SE/IV/Biotech/Rev/KT   2.30 - 5.30
17/12/14

Unit operation II

27   **QP Code :12604**

(3 Hours)   [Total Marks : 80

N.B. : (1) Question No 1 is **compulsory**.
     (2) Attempt any **three** questions out of remaining **five** questions.
     (3) Assume **suitable** data wherever **necessary**.

1. Attempt any **four** questions :–   20
     (a) Differentiate between convection and conduction.
     (b) Explain absorptivity, reflectivity and transmissivity.
     (c) Discuss critical and optimum thickness of insulation.
     (d) Give the classification of shell and tube heat exchnger.
     (e) Explain dropwise and film wise condensation.

2. (a) Derive the expression for rate of heat flow through a composite cylinder.   10
     (b) In an oxygen-nitrogen gas mixture at 101·325 kPa and 298 K, the concentration   10
     of oxygen at two phases 2 mm apart are 10 and 20% by volume respectively.
     Calculate the flux of diffusion of oxygen for the following :–
       (i) Nitrogen is non-diffusing
       (ii) There is equimolar counter diffusion of two gases $D_{AB} = 1.81 \times 10^{-5}$ m²/s.

3. (a) Calculate the inside heat transfer coefficient for a fluid flowing at a rate   10
     of 300 cm³/s through a 20 mm inside diameter tube of a heat exchange.
     Data :

Viscosity of flowing fluid	= 0·8 Ns/m².
Density of flowing fluid	= 1·1 g/cc.
Specific heat of fluid	= 1·26 kJ/kg. K.
Thermal conductivity of fluid	= 0·384 W/m. K.
Viscosity of water	= 1 Ns/m².
Length of heat exchanger	= 5 m.

     (b) Explain boiling point diagram of Benzene-Toluene system.   5
     (c) Calculate the heat loss by radiation from an unlagged horizontal steam   5
     pipe, 50 mm OD at 377 K to air at 283 K. Take emissivity = 0·90 and
     $\sigma = 5.67 \times 10^{-8}$ W/m² K⁴.

[TURN OVER

GN-Con.:12111-14.

4. (a) A furnace wall is constructed with a 299 mm thick layer of fire brick, a **10** 115 mm thick layer of insulation brick and again a 229 mm thick layer of building brick. The inside temperature is 1223 K and the temperature at the outemost wall is 323 K. The thermal conductivities of fire brick, insulating brick and building brick are 6·05, 0·581 and 2·33 w/m.K. respectively. Find the loss per unit area and the temperature at the interface..

   (b) Explain the role of diffusion in bioprocessing.   **10**

5. (a) What are the different types of distillation ? Explain simple distillation. **10**

   (b) Explain the physical significance of the following dimensionless **10** number :—
 (i) Reynold's no.
 (ii) Prandtl no.
 (iii) Grashof no.
 (iv) Nusselt no.
 (v) Biot no.

6. Write a short note on any **four** :—
 (a) Flash distillation   **20**
 (b) Nusselt theory
 (c) Fouling factor
 (d) Radiation shield
 (e) Factors affecting cellular oxygen demand.

****

GN-Con.:12111-14.