U.S.N.										

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

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main 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.

		UNIT - I	CO	PO	Marks
1	a)	How is the sphericity of a sphere calculated? Explain with an equation.	CO1	PO1	**05**
	b)	A dolomite mixture having the following screen analysis is screened through a standard 100-mesh screen. Calculate the effectiveness of the screen and the mass ratios of overflow and underflow to feed.	CO2	PO2	**07**
	c)	What is screen effectiveness? Derive an equation to determine effectiveness of screens.	CO2	PO2	**08**
		OR			
2	a)	With neat figures, explain the different screen motions.	CO3	PO3	**08**
	b)	List the various types of diameters used to analyse the industrial powders. Explain volume-surface mean diameter, volume-mean diameter, and mass mean diameters with equations.	CO2	PO2	**07**

Screen analysis

Mesh	Weight %		
	Feed	Oversize	Undersize
35	7.07	13.67	0.0
48	16.6	32.09	0.0
65	14.02	27.12	0.0
100	11.82	20.7	2.32
150	9.07	4.35	14.32
200	7.62	2.07	13.34
-200	33.8	0.0	70.02

		c)	Calculate the volume-surface mean diameter for the following particle size analysis. S. No. | Size range (µm) | Mass (g) 1. | –704 + 352 | 25.0 2. | –352 + 176 | 37.5 3. | –176 + 88 | 62.5 4. | –88 + 44 | 75.0 5. | Pan | 50.0	*CO2*	*PO2*	**05**
			UNIT - II			
	3	a)	With a neat figure, explain the construction and working principle of a fluid-energy mill.	*CO3*	*PO3*	**10**
		b)	Differentiate between open- and closed-circuit grinding with figure.	*CO1*	*PO1*	**06**
		c)	What rotational speed, in rpm, would you recommend for a ball mill of 1300 mm in diameter charged with 55 mm balls?	*CO2*	*PO2*	**04**
			OR			
	4	a)	Mention the forces involved in crushing and grinding operation. State and explain the laws of crushing with equations.	*CO1*	*PO1*	**10**
		b)	What is the critical speed of a ball mill? Derive an equation for the critical speed of the ball mill.	*CO2*	*PO2*	**10**
			UNIT - III			
	5	a)	Consider a cylindrical column packed with Berl saddles as packing material. The water is allowed to flow into the column against gravity. The velocity of the water is maintained very low. The pressure of the water drops as it flows through the column. Derive an equation to estimate the pressure drop in the column, stating the relevant assumptions.	*CO4*	*PO4*	**10**
		b)	How are solids conveyed in industries? Explain with examples.	*CO1*	*PO1*	**05**
		c)	What is fluidization? Discuss the different types of fluidizations.	*CO1*	*PO1*	**05**
			OR			
	6	a)	With a neat figure, explain the construction and working principle of a rotary drum filter.	*CO3*	*PO3*	**10**
		b)	What are filter-aids? Discuss their desired properties.	*CO1*	*PO1*	**05**
		c)	Estimate the minimum fluidization velocity of a bed of particles fluidized by water. Given data: temperature = 25°C, D_P = 120 µm, ρ_P = 2500 kg/m^3, ε_m = 0.45.	*CO4*	*PO4*	**05**

<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>How free settling is different from hindered settling?</td><td>CO1</td><td>PO1</td><td>06</td></tr>
<tr><td></td><td></td><td>b)</td><td>A single batch settling test was carried out using limestone slurry. The interface between clear liquid and suspended solids was observed as a function of time and the results are tabulated. The test was conducted using 236 g of limestone per litre of slurry.
<table>
<tr><td>Time (h)</td><td>0</td><td>0.25</td><td>0.5</td><td>1.0</td><td>1.75</td><td>3.0</td><td>4.75</td><td>10.20</td><td>12</td></tr>
<tr><td>High of interface (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>
Design a thickener, if the slurry is fed at a rate of 50,000 kg of dry solids/ h to produce a thickened sludge of 550 g of limestone per litre. Given: density of limestone = 2560 kg/m^3</td><td>CO4</td><td>PO4</td><td>14</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>How is thickener area determined? Discuss step by step procedure.</td><td>CO4</td><td>PO4</td><td>12</td></tr>
<tr><td></td><td></td><td>b)</td><td>With a figure, explain the working of a cyclone separator. What is separation factor?</td><td>CO3</td><td>PO3</td><td>08</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 the methods of prevention of swirling and vortex formation in agitated vessels.</td><td>CO4</td><td>PO4</td><td>10</td></tr>
<tr><td></td><td></td><td>b)</td><td>Explain the following.
i. Electrostatic separation
ii. Jigging</td><td>CO3</td><td>PO3</td><td>10</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 is the purpose of agitation?</td><td>CO1</td><td>PO1</td><td>05</td></tr>
<tr><td></td><td></td><td>b)</td><td>Discuss the types of impellers.</td><td>CO1</td><td>PO1</td><td>05</td></tr>
<tr><td></td><td></td><td>c)</td><td>With a neat figure, explain the construction and working principle of a ribbon blender.</td><td>CO3</td><td>PO3</td><td>10</td></tr>
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