

Roll No.....

CHE405: MECHANICAL OPERATION

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark)

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- i. The main differentiation factor between tube mill and ball mill is the
(a) length to diameter ratio. (b) size of the grinding media.
(c) final product size. (d) operating speed.
- ii. In case of a plate and frame filter press, filtrate flow through the cake follows _____ flow.
(a) plug (b) turbulent (c) laminar (d) none of these
- iii. Rittinger's number designates the new surface created per unit mechanical energy absorbed by the material being crushed. Larger value of Rittinger's number of a material indicates its
(a) easier grindability, (b) poor grindability,
(c) high power consumption in grinding (d) none of these
- iv. General crushing equation is given by $d\left(\frac{P}{m}\right) = -K \frac{d\bar{D}_s}{\bar{D}_s^n}$. Bond's crushing law is obtained by solving this equation for $n =$ _____ and feed of infinite size.
(a) 1 (b) 1.5 (c) 2 (d) 2.5
- v. Screen capacity is proportional to (where, S = screen aperture)
(a) S , (b) $1/S$, (c) S^2 (d) S
- vi. The most common filter aid is
(a) diatomaceous earth, (b) calcium silicate
(c) sodium carbonate, (d) silica gel
- vii. Which of the following gives the crushing energy required to create new surface?
(a) Taggart's rule, (b) Fick's law, (c) Rittinger's law, (d) none of these
- viii. Energy requirement (per unit mass of material crushed) is highest for
(a) Jaw crusher (b) Rod mill (c) Ball mill (d) Fluid energy mill
- ix. With increase in the capacity of screens, the screen effectiveness
(a) remains unchanged (b) increases (c) decreases (d) decreases exponentially



- x. Equivalent diameter of a particle is the diameter of the sphere having the same
 (a) ratio of surface to volume as the actual volume.
 (b) ratio of volume to surface as the particle.
 (c) volume as the particle.
 (d) none of these.

Q.2 Short answer type questions (4 questions @ 2.5 marks)

10

- What is the Separation factor in a Cyclone separator?
- What is compressible and incompressible cake?
- What is the function of filter aids?
- Define an ideal screen.

Q.3A Explain the open circuit and close circuit grinding operation. 05

Q.3B Write a note on the principle and operation of an electrostatic and magnetic separation. 05

Q.4A Define Rittingers law and Work Index. 05

Q.4B Calculate the sphericity of a cube of width 1 cm. 05

Q.5A Derive an expression for rate of filtration at constant pressure. 05

Q.5B What is a ball mill? Derive an equation for the critical speed of a ball mill. 05

Q.6A Define average size, volume-surface mean diameter and specific surface area. 05

Q.6B Calculate the mean size and specific surface area of the cement sample from the size distribution data given below. The particle density of cement sample may be taken as 3260 kg/m³. 05

Data:

Particle size, m	75-53	53-37	37-25	25-20	20-15	15-10	10-5	5-0
Weight fraction	0.05	0.12	0.18	0.23	0.14	0.12	0.10	0.8

OR

Q.6B Derive an expression for effectiveness of a screen 05

Q.7A Write a note on froth floatation and name some flocculation reagents. 05

Q.7B What is fluidization? Discuss the conditions for fluidization. 05

OR

Q.7B Explain differential and cumulative method of particle size analysis. 05

Q.8A Explain filtration principles and explain the working of any filtration process. 10

Q.9A With the help of a neat sketch explain the construction and working of a roller crusher and write the important equations for roll crusher. 10

Q.9B A pair of rolls is to take a feed equivalent to sphere 30mm in diameter and crush them to sphere having a diameter of 12.7mm. If the coefficient of friction is 0.29, what should be the diameter of the rolls? 10

OR

Q.9B A fluidized bed (0.5m diameter, 0.5m height) of spherical particles (diameter = 2000 μ m, specific gravity = 2.5) uses water as the medium. The porosity of the bed is 0.4. The Ergun equation for the system is 10

$$\frac{\Delta P}{L} = 3 \times 10^5 \bar{V}_{om} + 1 \times 10^7 \times \bar{V}_{om}^2$$

Calculate the pressure drop and velocity at minimum fluidization condition.

