

**II B.Tech II Semester Examinations, April/May 2012**  
**MECHANICAL UNIT OPERATIONS**  
**Chemical Engineering**

**Time: 3 hours****Max Marks: 75**

**Answer any FIVE Questions**  
**All Questions carry equal marks**

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1. (a) Classify the membranes based on size range of the particles.  
(b) Differentiate between observed rejection and real rejection with suitable equations?  
(c) Explain the solution diffusion mechanism under membrane based separations. [4+5+6]
2. (a) Explain the terms:
  - i. Super saturation
  - ii. Homogeneous Nucleation
  - iii. Heterogeneous Nucleation.(b) Describe the construction and working of a continuous vacuum crystallizer. [9+6]
3. Describe the Phenomenon of Flootation and applicability of Flootation concept in separation of ores? [15]
4. (a) Discuss how would you use a fluidizer in pneumatic conveyor.  
(b) Distinguish between screw conveyors and apron conveyors. [7+8]
5. (a) Write a note on gas dispersion in agitated vessels.  
(b) Write about Power Consumption in aerated turbine agitated vessel. [7+8]
6. (a) Define the term 'reduction desired ratio'.  
(b) Give general values of reduction ratio for crusher, grinder, and ultra fine grinders.  
(c) What is choke crushing? How is it different from free crushing?  
(d) Mention the situations where wet grinding is preferred over dry grinding. [15]
7. (a) A sponge-iron industry uses a reciprocating screen of 5-mm aperture to separate oversize from undersize fines which is then recycled to the furnace. The screen analysis of the furnace output was found to contain 25% fines. The screen efficiency was known to be 50%. The underflow from the screen contains around 95% fines. If the furnace production rate is 100 tonne/h, find the product rate and the amount of fines present in it  
(b) Discuss the types of screening surfaces and their material of construction. [9+6]

8. A spray dried detergent has the following screen analysis

S.No.	Tyler Screen	Weight fraction
1	-14+20	0.02
2	-20+28	0.17
3	-28+35	0.34
4	-35+48	0.22
5	-48+65	0.16
6	-65+100	0.06
7	-100	0.03

- (a) Present this information as a differential distribution and cumulative distribution plot.
- (b) Determine the surface mean diameter & volume mean diameter. It is given that diameter of the 100 mesh is 0.147 mm. [15]

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1. Explain different types of Pneumatic conveyors in details. [15]
2. (a) Distinguish between ideal and actual size reduction equipments.  
 (b) Recommend suitable equipment for fine grinding of explosives and outline its working principle.  
 (c) Explain briefly colloidal mill. [4+5+6]
3. (a) Discuss in detail about the principles of cake filtration.  
 (b) Write short notes on filter aids. [8+7]
4. (a) What is the rate of nucleation? Explain attrition and origins of crystal in crystallizers.  
 (b) Write short notes on fluid - shear nucleation.  
 (c) Write the application of Kelvin's equation in crystallization. [7+4+4]
5. (a) Determine the flux assuming that there is no effect of concentration polarization during ultrafiltration of fermentation broth containing 0.98 wt% protein at a pressure difference of 5 kg/atm psi and the membrane permeability is  $1.4 \times 10^{-2} \text{ kg/s m}^2 \text{ atm}$ .  
 (b) Give the cause, consequences and control techniques for cake formation in membrane ultrafiltration. [8+7]
6. (a) How Flootation equipment classified based on the generation and introducing of air bubbles.  
 (b) Write Short notes on Flootation plant operation. [7+8]
7. (a) What are the different ways to represent particle size of a mixture?  
 (b) Calculate the mass-mean diameter for the following screen analysis.

Size, mm	Mass retained, g
-1.70+0.85	25
-0.85+0.60	30
-0.60+0.50	40
-0.50+0.425	35
Pan	20

[7+8]

8. (a) Explain the significance of power number, Froude number and Reynold's number.

