R09

Set No. 2

II B.Tech II Semester Examinations, APRIL 2011 MECHANICAL UNIT OPERATIONS **Chemical Engineering**

Time: 3 hours

Code No: R09220805

Max Marks: 75

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

- 1. (a) What are the main objectives of crystallization?
 - (b) What is difference between mother liquor and magma?
 - (c) What are methods available to purify the crystals from mother liquor? [7+4+4]
- 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. Explain different types of Pneumatic conveyors in details. [15]

- 4. Write briefly about
 - (a) Settling flux, Transport flux and Total flux
 - (b) Sink-and Float method. [8+7]
- 5. Distinguish between Cyclone and Hydro cyclone? Explain briefly the working principle of any one with a neat diagram. [15]
- 6. (a) Classify mixers for free flowing solids based on their mode of operation.
 - (b) Explain the blending of salt and sand in a tumbling barrel with the help of a curve between mixing index and mixing time. [7+8]
- 7. A pilot-plant vessel 305 mm in diameter is agitated by a six-blade turbine impeller 102 mm in diameter. When the impeller Reynolds number is 10^4 , the blending time of two miscible liquids is found to be 15 sec. The power required is 2 hp per $1000 \text{ gal} (0.4 \text{ kW/m}^3)$ of liquid. Calculate and write necessary explanation for the following
 - (a) What power input would be required to give the same blending time in a vessel 1830 mm in diameter?
 - (b) What would be the blending time in 1830 mm vessel if the power input per unit volume was the same as in the pilot-plant vessel?

(for Reynolds number of 10^4 and above, the mixing time factor nt_T is constant)

[15]

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R09

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[15]

8. A Rotary- vacuum drum filter having a 33% submergence of the drum in the slurry is to be used filter a $CaCO_3$ slurry using a Pressure drop of 67.0 kPa. The solids Concentration in the slurry is $c_x = 0.199$ kg solid/kg slurry and the filter cake is such that the kg wet cake /kg dry cake = m = 2.0. The density and viscosity of the filtrate can be assumed as those of water at 298 K. Calculate the filtrate area needed to filter 0.478 kg slurry/s. The filter cycle time is 250 sec. The Specific cake resistance can be represented by $\alpha = 4.37 \times 10^9 (-\Delta P)^{0.3}$. Where $-\Delta P$ is in Pascal and is in m/kg.

Data : The density of water $\rho = 996.9 \text{ kg/m}^3$ Viscosity of water $\mu = 0.8937 \times 10^{-3}$ Pa-sec

NKE 251

 $\mathbf{R09}$

Set No. 4

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Time: 3 hours

Code No: R09220805

Max Marks: 75

[9+6]

[7+8]

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

1. (a) Distinguish between kneaders, dispersers and masticators.

(b) Describe with figures double-motion paste mixers.

- 2. (a) Explain briefly heterogeneous nucleation.
 - (b) Write short notes on crystal geometry.
- (a) Write briefly about Membrane separation process and mention advantages of 3. Membrane separation processes over other separation processes.
 - (b) Distinguish between ultra filtration and Cross flow filtration. [8+7]
- (a) Explain how would you proceed to compute pressure drop in a pneumatic 4. conveyor.
 - (b) Distinguish between belt conveyors and screw conveyors. [7+8]
- 5. (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 form free crushing?
 - (d) Mention the situations where wet grinding is preferred over dry grinding. [15]
- 6. (a) Write short notes on Characteristics of Dispersed Phase in Dispersion Operations.
 - (b) Write in detail the Bubble behavior under Gas Dispersion in Dispersion Operations. [8+7]
- 7. (a) A sample of bauxite ore is to be cleaned using water in a classifier. The ore particles have a size range of 10 to 500 microns. The mixture is being separated in to three parts: pure bauxite (specific gravity 2.2), pure silica (specific gravity 2.8) and the third fraction is the middling which is recycled. Assuming the flow to be laminar and neglecting any wall effect, estimate the size range of the three fractions?
 - (b) Discuss briefly Disk centrifuge with neat sketch? [8+7]
- 8. (a) Derive an expression for determination of the effectiveness of a screen.

