

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-V EXAMINATION – SUMMER 2025

Subject Code:3150502

Date:17-05-2025

Subject Name:Mechanical Operations

Time:02:30 PM TO 05:00 PM

Total Marks:70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

	Marks
Q.1 (a) Define: (1) Screen Effectiveness (2) Screen Capacity (3) Work Index	03
(b) Calculate the Sphericity of Rasching Ring of Dimensions $L=D_0$ and $D_i=0.5D_0$	04
(c) Describe various laws for size reduction and write principle of comminution.	07
Q.2 (a) Differentiate between constant rate filtration and constant pressure filtration.	03
(b) Explain sink and float method.	04
(c) Explain construction and working of continuous rotary vacuum filter.	07
OR	
(c) A material is crushed in a jaw crusher and the average size of the particle is reduced from 5 cm to 1 cm with consumption of energy at the rate of 1.32×10^4 J/kg. What will be the consumption of energy necessary to crush the same material of average size 7.5 cm to an average size 2.5 cm? The mechanical efficiency remains same. (a) Using Rittinger's law; (b) using Kick's law	07
Q.3 (a) Define: (i) angle of nip and (ii) mixing index (iii) mesh number.	03
(b) Explain: "For efficient grinding, ball mills must be operated at a speed less than the critical speed."	04
(c) Draw neat sketch of an agitated vessel and label the important parts. What are the various methods for prevention of swirling in an agitated vessel?	07
OR	
Q.3 (a) Give the difference between ideal screen and actual screen.	03
(b) A set of crushing rolls of 1000 mm diameter by 375 mm width of face. Minimum spacing between two rolls is 12 mm and the angle of nip is 30. What is the maximum permissible size of feed?	04
(c) Describe batch sedimentation process with a graph. Describe a continuous gravity thickener.	07
Q.4 (a) What is power number and its significance?	03
(b) Write short note on storage in bin and silos.	04
(c) In a filter press, at a constant pressure difference of 3.0 kg/cm^2 , a 12cm cake is formed in one hour with a filtrate volume of 5400 liters. Washing proceeds exactly as filtration using 900 liters. All other operation takes 11 minutes time.	07

Assume the filtrate has same properties of wash water. The rate of washing is 0.20 times the final filtration rate. Calculate the volume of filtrate produced in one day of operation.

OR

- Q.4** (a) Discuss about continuous fluidization. **03**
(b) With neat diagram explain about Tromells. **04**
(c) Explain characteristics, selection criteria and applications of paddles. **07**
- Q.5** (a) What rotational speed in RPM would you recommend for a ball mill 1200 mm in diameter charged with 75 mm balls? **03**
(b) Differentiate between clarifier and classifiers. **04**
(c) With neat sketch, explain pneumatic conveying system with advantages and disadvantages. **07**

OR

- Q.5** (a) Explain about electrostatic separation. **03**
(b) Write short note on batch centrifuge. **04**
(c) What are the different types of conveyers? Explain in detail the screw conveyer with its industrial applications. **07**

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-V (NEW) EXAMINATION – SUMMER 2024****Subject Code: 3150502****Date:21-05-2024****Subject Name: Mechanical Operations****Time:02:30 PM TO 05:00 PM****Total Marks:70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

	Marks
Q.1 (a) Define (a) Mesh number (b) Screen Effectiveness (c) Statistical diameter of particle.	03
(b) Differentiate between differential analysis and cumulative	04
(c) 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: $D_P = D_{PC} = 1.651$ mm, $x_U = x_B = 0.195$ (mass fraction of A in underflow) (cumulative mass fraction), $x_F = 0.47$ (Mass fraction of A in feed), $x_O = x_D = 0.85$ (mass fraction of A in overflow)	07
Q.2 (a) Differentiate between dry grinding and wet grinding.	03
(b) Calculate the sphericity of rectangular prism of dimension $a \times b \times c$ for criteria $a = b, c = 2a$.	04
(c) Write a short note on “Vibrating screen and its importance”.	07
OR	
(c) A material is crushed in a jaw crusher and an average size of the particle reduced from 5 cm to 1 cm with the consumption of energy of 1.32×10^4 J/kg. Determine the consumption of energy to crush the same material of an average size 7.5 cm to 2.5 cm by assuming (a) Rittinger’s law (b) Kick’s law.	07
Q.3 (a) Derive the expression for critical speed of a ball mill.	03
(b) The energy required per unit mass to grind limestone particles of very large size to $100 \mu\text{m}$ is 12.7 kWh/ton. Determine the estimated amount of energy to grind the particles from a very large size to $50 \mu\text{m}$.	04

- (c) Classify the size reduction equipment's according to their usage and give examples in each category. **07**

OR

- Q.3** (a) Define size enlargement process and its importance. **03**
 (b) Differentiate between Blake jaw crusher and Dodge jaw crusher. **04**
 (c) Explain and differentiate open and closed circuit operation for size reduction of solid with neat schematic diagram. **07**

- Q.4** (a) Enlist the applications of fluidization. **03**
 (b) Define filter aids and their importance. **04**
 (c) A tube of 0.05 m² cross sectional area is packed with spherical particles up to a height of 0.25 m. The porosity of the bed is 0.35. It is desired to fluidize the particles with water. Determine the minimum fluidization velocity using Ergun's equation.

Data: Density = 1000 kg/m³ and viscosity = 10⁻³ pa. sec.

