

INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

Mid Semester Examination: 2022

Date of Examination: .09.2022 Session: Duration: 2 hours Full Marks: 30
 2nd Year B.Tech.(Hons.)/Integrated M.Tech.
 Subject: Mechanical Operations Subject No. – CH21205
 Department: Chemical Engineering. Specific Charts, Graph paper, Etc. **not** required

Instructions: 1. Attempt ALL questions. 2. Assume, if necessary, clearly stating them. No queries will be entertained during the examination. 3. Write the answers of each question in one place. 4) Credit will be given for stepwise calculations and neatness.

Part A

1. A screen efficiency is defined as follows

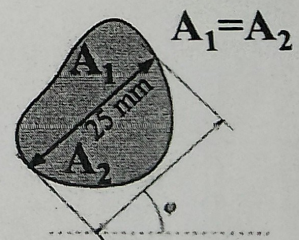
$$\eta = \frac{\left(\frac{\text{tonnes}}{\text{hr}} \text{ of feed} \right) - \left(\frac{\text{tonnes}}{\text{hr}} \text{ of material size} < \text{size of desired material in overflow} \right) - \left(\frac{\text{tonnes}}{\text{hr}} \text{ of material size} > \text{size of desired material in underflow} \right)}{\left(\frac{\text{tonnes}}{\text{hr}} \text{ of feed} \right)}$$

Find the efficiency of the screen, following the above definition, as a function of a , b , and c , where a , b and c are the cumulative weight fraction of the desired material in the feed, overflow, and underflow respectively. 2

2. Find the sphericity of the Earth with a surface area of about 197 million ($\times 10^6$) square miles and volume of about 255 billion ($\times 10^9$) cubic miles. 2

3. (a) Find the martin's diameter of the catalyst particle presented in the figure.
 (b) Find the equivalent diameter of the same particle.

[1+1=2]



4. (a) Derive the expression of the effectiveness of a screen as a function of the cumulative mass fraction of the desired material (particle of the desired size) in the feed, product, and reject stream.
 (b) Analyses of the (international standard, ISO 1944) different streams obtained from the vibrating screen is given in the following table

Mesh	Vibrating screen products		
	+20 Wt in kg	–20 +24 Wt in kg	–24 Wt in kg
+20	4.0	-	-
–20 +24	2.75	5.5	0.1
–24	1.25	1.5	7.9

Calculate:

- (a) Recovery of the –20 +24 material
 (b) Percentage removal of +20 and –24 material
 (c) Efficiency of the screen in separating the fraction –20 +24

[3+6=9]