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

Autonomous Institute Affiliated to VTU

May 2023 Semester End Main Examinations

Programme: B.E. **Semester: III**
Branch: Chemical Engineering **Duration: 3 hrs.**
Course Code: 22CH3PCMOP / 19CH3DCMOP **Max Marks: 100**
Course: Mechanical Operations **Date: 15.05.2023**

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

1 a) From the data given below, plot the cumulative size distribution curves and find the average particle size of the sample. **10**

Mesh Number	6	8	10	14	20	28	35	48	65	100	150	200
Screen Openings (μm)	3327	2362	1651	1168	833	589	417	295	208	147	104	74
Weight percent retained	0	1.7	23.5	29.8	21.7	10.5	6.2	2.8	1.7	0.5	0.2	0.4

b) Apply material balance over screen and derive an expression to estimate its effectiveness. **10**

UNIT - II

2 a) Calculate the energy required to crush 100 ton/h of limestone if 80 % of the feed passes through a screen. The screen opening is 3.75 cm. 80 % of the product passes through another screen with 0.03 cm opening. The work index for limestone is 12.74. **10**

b) Explain the construction and working principle of jaw crusher with a neat diagram. **10**

UNIT - III

3 a) With a neat diagram, explain the working principle of leaf filtration. **08**

b) Derive an expression for Kozeny-Carman equation. State all the assumptions made. **12**

OR

4 a) A plate and frame press filtering a slurry solution at constant pressure conditions resulted in 25 m^3 of filtrate volume in 30 min for first run and 35 m^3 in 60 min for the second run and filtration was stopped after second run. Determine the washing time required if 10 m^3 of water is used as wash water. The resistance of the filter medium is negligible. **10**

b) Derive an expression to estimate cake resistance and filter medium resistance considering the pressure is constant during filtration. **10**

UNIT - IV

5 a) Derive an expression to estimate terminal settling velocity of spherical particles in Stoke's regime. **10**

b) Apply the mass balance on a sedimentation process and derive an expression to estimate the minimum area for continuous operation of the process. **10**

OR

6 a) Explain the construction and working principle of hydro-cyclones. **08**

b) A slurry of 5% $CaCO_3$ was subject to a batch sedimentation test. The results of the test are tabulated below. **12**

Time (min)	0	20	40	60	80	100	120	140
Interface Height (m)	1.76	1.00	0.74	0.57	0.42	0.34	0.26	0.22

Determine the minimum area required for a continuous thickener to handle 100 ton of solid per day. The initial solids concentration 5 % (by weight) is concentrated to 20 % (by weight).

UNIT – V

7 a) Elucidate the working principle of internal screw mixer. **06**

b) With neat figures, explain the working principle of electrostatic separation and froth floatation. **08**

c) A six-blade turbine is used in a cylindrical tank with a flat bottom. The diameter of the turbine is 60 cm. The vessel diameter is 1.8 m. Vessel is filled with a solution of viscosity 10 cP and density of the solution is 1450 kg/m^3. The agitator speed is 90 rpm. The power number is 1.05. Estimate the power required. **06**

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