

# GUJARAT TECHNOLOGICAL UNIVERSITY

## BE-5 SEMESTER – OLD PAPER – S22 TO W25 – QUESTION BANK

### Subject Name & Code: Mechanical Operations (3150502)

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#### Unit 1: Solids and Its Flow Properties

##### Repeated Questions:

1. **Define/Explain Sphericity and prove that for a sphere it is unity.**
  - Appeared in: S23 (Q4a, 03 marks), S22 (Q1b, 04 marks), W22 (Q1b, 04 marks), W23 (Q1b, 04 marks), W24 (Q2c, 07 marks)
2. **Define Mesh Number / Screen Analysis.**
  - Appeared in: S24 (Q1a-i, 03 marks), S23 (Q1a-1, 03 marks), W24 (Q1a-ii, 03 marks), S25 (Q3a-iii, 03 marks)
3. **Define Screen Effectiveness / Efficiency.**
  - Appeared in: S25 (Q1a-1, 03 marks), S24 (Q1a-ii, 03 marks), W22 (Q1a-1, 03 marks)
4. **Define/Explain Ideal Screen and differentiate it from Actual Screen.**
  - Appeared in: S23 (Q4a, 03 marks), S22 (Q1a-2, 03 marks), W24 (Q3a, 03 marks), W22 (Q1a-2, 03 marks)
5. **Describe the construction and working of Trommels with a neat sketch.**
  - Appeared in: S23 (Q1c, 07 marks), S24 (Q4c, 07 marks), W25 (Q1c, 07 marks), W22 (Q1c, 07 marks)
6. **Differentiate between Differential and Cumulative Analysis.**
  - Appeared in: S23 (Q4b, 04 marks), S22 (Q2b, 04 marks)

##### Other Important Questions:

1. **Define: (i) Angle of Nip (ii) Work Index (iii) Screen Capacity.**
  - Appeared in: S25 (Q3a-i&iii, Q1a-3, 03 marks), S23 (Q1a-2&3, 03 marks)
2. **Define: Statistical diameter, Volume-surface mean diameter, Mass mean diameter, Arithmetic mean diameter.**
  - Appeared in: S24 (Q1a-iii, 03 marks), W24 (Q1a-i, 03 marks), W23 (Q1a, 03 marks)
3. **Define: Specific surface area of mixture, Number of particles in mixture.**
  - Appeared in: W22 (Q1a-1&3, 03 marks)
4. **Calculate the Sphericity of a Raschig Ring of dimensions  $L=D_o$  and  $D_i=0.5D_o$ .**
  - Appeared in: S25 (Q1b, 04 marks)
5. **Calculate the Sphericity of a rectangular prism ( $a \times b \times c$ ) for criteria  $a = b$ ,  $c = 2a$ .**
  - Appeared in: S24 (Q2b, 04 marks)
6. **Calculate the Sphericity of a solid particle of cubical shape / a cube.**
  - Appeared in: W25 (Q1b, 04 marks), W24 (Q2c, 07 marks)
7. **Find the sphericity of a cylinder having  $D = H$ .**
  - Appeared in: W23 (Q1b, 04 marks), W22 (Q1b, 04 marks)
8. **Discuss the characterization of solid particles.**
  - Appeared in: W25 (Q1a, 03 marks)
9. **Define Screening. Discuss various factors affecting the screening operation.**
  - Appeared in: W24 (Q1a-iii & Q1b, 03+04 marks)
10. **Develop the equation for the calculation of effectiveness of the screen.**
  - Appeared in: W24 (Q2c-OR, 07 marks), W23 (Q1c, 07 marks)
11. **A quartz mixture having a certain screen analysis through a standard 10 mesh screen. Calculate (a) the mass ratio of overflow and underflow to feed and (b) the effectiveness of the screen. (Data provided)**
  - Appeared in: S24 (Q1c, 07 marks)
12. **A feed consists of 60% coarse particles, which are to be recovered. The oversize and**

