U.S.N.										

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

Autonomous Institute Affiliated to VTU

April 2025 Semester End Make-Up Examinations

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

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

Course Code: 23CH3PCMOP/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.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	*CO*	*PO*	Marks
1	a)	Define sphericity and shape factor. Give its importance in screening processes?	*CO1*	*PO1*	**04**
	b)	Differentiate between differential and cumulative size analysis with assumptions	*CO1*	*PO1*	**06**
	c)	The screen analysis of crushed quartz is provided in the table below. The particle density is 2650 kg/m³, with shape factors a = 2 and ∅ = 0.571. For the particle size range between 4 mesh and 200 mesh, perform the following calculations: i. A_W in square millimeter per gram and N_w in particles/gm ii. Volume surface mean diameter. iii. Determine the fraction of the total number of particles present in the 150/200 mesh increment.	*CO2*	*PO2*	**10**

Mesh	Screen Opening	Mass fraction retained
4	4.699	0
6	3.327	0.0251
8	2.362	0.125
10	1.651	0.3207
14	1.168	0.257
20	0.833	0.159
28	0.589	0.0538
35	0.417	0.021
48	0.295	0.0102
65	0.208	0.0077
100	0.147	0.0058
150	0.104	0.0041
200	0.074	0.0031
Pan		0.0075

			OR			
	2	a)	Explain the working principle of gyratory and vibrating screens, highlighting their advantages and limitations in the process of screening.	*CO3*	*PO3*	**12**
		b)	What is sub-sieve analysis? Discuss any one method used for analysing fine particles in detail.	*CO3*	*PO3*	**08**
			UNIT - II			
	3	a)	State and explain the laws of size reduction.	*CO3*	*PO3*	**06**
		b)	Discuss about open circuit grinding and closed-circuit grinding	*CO3*	*PO3*	**06**
		c)	The pair of crushing rolls with a diameter of 1 m is set with a gap of 12.5 mm between them. Given that the angle of nip is 31^0, determine the largest particle size that can be fed into the rolls. If the rolls are 0.4 m wide and operate at 100 rpm, calculate the throughput of the rolls in tonnes per hour, considering density of the material 2330 kg/m^3 and efficiency 12%.	*CO3*	*PO3*	**08**
			OR			
	4	a)	Illustrate the working principle and operation of a Blake jaw crusher with its figure.	*CO3*	*PO3*	**10**
		b)	Derive the relation between the angle of nip, diameter of rolls, radius of feed, and radius of product in a roll crusher. Explain the significance of the angle of nip in the crushing process.	*CO3*	*PO3*	**10**
			UNIT - III			
	5	a)	Describe the types of fluidizations and their application in industries.	*CO4*	*PO4*	**08**
		b)	Derive the Kozeny-Carman equation used for the determination of particle size with assumption in detail.	*CO4*	*PO4*	**12**
			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. Find the volume of slurry 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 $\alpha = 1.14\ x\ 10^{11}\ \frac{m}{kg}$.	*CO4*	*PO4*	**12**
		b)	Describe with a figure, the construction and working of a rotary drum filter.	*CO4*	*PO4*	**08**

<table>
<tr><td></td><td></td><td></td><td>UNIT - IV</td><td></td><td></td><td></td></tr>
<tr><td></td><td>7</td><td>a)</td><td>Derive an equation for the one-dimensional motion of a particle through a fluid under the influence of gravitational and centrifugal fields. Explain the factors affecting the motion of the particle.</td><td>CO4</td><td>PO4</td><td>12</td></tr>
<tr><td></td><td></td><td>b)</td><td>Calculate the settling velocity of glass spheres having a diameter of 1.554 x 10^{-4} m in water at 20 ℃. The slurry contains 60 weight % of solids. The density of glass spheres is 2467 kg/m^3.
Given: Density of water is 998 kg/m^3 and Viscosity of water is 1.005 x 10^{-3} Pa. s.</td><td>CO4</td><td>PO4</td><td>08</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>8</td><td>a)</td><td>Describe the settling process of a flocculated suspension and explain the various zones observed during sedimentation process</td><td>CO4</td><td>PO4</td><td>08</td></tr>
<tr><td></td><td></td><td>b)</td><td>A single batch settling test was made on a lime stone slurry. The interface between clear liquid and suspended solids were observed as a function of time and the results are tabulated below. The test was made using 23.6 g of lime stone per litre of slurry.
<table>
<tr><td>Time (Hrs) (θ_b)</td><td>0</td><td>0.25</td><td>0.50</td><td>1.0</td><td>1.75</td><td>3.0</td><td>4.75</td><td>12</td><td>20</td></tr>
<tr><td>Height of inter face (Cm)</td><td>36</td><td>32.4</td><td>28.6</td><td>21</td><td>14.7</td><td>12.3</td><td>11.55</td><td>9.8</td><td>8.8</td></tr>
</table>
Prepare a curve showing the relationship between settling rate and solids concentration using this, plot a curve of settling velocity versus solid concentration. Find the thickener area if the slurry is fed at a rate of 50,000 kg dry solids/ h to produce a thickeners sludge of 550 g of lime stone per litre.</td><td>CO4</td><td>PO4</td><td>12</td></tr>
<tr><td></td><td></td><td></td><td>UNIT - V</td><td></td><td></td><td></td></tr>
<tr><td></td><td>9</td><td>a)</td><td>Discuss flow patterns of the fluid observed in agitated vessels? How is swirling prevented during agitation?</td><td>CO3</td><td>PO3</td><td>08</td></tr>
<tr><td></td><td></td><td>b)</td><td>What is a ribbon blender? Explain its working principle and applications.</td><td>CO3</td><td>PO3</td><td>06</td></tr>
<tr><td></td><td></td><td>c)</td><td>What is an internal screw mixer? Explain its advantages.</td><td>CO3</td><td>PO3</td><td>06</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>10</td><td>a)</td><td>What are the different types of impellers? explain in detail.</td><td>CO4</td><td>PO4</td><td>08</td></tr>
<tr><td></td><td></td><td>b)</td><td>Explain the principle of jigging and its application in the separation of materials.</td><td>CO4</td><td>PO4</td><td>06</td></tr>
<tr><td></td><td></td><td>c)</td><td>Describe the froth flotation process. Discuss the role of additives and typical flotation circuits.</td><td>CO4</td><td>PO4</td><td>06</td></tr>
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