Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

III[rd] SEMESTER B.TECH (CHEMICAL ENGINEERING)

END SEMESTER MAKEUP EXAMINATIONS, DEC 2015/JAN 2016

SUBJECT: MECHANICAL OPERATIONS [CHE 2103]

REVISED CREDIT SYSTEM

Time: 3 Hours Max. Marks: 100

Instructions to Candidates:

- **Answer all the questions.**
- **Each questions carry equal marks(5 X 20 = 100).**
- **Missing data, if any, may be suitably assumed.**
- **Write specific and precise answers, Usual notations shall apply.**

1A.	(i) With a neat sketch explain the construction and working operation of vibrating screen. (ii) Compare and contrast between ideal and actual screen (any 5 points).	**[05]** **[05]**
1B.	(i) Define overall effectiveness of the screen. Derive an expression to determine the effectiveness of the screen with graphical representation. (ii) One ton/hr of bauxite is produced by crushing and screening through 24 mesh screen. A cumulative weight percentage of feed analysis is 54.3% and over size analysis is 76 % retained on the test sieve. Calculate the total feed of the crusher.	**[07]** **[03]**
2A.	(i) Explain the construction and working operation of Ball mill with neat sketch. (ii) Derive an equation to determine the power required for crushing based on crushing efficiency.	**[05]** **[05]**
2B.	The following experimental results were obtained by crushing iron ore (hemaltite) using Jaw crusher. Weight of the feed is 2 kg, average size of feed is 15 mm. Energy meter reading is 3600 rev=1 kw-hr. Under no load condition the disc takes 25 sec per revolution. Crushing duration of the disc is 15 sec per revolution. The total time required for crushing is 75 sec. Calculate the Rittinger's law constant in KJ-m/kg by using cumulative analysis.	**[10]**
3A.	Derive an entire expression to determine the terminal settling velocity (U_t) of spherical particle settling freely in a liquid medium under the influence of gravity in an intermediate region. List out the significance of criterion constant with equation.	**[12]**
3B.	(i) Write the various steps with figure to design the maximum cross sectional area of thickener.	**[03]**

A	10	7.5	5.0	3.7	2.5	1.8	1.2	0.9	0.6
B	503	1114	115	62	49	70	22	15	50

Where A = Screen size opening (mm); B = Mass of particle retained (gm).

	(ii) The data given where obtained from a single batch sedimentation test in a ore slurry. Determine the maximum area of continuous thickener to handle 400 tones of solids/day from a feed concentration of 60 kg solids/m^3 of slurry to give an under flow concentration of 500 kg solids/ m^3 of slurry. C_L (kg/m^3) 60 70.1 95 126 160 240 330 V_L (m/hr) 1.4 1.12 0.75 0.37 0.2 0.035 0.024 Where V_L= settling rate (m/hr); C_L= concentration of solids (kg/m^3)	**[05]**
4A.	(i) Draw a neat sketch and explain the construction and working operation of continuous rotary drum vacuum filter. (ii) Derive an equation to determine the speed of rotary drum vacuum filter for the formation of compressible cake.	**[05]** **[05]**
4B.	(i) Write the significance of cake compressibility factor. List out any 2 names of filter aids. (ii) A suspension of solute is filtered under constant pressure for the recovery of valuable product. A pilot scale filter is used to measure filtration properties. The filter area is 0.25 m^2. The pressure drop across the filter is 360 mm Hg and the filtrate viscosity is 4 cp. At the end of 20 minutes 32 liters of filtrate were collected. The mass of cake solids per unit volume of filtrate was 22 gm/lit. Assume that the filter medium resistance is negligible. (i) Calculate the specific cake resistance. (ii). What size filter is required to process 4000 lit of feed slurry in 30 min at a pressure drop of 360 mm Hg?. The density of mercury is 13.6 g/cc.	**[02]** **[08]**
5A.	Describe in detail about the flow patterns in an agitated vessels with necessary neat sketch.	**[10]**
5B.	(i) Describe in detail about the construction and working operation of 'Tubular bowl centrifuge'. (ii) A fine particles are to be separated from a feed solution. Assume that the particles are spherical with diameter 5 μm and density 1.06 g/cc. viscosity of the feed solution is 1.36 mpa per sec. At the temperature of separation, the density of the suspending fluid is 0.997 g/cc. 500 liters of feed solution must be treated every hour for an suitably sized tubular bowl centrifuge. The small size and low density of fine particles are disadvantages in centrifugation. If instead of fine particles, silica particles of diameter 0.1 mm and specific gravity 2.0 are separated from the liquid, by how much percentage (%) of centrifugation coefficient is reduced?.	**[05]** **[05]**

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