

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

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

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

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) Kick's law relates to
(a) energy consumption (b) final particle size
(c) feed size (d) product size.
- (ii) Which of the following terminology is not used for size reduction of materials to finesizes or powders?
(a) Comminution (b) Dispersion
(c) Pulverisation (d) Compression.
- (iii) The value of compressibility co-efficient for compressible cake is
(a) Zero (b) 0.2 to 0.8 (c) 1 (d) 20 to 40.
- (iv) Gizzlies are used for separating _____ solids.
(a) coarse (b) fine (c) any size (d) micro
- (v) The most accurate law for estimating the power is
(a) Rittingers law (b) Bond's law
(c) Kick's law (d) Power law.
- (vi) 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.
- (vii) Separation of materials into products based on the difference of their sizes is called
(a) Sizing (b) Sorting (c) Classification (d) Flocculation.
- (viii) What is the type of flow called when the particle Reynolds number is less than 1?
(a) Couette flow (b) Creeping flow
(c) Vortex flow (d) Poiseuille flow.

- (ix) The ratio of drag stress to inertial stress is called
 (a) Flow number (b) Reynolds number
 (c) Froude number (d) Power number
- (x) Which is the predominating force contributing to pressure drop when there is laminar flow of liquid through a packed bed?
 (a) Inertial force (b) Centrifugal force
 (c) Viscous force (d) Adhesive force.

Fill in the blanks with the correct word

- (xi) The unloading time depends upon the _____.
- (xii) Centrifuge and automatic discharges are used for _____.
- (xiii) A measure of the power consumed in agitation is the _____ number.
- (xiv) In creeping flow, the drag coefficient is given by _____.
- (xv) Turbine is a _____ flow impeller.

Group - B

2. (a) Compute the effectiveness of 14 mesh screen if average is the desired product.

Mesh	Particle diameter (D_p), mm	Cumulative fraction		
		Feed	Overflow	Under flow
4	4.669	1	1	1
6	3.327	0.95	0.91	1
8	2.362	0.88	0.67	1
10	1.651	0.50	0.18	0.81
14	1.168	0.25	0.03	0.45
20	0.833	0.10	0.01	0.20
28	0.589	0.07	0	0.11
35	0.417	0.04	0	0.05
65	0.208	0.02	0	0.03

[[CO1](Analyse/IOCQ)]

- (b) Define Sauter diameter and its significance.

[[CO1](Understand/LOCQ)]

9 + 3 = 12

3. (a) Define mesh number, aperture length and sphericity of a screen.

[[CO1](Analyse/IOCQ)]

- (b) Describe the role of banana screen and vibrating screen.

[[CO1](Remember/LOCQ)]

6 + 6 = 12

Group - C

4. (a) Describe the laws of comminution. State the Kick's law and its limitation.

[[CO1,CO2](Remember/LOCQ)]

- (b) A material is crushed in a jaw crusher in which feed of average size of 70 mm is reduced to 30 mm while consuming 15 kW/(kg/s) energy. Compute the energy

consumption to crush the same material of 90 mm average size to 20 mm. use Kick's and Rittinger's laws.

[[CO1,CO2](Apply/IOCQ)]

(2 + 4) + 6 = 12

5. (a) Describe the working principle of Jaw crusher and cone crusher. [[CO1,CO2](Understand/LOCQ)]
 (b) Describe the various breaking pattern applied for the different types of size reduction. [[CO1,CO2](Analyze/IOCQ)]
 (c) Describe the size reduction process using attrition mill. [[CO2](Apply/IOCQ)]
6 + 3 + 3 = 12

Group - D

6. (a) A particle of diameter 5 mm is settling through a liquid of density 1000 kg/m³ and viscosity 1 cP. In a separate settling experiment it was found that a 0.2 kg sample of the particle displaced 0.00013 m³ of liquid. Determine the terminal settling velocity of the 5 mm particle. [[CO3](Evaluate/HOCQ)]
 (b) What kind of settling is seen in sedimentation experiments? Explain. [[CO3](Analyse/IOCQ)]
 (c) Explain the working principle of a Hirate thickener. [[CO3](Understand/LOCQ)]
6 + 2 + 4 = 12
7. (a) For agitating a large volume of a moderately viscous liquid, what type of agitator would you select? Explain. [[CO4](Evaluate/HOCQ)]
 (b) What are the significances of Power number and Flow number? [[CO4](Understand/LOCQ)]
 (c) Explain the working of a flotation cell. [[CO3](Understand/IOCQ)]
4 + 2 + 6 = 12

Group - E

8. (a) Describe the cake filtration process and the role of clarifying filter. [[CO3, CO4](Understand/LOCQ)]
 (b) Describe the working principle of Bag filters. [[CO3,CO4](Analyze/IOCQ)]
6 + 6 = 12
9. (a) Explain the working principle of electrostatic filter with net schematic diagram. [[CO2](Remember/LOCQ)]
 (b) Describe important properties of nanomaterials and its characterization. [[CO4,05](Apply/IOCQ)]
6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	47.92	34.38	17.70

Course Outcome (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 and get knowledge on drag force and terminal velocity.
3. Select the type of classifier required for a given operation and given a particular thickening operation, design the thickener required.
4. Calculate power consumption for an agitation operation and scale up the agitator as per the problem given.
5. Analyse filtration data and select filtration equipment based on requirements.

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