Code No: RR310801 **Set No. 1**

III B.Tech I Semester Regular Examinations, November 2006
MECHANICAL UNIT OPERATIONS
(Chemical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain how cohesive solids flow out of bins. [6]
   (b) The discharge opening for flow of solids out of bins plays an important role in maintaining a proper control of the flow rate. Explain. [5]
   (c) What causes the solids to arch or bridge in the container and prevent flow? How is it overcome? [5]
2. (a) Classify the mixers for free flowing solids based on their mode of operation. [8]
   (b) Explain the blending of salt and sand in a tumbling barrel with the help of a curve between mixing index and mixing time. [8]
3. (a) Mention general characteristics of an ideal comminution machine. How does an actual unit differ from an ideal one? [8]
   (b) Classify various size reduction machines. Specify general range of product size for each type of machine. [8]
4. (a) Explain the working of plate and frame filter press with a neat diagram. [10]
   (b) Discuss about shell-and-leaf filters. [6]
5. (a) Explain the performance of a ultrafiltration membrane in terms of permeate flux and solute rejection. [8]
   (b) Write about the ultrafiltration of skimmed milk in a hollow fiber UF module. [8]
6. (a) Define Flocculation. [4]
   (b) Discuss the settling characteristics of fine solids from liquids using batch sedimentation test. [12]
7. (a) Critically discuss the relative merits and demerits between turbine and propeller impellers. Show the mixing profiles in a figure. [8]
   (b) What are the various kinds of impellers for mixing of:
      i. Gases in liquids
      ii. Solids catalysts in oil
      iii. Emulsions of liquids

      Also give reasons for your choice. [8]

8. (a) What is Ostawald ripening? Explain homogeneous nucleation. [12]
   (b) Explain Kevin equation. [4]

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Code No: RR310801 **Set No. 2**

III B.Tech I Semester Regular Examinations, November 2006
MECHANICAL UNIT OPERATIONS
(Chemical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Crushed galena from a ball mill has the following screen analysis:

Mesh no.	D_{pi},mm	Mass fraction,X_i
28	0.589	0.000
35	0.417	0.150
48	0.295	0.200
65	0.208	0.171
100	0.147	0.134
150	0.104	0.104
200	0.074	0.080
Pan	....	0.161

   (a) Present the information in the form of a histogram.

   (b) Determine the average particle diameter based on weight

   (c) Determine the total surface area of a 100 g sample of the crushedore. Φ_s = 0.5 and specific gravity of galena = 7.43 [16]

2. (a) How is the mixing index for a mixture of solids estimated? Explain. [6]

   (b) What is the effect of mixing time on mixing index for granular solids? Discuss briefly. [5]

   (c) Write the equation for the rate of mixing in terms of the mixing index I_s and thereby derive the equation to calculate the time required for any desired degree of mixing. [5]

3. (a) 3.0 kW has to be supplied to a material crushing at the rate of 0.3 kg/s from 12.5 mm cubes to a product of 3.1 mm. What would be the rate at which same material should be supplied to the machine if its power consumption remains same to get the product of 2 mm cube? [10]

   (b) Discuss various variables which affect the power requirement of a crusher. [6]

4. (a) Explain screening. [6]

   (b) Discuss with suitable sketches the functioning of different types of screens.[10]

5. Write short notes on.

   (a) Partial rejection of solutes. [4]

   (b) Microfiltration [8]

(c) Different types membranes used for ultrasiltration. [4]

6. (a) Describe the different stages of the hatch sedimentation process. [8]

   (b) Write about of rate of sedimentation and explain the relation between the interface height and settling time. [8]

7. (a) List the type of impellers used for suspending solids in liquids. [8]

   (b) Explain the procedure to determine the maximum gas-handling capacity of the agitated vessel. [8]

8. A salt solution is weighing 10,000 kg with 30 wt% Na_2CO_3 is cooled to 293k. The salt crystallizes as the dehydrate. What will be the yield of Na_2CO_3, 10 H_2O crystals if the solubility is 21.5kg anhydrous Na_2CO_3 / 100 kg of total water. Do this for the following cases.

   (a) Assume that no water is evaporated.

   (b) Assume that 3% of the total weight of solution is lost by evaporation of water in cooling. [16]

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III B.Tech I Semester Regular Examinations, November 2006
MECHANICAL UNIT OPERATIONS
(Chemical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Crushed pyrite is having the screen analysis shown below. Specific gravity of pyrite = 5.0 and the shape factors are a = 2 and $\Phi_s = 0.28$.