**undersize contain 20% and 90%, respectively, fine particles. What is the values of YA, YB and YC?**

- Appeared in: W22 (Q2a, 03 marks)

**13. Explain the construction and working of Grizzlies with a neat sketch.**

- Appeared in: S22 (Q2c-OR, 07 marks)
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## Unit 2: Size Reduction, Enlargement, Screening

### Repeated Questions:

- Describe various laws for size reduction (Rittinger's, Kick's, Bond's) and write the principle of comminution.**
  - Appeared in: S25 (Q1c, 07 marks), S23 (Q2c, 07 marks), S22 (Q1c, 07 marks), W24 (Q1c, 07 marks)
- Calculate energy consumption for crushing the same material from one size to another using Rittinger's Law and Kick's Law. (Numerical)**
  - Appeared in: S25 (Q2c-OR, 07 marks), S24 (Q2c-OR, 07 marks), S22 (Q2c, 07 marks), W25 (Q2c-OR, 07 marks), W23 (Q2c-OR, 07 marks), W22 (Q2c-OR, 07 marks)
- "For efficient grinding, ball mills must be operated at a speed less than the critical speed." Explain.**
  - Appeared in: S25 (Q3b, 04 marks), S23 (Q3b, 04 marks), W24 (Q3b, 04 marks)
- Derive the expression for / What is the critical speed of a ball mill?**
  - Appeared in: S24 (Q3a, 03 marks)
- A set of crushing rolls... Calculate the maximum permissible size of feed. (Numerical - Angle of Nip)**
  - Appeared in: S25 (Q3b-OR, 04 marks), S22 (Q2a, 03 marks), W25 (Q2b, 04 marks), W23 (Q2b, 04 marks)
- Differentiate between Open circuit and Closed circuit operations.**
  - Appeared in: S24 (Q3c, 07 marks), S23 (Q2b, 04 marks)
- Classify comminuting/size reduction equipment and give suitable industrial applications.**
  - Appeared in: W25 (Q2c, 07 marks), W23 (Q2c, 07 marks), W22 (Q2c, 07 marks)

### Other Important Questions:

- Define: Angle of Nip, Mixing Index.**
  - Appeared in: S25 (Q3a-i&ii, 03 marks)
- Differentiate between Crusher and Grinder / Dry grinding and Wet grinding.**
  - Appeared in: W23 (Q2a, 03 marks), S24 (Q2a, 03 marks)
- Differentiate between Blake Jaw Crusher and Dodge Jaw Crusher.**
  - Appeared in: S24 (Q3b, 04 marks)
- Classify the size reduction equipment according to their usage and give examples.**
  - Appeared in: S24 (Q3e, 07 marks), S23 (Q2c-OR, 07 marks)
- Define size enlargement process and its importance.**
  - Appeared in: S24 (Q3a-OR, 03 marks)
- Calculate the power required to crush 150 tonnes per hour of limestone... (Bond's Law Numerical)**
  - Appeared in: S23 (Q2a, 03 marks)
- The energy required per unit mass to grind limestone... Determine the estimated amount of energy to grind from very large size to 50  $\mu\text{m}$ . (Numerical)**
  - Appeared in: S24 (Q3b, 04 marks)
- What rotational speed in RPM would you recommend for a ball mill? (Critical Speed Numerical)**
  - Appeared in: S25 (Q5a, 03 marks), S23 (Q3b-OR, 04 marks), W22 (Q2b, 04 marks)
- A roller crusher has rolls of 200 cm in diameter... Calculate the maximum permissible size of feed and the maximum actual capacity in metric tons per hour...**
  - Appeared in: S23 (Q4c, 07 marks)
- Explain and differentiate open and closed circuit operation for size reduction with a neat schematic diagram.**
  - Appeared in: S24 (Q3c-OR, 07 marks)
- A Black jaw crusher is used for crushing limestone... Calculate energy using Rittinger's, Kick's, and Bond's law. (Numerical)**
  - Appeared in: W25 (Q2c-OR, 07 marks), W23 (Q2c-OR, 07 marks)