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Code No: R09220805

R09

Set No. 4

(b) Quartz mixture is screened in a screen having aperture of 0.117 cm. The cumulative screen analysis of feed, overflow and underflow are given below. Calculate the effectiveness of the screen:

Cumulative weight Fraction									
Mesh	D_p (cm)	Feed	Over-flow	Underflow					
			Underflow						
4	0.4699	0	0						
6	0.3327	0.0251	0.071						
8	0.2362	0.1501	0.430	0					
10	0.1651	0.4708	0.800	0.195					
14	0.1168	0.7728	0.970	0.580					
20	0.0833	0.8868	0.990	0.830					
28	0.0589	0.9406	1.000	0.910					
35	0.0417	0.9616		0.940					
65	0.0209	0.9765		0.960					
Pass	_	1.000		1.000					

eness of the screen:

[7+8]

R09

Set No. 1

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Time: 3 hours

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Max Marks: 75

[5+5+5]

[11+4]

[7+8]

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

- 1. Write Short notes on
 - (a) Applications of Ultra-filtration
 - (b) Partial rejection of solutes
 - (c) Concentration Polarization.
- 2. (a) State and explain the laws of crushing.
 - (b) Write short notes on necessity of size reduction
- (a) What are the Three ways of Prevention of Swirling? Discuss briefly. 3.
 - (b) Discuss the importance of Draft tubes briefly.
- 4. (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]
- (a) Write short notes Tylor standard screens. 5.
 - (b) Recommend suitable equipment for each of the following operations and outline its working principle:
 - i. mixing of dry salt and sand
 - ii. mixing of a rubber compound [5+10]
- 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. The following data are given for a horizontal screw conveyor for handling molding sand in a foundry: Bulk density of material = $1600 \text{ kg} / \text{m}^3$ Diameter of screw = 0.4 m
 - Screw pitch = 0.32 m Conveying length = 15 mFilling coefficient = 0.125Speed of screw shaft = 40 rpm Reducer efficiency = 0.77
 - Total coefficient of resistance = 4.0

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R09

Set No. 1

- (a) the rate of conveying of material in kg / hour
- (b) the motor power.

Code No: R09220805

[15]

8. The following data were collected when a crushed ore was screened using a 3.0 mm screen to separate the under crushed material so that it can be returned to the crusher for further processing. Compute the effectiveness of the screen by drawing graph between the particle size and cumulative mass fraction of feed, oversize and under size. [15]

Average diameter (mm)	Feed	Mass fraction oversize	Undersize	
		from screen	from screen	
0.4056	0.548	0.596	0.0	
0.2876	0.146	0.168	0.113	
0.19995	0.109	0.096	0.147	
0.14005	0.045	0.039	0.086	
0.10215	0.034	0.029	0.033	
0.0717	0.118	0.072	0.621	

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R09

Set No. 3

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Time: 3 hours

Code No: R09220805

Max Marks: 75

[6+9]

[7+8]

[9+6]

[11+4]

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

- 1. (a) What are the various ways to achieve super saturation?
 - (b) What are the variations in crystallizers?
- 2. Write a Brief note on
 - (a) Permeate Flux for Ultra filtration
 - (b) Concentration Polarization.
- 3. (a) Explain briefly classification of electrostatic precipitator?
 - (b) What are the advantages of vibrating screens?
- 4. (a) A material is crushed in a jaw crusher and the average particle size is reduced from 10 cm to 4 cm with a consumption of energy of 4kWh per ton. What will be the consumption of energy per ton to crush the same material from 4 cm to 0.5 cm, assuming Rittinger's law and Kick's law to be valid?
 - (b) State and explain work index.
- (a) How is the mixing index for a mixture of solids estimated? Explain. 5.
 - (b) What is the effect of mixing time on mixing index for granular solids? Discuss briefly
 - (c) Write the equation for the rate of mixing in terms of the mixing index Is and thereby derive the equation to calculate the time required for any desired degree of mixing. [5+5+5]
- 6. Derive the equation for power consumption in Pneumatic conveyors and explain the significance of each term. 15
- 7. (a) Explain the significance of power number, Froude number and Reynold's number.
 - (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° 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]

R09

Set No. 3

8. An ore sample having a specific gravity of 2.1 is to be separated from rock associated with it using a hydraulic classifier. The ore consists of 1mm spherical particles. The rock particles have an average specific gravity of 5.4 and the screen analysis gives the following:

Particle size mm	Mass fraction
+2-5	0.43
+0.5-2	0.47
< 0.5	0.10

Code No: R09220805

The ore rock mixture contains 30% rock particles. Estimate the % purity of the dressed ore. Assume settling to be laminar. [15]
