

End Semester Examinations - 2015-16 Even Semester - May 2016

14BT2022 Unit Operations

Set B

Time : 3 hrs
Total Marks: 100

1. a) Differentiate the Jaw crusher and Gyratory crusher? (4 Marks)
- b) What should be the diameter of a set of rolls to take feed of size equivalent to 38 mm spheres and crush to 12.7 mm? [Assume the co-efficient of friction is 0.35] (6 Marks)
- c) What will be the power required to crush 150 tonnes per hour of material if 80 percent of the feed passes 50 mm screen and 80 percent of the product a 3.125 mm screen and work index of material is 12.74? (3 Marks)
- d) What rotational speed, in revolutions per minute, would you recommend for a ball mill 1.2 m in diameter charged with 75 mm balls? (3 marks)
- e) Calculate the operating speed of the ball mill from the data given below: (4 Marks)
- Diameter of ball mill = 80 cm, diameter of ball = 60 mm, if
- i. Operating speed is 55% less than the critical speed
 - ii. Critical speed is 40% more than operating speed

OR

2. a) A certain crusher employed in ore dressing unit accepts a feed having a volume-surface mean diameter of 2 cm and gives a product of volume-surface mean diameter of 5 mm. The power required to crush 15 tonnes per hour of this feed material is 10 HP. Determine the power consumption if the capacity is reduced to 10 tonnes per hour? (4 Marks)
- b) A material is crushed in a jaw crusher and the average size of the particle reduced from 5 cm to 1 cm, with the consumption of energy 1.32×10^4 J/kg. What will be the consumption of energy to crush the same material of an average size of 7.5 cm to 2.5 cm, assuming (i) Rittinger's Law and (b) Kick's Law (5 Marks)
- c) Write the comparison between crushing and grinding operations? (5 Marks)
- d) Explain the working principle of Hammer mill with neat sketch? (6 Marks)
3. a) Differentiate the Ideal and Actual screen. (4 Marks)
- b) Compare the Grizzlies and Trommels. (4 Marks)
- c) Find the effectiveness 200 mesh screen using cumulative mass fraction method based on the screen data: (12 marks)

Mesh No.	Weight in each screen in grams		
	Feed	Oversize	Undersize
50	1.50	1.13	----
72	3.50	4.20	----
100	18.50	17.40	----
150	20.10	19.80	0.15
200	22.05	21.12	0.25
250	13.15	1.50	14.25
300	4.20	0.50	3.50
400	10.00	----	11.70
Pan	7.00	----	4.50

OR

4. a) A mixture having a certain screen analysis is screened through a standard 10 mesh screen. Calculate the (i) mass ratio of overflow and underflow to feed and (ii) effectiveness of the screen. Data: $D_p = 1.651$ mm, $X_F = 0.47$, $X_D = 0.85$ and $X_B = 0.195$ (6 Marks)

b) A mixture having the following screen analysis is screened through a standard 100 mesh screen. Calculate the effectiveness of the screen and the mass ratios of overflow and underflow to feed. Screen analysis data: (6 Marks)

Mesh	Feed	Oversize	Undersize
35	7.07	13.67	0.00
48	16.60	32.09	0.00
65	14.02	27.12	0.00
100	11.82	20.70	2.32
150	9.07	4.35	14.32
200	7.62	2.07	13.34
-200	33.80	0.00	70.02
	100	100	100

c) Explain in detail about vibratory screen with neat sketch? (8 Marks)

5. a) A six-blade turbine agitator of diameter 60 cm is installed centrally in tank with flat bottom of diameter 180 cm, at a height of 60 cm from the bottom. The tank is filled with a solution of viscosity 10 centipoise and of 1.45 g/ml density. The speed of agitation is 90 rpm. The tank is baffled. Calculate the power required by using power number as 1.05 for $Re > 300$. (7 Marks)

b) The screen analysis shown in the following table applies to a sample. The density of the particles is 2650 kg/m^3 and shape factor is 2 & sphericity is 0.571. Calculate (a) A_W in mm^2/g (b) N_W in particles/g (c) D_S (d) D_V & (e) D_W (13 marks)

Mesh No.	4	6	8	10	14	20	28	35	48	65	100	150	200	Pan
Opening in mm	4.699	3.327	2.362	1.651	1.168	0.833	0.589	0.417	0.295	0.208	0.147	0.104	0.074	-
Mass fraction	0	0.025	0.125	0.321	0.257	0.159	0.054	0.021	0.010	0.008	0.006	0.004	0.003	0.008

OR

6. a) In a mixing operation, 5 kg of starch (A) and 1 kg of additives (B) were taken. The samples were collected at 3 different location for every 2 minutes, analysed & tabulated. Find the mixing index for 10 min of operation & further time required for 95% efficiency? (15 Marks)

Time (min)	Weight of sample 1			Weight of sample 2			Weight of sample 3		
	in grams			in grams			in grams		
	A	B	Total	A	B	Total	A	B	Total
2	9.5	0.5	10.0	9.6	0.5	10.1	9.801	0.401	10.202
4	8.7	1.7	10.4	8.8	1.302	10.102	8.902	1.201	10.103
6	8.5	2.2	10.7	8.301	1.901	10.202	8.5	1.605	10.105
8	8.0	2.7	10.7	7.8	2.202	10.002	8.0	2.101	10.101
10	7.8	3.0	10.8	7.7	3.603	11.303	7.7	3.4	11.1

b) Write about Banbury mixer. (5 Marks)

7. a) Calculate the velocity at which a spherical particle of 0.15 cm in diameter will fall in water. Also, find the Reynolds number and flow type. (6 Marks)

Data: specific gravity of particle = 7.5; specific gravity of water = 1; viscosity of water = 0.82 Cp; Drag coefficient = 0.45

b) An aqueous slurry containing 1.2 wt % of solids (specific gravity = 2) is to be clarified by sedimentation. Feed to the thickener is 3600 m^3 per day and underflow from the unit analyses 8 wt % solids. Specify the diameter of the thickener. A batch sedimentation test on the feed material gave the following information: (14 Marks)

Time (min)	0	5	10	20	40	60	180	240	∞
Height of interface (cm)	31	21	10	3.2	2.2	2.1	2.0	1.96	1.94

OR

8. Explain in detail about techniques to separate the solids from slurry? (20 Marks)
9. a) Derive the expression for constant pressure filtration process? (15 Marks)
- b) A rotary filter, operating at 2 rpm filters 1000 lits/min. operating under the same vacuum and neglecting the resistance of the filter cloth at what speed must the filter be operated to give a filtration rate of 2000 lits/min. (5 Marks)

Wishing you All the Best
