BACHELOR OF CHEMICAL ENGINEERING EXAMINATION, 2018
(2nd Year, 2nd Semester)
MECHANICAL OPERATIONS

Time: Three hours   Full Marks: 100

Use a separate Answer-Script for each part

PART – I

Assume any missing data

All the symbols have usual meaning

Answer all the questions

1. What is crushing efficiency? How power requirement in crusher depends on the crushing efficiency?   **[5]**

2. State the Kick's and Bond crushing laws.   **[5]**

3. A screen analysis of crushed particles is shown below. The density of the particles is 2375 kg/m^3 and the shape factors are $a = 3.5$ and $\Phi_s = 0.84$. For the materials between 4-mesh and 100-mesh in particle size, calculate i) A_w in mm^2/gm and N_w in particles per gm, ii) $\overline{D_v}$, iii) $\overline{D_w}$ and   draw the cumulative plot. **[20]**

Mesh	Screen opening D_{pi}, mm	Mass retained, gm
4	4.699	0.0
10	1.651	22.4
14	1.168	45.2
20	0.833	105.4
28	0.589	100.2
35	0.417	132.2
65	0.208	56.7
100	0.147	42.3
Pan	---	3.5

4. Filtration experiments for a slurry at constant pressure gives the following results. The filter area was 250 cm^2 and the mass of solid per unit volume of filtrate was 25.5 g/L. Evaluate specific cake resistance (α) and filter medium resistance (R_m) for each of the run. Viscosity of water 9.0×10^{-4} Pa.s.   **[20]**

Filtrate volume, L	Run I (105.5 kPa)	Run II (155.4 kPa)
	Time, s	Time, s
0.2	10	4
0.5	30	10
0.8	60	18
1.2	120	30
1.9	240	50
2.2	320	70
3.5	--	120
4	--	150

[Turn over

B.CH.E SECOND YEAR SECOND SEMESTER EXAMINATION 2018

MECHANICAL OPERATIONS

Time: Three hours   Full marks 100

(50 marks for each Part)

Use Separate Answer Script for each Part.

PART II

Answer any five questions

Assume any data missing

1. Define the term net positive suction head (NPSH) of a centrifugal pump.   **2+8= 10**

   Show that head and volume flow rate is linearly proportional in case of centrifugal pump.

2. A pump draws a solution of specific gravity 1.84 from a storage tank of large section   **10**

   through 8 cm id pipe. The velocity in the suction pipe is 1.2 cm/sec. The pump discharges

   through 5 cm id pipe to an overhead tank. The end of the discharge line is 10m above the

   level of solution in the tank. Friction loss in the entire system may be taken as 2m of

   solution.

   (i)What pressure must the pump develop?

   (ii)What is the horsepower required to this pumping? Assume that the pump efficiency is

   65%.

3. What are the factors on which the effectiveness and capacity of screening   **10**

   depends? Derive an expression for the estimation of the size of the biggest particle

   that can be caught and crushed between a pair rolls as a function of roll sizes,

   roughness of the rolls and the distance between them.

4. Show that $\log f_D = \log 24 - \log R_e$ when flow of solids through fluid is laminar.   **10**

5. A certain set of crushing rolls of 40 inches diameter by 15 inches width of face. They are set so that crushing surfaces are 1 inch apart at the nearest point. The manufacturers recommended that they be run at 50 to 100 r.p.m. They are to crush a rock having a sp.gr. of 4.2 and angle of nip of 30^0. What are the permissible of feed and maximum actual capacity in tons per hour, if the actual capacity is 15% of theoretical?   **10**

6. A thickener produces a thickened limestone sludge whose concentration is 550 kg/m^3. The feed of slurry (limestone-water) to the thickener is 12.626 kg/sec. Initial slurry concentration is 236 kg/m^3. For these conditions find the thickener area taking the results of batch settling tests is as follows:-   **10**

t(sec)	Interface height (m)
0	0.36
900	0.324
1800	0.286
3600	0.210
6300	0.147
10800	0.123
17100	0.116
43200	0.098
72000	0.088

7. What do you mean by term "equal Jigging'? Show that $C_0 Z_0 = C_i . Z_i$ using Kynch theory of sedimentation.   **2+8=10**