

**PARTICLE & FLUID PARTICLE PROCESSING
(CHEN 2101)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

Candidates are required to give answer in their own words as far as practicable.

**Group – A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) The main size reduction operation in ultrafine grinders is
(a) cutting (b) attrition (c) compression (d) impact.
 - (ii) In the Newton's Law region terminal velocity of particle is proportional to
(a) square root of particle diameter (b) particle diameter
(c) square of particle diameter (d) cube root of particle diameter
 - (iii) Fick's law relates to
(a) energy consumption (b) final particle size
(c) feed size (d) product size.
 - (iv) Short distance transportation of grain, gravel, sand, ash, asphalt etc. is done by using a _____ conveyor.
(a) Flight (b) slat or drag (c) ribbon (d) screw.
 - (v) Equivalent diameter of a particle is the diameter of the sphere having the same
(a) ratio of surface to volume as the actual volume
(b) ratio of volume to surface as the particle
(c) volume as the particle
(d) none of these.
 - (vi) The gross energy requirement is called as ____
(a) Work index (b) Power index (c) Energy index (d) Final index.
 - (vii) Separation of materials into products based on the difference of their sizes is called
(a) sizing (b) sorting (c) classification (d) flocculation.
 - (viii) Diatomaceous earth is a
(a) Filter aid (b) Catalyst (c) Filter media (d) Collector.
 - (ix) Which of the following is a type of coarse crusher?
(a) Rod mill (b) Stamp battery (c) Jaw crusher (d) Dicer.
 - (x) The value of compressibility co-efficient for compressible cake is
(a) Zero (b) 0.2 to 0.8 (c) 1 (d) 20 to 40.

Group- B

2. (a) Define sphericity. Define volume shape factor of a particle and describe it's importance.
[[CO1,CO2](Remember/LOCQ)]
(b) Describe the working principle of Grizzlies and vibrating screen with schematic diagram.
[[CO1, CO2](Apply/HOCQ)]
(c) Describe the benefit of vibrating screen.
[[CO1](Understand/IOCQ)]
(1 + 3) + (4 + 2) + 2 = 12
3. (a) Define aperture length of screen. Describe the difference between ISS and BSS.
[[CO1](Understand/IOCQ)]
(b) Describe the working principle of Trommels screen and Banana screen with net schematic diagram.
[[CO1, CO2](Remember/LOCQ)]
(c) Describe the relation between screen efficiency and feed rate of a screen.
[[CO1](Analyze/HOCQ)]
(1 + 3) + (3 + 3) + 2 = 12

Group - C

4. (a) State the limitation of Kick's law, Rittinger's law, and Bond's law with an example.
[[CO2](Understand/IOCQ)]
(b) State the classification of size reduction equipments.
[[CO2](Remember/LOCQ)]
(3 × 3) + 3 = 12
5. (a) A ball mill is fed with fresh feed (F) as 30×10³ kg/h and the product P is screened using a screen of 295 μm aperture size. Oversize are recycled at a rate of 60×10³ kg/h. Calculate the energy consumption of ball mill for open circuit as well as closed circuit grinding. Work index is given as 12.74 kWh/ton. Draw the schematic diagram of the operation.

Mesh size (μm)	Mass fraction		
	F	R	P ₁
-4699+3327	0.125	0.082	0
-3327+2362	0.085	0.095	0
-2362+1651	0.055	0.028	0
-1651+1168	0.047	0.155	0
-1168+833	0.031	0.169	0
-833+589	0.034	0.209	0
-589+417	0.026	0.036	0.051
-417+295	0.019	0.026	0.125
-295+208	0.021	0.014	0.19
-208+147	0.017	0.011	0.131
-147+104	0.015	0.009	0.119
-104+74	0.013	0.006	0.097
-74	0.085	0.03	0.287

[[CO3](Analyze/HOCQ)]

- (b) Define work index and describe its importance.

[[CO2,3](Remember/LOCQ)]

10 + 2 = 12

Group - D

6. (a) State the difference between free settling and hindered settling.

[[CO3] (Remember/LOCQ)]

(b) Define Stokes's law and Newton's law of settling particles in a medium.

[[CO3] (Remember/IOCQ)]

(c) Bauxite ore, consists of bauxite and silica, is cleaned through water flowing in laminar zone in classifier. After cleaning three prats should be appeared: pure bauxite, pure silica and mixture of these. The size range of particle is 20-600 micrometre. Compute the size range of three parts. Densities of bauxite and silica are 2200 kg/m³ and 2800 kg/m³, respectively.

[[CO2] (Analyze/HOCQ)]

2 + 4 + 6 = 12
7. (a) State Darcy’s law. Describe Ergun and Kozeny Carman equation.

[[CO4] (Remember/LOCQ)]

(b) State the deferent names of the agitator. Define the expression of power consumption in agitated vessel.

[[CO4] (Understand/IOCQ)]

(c) Define the forth flotation. State the working principle of flotation process.

[[CO4] (Analyze/HOCQ)]

4 + 4 + 4 = 12

Group - E

8. (a) Write important properties of nanomaterial. Define band-gap. Write about different types of nanomaterials.

[[CO5](Remember/LOCQ)]

(b) Write the name of different types of characterization techniques for the nanomaterial.

[[CO5, CO4](Understand/LOCQ)]

(c) Write the importance of optical and magnetic properties of nanomaterial.

[[CO5](Understand/HOCQ)]

4 + 4 + 4 = 12
9. (a) Describe the working principle of continuous rotary vacuum filter.

[[CO4](Analyze/HOCQ)]

(b) Describe the working principle of electrostatic precipitator with net schematic diagram.

[[CO5](Understand/LOCQ)]

(c) State the working principle of bag filter.

[[CO5](Analyse/IOCQ)]

4 + 4 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	34.4	28.1	37.5

Course Outcomes (CO):

After the completion of the course students will be able to

1. Calculate average particle diameters for a mixture of solid particles and select different screens according to specifications.
2. Select the type of crusher/grinder for a particular comminution operation and calculate the energy consumption.
3. Calculate drag force and terminal settling velocity for single particles.
4. Select the type of classifier required for a given operation and given a particular thickening operation, design the thickener required.
5. Calculate power consumption for an agitation operation and scale up the agitator as per the problem given and analyze filtration data and select filtration equipment based on requirements.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question