CBCS Scheme

USN | | | | | | | | | | 15BT32

Third Semester B.E. Degree Examination, Dec.2017/Jan.2018
Unit Operations

Time: 3 hrs. Max. Marks: 80

Note: *Answer FIVE full questions, choosing one full question from each module.*

Module-1

1 a. With the help of a diagram, explain the Newtonian and Non – Newtonian fluids. **(04 Marks)**

b. Differentiate between : i) Ideal and real fluid ii) Compressible and Incompressible flow iii) Steady and Unsteady flow iv) Uniform and Non – Uniform flow. **(08 Marks)**

c. The right limb of a simple U – tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of the pipe is 12cm below the level of mercury in the right limb. Find the pressure of the fluid in the pipe if the difference of mercury level in the two limbs is 20cm. **(04 Marks)**

OR

2 a. Derive an expression for terminal settling velocity of a spherical particle settling in Stoke's region. **(10 Marks)**

b. Calculate the pressure drop across the bed of solids of thickness 5cm. The average size of the particle is 75 μ (micron). Water flows at a rate of 60lit/min through the bed having a porosity of 0.38. The bed diameter is 5cm. **(06 Marks)**

Module-2

3 a. With a neat sketch, explain the working principle of a orifice meter. **(08 Marks)**

b. 1500 kg/hour of certain material is produced by crushing and then screened through 10 mesh/cm screen constructed of 0.035 cm / wire. From screen analysis shown below, calculate the effectiveness of the screen. **(08 Marks)**

Aperture dia, cm	0.47	0.2362	0.117	0.059	0.03	0.0147	PAN	TOTAL
Feed	14.3	20.0	20.0	28.5	8.6	5.7	2.9	100
Underflow	-	-	10.5	29.5	30.0	20.0	10.0	100
Overflow	20	28	28	24	-	-	-	100

OR

4 a. Explain the different types of filtration. **(04 Marks)**

b. In the crushing of an ore 80% of feed passes through 5mm screen and 80% of product passes through 0.5mm screen. Now it is desired to alter the product size such that 80% of the product passes through 0.2mm screen. What is the percentage increase in power consumption? **(08 Marks)**

c. Define Sphericity and equivalent diameter. **(04 Marks)**

Module-3

5 a. Derive an expression for critical thickness of insulation of a cylindrical surface. **(08 Marks)**

b. A steam pipe, 40mm outside diameter, is to be insulated by two layers of insulation each 20mm thick. The material M-1 has conductivity k and the material M-2 has conductivity 3k. Assuming that the inner and outer surface temperatures of composite insulation to be fixed, find which arrangement would give less heat loss rate, M-1 near pipe surface and M-2 as the outer layer or vice versa? Also calculate the percent reduction in heat loss. **(08 Marks)**

OR

6 a. Differentiate between Natural and Forced convection. **(04 Marks)**

b. Explain the fluid flow patterns in an heat exchanger. **(06 Marks)**

c. Methyl alcohol flowing in the inner pipe of an heat exchanger is cooled with water flowing in the outer pipe. The ID and OD of the inner pipe are 26mm and 35mm respectively. The thermal conductivity of the pipe material is 50W/m.K. The individual heat transfer co-efficient and fouling factors are : Alcohol co-efficient = 250 $W/m^2.K$; Water co-efficient = 500 $W/m^2.K$; Inside fouling factor, $R_{D_i} = 0.86 \times 10^{-3} m^2.K/W$; Outside fouling factor, $R_{Do} = 1.7 \times 10^{-3}$ $m^2.K/W$. Calculate the outside co-efficient based on the inside area of the inner pipe including dirt factors and excluding the dirt factors. **(06 Marks)**

Module-4

7 a. Give the stepwise procedure for the design of STHE. **(08 Marks)**

b. Calculate the heat transfer area of 1-2 heat exchanger from the following data : Inlet and the Outlet hot fluid temperature 150^0C and 80^0C respectively. Inlet and Outlet temperature of cold fluid are 30^0C and 45^0C respectively. Overall heat transfer co-efficient = 4100 $W/m^2.K$. Heat loss = 407 kW. LMTD correction factor = 0.84. **(08 Marks)**

OR

8 a. Explain the Arnold's cell experiment used to determine diffusivity. **(08 Marks)**

b. In an oxygen – nitrogen gas mixture at 101.3 kPa and 298K, the concentrations of oxygen at two phases 2mm apart are 10% and 20% by volume respectively. Calculate the flux of diffusion of oxygen for the cases where : i) the nitrogen is non – diffusing ii) there is equimolar counter diffusion of the two gases. Diffusivity of oxygen in nitrogen is 1.81×10^{-5} m^2/s. **(08 Marks)**

Module-5

9 a. Explain the common methods used in distillation. **(06 Marks)**

b. 100 kmol of mixture containing 50 mole % n – heptane (mole volatile) and 50 mole % n – octane is subjected to a differential distillation at atmospheric pressure, with 60 mole % of liquid distilled. Compute the composition of the distillate and the residue using Rayleigh equation. **(10 Marks)**

Equilibrium Data :

X	0.5	0.46	0.42	0.38	0.34	0.32
Y	0.689	0.648	0.608	0.567	0.523	0.497

OR

10 a. Differentiate between Distillation and Extraction. **(04 Marks)**

b. Explain the characteristics of solvent used for extraction. **(04 Marks)**

c. A 100 kg bath of granular solids containing 30% moisture is to be dried in a tray dryer to 16% moisture by passing a current of air at 350K across its surface at a velocity of 1.8m/s. If the constant rate of drying under these conditions is 0.7×10^{-3} $kg/(m^2.s)$ and the critical moisture content is 15%, calculate the drying time. Drying surface = 0.03 m^2/kg dry weight. **(08 Marks)**

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