12. Calculate the operating speed of the ball mill from the given data (Diameter of mill, Diameter of ball, % of critical speed).
- Appeared in: W24 (Q3b-OR, 04 marks)

### Unit 3: Fluidization and Conveying

#### Repeated Questions:

1. **Discuss Minimum Fluidization Velocity and Pressure Drop in a fluidized bed with a neat sketch.**
  - Appeared in: S22 (Q5b-OR, 04 marks), W25 (Q5b, 04 marks), W24 (Q3c, 07 marks), W23 (Q5b, 04 marks), W22 (Q5b-OR, 04 marks)
2. **Explain in detail: Types of Fluidization.**
  - Appeared in: S23 (Q3c-OR, 07 marks), S22 (Q5c-OR, 07 marks), W25 (Q5c-OR, 07 marks), W23 (Q5c-OR, 07 marks), W22 (Q5c, 07 marks)
3. **With a neat sketch, explain a Pneumatic Conveying System with its advantages and disadvantages.**
  - Appeared in: S25 (Q5c, 07 marks), W25 (Q5c, 07 marks), W23 (Q5c, 07 marks)
4. **List different types of industrial conveyors and explain any one in detail.**
  - Appeared in: S23 (Q3c, 07 marks), S22 (Q5c, 07 marks), W24 (Q3c-OR, 07 marks), W22 (Q5c-OR, 07 marks)
5. **Enlist the industrial applications of (batch and continuous) fluidization.**
  - Appeared in: S22 (Q5a-OR, 03 marks), S24 (Q4a, 03 marks), W23 (Q5a, 03 marks), W22 (Q5a-OR, 03 marks)
6. **Discuss the different criteria for the selection of conveyors.**
  - Appeared in: S22 (Q5a, 03 marks), W25 (Q5b-OR, 04 marks), W23 (Q5b-OR, 04 marks)

#### Other Important Questions:

1. **Define Pneumatic Conveying and its applications.**
    - Appeared in: S24 (Q4b-OR, 04 marks)
  2. **Write a short note on storage in bins and silos.**
    - Appeared in: S25 (Q4b, 04 marks)
  3. **What are the various equipment used for storage of solids? Discuss any one.**
    - Appeared in: S23 (Q3a-OR, 03 marks)
  4. **Discuss Continuous Fluidization.**
    - Appeared in: S25 (Q4b-OR, 04 marks)
  5. **A tube of  $0.05 \text{ m}^2$  cross-sectional area is packed with spherical particles... Determine the minimum fluidization velocity using Ergun's equation. (Numerical)**
    - Appeared in: S24 (Q4c, 07 marks)
  6. **Explain in detail the Belt Conveyor / Bucket Conveyor / Screw Conveyor.**
    - Appeared in: S22 (Q5b, 04 marks), S25 (Q5d-OR, 07 marks), W22 (Q5b-OR, 04 marks)
  7. **What are the different types of conveyors? Explain in detail the screw conveyor with its industrial applications.**
    - Appeared in: S25 (Q5d-OR, 07 marks)
  8. **Explain in detail about slurry transport.**
    - Appeared in: W24 (Q5b, 04 marks)
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## Unit 4: Filtration and Sedimentation

