

BACHELOR OF CHEMICAL ENGINEERING EXAMINATION, 2017(OLD)

(3rd Year, 1st 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 five questions

5×10

With the help of a neat sketch discuss how:

1. Fabric Filters (Bag filters) operate.
2. Liquid Ring compressors operate.
3. Gyratory crushers operate.
4. Forced-Circulation Crystallizers operate.
5. Steam-jet ejector systems operate.
6. Ball mills operate.

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Mechanical Operations

Use Separate answer script for each part

Part: II

Full Marks: 50

Answer any two

Assume any missing data

1.

- Describe sphericity with reference to cylindrical and cubical solid particles.
- What do you mean by screen effectiveness and screen capacity? Discuss the factors on which screen effectiveness depends?
- Show that for an unbaffled mixing tank, power number (N_{PO}) is function of vessel Reynolds Number (N_{Re}) and Froude Number (N_{Fr}).
- Differentiate 'angle of nip' and 'angle of bite' with schematic diagram of a roll crusher.

5+5+12+3

2.

- A rotary drum filter of area 3 m^2 operates with an internal pressure of 30 KN/m^2 and 30% of its surface submerged in the slurry. Calculate the rate of production of filtrate when it rotates at 0.0083 Hz if filter cake is incompressible and filter cloth has a resistance equal to that of 1 mm of cake. It is desired to increase of rate of filtration by raising the speed of rotation of the drum. If the thinnest cake that can be removed from the drum has a thickness of 5 mm , what is the maximum rate of filtration which can be achieved and what speed of rotation of the drum is required?

Voidage of cake: 0.4,

specific resistance of cake: $2 \times 10^{12} / \text{m}^2$

Density of solids: 2000 Kg/m^3 ;

Density of filtrate: 1000 Kg/m^3 ;

Slurry concentration: 20% by mass.

- 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?
- Derive and explain how the particle cut size of a cyclone separator is related with dimension of gas inlet and outlet pipe? How the pressure drop penalty is optimized?

10+4+ (7+4)

3.

- What are the significant factors on which the performance of a froth floatation cell depends?
- What are the basic differences between differential and cumulative screen analysis used for determination of average particle size of a solid mixture?
- Why closed circuit grinding is more favorable than open circuit grinding?

- d) The reaction is to be carried out in an agitated vessel. Pilot plant experiments were performed under fully turbulent condition in a tank 0.6 m diameter, fitted with baffles and provided with a flat bladed turbine. It was found that satisfactory mixing was obtained at a rotor speed of 4 rps, when the power consumption was 0.15 kw and Reynolds number 1, 60,000. What will be the power consumption and Reynolds number when same mixing performance prevails (i.e. constant impeller tip speed, constant power/unit volume) but if the linear scale of the equipment is increased 6 times?
- e) State the Bond's law of crushing.

4+4+3+12+2