Diameter of particle = 0.01 m and particle density = 2600 kg/m³

$$\frac{\Delta P}{L} = \frac{1.75 \bar{V}_{0M}^2 (1-\epsilon) \rho}{\Phi_S D_p \epsilon^3} + \frac{150 \mu \bar{V}_{0M} (1-\epsilon)^2}{\Phi_S^2 D_p^2 \epsilon^3}$$

OR

- Q.4** (a) Define cake resistance and filter medium resistance. **03**
 (b) Define pneumatic conveying and its applications. **04**
 (c) With neat and clean diagram explain, Batch sedimentation process in detail. **07**

- Q.5** (a) Enlist the various types of propellers. **03**
 (b) Write a short note on washing of filter cakes. **04**
 (c) Explain in detail with neat and clean diagram. "Basket centrifuge" **07**

OR

- Q.5** (a) Define, "Power number and its significance" **03**
 (b) Discuss the important features of cyclone separator. **04**
 (c) Discuss in detail. "Classification of turbine" **07**

GUJARAT TECHNOLOGICAL UNIVERSITY**BE – SEMESTER- V EXAMINATION-SUMMER 2023****Subject Code: 3150502****Date: 27/06/2023****Subject Name: Mechanical Operations****Time: 02:30 PM TO 05:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		MARKS
Q.1	(a) Define (1) Mesh number (2) Angle of nip (3) Work index	03
	(b) What the use is of filter aid and filter media?	04
	(c) Explain the construction and working of trommels with the help of a neat sketch and enlist various trommels arrangement.	07
Q.2	(a) Calculate the power required to crush 150 tonnes per hour of limestone if 80% of the feed passes 50mm screen and 80% of the product passes a 3.125mm screen? Work index of limestone = 12.74.	03
	(b) Differentiate between open circuit and closed circuit operations.	04
	(c) Write principle of comminution. Explain various laws of size reduction in detail.	07
OR		
	(c) Give classification of various size reduction equipments.	07
Q.3	(a) Give significance of Power no, Reynolds no and Froude no for mixing of liquids.	03
	(b) Explain: "For efficient grinding, ball mills must be operated at a speed less than the critical speed."	04
	(c) List different types of industrial conveyers and explain any one in detail.	07
OR		
Q.3	(a) What are the various equipments used for storage of solids? Discuss any one.	03
	(b) What rotational speed in RPM would you recommend for a ball mill 1100mm in diameter charged with 70 mm balls?	04
	(c) Explain in detail: Types of fluidization.	07
Q.4	(a) Define sphericity. Prove that sphericity of sphere is unity.	03
	(b) Differentiate differential and cumulative analysis.	04
	(c) A roller crusher has rolls of 200 cm in diameter and 75 cm face width. The crushing roll surfaces are 1.25 cm apart at the narrowest point. The angle of nip 30°. The roll crusher operates at a speed of 150 rpm. They are used to crush a rock of specific gravity of 2.35. Calculate the maximum permissible size of feed and the maximum actual capacity in metric tons per hour, if the actual capacity is 15 % of the theoretical.	07
OR		
Q.4	(a) Give the difference between ideal screen and actual screen.	03
	(b) Explain construction and working of the Dorr thickener	04
	(c) What is the differential settling method? Explain in detail the working of batch sedimentation with application.	07
Q.5	(a) Define: electrostatic separation.	03
	(b) Discuss Sink and float method	04
	(c) Discuss selection criteria of agitator.	07
OR		
Q.5	(a) Differentiate between clarifier and classifiers	03
	(b) Discuss different method for prevention of swirling and vortex formation in agitated tank.	04
	(c) Explain construction and working of continuous rotary vacuum filter.	07

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-V(NEW) EXAMINATION – SUMMER 2022****Subject Code:3150502****Date:09/06/2022****Subject Name:Mechanical Operations****Time:02:30 PM TO 05:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

	MARKS
Q.1 (a) Define (1) Screen capacity (2) Ideal screen (3) No of particles in mixture	03
(b) Define Sphericity. Prove that Sphericity of sphere is unity.	04
(c) Describe various laws for size reduction and write principle of Comminution.	07
Q.2 (a) A certain set of rolls of 1000mm diameter by 375mm width of face. They are set so that the crushing surfaces are 12 mm apart at the narrowest point. The angle of nip is 30 °. What is the maximum permissible size of feed?	03
(b) Differentiate differential and cumulative analysis.	04
(c) A material is crushed in a jaw crusher and the average size of the particle is reduced from 5 cm to 1.3 cm with consumption of energy at the rate of 37 Watt.hr/ton. What will be the consumption of energy necessary to crush the same material of average size 8 cm to an average size 3 cm? The mechanical efficiency remains same. (a) Using Rittinger's law; (b) using Kick's law	07
OR	
(c) Explain the construction and working of Grizzlies with the help of a neat sketch.	07
Q.3 (a) Explain principle of filtration.	03
(b) Derive the mathematical expression for constant rate filtration.	04
(c) Explain in detail the working of batch sedimentation with application.	07
OR	
Q.3 (a) Discuss Sink and float method	03
(b) Explain construction and working of the Dorr thickener.	04
(c) Explain construction and working of filter press.	07
Q.4 (a) Write down purpose of agitation	03
(b) Define power number and write down its significance.	04
(c) Discuss scale up of agitation vessel	07
OR	
Q.4 (a) Define mixing index and its significance.	03
(b) Discuss paddles agitator.	04
(c) Explain double arm kneading mixture in detail with neat sketch.	07
Q.5 (a) Discuss the different criteria's for selection of conveyers.	03
(b) Explain in detail the belt conveyer.	04

(c) List different types of industrial conveyers and explain any one in detail. **07**

OR

Q.5 (a) Enlist the industrial applications of batch and continuous fluidization. **03**

(b) Discuss minimum fluidization velocity and pressure drop in fluidized bed with neat sketch. **04**

(c) Explain in detail: Types of fluidization. **07**
