

**VIT**Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

REG.NO.: 228CN0050

**SCHOOL OF CHEMICAL ENGINEERING
CONTINUOUS ASSESSMENT TEST -I
FALL SEMESTER 2024-2025**

SLOT: F1+TF1

Programme Name & Branch : B.Tech; Chemical Engineering
Course Code : BCHE301L
Course Name : Mechanical Operations
Faculty Name(s) : Dr. Aabid Hussain Shaik
Class Number(s) : VL2024250102957
Date of Examination : 30/08/2024
Exam Duration : 90 minutes

Maximum Marks: 50**General instruction(s):**

- Answer all the questions
- Assume any missing data if necessary

Q. No	Question	Marks																																																
1.	The screen analysis shown in the following table applies to a sample of crushed quartz. The density of the particles is 2650 kg/m^3, the shape factor is 2 and the sphericity is 0.571. For the material between 4-mesh and 200-mesh in particle size, calculate: (a) A_w in square millimeters per gram and N_w in particles per gram (b) Volume mean diameter (c) Volume surface mean diameter <table><tr><th>Mesh</th><th>Screen opening D_{Pi}, mm</th><th>Mass fraction, x_i</th><th>Average particle size, mm</th></tr><tr><td>4</td><td>4.699</td><td>0.0000</td><td>-</td></tr><tr><td>6</td><td>3.327</td><td>0.0251</td><td>4.013</td></tr><tr><td>8</td><td>2.362</td><td>0.1250</td><td>2.845</td></tr><tr><td>10</td><td>1.651</td><td>0.3207</td><td>2.007</td></tr><tr><td>14</td><td>1.168</td><td>0.2570</td><td>1.4009</td></tr><tr><td>20</td><td>0.833</td><td>0.1590</td><td>1.001</td></tr><tr><td>28</td><td>0.589</td><td>0.0538</td><td>0.711</td></tr><tr><td>35</td><td>0.417</td><td>0.0210</td><td>0.503</td></tr><tr><td>48</td><td>0.295</td><td>0.0102</td><td>0.356</td></tr><tr><td>65</td><td>0.208</td><td>0.0077</td><td>0.252</td></tr><tr><td>100</td><td>0.147</td><td>0.0058</td><td>0.178</td></tr></table>	Mesh	Screen opening D_{Pi} , mm	Mass fraction, x_i	Average particle size, mm	4	4.699	0.0000	-	6	3.327	0.0251	4.013	8	2.362	0.1250	2.845	10	1.651	0.3207	2.007	14	1.168	0.2570	1.4009	20	0.833	0.1590	1.001	28	0.589	0.0538	0.711	35	0.417	0.0210	0.503	48	0.295	0.0102	0.356	65	0.208	0.0077	0.252	100	0.147	0.0058	0.178	10
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	150	0.104	0.0041	0.126		
	200	0.074	0.0031	0.0889		
	Pan	-	0.0075	0.037		
2.	(a) Discuss various conveying techniques to transport the bulk solid materials. (5 marks)					10
	(b) 30 ton/h of heavy material is to be transported by a horizontal screw conveyor. Density of the solid is 2000 kg/m ³ and speed of the screw shaft is 35 rpm. Compute the diameter and pitch of the screw if lead of the screw/diameter of the screw is 0.8. Consider the filling coefficient as 0.125. (5 marks)					
3.	a) Derive an expression for the calculation of a critical speed of a ball mill. (5 marks)					10
	b) What rotational speed, in revolutions per minute, would you recommend for a ball mill 1200 mm in diameter charged with 75 mm balls. (5 marks)					
4.	A certain set of crushing rolls has rolls of 100 cm diameter by 38 cm width face. They are set so that the crushing surfaces are 1.25 cm apart at the narrowest point. The manufacturer recommends that they must be run at 50 to 100 rpm. They are used to crush a rock having a specific gravity of 2.35, and the angle of nip is 30°. What are the maximum permissible size of the feed and the maximum actual capacity in tone per hour, if the actual capacity is 12 percent of the theoretical? Theoretical capacity in ton/h, = 4.352 X 10 ⁻⁷ N.D.W.S Where N is in r.p.m., D (roll diameter) in mm, W (width) in mm, d (half the gap/width between the roll surfaces) in mm and S (specific gravity).					10
5.	Define Screen Effectiveness and derive an expression for estimating the screening effectiveness.					10
