CBCS SCHEME

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18BT33

Third Semester B.E. Degree Examination, Jan./Feb. 2021
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. Derive the expression for hydrostatic equilibrium. **(10 Marks)**

b. Explain the different types of fluids with the help of plots of shear stress-strain behavior of fluids. **(10 Marks)**

OR

2 a. Define Pascal's law and derive an expression for the measurement of pressure at any part in a fluid at rest. **(10 Marks)**

b. State and derive the Bernoulli's equation. **(10 Marks)**

Module-2

3 a. With a neat sketch, explain the working of ball mill mention its uses. **(10 Marks)**

b. A venturimeter is installed in a pipe of diameter 25mm for the measurement of flow rate of water. Pressure drop across the throat and upstream of the meter is 10cm of mercury. Calculate the volumetric flowrate of water in m^3/s.
Diameter of throat in 15mm
Co-efficient of venturimeter (C_v) = 0.98
Density of water = 1000 kg/m^3
Density of mercury = 13600 kg/m^3. **(05 Marks)**

c. A 30cm × 15cm ventruimeter is installed in vertical pipe conveying a fluid of S.G 0.6 and is flowing upwards. Differences in level between throat and inlet section is 60cm. Mercury manometer shows the reading of 10cm calculate the rate of discharge of fluid $C_v = 0.8$. **(05 Marks)**

OR

4 a. With a neat sketch, explain the principle and working of venturimeter. **(08 Marks)**

b. Explain the factors considered for the selection of filter medium. **(07 Marks)**

c. A certain crusher accepts a feed material having a volume surface mean diameter of 19mm and gives a product of volume surface mean diameter of 5mm. Power required to crush 15 ton/h is 7.5kW. What will be power consumption if the capacity is reduced to 12 tons/h. **(05 Marks)**

Module-3

5 a. Derive an expression for steady state heat conductor through composite cylinder. **(10 Marks)**

b. It is necessary to insulate a flat furnace wall so that rate of heat loss per unit area of this surface does not exceed 450w/m^2. Temperature difference across the insulating layer is 400K. Evaluate the thickness of insulation if
i) Insulation is made of asbestos cement having K = 0.11w/mK
ii) Insulation is made of fire clay having K = 0.84w/mK. **(10 Marks)**

OR

6 a. Calculate the inside htc for fluid flowing at a rate of 300cm^3/s through a 20mm inside diameter tube of heat exchanger.
Viscosity of flowing fluid = 0.8Ns/m^2
Density of flowing fluid = 1.1g/cm^3
specific heat of fluid = 1.26kJ/kg K
Thermal conductivity of fluid = 0.384 W/mK
Viscosity at wall temperature (μ_w) = 1 Ns/m^2
length of tube = 5m **(08 Marks)**

b. For the forced convection in pipe, obtain $Q = u_i A_i \Delta T$. **(12 Marks)**

Module-4

7 a. Derive the expression for steady state diffusion of A through non-diffusing B. **(10 Marks)**

b. A large tank filled with a mixture of gases A and B at 101KPa and 298K (25°C) is connected to another large tank filled with a mixture of A and B of different compositions A and B at 101 KPa and 298K. Tanks are connected by a tube of inner diameter of 50mm and is 150mm long. Calculate the steady state rate of transport of A through the tube when the concentration of A in one tank is 90mol% and other 5mol%, assuming uniformity in composition in each tank and transfer takes place by molecular diffusion diffusivity of A and in B is $4.3 \times 10^{-3} m^2/s$. **(10 Marks)**

OR

8 a. Explain the theories related to the mechanism of mass transfer across a phase boundary at interface. **(12 Marks)**

b. Ammonia gas (A) diffuses through nitrogen gas (B) under steady state conditions with nitrogen non-diffusing partial pressure of A at location 1 is 1.5×10^4 Pa and that at location 2 is 5×10^3Pa. Location 1 and 2 are 0.15m apart. Total pressure is 1.103×10^5Pa and at 298K. Calculate the flux of diffusion of Ammonia. Diffusivity is taken as 2.3×10^{-5} m^2/s. **(08 Marks)**

Module-5

9 a. 100 Kmol/h of a feed containing 40mol% hexane and 60mol% octane is to be distilled in a column consisting of a still pot ; plate and condenser, feed is a liquid at its boiling point and is fed into the reboiler from which a residue is continuously withdrawn and rate of liquid reflux flow to distillate is 2. Distillate containing 80mol% hexane. Using McCabe Thiele's procedure, calculate the bottom composition and moles of distillate per hour.

x	1	0.69	0.4	0.192	0.045	0
y	1	0.932	0.78	0.538	0.1775	0

(14 Marks)

b. Explain the different types of distillation. **(06 Marks)**

OR

10 a. Explain the factors considered for the selection of solvent used in extractions process. **(08 Marks)**

b. Explain the steps considered to determine the stages in distillation column using McCabe-Thiele's method. **(12 Marks)**

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