### Repeated Questions:

1. **Explain the construction and working of a Continuous Rotary (Drum) Vacuum Filter.**
  - Appeared in: S25 (Q2c, 07 marks), S23 (Q5c-OR, 07 marks), W25 (Q3c, 07 marks), W24 (Q5c, 07 marks), W22 (Q3c-OR, 07 marks)
2. **Explain in detail the working of Batch Sedimentation with application.**
  - Appeared in: S25 (Q3c-OR, 07 marks), S23 (Q4c-OR, 07 marks), S22 (Q3c, 07 marks), W25 (Q3c-OR, 07 marks), W23 (Q3c-OR, 07 marks)
3. **Discuss the Sink and Float method.**
  - Appeared in: S25 (Q2b, 04 marks), S23 (Q5b, 04 marks), W24 (Q5a, 03 marks), W22 (Q3a-OR, 03 marks)
4. **Differentiate between Clarifier and Classifier.**
  - Appeared in: S25 (Q5b, 04 marks), S23 (Q5a-OR, 03 marks), W25 (Q3a-OR, 03 marks), W24 (Q4b-OR, 04 marks), W23 (Q3a-OR, 03 marks)
5. **Define Filter Aids and their importance / use.**
  - Appeared in: S24 (Q4b, 04 marks), S23 (Q1b, 04 marks), W25 (Q3b, 04 marks), W22 (Q3a, 03 marks)
6. **Define Cake Resistance and Filter Medium Resistance.**
  - Appeared in: S24 (Q4a-OR, 03 marks)
7. **Explain the construction and working of the Dorr Thickener / Hydrocyclone Separator.**
  - Appeared in: S23 (Q4b-OR, 04 marks), S22 (Q3b-OR, 04 marks), W25 (Q3b-OR, 04 marks), W24 (Q5c, 07 marks), W22 (Q3b-OR, 04 marks)

### Other Important Questions:

1. **Differentiate between Constant Rate Filtration and Constant Pressure Filtration.**
  - Appeared in: S25 (Q2a, 03 marks)
2. **Derive the mathematical expression for Constant Rate Filtration.**
  - Appeared in: S22 (Q3b, 04 marks), W24 (Q4b, 04 marks)
3. **Explain the Principle of Filtration.**
  - Appeared in: S22 (Q3a, 03 marks)
4. **Discuss various mechanisms of filtration in brief.**
  - Appeared in: W24 (Q3a-OR, 03 marks), W23 (Q3a, 03 marks)
5. **Classify the Filtration equipment with examples in each category.**
  - Appeared in: W23 (Q3b, 04 marks), W22 (Q3b, 04 marks)
6. **In a filter press, at a constant pressure difference... Calculate the volume of filtrate produced in one day of operation. (Numerical)**
  - Appeared in: S25 (Q4c, 07 marks)
7. **Describe Batch Sedimentation process with a graph. Describe a continuous gravity thickener.**
  - Appeared in: S25 (Q3c-OR, 07 marks)
8. **What is the Differential Settling method? Explain in detail.**
  - Appeared in: S23 (Q4c-OR, 07 marks), W22 (Q3c, 07 marks)
9. **Explain the construction and working of a Filter Press / Continuous Plate and Frame Filter Press.**
  - Appeared in: S22 (Q3c-OR, 07 marks), W23 (Q3c, 07 marks)
10. **Write a short note on the washing of filter cakes.**
  - Appeared in: S24 (Q5b, 04 marks)
11. **Explain with a neat diagram: Batch sedimentation process in detail.**
  - Appeared in: S24 (Q4c-OR, 07 marks)
12. **Discuss the classification of filtration with suitable examples.**
  - Appeared in: W25 (Q3a, 03 marks)
13. **Explain construction and working of the Cyclones separator.**
  - Appeared in: W23 (Q3b-OR, 04 marks)

