

B.TECH/CHE/3RD SEM/CHEN 2101/2016

**MECHANICAL OPERATION
(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) 200 mesh screen is the basis for
(a) BSS Screen (b) Tyler screen
(c) IS screen (d) None of these.
- (ii) The value of sphericity for cube is
(a) 2 (b) 1 (c) 1.75 (d) 0.65.
- (iii) Angle of nip is inherent with
(a) toothed roll crushers (b) impactors
(c) smooth roll crushers (d) none of these.
- (iv) For a mixing tank operating in the laminar regime, the power number varies with Reynolds number (Re) as
(a) $Re^{-1/2}$ (b) $Re^{1/2}$ (c) Re (d) Re^{-1} .
- (v) In constant pressure filtration, the rate of filtration follows the relation (V = filtrate volume, t = time, K_p and C constant)
(a) $dV/dt = K_p + C$ (b) $dV/dt = 1/K_p + C$
(c) $dV/dt = K_p$ (d) $dV/dt = K_p^2$
- (vi) The power number for a stirred tank becomes constant at high Reynolds number. In this limit, the variation of power input with impeller rotational speed (N) is proportional to
(a) N^0 (b) N^1 (c) N^2 (d) N^3 .
- (vii) Which product is used as a collector
(a) Alum (b) Petroleum
(c) Xanthates (d) Copper.

B.TECH/CHE/3RD SEM/CHEN 2101/2016

- (viii) For uniform sphere ϵ varies from
(a) 0.1 to 10 (b) 1 to 100
(c) 0.5 to 0.95 (d) none of these.
- (ix) In Newton law region terminal settling velocity u_t varies with
(a) $D_p^{0.5}$ (b) D_p^2 (c) D_p^3 (d) D_p^5 .
- (x) An example of a hydraulic classifier is
(a) Cyclone separator (b) Colloid mill
(c) Screw mixer (d) Spitzkasten.

Group - B

2. (a) With a neat diagram describe the operation of a grizzly.
(b) Differentiate between differential and cumulative screen analysis. Which one is more preferable and why?
6 + (3 + 3) = 12
3. (a) For transportation of heavy materials which type of conveyor is preferable? Explain the action of a flight conveyor with a neat diagram.
(b) What are the advantages of pneumatic conveyors over mechanical conveyor? Explain the working principle of a dense phase pressure system with a neat diagram.

(1 + 5) + (2 + 4) = 12

Group - C

4. (a) A material is crushed in a jaw crusher and the average size of the particle is reduced from 10 cm to 2 cm with consumption of energy 2.64×10^4 J/kg. What will be the consumption of energy to crush the same material from 12 cm to 3 cm, assuming (i) Rittinger's law (ii) Kick's law?
(b) Derive Kick's law and Bond's law from the generalized crushing law.
6 + (3 + 3) = 12
5. (a) In a ball mill of 2500 mm diameter, 200 mm steel balls are being used for crushing. Presently the mill runs at 25 rpm. At what speed will the mill have to run if 200 mm balls are replaced by 100 mm balls, all other conditions remaining same?

- (b) (i) Explain the principle of action of a fluid energy mill with a neat diagram.
 (ii) Define work index.

$$6 + (4+2) = 12$$

Group - D

6. (a) A silty soil containing 14% moisture was mixed in a large muller mixer with 10.0 weight percent of a tracer consisting of dextrose and picric acid. After 3 minutes of mixing 12 random samples were taken from the mix and analysed colorimetrically for tracer material. The measured concentration in the samples were, in weight percent tracer, 10.24, 9.30, 7.94, 10.24, 11.08, 10.03, 11.91, 9.72, 9.20, 10.76, 10.97 and 10.55. Calculate the mixing index.

- (b) Write short notes on cyclone separator and continuous thickener.

$$6 + (3 + 3) = 12$$

7. (a) A tank is 1.83 m in diameter, the turbine is 0.61 m in diameter and is positioned 0.61 m from the bottom of the tank. The tank is filled to depth of 1.83 m with a solution of 50% caustic soda which has a viscosity of 12 cp and a density of 1.5 gm/cm³. The turbine is operated at 90 rpm. What will be the power consumption for the operation of the baffled mixer?

Data given:

N_{RE}	ϕ
10000	5.8
60000	6.0
80000	6.0

- (b) Prove that " $P_0 = \text{fn} [R_{em}, F_{rm}, S_1, S_2, S_3, S_4, S_5, S_6]$ ".
 (c) What is lamella clarifier?

$$4 + 6 + 2 = 12$$

Group - E

8. Write short notes on (any four) (4 × 3) = 12
 (i) Compressible filter cake
 (ii) Filter medium resistance
 (iii) Gravity settling tank
 (iv) Froth floatation
 (v) Filter media
 (vi) Filter aids.

9. A leaf filter with 1.0 m² of filtering surface operated at a constant pressure of 1.8 bar (gage) gave the following results:

Filtrate volume (m ³)	3.99	6.09	7.65	9.63	11.33
Time (min)	10	20	30	45	60

The original slurry contained 10% by weight of solid calcium carbonate (specific gravity = 2.72) in water and the cake formed is essentially incompressible. Determine the time required to wash cake formed at the end of 70 minutes of filtering at the same pressure using 3.0 m³ of wash water.

12