EX/CHE/T/225/2017

BACHELOR OF CHEMICAL ENGINEERING EXAMINATION, 2017

(2nd Year, 2nd Semester)

MECHANICAL OPERATIONS

Time: Three hours

Full Marks: 100
(50 marks for each part)

Use a separate Answer-script for each part

Part I

Answer any ***ten*** questions 10×5

1. Make a comparative study between Blake type jaw crushers and Dodge type jaw crushers.

2. What are the advantages with the use of ball mill?

3. There are two distinct methods of feeding materials to a crusher — what are they and what are their relative advantages and disadvantages?

4. What are the advantages and disadvantages of Settling chambers (Gravity Settlers)?

5. What are the factors on which depend the collection efficiency of cyclones?

6. What will be the method of bag cleaning (of a bag-filter) when the top of the bag is closed and the bottom is open?

7. What are the major components found in compressed air systems? Justify their needs.

8. Discuss the operating principle of the steam-jet ejector system.

9. Give an example of open pump and discuss where it is used.

10. Draw the theoretical head-flow rate (often called head-capacity) curve of a centrifugal pump and explain it.

11. Make your choice with justification between Flat Bottom Silos and Hopper Silos for industrial storage of bulk solids in quantities.

[Turn over

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Mechanical Operations
Answer any ***two***
Assume any **missing** data
PART: II

1.a. Slurry is filtered in a plate & frame press containing 12 frames, each 0.3 m squre and 25 mm thick. During the first 180 s, the filtration pressure is slowly raised to the final value of 400 kN/m^2 and during this period, the rate of filtration is maintained constant. After the initial period, filtration is carried out at constant pressure and the cakes are completely formed in s further 900 s. the cakes are then washed with a pressure difference of 275 kN/m^2 for 600 s, using *thorough washing*. What is the volume of filtrate collected per cycle and how much wash water is used?

A sample of the slurry was tested, using a vacuum leaf filter of 0.05 m^2 filtering surface and a vacuum giving a pressure difference of 71.3 kN/m^2. The volume of filtrate collected in first 300 s was 250 cm^3 and after a further 300 s, an additional 150 cm^3 was collected. It may be assumed that the cake is incompressible and cloth resistance is the same in the leaf as in the filter press.

b. What is jigging ratio? Lower settling time ensures better stratification of solids in jigging operation. Why?

20+5

2.a. A material is crushed in a Blake jaw crusher such that the average size of the particle is reduced from 50 mm to 10 mm, with the consumption of energy of 13.0 kW/(kg/s). What will be the consumption of energy needed to crush the same material of average size 75 mm to average size of 25 mm:
i) assuming Rittinger's law applies;
ii) assuming Kick's law applies?
Which of these results would be regarded as being more reliable and why?

b. Discuss the effect of transport solid flux and settling solid flux in designing the area of a continuous thickener.

c. What are the basic differences between axial flow and radial flow impellers? What are the means generally adapted to maintain proper flow pattern in an agitated vessel?

d. Compare the screening effectiveness of vibratory grizzlies and trommels.

(8+2)+6+(3+3)+3

3.a. A mixture of an ore (sp. Gravity =2.0) and the gangue (sp. Gravity = 7.0) has to be separated in a hydraulic free settling elutritor. If the mixture has the following size distribution (valid for both ore & gangue) and a relation $\left(C_D = \frac{18.5}{N_{Rep}^{0.6}}\right)$ is valid for the flow zone under consideration,

estimate the upward velocity of hydraulic water to be used in the elutriator so that the entire ore is collected in the overflow. Will the overflow be gangue-free?

Particle size (mm)	Mass fraction
-0.58+0.49	0.62
-0.49+0.40	0.21
-0.40+0.36	0.17

b. Name two classifiers with justification which are used industrially for preparation of dry fractions of solids from its mixture.

c. Discuss the factors on which "cut size" of particles in a cyclone separator depends.

d. (-200) mesh particles are not responsive in gravity separation process. Discuss one suitable method of separation of them.

e. In practice, balance between capacity and effectiveness of a industrial screen should be maintained. Discuss.

10+4+4+5+2