3rd Semester Regular / Back Examination 2017 - 18
MECHANICAL OPERATIONS
BRANCH : Chemical Engineering
Time : 3 Hours
Max Marks : 100
Q Code :B791
Answer Part-A which is compulsory and any four from Part-B.
The figures in the right-hand margin indicate marks.
Assume suitable notations and any missing data wherever necessary.
Answer all parts of a question at a place.

Part – A (Answer all the questions)

Q1.   **Answer the following questions :**   (2 x 10)

(a) Which of the following is a non-cohesive material?
    i.   Plastic chips
    ii.   Dehydrated peas
    iii.   Dry sand
    iv.   All of the above

(b) The value of work index (kWh/tonne) for hard material is:
    i.   7 – 9
    ii.   9 – 14
    iii.   14 – 20
    iv.   greater than 20

(c) Bond's law is applicable for feed sizes:
    i.   greater than 50 mm
    ii.   less than 50 microns
    iii.   greater than 50 micron and less than 50 mm
    iv.   greater than 50 micron and less than 5 mm

(d) Recovery of ilmenite from beach sands is achieved by:
    i.   Wemco Remer jig
    ii.   shaking table
    iii.   spiral concentrator
    iv.   rake classifier

(e) Spiral concentrators are used for the concentration of:
    i.   high grade ore
    ii.   low grade ore
    iii.   all grades of ore
    iv.   none of the above

(f) For handling toxic and flammable liquid (filtrate), the recommended filter is:
    i.   leaf filter
    ii.   disc filter
    iii.   drum filter

      iv.   filter press

(g) The size of dust particles that can be effectively handled in cyclones varies from:
- i. 5 to 10 microns
- ii. 10 to 50 microns
- iii. 50 to 100 microns
- iv. 100 to 200 microns

(h) Which of the following conveyors can be used for the transportation of boiler ash?
- i. Belt conveyor
- ii. Screw conveyor
- iii. Bucket elevator
- iv. Apron conveyor

(i) The speed of propellers in mixing vessels for liquids vary from:
- i. 100–1000 rpm
- ii. 200–1200 rpm
- iii. 400–1750 rpm
- iv. 500–2250 rpm

(j) Size-enlargement operation is practiced to produce a product of:
- i. definite shape and size
- ii. increased bulk density
- iii. enhanced appearance
- iv. all of the above

Q2   **Answer the following questions :**   **(2 x 10)**

(a) Is sphericity independent of particle size? Justify your answer with proper explanation.

(b) How do the solid particles break into smaller fragments? Give your answer from energy point of view.

(c) Distinguish between autogenous and semi-autogenous grinding mills.

(d) What is the importance of stratification in screening?

(e) Differentiate between a forward and a reverse hydrocyclone.

(f) What is the role of electrolyte in sedimentation?

(g) What are the factors affecting the collection efficiency of electrostatic precipitators?

(h) Name a few materials for which pipe transport is used.

(i) What is the mechanism of mixing in V-blenders?

(j) Name the forces responsible for coagulation.

Part – B (Answer any four questions)

Q3 **(a)** Discuss various average particle sizes used to represent the particle size of a mixture.   **(5)**

(b) Calculate the range of the values for internal friction for which a material is flowable.   **(5)**

(c) Briefly explain the problems associated with the flow of bulk-solids.   **(5)**

Q4 **(a)** Differentiate between single- and double-toggle jaw crushers.   **(5)**

(b) A set of crushing rolls to crush a material of specific gravity of 2.8 from a **(10)** maximum feed size of 7 cm to a product size of 1 cm. The rolls with a width of 60 cm run at 100 rpm and have a clearance of 1.2 cm between them. If the angle of nip is 32°, find the diameter of the rolls and the actual capacity, if the actual capacity is 10 % of the theoretical one.

Q5 (a) Discuss in detail the theory of vibrational separation with appropriate figures. **(7)**

(b) Discuss the construction and operation of the following equipments with their neat figures.

    i.   Triboelectrostatic separator **(4)**

    ii.   Rake classifier **(4)**

Q6 (a) Discuss the construction and operation of a shaking table with a neat diagram giving emphasis on stratification of materialsbetween riffles. **(6)**

(b) Discuss the role of various floatation reagents used to modify the surface properties of the solid particles. **(5)**

(c) Derive the equation for settling ratio in the Stokes' law region. **(4)**

Q7 (a) For continuous filtration derive the equation for amount of dry cake produced per minute (W_C). **(10)**

(b) Discuss the construction and operation of a rotary drum filter with a neat diagram. **(5)**

Q8 (a) Discuss the construction and working of a venturi scrubber. **(5)**

(b) Discuss the construction, working, advantages, and disadvantages of a screw conveyor. **(6)**

(c) Discuss the construction and working of a bucket elevator with a neat diagram. **(4)**

Q9 (a) A solution with a density of 1600 kg/m^3 and a viscosity of 35 mNs/m^2 is to be agitated by a propeller mixer of 0.5 m diameter in a baffled tank of 2.5 m diameter where the liquid depth is 2.5 m. The propeller is situated 0.6 m above the bottom of the tank. For a rotational speed of 2 revolutions per second, what will be the power consumption by the motor to drive the propeller? **(5)**
Note: Power number remains almost constant at a value of 6.0 for Reynolds number above 10,000.

(b) Briefly discuss the two major steps of crystallization process. **(5)**

(c) Discuss the objectives and applications of sizeenlargement operations. **(5)**