

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

SLOT: B1+TB1

Programme Name & Branch : B.Tech (Chemical Engineering)  
Course Code : BCHE301L  
Course Name : Mechanical Operations  
Faculty Name : D Chitra  
Class Number : VL2025260103876  
Date of Examination : 18-8-2025  
Exam Duration : 90 minutes

Maximum Marks: 50

**General instruction:**

- Answer ALL Questions
- Assume necessary and appropriate data if required

| Q. No | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Marks         | Course Outcome (CO)       | Bloom's Taxonomy (BL) |   |       |        |   |       |        |   |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |     |       |        |     |       |        |     |       |        |     |  |        |    |   |   |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------------------|-----------------------|---|-------|--------|---|-------|--------|---|-------|--------|----|-------|--------|----|-------|--------|----|-------|--------|----|-------|--------|----|-------|--------|----|-------|--------|----|-------|--------|-----|-------|--------|-----|-------|--------|-----|-------|--------|-----|--|--------|----|---|---|
| 1.    | <p>The screen analysis in the following table applies to a sample of crushed quartz. The density of the particles is <math>2650 \text{ kg/m}^3</math>. The shape factor and sphericity are <math>a = 2</math> and <math>\Phi_s = 0.571</math>, respectively. Calculate,</p> <p>(i) the number of particles/g.<br/>(ii) specific surface area in <math>\text{mm}^2/\text{g}</math>.<br/>(iii) volume surface mean diameter.</p> <table><tr><th>Mesh</th><th>Screen Opening <math>D_p</math> (mm)</th><th>Mass Fraction</th></tr><tr><td>4</td><td>4.699</td><td>0.0000</td></tr><tr><td>6</td><td>3.327</td><td>0.0251</td></tr><tr><td>8</td><td>2.362</td><td>0.1250</td></tr><tr><td>10</td><td>1.651</td><td>0.3207</td></tr><tr><td>14</td><td>1.168</td><td>0.2570</td></tr><tr><td>20</td><td>0.833</td><td>0.1590</td></tr><tr><td>28</td><td>0.589</td><td>0.0538</td></tr><tr><td>35</td><td>0.417</td><td>0.0210</td></tr><tr><td>48</td><td>0.295</td><td>0.0102</td></tr><tr><td>65</td><td>0.208</td><td>0.0077</td></tr><tr><td>100</td><td>0.147</td><td>0.0058</td></tr><tr><td>150</td><td>0.104</td><td>0.0041</td></tr><tr><td>200</td><td>0.074</td><td>0.0031</td></tr><tr><td>Pan</td><td></td><td>0.0075</td></tr></table> | Mesh          | Screen Opening $D_p$ (mm) | Mass Fraction         | 4 | 4.699 | 0.0000 | 6 | 3.327 | 0.0251 | 8 | 2.362 | 0.1250 | 10 | 1.651 | 0.3207 | 14 | 1.168 | 0.2570 | 20 | 0.833 | 0.1590 | 28 | 0.589 | 0.0538 | 35 | 0.417 | 0.0210 | 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 | 10 | 1 | 3 |
| Mesh  | Screen Opening $D_p$ (mm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Mass Fraction |                           |                       |   |       |        |   |       |        |   |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |     |       |        |     |       |        |     |       |        |     |  |        |    |   |   |
| 4     | 4.699                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.0000        |                           |                       |   |       |        |   |       |        |   |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |     |       |        |     |       |        |     |       |        |     |  |        |    |   |   |
| 6     | 3.327                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.0251        |                           |                       |   |       |        |   |       |        |   |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |     |       |        |     |       |        |     |       |        |     |  |        |    |   |   |
| 8     | 2.362                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.1250        |                           |                       |   |       |        |   |       |        |   |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |     |       |        |     |       |        |     |       |        |     |  |        |    |   |   |
| 10    | 1.651                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.3207        |                           |                       |   |       |        |   |       |        |   |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |     |       |        |     |       |        |     |       |        |     |  |        |    |   |   |
| 14    | 1.168                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.2570        |                           |                       |   |       |        |   |       |        |   |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |     |       |        |     |       |        |     |       |        |     |  |        |    |   |   |
| 20    | 0.833                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.1590        |                           |                       |   |       |        |   |       |        |   |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |     |       |        |     |       |        |     |       |        |     |  |        |    |   |   |
| 28    | 0.589                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.0538        |                           |                       |   |       |        |   |       |        |   |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |     |       |        |     |       |        |     |       |        |     |  |        |    |   |   |
| 35    | 0.417                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.0210        |                           |                       |   |       |        |   |       |        |   |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |     |       |        |     |       |        |     |       |        |     |  |        |    |   |   |
| 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        |                           |                       |   |       |        |   |       |        |   |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |     |       |        |     |       |        |     |       |        |     |  |        |    |   |   |
| 2.    | <p>(a) Write briefly about the pressure developed by solid particles in bins or silos. (4 marks)</p> <p>(b) Explain in detail the flow of bulk solids from bins or silos and the problems associated with it. (6 marks)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 10            | 1                         | 2                     |   |       |        |   |       |        |   |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |    |       |        |     |       |        |     |       |        |     |       |        |     |  |        |    |   |   |



# VIT

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

REG.NO.:

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3. A dolomite mixture having the following screen analysis.  
Calculate the  
(i) effectiveness of a 100-mesh screen  
(ii) mass ratios of overflow and underflow to feed.

Screen analysis:

| Mesh | Feed<br>(weight %) | Oversize<br>(weight %) | Undersize<br>(weight %) |
|------|--------------------|------------------------|-------------------------|
| 35   | 7.07               | 13.67                  | 0                       |
| 48   | 16.6               | 32.09                  | 0                       |
| 65   | 14.02              | 27.12                  | 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                      | 70.02                   |

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4. Compare grizzlies with trommels. Also, explain the construction and working of various trommel arrangements with a neat diagram.

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5. A crusher was used to crush a material with a feed size of  $-5.08 \text{ cm} +3.81 \text{ cm}$ , and the power required was  $3.73 \text{ kWh/ton}$ . The screen analysis of the product was as follows. What would be the power required to crush one ton per hour of the same material from a feed of  $-4.44 \text{ cm} +3.81 \text{ cm}$  to a product of average size  $0.051 \text{ cm}$ ? Use Rittinger's law.

| Size of Aperture (cm) | % Product |
|-----------------------|-----------|
| 0.63                  | Nil       |
| 0.38                  | 26        |
| 0.203                 | 18        |
| 0.076                 | 23        |
| 0.051                 | 8         |
| 0.025                 | 17        |
| 0.013                 | 8         |

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