Code No: R09220805

**R09**

**Set No. 4**

- (b) Estimate the power required by a three bladed square pitched 40 cm marine propeller rotating at 300 rpm in a 30% by weight sodium hydroxide solution at 25<sup>o</sup> C in an unbaffled tank of 3 m diameter and 2.5 m liquid depth. The specific gravity of sodium hydroxide solution at this temperature is 1.3 and its viscosity is 13 CP. The power function is 0.245. The constants a = 2.1 and b = 18. [6+9]

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**R09**

**Set No. 1**

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1. (a) What are the requirements of continuous MSMPR crystallizer?  
(b) Write short notes on classification of crystallizers. [6+9]
2. Write briefly about  
(a) Propellers  
(b) Motionless Mixers [7+8]
3. (a) Distinguish between mixing of solids and pastes, and blending of liquids.  
(b) Describe the construction a working of change-can mixers and mention their uses. [7+8]
4. (a) Derive relationship between pressure drop and time for constant rate filtration?  
(b) Define specific cake resistance with relevant equation.  
(c) Write short notes on gas cleaning. [7+4+4]
5. (a) Briefly explain super capacity Continuous bucket elevators.  
(b) Briefly explain V - elevator conveyors. [7+8]
6. (a) How and with what rate different zones vary as Sedimentation proceed? Explain how interface height varies with settling time with a neat graph.  
(b) Discuss briefly the working Principle of a Thickener. [9+6]
7. A creap rock is crushed in Gyrotory crusher and the feed is nearly uniform with 2 inch spheres. The differential analysis of the product is given in the table as first grind. The power required to crush this material is 575 HP/1000 kg of this 15 HP is needed to operate the empty mill. By reducing the clearance between the crushing head and the cone, the differential analysis of the product given in table as second grind. Calculate the power required for the second operation from  
(a) Rittinger's law  
(b) Kicks law.

The feed rate is 125 tons/hr.

Mesh	First grind	Second grind
4	3.1	0
6	10.3	3.3
8	20	8.2
10	13.6	11.2
14	18.2	12.3
20	14	16
28	9.5	16.5
35	6.5	13.5
48	4.3	8.5
65	0.5	0.2
100	—	4
150	—	0.2
200	—	0.1
Pan	—	—

It is given that the opening of the 200 mesh Tyler standard screen is 0.074 mm.

[15]

8. (a) Derive an expression for determination of the effectiveness of a screen.  
 (b) Sand mixture is screened in a screen having mesh size of 10. The cumulative screen analysis of feed, overflow and underflow are given below. Calculate the effectiveness of the screen:

[7+8]

Mesh	Clear opening mm	Feed	Overflow	Underflow
4	0.470	—	—	—
8	0.236	0.150	0.430	—
10	0.165	0.471	0.850	0.20
20	0.083	0.887	0.990	0.83
28	0.059	0.941	1.000	0.91
35	0.042	0.962	—	0.94
65	0.021	0.979	—	0.96
100	0.015	0.989	—	0.97
150	0.010	1.000	—	1.00

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1. (a) What is Clarifying filters?  
 (b) Write briefly about
  - i. Liquid clarification
  - ii. Gas cleaning. [5+10]
2. Discuss about mixers for cohesive solids. [15]
3. (a) Explain briefly characteristics of comminuted products.  
 (b) Explain briefly the energy requirements in size reduction equipments. [7+8]
4. (a) Discuss what happens when near-mesh particles are fed to screen.  
 (b) Mention the requirements for effective filtration. [7+8]
5. (a) What is the criterion for deciding the crystal size?  
 (b) Name a few hydrates of industrial importance.  
 (c) What are the different types of crystallizers used in industrial practice? [5+5+5]
6. Explain briefly about
  - (a) Belt conveyor design.
  - (b) Belt conveyor operating conditions. [7+8]
7. (a) What is the capacity in cubic meter per hour of a clarifying centrifuge operating under the following conditions:  
 Diameter of the bowl = 600mm.      Specific gravity of liquid = 1.3  
 Thickness of the liquid layer = 75mm.      Specific gravity of solid = 1.6  
 Depth of the bowl = 400 mm.      Viscosity of liquid = 3 cp  
 Speed = 1000 r/min.      Cut size of particles = 30  $\mu$ m  
 (b) Write a short note on sedimentation zones in continuous thickener. [8+7]
8. (a) A flat bladed turbine impeller with six blades is installed centrally in a vertical cylindrical tank of 1 m dia. The turbine is 0.3 m diameter and is positioned 0.3 m from the bottom of the tank. The tank is filled to a depth of 1m with a liquid viscosity of 100 Cp and a density of 700 kg/m<sup>3</sup>. The tank is unbaffled. What power is required to operate this impeller at a speed of 100 RPM?  
 $N_P \cdot N_{Re} = 80$ .  
 (b) Write short notes on Geometric Similarity and Dynamic similarity [9+6]

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