U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: III**

Branch: Chemical Engineering **Duration: 3 hrs.**

Course Code: 23CHPCMOP / 22CH3PCMOP **Max Marks: 100**

Course: Mechanical Operations

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

		UNIT - I	CO	PO	Marks
1	a)	Explain differential and cumulative method of analysis.	CO1	PO1	**10**
	b)	Calculate the volume surface mean diameter for the following particulate material:	CO1	PO1	**10**

Size Range µm	Mass of particles in the range gm
-710+310	30
-300+180	35
-180+90	65
-90+38	70
Pan	55

OR

2	a)	Following is the Particle Size Distribution (PSD) of three cuts obtained from a double deck vibrating screen (48 and 65 mesh). The mass ratio of oversize: Intermediate: Undersize is 3:3:4. i. Construct particle size distribution for 48 and 65 mesh. ii. Calculate effectiveness of 48 and 65 mesh screens individually if oversize and under size are the desired products.	CO2	PO3	**12**

	Mass Fraction Retained		
Mesh No	Oversize	Intermediate	Undersize
14	0.0012	0	0
20	0.0068	0	0
28	0.189	0.2	0
35	0.389	0.039	0.001
48	0.337	0.322	0.003
65	0.066	0.526	0.344
100	0.005	0.067	0.299
150	0.005	0.024	0.237
200	0.001	0.002	0.116

		b)	Derive an expression to find the effectiveness of screens.	*CO1*	*PO1*	**08**
			UNIT - II			
	3	a)	State and explain the empirical laws of size reduction.	*CO1*	*PO1*	**10**
		b)	Derive an expression to find the critical speed of a ball mill.	*CO2*	*PO3*	**10**
			OR			
	4	a)	With a neat sketch explain the working of a Blake Jaw Crusher.	*CO3*	*PO3*	**10**
		b)	A certain crusher accepts a feed material having a volume surface mean diameter of 19 mm and gives a product of volume surface mean diameter of 5 mm. The power required to crush 15 ton per hour is 7.5 kW. What will be the power consumption if the capacity is reduced to 12 ton per hour?	*CO3*	*PO3*	**10**
			UNIT - III			
	5	a)	Derive an expression for minimum fluidization velocity.	*CO4*	*PO2*	**12**
		b)	A water softener consists of a vertical tube of 50 mm diameter and packed to a height of 0.5 m with ion exchange resin particles. The particles may be considered spherical with a diameter of 1.25 mm. Water flows over the bed because of gravity as well as the pressure difference at a rate of 300 ml/s. The bed has a porosity of 0.3. Calculate the pressure gradient across the bed.	*CO3*	*PO3*	**08**
			OR			
	6	a)	A slurry is filtered in a filter of cross-sectional area 20 m^2 the slurry consists of particles of density 2.26 gm/ cc. The filter cake has a porosity of 32%. For constant pressure filtration at 3 kg_f/cm^2. i) What volume of slurry is required to build up a cake of 12.5 mm thick? ii) How long will it take to form the cake if the cloth resistance can be neglected? **Data:** Filtrate Viscosity = 1.6 cP Filtrate density = 1.05 gm/cc Solid concentration in the slurry = 4.8 % by wt. Specific cake Resistance, $\alpha = 1.14\ x\ 10^{11}\ \frac{m}{kg}$	*CO5*	*PO9*	**10**
		b)	With a neat sketch explain the working of rotary drum filter.	*CO2*	*PO3*	**10**
			UNIT - IV			
	7	a)	Derive the equations used for finding the settling velocity and Reynolds number for hindered settling.	*CO2*	*PO3*	**10**
		b)	Particles of sphalerite (sp.gr of 4) are settling under the force of gravity through a slurry 25% by volume of quartz particles (sp.gr of 2.65) and water. The diameter of sphalerite particles is 0.15	*CO4*	*PO2*	**10**

			mm. The volumetric ratio of sphalerite to slurry is 0.30. What is the terminal settling velocity of sphalerite? The viscosity of water 1 Cp = 0.001 N s / m^2.			
			OR			
	8	a)	Explain the Kynch Theory of sedimentation.	*CO6*	*PO2*	**10**
		b)	Derive an expression to find the minimum area of thickener and explain the step-by-step procedure for designing thickener.	*CO6*	*PO2*	**10**
			UNIT - V			
	9	a)	Using dimensional analysis, estimate the power required to rotate a given impeller at a given speed.	*CO5*	*PO9*	**10**
		b)	Explain in detail the design and construction of an agitated vessel.	*CO2*	*PO3*	**10**
			OR			
	10	a)	With a neat diagram, explain the construction and working principle of muller mixer and a ribbon blender.	*CO2*	*PO3*	**12**
		b)	A disk turbine with six flat blades is installed centrally in a vertical baffled tank. The tank is 1.83 m in diameter, The turbine is 0.61 m in diameter and is positioned 0.61 m from the bottom of the tank. The turbine bladed are 127 mm wide. The tank is filled to a depth of 1.83 m with an aqueous solution of 50% NaOH at 65 ^oC, which has a viscosity of 12 cP and a density of 1498 kg/m^3. The turbine turns at 90 rpm. The tank is baffled. Calculate the Reynolds number and the power consumed. Data $N_P = 5.8$	*CO4*	*PO2*	**8**

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