## Unit 5: Mixing and Agitation

### Repeated Questions:

1. **Define Power Number and write down its significance.**
  - Appeared in: S25 (Q4a, 03 marks), S24 (Q5a-OR, 03 marks), S22 (Q4b, 04 marks), W23 (Q4a-OR, 03 marks)
2. **Explain different types of impellers for agitation of liquids along with their application.**
  - Appeared in: W25 (Q4c-OR, 07 marks), W24 (Q4b, 04 marks), W23 (Q4c-OR, 07 marks)
3. **Discuss the selection criteria of an agitator.**
  - Appeared in: S23 (Q5c, 07 marks), W22 (Q4c, 07 marks)
4. **What is Mixing Index and its significance?**
  - Appeared in: S22 (Q4a-OR, 03 marks), W24 (Q5a-OR, 03 marks), W22 (Q4a-OR, 03 marks)
5. **Draw a neat sketch of an agitated vessel and label the important parts. What are the various methods for prevention of swirling?**
  - Appeared in: S25 (Q3c, 07 marks)
6. **Enlist different types of flow patterns induced in an agitated vessel.**
  - Appeared in: W25 (Q4a-OR, 03 marks), W24 (Q4a, 03 marks)
7. **Discuss different methods for prevention of swirling and vortex formation in an agitated tank.**
  - Appeared in: S23 (Q5b-OR, 04 marks), W22 (Q4b-OR, 04 marks)
8. **Describe the different mixing equipment used for solid mixing in brief.**
  - Appeared in: W25 (Q4c, 07 marks), W23 (Q4c, 07 marks), W22 (Q4c-OR, 07 marks)

### Other Important Questions:

1. **Define: (i) Agitation (ii) Mixing (iii) Power Index.**
  - Appeared in: W24 (Q2a, 03 marks)
2. **Write down the purpose of agitation / mixing.**
  - Appeared in: S22 (Q4a, 03 marks), W23 (Q4a, 03 marks), W22 (Q4a, 03 marks)
3. **Differentiate between Agitation and Mixing.**
  - Appeared in: W22 (Q4b, 04 marks)
4. **Discuss the importance of mixing and agitation.**
  - Appeared in: W25 (Q4a, 03 marks)
5. **Give the significance of Power no, Reynolds no, and Froude no for mixing of liquids.**
  - Appeared in: S23 (Q3a, 03 marks)
6. **Write a short note on: Ribbon Blender / Tumbler Mixer / Paddles agitator.**
  - Appeared in: W25 (Q4b, 04 marks), W23 (Q4b, 04 marks), S22 (Q4b-OR, 04 marks)
7. **Explain characteristics, selection criteria, and applications of paddles.**
  - Appeared in: S25 (Q4d, 07 marks)
8. **Discuss Scale-up of an agitation vessel.**
  - Appeared in: S22 (Q4c, 07 marks)
9. **Explain Double Arm Kneading Mixture in detail with a neat sketch.**
  - Appeared in: S22 (Q4c-OR, 07 marks), W24 (Q4c-OR, 07 marks)
10. **Write a short note on equipment used for cohesive / non-cohesive solid mixing.**
  - Appeared in: W25 (Q4b-OR, 04 marks), W23 (Q4b-OR, 04 marks)
11. **Enlist the various types of propellers.**
  - Appeared in: S24 (Q5a, 03 marks)
12. **Discuss in detail: "Classification of Turbine".**
  - Appeared in: S24 (Q5c-OR, 07 marks)

## Unit 6: Miscellaneous & Combined Topics

*(Questions that span multiple units or are listed under 'OR' parts in the syllabus)*

### Repeated Questions:

1. **Explain Electrostatic Separation.**
  - Appeared in: S25 (Q5b-OR, 04 marks), S23 (Q5a, 03 marks)
2. **Write a short note on Batch Centrifuge.**
  - Appeared in: S25 (Q5c-OR, 07 marks)
3. **Explain with a neat diagram: Basket Centrifuge.**
  - Appeared in: S24 (Q5c-OR, 07 marks)
4. **Discuss the important features of a Cyclone Separator.**
  - Appeared in: S24 (Q5b-OR, 04 marks)

### Other Important Questions:

1. **With a neat diagram explain about Trommels.**
  - Appeared in: S25 (Q4c-OR, 07 marks)
2. **Explain about Vibrating Screen and its importance.**
  - Appeared in: S24 (Q2c, 07 marks)

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