



CBCS SCHEME

15BT32

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020 Unit Operations

Time: 3 hrs.

Max. Marks: 80

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

Module-1

- 1 a. What are Newtonian and non-Newtonian fluids? Explain with examples. (08 Marks)
b. Derive Bernoulli's equation starting with all assumptions. (08 Marks)

OR

- 2 a. With neat sketch, explain Reynolds experiment. (05 Marks)
b. The acetic acid is to be pumped at a rate of $0.02 \text{ m}^3/\text{sec}$ through a 75mm ID pipe 70m long. What is the pressure drop in the pipe? ($\rho = 1060 \text{ kg/m}^3$, $\mu = 0.0025 \text{ NS/m}^2$) (05 Marks)
c. With neat sketch explain the working principle of cyclones. (06 Marks)

Module-2

- 3 a. With neat sketch, explain the working and construction of venturimeter. (08 Marks)
b. Water flowing at the rate of $500 \text{ cm}^3/\text{s}$ through an orifice of 25mm diameter in 75mm diameter pipe. What will be the difference in the level of mercury manometer connected across the meter? $C_v = 0.65$. (08 Marks)

OR

- 4 a. Explain the following:
i) Crushing efficiency
ii) Rittinger law
iii) Kick's law
iv) Bonds law. (08 Marks)
b. With neat sketch, explain the principle construction and working of Ball mill. (08 Marks)

Module-3

- 5 a. Derive an expression for heat transfer through a furnace wall made of three different materials in series. Assume K_1 , K_2 , K_3 to be the thermal conductivity of the materials and x_1 , x_2 and x_3 are the respective thickness. Assume that the hot face and cold face temperatures to be T_1 and T_2 . (05 Marks)
b. What is insulation? List out the properties of insulating material. (04 Marks)
c. What is critical thickness of insulation? Obtain critical radius of insulation for an insulated cylinder. (07 Marks)

OR

- 6 a. Explain different types of flow patterns used in heat exchangers. (05 Marks)
b. Derive equation for Logarithmic Mean Temperature Difference (LMTD). (05 Marks)
c. Differentiate between drop wise and film wise condensation. (06 Marks)

Module-4

- 7 a. With neat sketch, explain the construction and working of shell and tube heat exchanger. (10 Marks)
- b. A shell and tube heat exchanger is to be provided with tubes of 31mm OD, 27mm ID and 4m long. It is required for heating water from 295K (22°C) to 318K (45°C) with the help of condensing steam at 393K (120°C) on the outside of the tube. Determine the number of tubes required if the water flow rate is 10kg/s. The heat transfer coefficient on the steam side and water side are 6000W/m²-K and 850W/m²K respectively. Neglect all other resistance. (06 Marks)

OR

- 8 a. Derive equation for equimolar counter diffusion. (06 Marks)
- b. In an oxygen –nitrogen mixture at 10 atmosphere and 25°C the concentration of oxygen at two places of 0.2cm apart are 10 and 20 volume percent respectively. Calculate the rate of diffusion of oxygen expressed as gm/cm²-hr for the case of unicomponent diffusion (nitrogen to non-diffusing).

$$D_{AB} = 0.181 \text{ cm}^2 / \text{sec} \quad R = 82.06 \frac{\text{atm cm}^3}{\text{gm mole K}} \quad (06 \text{ Marks})$$

- c. Write a note on mass transfer coefficients for gases and liquids. (04 Marks)

Module-5

- 9 a. Explain the analysis of simple distillation by Rayleigh equation. (06 Marks)
- b. It is desired to separate by distillation at 760mm Hg mixture containing 42% m-heptane and 58% mole ethyl benzene to produce distillate containing 97% mole heptanes and residue containing 99% mole ethyl benzene.
- i) Using reflux ratio of 2.5 determine the number of equilibrium stages needed for a saturated liquid feed and bubble reflux by the McCabe Thiele method.
- ii) Determine the minimum reflux ratio
- iii) Determine the number of equilibrium stages at total reflux.

Y	0	0.233	0.428	0.514	0.608	0.729	0.814	0.904	0.963	1.0
X	0	0.08	0.185	0.251	0.335	0.489	0.651	0.788	0.914	1.0

Where Y and X are mole fraction of heptanes in vapour and liquid respectively. (10 Marks)

OR

- 10 a. Explain drying rate curve. (08 Marks)
- b. With neat sketch explain working and construction of basket type of extractor. (08 Marks)

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