

III B.Tech I Semester Supplementary Examinations, May 2005
MECHANICAL UNIT OPERATIONS
(Chemical Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
 All Questions carry equal marks

1. (a) Describe the methods of particle size analysis.
- (b) Determine \overline{D}_s and \overline{D}_v of the crushed ilmenite sample given below:

Weight fraction	$\overline{D}_p, \text{mm}$	Weight fraction	$\overline{D}_p, \text{mm}$
0.075	1.409	0.106	0.252
0.136	1.001	0.082	0.178
0.158	0.711	0.056	0.126
0.154	0.503	0.047	0.089
0.133	0.356	0.057	0.037

2. (a) Distinguish between mixing of solids and pastes, and blending of liquids.
- (b) Describe the construction and working of change-can mixers and mention their uses.
3. (a) What is a tumbling mill? Discuss the action of size reduction in it.
- (b) Draw a conical ball mill and specify its salient constructional and operational features.
- (c) What do you understand by critical speed of a ball mill.? Obtain an expression for it.
4. (a) Discuss differential and cumulative analysis.
- (b) Derive the relationship between the screen effectiveness and the mass fractions of material in feed, overflow and underflow.

5. A tubular membrane with a diameter of 2 cm and a water permeability of 250 L/m²-h-atm is being used for UF of cheese whey. The whey proteins have an average diffusivity of 4×10^{-7} cm²/s and the osmotic pressure in atmospheres is given by Jonsson's equation:

$$\pi = 4.4 \times 10^{-3}c - 1.7 \times 10^{-6}c^2 + 7.9 \times 10^{-8}c^3$$

where c is the protein concentration in grams per liter. Calculate the effect of Δp on the flux for a clean membrane if the solution velocity is 1.5 m/s and the protein concentration is 10, 20 or 40 g/L. Assume the gel concentration is 400 g/L and the rejection is 100 percent. Assume the bulk solutions have the same density and viscosity as water:

$$\rho = 1 \text{ g/cm}^3 \quad \mu = 0.01 \text{ g/cm-s}$$

6. (a) Write about the sink-and-float method for separation of differing density particles.

- (b) Explain heavy media separation method of cleaning coal.
7. A flat-blade turbine with six blades is installed centrally in a vertical tank. The tank is 1.5 m in diameter; the turbine is 0.5 m in diameter and is positioned 0.5 from the bottom of the tank. The turbine blades are 125 mm wide. The tank is filled to a depth of 1.5 m with rubber-latex compound at 65⁰C having a viscosity of 1200 P and a density of 1129 kg/m³. The turbine is operated at 95 rpm. The tank is unbaffled. What power will be required to operate the mixer?
8. (a) Write about the temperature difference as a potential in achieving supersaturation.
- (b) Discuss about the units for supersaturation.