   (a) What fraction of the total number of particles is in the 150/200-mesh increment?

   (b) Determine the total surface area of a unit mass of particles.

Mesh no.	D_{pi},mm	Percentage Retained
4	4.699	0.0
6	3.327	4.0
8	2.362	7.2
10	1.651	12.0
14	1.168	17.6
20	0.833	15.4
28	0.589	12.0
35	0.417	10.0
48	0.295	7.2
65	0.208	6.0
100	0.147	3.8
150	0.104	2.8
200	0.074	2.0

2. Discuss about the equipment used for the following purposes:

   (a) Blending fine, light powders such as insecticides

   (b) Mixers for thin pastes and for powders that do not flow readily

   (c) Blending and homogenizing clays

   (d) Mix, compound, and work thermoplastics [4×4=16]

3. (a) Draw a diagram of a gyratory crusher and discuss its construction and operation. [12]

   (b) How does gyratory crusher differ from a Jaw crusher? [4]

4. (a) State and explain "screen effectiveness". [6]

   (b) One tonne per hour of dolomite is produced by a ball mill operating in closed circuit with a 100 mesh screen. The screen analysis (weight) is given below calculate the screen efficiency. [10]

Mesh	35	48	65	100	150	200	200
Feed	7.07	16.6	14.02	11.82	9.07	7.62	33.8
Oversize	13.67	332.09	27.12	20.7	4.35	2.07	0
Undersize	0	0	0	2.32	14.32	13.34	70.02

5. Write short notes on.
   (a) Partial rejection of solutes. [4]
   (b) Microfiltration [8]
   (c) Different types membranes used for ultrasiltration. [4]
6. (a) What is meant by sorting classifier. [4]
   (b) What are different separation methods followed in sorting classifiers and discuss them in detail. [12]
7. (a) Critically discuss the relative merits and demerits between turbine and propeller impellers. Show the mixing profiles in a figure. [8]
   (b) What are the various kinds of impellers for mixing of:
      i. Gases in liquids
      ii. Solids catalysts in oil
      iii. Emulsions of liquids

      Also give reasons for your choice. [8]
8. (a) Explain where equilibrium in crystallization process is reached? [8]
   (b) Describe about the yield of crystallization. [8]

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Code No: RR310801 **Set No. 4**

III B.Tech I Semester Regular Examinations, November 2006
MECHANICAL UNIT OPERATIONS
(Chemical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Crushed pyrite is having the screen analysis shown below. Specific gravity of pyrite = 5.0 and the shape factors are a = 2 and $\Phi_s = 0.28$.

   (a) What fraction of the total number of particles is in the 150/200-mesh increment?

   (b) Determine the total surface area of a unit mass of particles.

Mesh no.	D_{pi},mm	Percentage Retained
4	4.699	0.0
6	3.327	4.0
8	2.362	7.2
10	1.651	12.0
14	1.168	17.6
20	0.833	15.4
28	0.589	12.0
35	0.417	10.0
48	0.295	7.2
65	0.208	6.0
100	0.147	3.8
150	0.104	2.8
200	0.074	2.0

2. (a) Describe the construction and working of the Banbury mixer with a neat sketch. What are its uses? [6]

   (b) A large Banbury mixer masticates 816 kg of scrap rubber with a density of 1121.26 kg/m^3. The power load is 1182 kW/m^3 of rubber. How much cooling water in m^3/min is needed to remove the heat generated in the mixer if the temperature of the water is not to rise more than 27^0C? [10]

3. (a) What are various laws of size reduction? State each one of them with their limitations. [10]

   (b) Which law is more realistic in estimating power requirement of a commercial comminuting machine? Give answer with justification. [3]

   (c) State the generalized relation for all the laws of size reduction. [3]

4. Write short notes on.

   (a) Ideal and actual screens. [8]

(b) Capacity and effectiveness of screens. [8]

5. Write short notes on.

   (a) Partial rejection of solutes. [4]

   (b) Microfiltration [8]

   (c) Different types membranes used for ultrasiltration. [4]

6. Write notes on:

   (a) Axial flow conveyor centrifuges [8]

   (b) Centrifugal classifiers. [8]

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 65^0C having a viscosity of 1200 P and a density of 1129 kg/m^3. The turbine is operated at 95 rpm. The tank is unbaffled. What power will be required to operate the mixer(Make suitable assumptions)? [16]

8. (a) Explain in detail MSMPR crystallizer. [8]

   (b) Describe population density function. [8]

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