CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐

18BT33

Third Semester B.E. Degree Examination, July/August 2022
Unit Operations

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. State and explain Pascal's law. **(06 Marks)**
   b. Differentiate between laminar and turbulent flow. **(04 Marks)**
   c. The water is flowing through a pipe having diameter 20 cm and 10 cm at section 1 and 2 respectively. The rate of flow through the pipe is 35 l/sec. The section 1 is 6 m above datum and at section - 2 is 4 m above data. If the pressure at sec - 1 is 39.24 N/cm^2. Find the intensity of pressure at sec – 2. **(10 Marks)**

OR

2 a. Derive an expression for the terminal settling velocity for a spherical particle settling in Stoke's region and under free settling coefficient. **(10 Marks)**
   b. Derive Barometric equation by stating all assumptions. **(10 Marks)**

Module-2

3 a. With a neat sketch, explain the working principle of centrifugal pumps. **(10 Marks)**
   b. Derive the discharge coefficient equation for orifice meter. **(10 Marks)**

OR

4 a. Define filtration. With a neat sketch, explain the concept of rotary drum vacuum filtration. **(10 Marks)**
   b. An orifice meter with orifice diameter 10 cm is inserted in a pipe of 20 cm in diameter. The pressure gauges fitted upstream and downstream of the orifice meter given readings of 19.62 N/cm^2 and 9.81 N/cm^2 respectively. Coefficient of discharge for the meter is given as 0.6. Find the discharge for the water through pipe. Calculate a_0, a_1 and a_2. **(10 Marks)**

Module-3

5 a. Define convection. Explain types of convection. **(10 Marks)**
   b. Calculate the heat transfer coefficient for fluid flowing at a rate of 300 cm^3/s through a 20 mm inside diameter tube of heat exchanger.
      Data : Viscosity of flowing fluid : 0.8 NS/m^2
      Density of fluid flow : ρ : 1.1 g/cm^3
      Specific heat of fluid = C_p = 1.26 kJ/kgK
      Thermal conductivity of fluid = K = 0.384 W/mK
      Viscosity at wall temperature = 1.0 NS/m^2
      Length of heat exchanger = 5 m **(10 Marks)**

OR

6 a. What is fouling factor? How does it affect the rate of heat transfer? **(10 Marks)**
   b. An ice box has walls constructed of a 10 mm layer of corkboard contained between two wooden walls, each of 20 mm thick. Find the rate of heat removed per unit area if the inner wall surface is kept at 263 K [−10°]. While the outer surface temperature is 303 K [30°C]. Find out the zone in wall where the temperature is 293 K [20°C].
   Data: Thermal conductivities of cork board and wood respectively are 0.041 and 0.105 W/mK. **(10 Marks)**

Module-4

7 a. What is Fick's law of diffusion and explain the types of diffusion. **(10 Marks)**
   b. Oxygen – N_2 gas mixture at 101.3 kPa and 298 K the concentrations of O_2 at 2-phase 2 mm apart are 10 and 20% by volume respectively. Calculate the flux of diffusion of O_2 for the cases where:
   (i) N_2 is not diffusing.
   (ii) There is equimolar counter diffusion of the two gases. Diffusivity of O_2 is N_2 is 1.81×10^{-5} m^2/s. **(10 Marks)**

OR

8 a. Briefly explain the concept of steady state equimolar counter diffusion (of gas). **(10 Marks)**
   b. Explain the theories related to the mechanism of mass-transfer across a phase boundary at interface. **(10 Marks)**

Module-5

9 a. Explain the steps considered to determine the stages in distillation column using Mc.Cab and Thiele method. **(10 Marks)**
   b. Picric acid is to be extracted with benzene. If the aqueous solution contains 0.2 mol of picric acid 1 per litre. Calculate the volume of benzene with which 1 litre of the solution must be extracted in order to form a benzene solution containing 0.02 mol of picric acid per litre.
   Given: K = distribution coefficient = C_E/C_R = 0.505
      C_E = concentration of picric acid in benzene, mol/l
      C_l = concentration of picnic acid in water mol/lt **(10 Marks)**

OR

10 a. Give the advantages, disadvantages and applications of :
   (i) Tray dryer
   (ii) Spray dryer **(10 Marks)**
   b. With a neat labelled diagram, explain steam distillation. **(10 Marks)**

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