

Register No.: ..... Name: .....

**SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)**

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

**FOURTH SEMESTER B.TECH DEGREE EXAMINATION (R), MAY 2023****CHEMICAL ENGINEERING****(2020 SCHEME)****Course Code : 20CHT206****Course Name: Particle Technology****Max. Marks : 100****Duration: 3 Hours****PART A****(Answer all questions. Each question carries 3 marks)**

1. Define the term sphericity. Prove that the sphericity of cube is  $(\pi/6)^{1/3}$ .
2. Name and explain the working of the screen used for sizing the construction gravel and crushed stone.
3. With the help of a schematic, explain the working of rake classifier.
4. List out the assumptions used in Kynch theory.
5. Explain the three basic laws of comminution with appropriate equations.
6. Differentiate between open and closed circuit grinding with the help of a neat sketch.
7. Write a brief note on filter media and filter aids.
8. What is the principle of filtration and list the different factors affecting the rate of filtration.
9. Explain the different types of storage for solids.
10. Write a brief note on ribbon blender.

**PART B****(Answer one full question from each module, each question carries 14 marks)****MODULE I**

11. a) Briefly explain the following methods of particle size analysis. (7)
  - i) Pipette analysis
  - ii) Beaker decantation
- b) The product obtained from a chemical production company is used as a feed for catalyst manufacturing. The product has a density of 1.3 g/cc and a sphericity of 0.5. The size analysis is as follows. (7)

Size range ( $\mu\text{m}$ )	-704+352	-352+176	-176+88	-88+44	Pan
Mass of the particle in the range (g)	25	37.5	62.5	75	50

Find the specific surface area and Sauter mean diameter of the material.

**OR**

12. a) Define and explain the effectiveness of screen. Derive the equation used to calculate the effectiveness. (7)
- b) A quartz mixture is screened through a 10-mesh screen. The cumulative screen analysis of the feed, overflow, and underflow are given in the following table. (7)

Mesh	$D_p$ , mm	Cumulative mass fraction greater than $D_p$		
		Feed	Overflow	Underflow
4	4.699	0	0	0
8	2.362	0.15	0.43	0
10	1.651	0.47	0.85	0.195
28	0.589	0.94	1.00	0.91
65	0.208	0.98	-	0.975
Pan	-	1.00	-	1.00

Calculate the mass ratios of overflow to feed and underflow to feed. Also calculate the overall effectiveness of the screen.

**MODULE II**

13. a) With an appropriate sketch, explain how the particle separation take place in jigging. (7)
- b) Describe the principle, mechanism and working of a froth floatation cell. (7)

**OR**

14. a) Explain the steps involved in the design of thickener. (7)
- b) A slurry containing 5 kg of water/kg of solids is to be thickened to a sludge containing 1.5 kg of water/kg of solids in a continuous operation. Laboratory test using five different concentrations of the slurry yields the following data. (7)

Concentration (kg of water/kg of solids)	5.0	4.2	3.7	3.1	2.5
Rate of sedimentation (mm/s)	0.20	0.12	0.094	0.070	0.050

Calculate the area of the thickener required to effect the separation of a flow of 1.33 kg/s of solids.

**MODULE III**

15. a) With the help of a neat sketch, explain the construction and working of hammer mill. (7)
- b) Particles of average feed size of  $50 \times 10^{-4}$  m are crushed to an (7)

average product size of  $10 \times 10^{-4}$  m at the rate of 20 tonnes per hour. At this rate, the crusher consumes 40 kW of power of which 5 kW are required for running the mill empty. Calculate the power consumption if 12 tonnes/h of this product is further crushed to  $5 \times 10^{-4}$  m size in the same mill? Assume that Rittinger's law is applicable.

**OR**

16. a) Explain the construction and working of ball mill with the help of a neat sketch. (7)  
 b) What rotational speed in rpm would you recommend for a ball mill having 1000 mm in diameter charged with 70 mm balls? (7)

**MODULE IV**

17. a) Explain the construction and working of plate and frame filter press. (7)  
 b) At constant pressure conditions during preliminary analysis, the rate of filtration per square meter of the filter is as follows. Determine the time required to filter out 1500 L of liquid throughout  $1 \text{ m}^2$  of filter surface. Determine the time required to filter out 1500 L of liquid through  $1 \text{ m}^2$  of filter surface. (7)

Volume of filtrate	120 L	300 L
Collection Time	2.5 mins	15 mins.

**OR**

18. a) Write a brief note on constant pressure and constant rate filtration. (7)  
 b) Explain the construction and working of rotary drum filter. (7)

**MODULE V**

19. a) Explain the construction and working of cyclone separator. (7)  
 b) Explain how venture scrubber helps in gas cleaning. (7)

**OR**

20. a) Explain how belt conveyors helps in the transportation of solids and mention the factors influencing the capacity of belt conveyor. (7)  
 b) Explain various mixers used for cohesive and non-cohesive solids. (7)

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