Register No.: …… Name: ……..

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FOURTH SEMESTER B.TECH DEGREE EXAMINATION (S), SEPT 2022

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. In a Tyler standard series for a 200-mesh screen, the clear opening is said to be 0.074 mm. Find out the clear opening for 150, 100, and 65 meshes?
2. Name any five requirements that any filter medium (septum) is expected to meet. Give few Examples.
3. Differentiate between free and hindered settling.
4. Define closed circuit grinding and how is it advantageous over open circuit grinding?
5. Why is Rittinger's and kicks law applicable for finer and coarser grinding respectively?
6. Differentiate between axial flow and radial flow impellers used in the agitation of liquids.
7. Define frothers and collectors with respect to froth floatation cells used in the separation of solids from liquids.
8. Write equations for Froude's and flow number used to derive power consumption in agitators.
9. Compare between ideal and actual screen.
10. List out the applications of centrifugal filtration.

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Write simple material balances over a screen and derive the expression for determining the overall screen efficiency in terms of mass fraction of material. (9)

    b) Derive an expression to determine the total surface area and the total number of particles in a heterogeneous sand mixture. (5)

OR

12. (a) Derive an expression to calculate the volume-surface mean diameter and determine the volume-surface mean diameter for the following particulate. (7)

Size range μm	-710+300	-300+180	-180+90	-90+38	Pan
Mass of particles in the range, g	30	35	65	70	55

(b) Calculate the sphericity of a cylinder of diameter 1 cm and height of 3 cm. (7)

MODULE II

13. a) Explain the unique feature of a spitzkasten classifier and double cone classifier with a neat sketch. (8)

b) Describe the principle of floatation techniques in the separation of solids and explain the construction, working, and application of a froth floatation cell with a neat sketch. (6)

OR

14. a) A mixture of solid particles (A and B) having a size range of 7.21×10^{-6} m to 3.50×10^{-5} m is to be separated under free settling conditions in water at 20°C. The specific gravity of the silica is 2.65 and galena is 7.5. Calculate the size range of the various fractions obtained in the settling. The water viscosity at 20°C is 1.005×10^{-3} Pa-s. Draw relevant sketches and depict the terminal settling velocities of each particle. (7)

b) Write the theory behind the mathematical analysis of the batch settling test and, arrive at an expression to determine the area required for a continuous thickener. (7)

MODULE III

15. a) Describe the principles of grinding and derive the classical laws for the prediction of energy consumption in size reduction operations. (8)

b) A certain crusher accepts a feed of rock having a volume-surface mean diameter of 0.75 inches and discharges a product of diameter of 0.20 inches. The power required to crush 15 tonnes/hr is 12 hp. What should be the power consumption if the capacity is reduced to 10 tonnes/hr and volume – surface mean diameter is 0.15 inches? Assume fine grinding takes place. (6)

OR

16. a) If the crushing machine utilizes 9 kW power to crush 5 tonnes/hour of dolomite and reduces the particle from 6 mm diameter to product which consists of 20% with an average diameter of 0.25 mm, 60% with an average diameter of 0.125 mm, and the balance having an average diameter of 0.085 mm. Estimate the value of K_R. (6)

b) On what basis the work index expression has been arrived at? Derive and explain its significance. (8)

MODULE IV

17. a) Derive the empirical equations for specific cake resistance and filter medium resistance and express the differential rate of filtration per unit area of the filtering surface. (7)

b) Draw neat diagrams of washing & non-washing plates with flow connections of filtrate outlet and wash inlet of plate & frame filter press. (7)

OR

18. a) A slurry of lime powder giving 45 kg of cake solid per cubic meter of filtrate is to be filtered at a constant pressure drop of 5 atm and a temperature of 30˚C. Experiments on this sludge and filter cloth to be used given a value of R_m = 7.8 x 10^{10} m^{-1} and cake resistance of 7.38 x 10^{10} m/kg. A pressure filter of tank-type is to be used. Evaluate the filter surface area needed to give 10 cubic meters of filtrate in a 1-hour filtration? The viscosity of water at 30˚C = 0.8, pressure drop at 5 atm = 5 x 1.013 x 10^5 N/M^2. (9)

b) In a plate and frame filter press operating at constant pressure conditions, 283 liters of the filtrate were collected in 30 minutes. Calculate the volume of the filtrate collected in the next 30 minutes? When the filtration is stopped what is the rate of filtration by the end of filtration? Assume filter medium resistance to be negligible. (5)

MODULE V

19. a) Explain the construction, working, and applications of screw and pneumatic conveyors with the help of neat figures. (7)

b) State the similarities and differences between Propellers, Turbines, and Paddles with examples used in agitation and mixing of liquids. (7)

OR

20. a) Write the values of typical proportions for a standard impeller design. (6)

b) Give a detailed description of the various types of impellers used in the agitation of liquids with neat sketches. (8)

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