(3 HOURS) (27) (MAX. MARKS : 80)

Note:

1. Question No. 1 is compulsory.
2. Attempt any three questions out of remaining five questions.
3. Assume suitable data wherever necessary.
4. Figures to right indicate full marks.

Q.1 Answer the following (Any four) 20

a. Define and explain nucleate boiling and film boiling.

b Discuss Kirchoff's law and Boltzmann Law of radiation.

c. What are the factors affecting the cellular oxygen demand.

d. Explain diffusion in polymers.

e. Give the comparison of convection and radiation.

Q.2a. Differentiate between natural convection and forced convection. 05

b. Differentiate between single-effect evaporator and multiple-effect evaporator. 05

c. A 50 mm diameter pipe of circular cross section and with walls 3 mm thick is covered with two concentric layers of lagging, the inner layer having a thickness of 25 mm and and thermal conductivity of 0.08 W/m.K, and the outer layer having thickness of 40 mm and a thermal conductivity of 0.04 W/m.K. Estimate the rate of heat loss per meter length of pipe if the temperature inside the pipe is 550K and the outside surface temperature is 330K. k for pipe is 45 W/m.K. 10

Q.3a. Explain the role of diffusion in bioprocessing. 04

b. Derive the feed line equation for rectifying column. 08

c. Estimate the total heat loss by convection and radiation from an unlagged steam pipe, 50 mm o.d. at 415K to air at 290 K. 08

Data:

Emmissivity = 0.90

The film coefficient (h_c) to calculate heat loss by natural convection is given by

$h_c = 1.18(\Delta T / D_0)^{0.25}$, W/(m^2.K)

Q.4a. A mixture of 35 mole % A and 65 mole% B is to be separated in distillation column. The concentration of A in the distillate is 93mol% and 96 mol% of all A is in distillate. The feed is half vapour and the reflux ratio is 4:1. How many equilibrium stages are required 12

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in each section of the column? What could be the minimum reflux ratio for such operation? The equilibrium data is;

x	0	0.2	0.4	0.6	0.8	1
y	0	0.385	0.625	0.789	0.91	1

b. How is oxygen transfer in large vessel takes place? 08

Q.5a. A shell and tube heat exchanger is to be provided with tubes of 31 mm o.d., 27 mm i.d. and 4 m long. It is required for heating water from 295 K to 318K with the help of condensing steam at 393K on the outside of tubes. Determine the number of tubes required if water flow rate is 10 kg/s. Heat transfer coefficient on the steam side and water side are 6000 W/ m^2.K and 850W/m^2.K respectively. Neglect all other resistances. Cp of water = 4.187 kJ/kg.K. 10

b A 0.25 m diameter cicular disc is exposed to atmospheric air at 298K. One surface of the disc is insulated and the other surface is maintained at 403K. Calculate the amount of heat transferred from the disc when it is: 10

i) Horizontal with hot surface facing up ii) Horizontal with hot surface facing down

Data: The properties of air at the mean film temperature are:

Kinematic viscosity $= 2 \times 10^{-5}$ m^2/s

N_{Pr} = 0.70

k = 0.03 W/m.K

Characteristic length, L = 0.90 D

Q.6 Write a short note on (any four) 20

a. Penetration theory

b. Forward feed multiple effect evaporator

c. Critical and optimum thickness of insulation

d. Effect of temperature and pressure on diffusivity

e. Drop wise condensation