CBCS SCHEME

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BBT302

Third Semester B.E./B.Tech. Degree Examination, June/July 2025
Unit Operations + Lab

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Define fluid, with the help of neat shear – stress shear rate plot explain different types of fluids.	10	L1	CO1
	b.	A 30 cm pipe conveying water branches into 2 pipes of diameter 20 cm and 15 cm respectively. The average velocity in the 30 cm pipe is 2.5 m/s. Find the discharge in this pipe. Also determine the velocity in the 15 cm pipe, if the average velocity in the 20 cm pipe is 2 m/s.	10	L3	CO1
		OR			
Q.2	a.	Derive the Bernoulli's equation for the fluid flowing in a circular pipe.	10	L2	CO1
	b.	With a neat sketch, explain Reynolds experiment. Also explain the significance of Reynolds number.	10	L2	CO1
		Module – 2			
Q.3	a.	With a neat sketch, explain the working of reciprocating pump.	10	L2	CO2
	b.	Derive an expression for coefficient of discharge in an venturimeter.	10	L2	CO2
		OR			
Q.4	a.	With a neat sketch explain working and application of rotary drum filtration.	10	L2	CO2
	b.	With a neat diagram, explain working and applications of ball mill.	10	L2	CO2
		Module – 3			
Q.5	a.	Derive an expression for heat flow through composite wall.	10	L2	CO3
	b.	A steel pipe of 40 mm OD is to be insulated by two layers of insulations each 20 mm thickness. The material M_1 has a conductivity of k and the material M_2 has a conductivity of 3 K. Assuming that the inner and outer surface temperature of composite insulation is to be fixed. Find which arrangement could give less heat loss rate. (M_1 – near the pipe surface and M_2 – as outer layer or vice versa). Also calculate the percentage heat loss in the arrangement.	10	L3	CO3
		OR			
Q.6	a.	With a neat sketch explain construction working of shell and tube heat exchanger.	10	L2	CO3
	b.	Cold fluid is flowing through the heat exchanger at a rate of 15 m^3/h. It enters the heat exchanger at 303 K and leaves at 328 K. The hot thermic fluid enters the heat exchanger at the rate of 21 m^3/h at a temperature of 388 K. Find out the area of heat transfer required assuming the flow is counter current and overall heat transfer coefficient is 3490 w/m^2 K. Data : $\rho_c = 1000/m^3$ $C_{P_c} = 4.187 kJ/kgK$ $\int_n = 950\ kg/m^3$ $C_{P_h} = 2.93 kJ/kgK$	10	L3	CO3

		Module – 4			
Q.7	**a.**	Define Fick's law of diffusion and the types of diffusion.	**8**	**L2**	**CO4**
	b.	Ammonia gas (A) diffuses through nitrogen gas (B) under steady state conditions with nitrogen as non diffusing. Partial pressure of A at location : (1) is 1.5×10^4 Pa and that at location (2) is 5×10^3 Pa. Locations (1) and (2) are 0.15 m apart. Total pressure is 1.103×10^5 Pa and temperature is 298 K. Calculate the flux of diffusion of ammonia also calculate the flux of diffusion in equimolar counter diffusion assuming nitrogen is also diffusing. Diffusivity factor is 2.3×10^{-5} m^2/s.	**12**	**L3**	**CO4**
		OR			
Q.8	**a.**	Interpret on the theories of mass transfer across a phase boundary at the interphase.	**8**	**L2**	**CO4**
	b.	Obtain the expression for steady state equimolar counter current diffusion.	**12**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	With a neat sketch explain the working of any one distillation method.	**10**	**L2**	**CO5**
	b.	Explain the McCabe-Thiele's method to determine the theoretical plate in distillation of binary mixtures.	**10**	**L2**	**CO5**
		OR			
Q.10	**a.**	Describe the drying characteristics curve.	**6**	**L1**	**CO5**
	b.	Describe the factors considered for the selection of solvent for extraction.	**6**	**L1**	**CO5**
	c.	With a neat sketch, explain the working of tray Dryer.	**8**	**L2**	**CO5**

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