मोतीलाल नेहरू राष्ट्रीय प्रौद्योगिकी संस्थान इलाहाबाद
प्रयागराज – २११००४ (भारत)

Motilal Nehru National Institute of Technology Allahabad
Prayagraj – 211004 (India)

Mid (Odd) Semester Examination 2023-24

Programme Name: B.Tech. **Semester:** III[rd]

Course Code: CHN13105 **Course Name:** Fluid Particle Mechanics & Mechanical Operations

Branch: Chemical Engineering **Student Reg. No.:** 2 0 2 2 2 0 6 8

Duration: 1½ Hour **Max. Marks:** 20

Instructions to the students:

1. *Write neatly. Attempt all questions and be precise in your answers.*
2. *Marks for each question given on right hand side. Draw neat and labelled diagrams wherever necessary.*

		Marks	COs.
		[3×1=3]	
Q.1.	**Differentiate between:**		CO1
	(a) Dynamic and static angle of repose		CO1
	(b) Ideal and actual screening		CO2
	(c) Volume and surface shape factor		
		[3×2=6]	
Q.2.	**Attempt all the questions.**		
	(a) What are the factors depending on the flowability coefficient of bulk solids?		CO2
	(b) Calculate the sphericity of a cuboid with dimensions 1 × 2 × 3. Use as the equivalent diameter of a sphere with the same volume. [Given: $d = (\frac{6Vp}{\pi})^{\frac{1}{3}}$]		CO1
	(c) Explain why cumulative screen analysis are more accurate when compared to differential analysis.		CO1
		[2×3=6]	
Q.3.	**Write a note on the following terms:**		
	(a) Mass flow pattern of solids		CO2
	(b) Specific surface of mixture		CO1
		[1×5=5]	
Q.4.	**Solve the following problem. Take necessary assumptions, if required.**		CO1

The size distribution of a dust as measured by a microscope is given. Convert these data obtain the distribution on a mass basis and calculate the surface mean diameter and specific surface, assuming spherical particles of density of 2650 kg/m^3.

Size range (μm)	0-2	2-4	4-8	8-12	12-16	16-20	20-24
No. of particle in range	200	600	140	40	15	5	2

---------- *Best of Luck* ----------

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End-Semester (Odd) Examination, 2023-24

Programme Name: B.Tech. **Semester:** III[rd]

Course Code: CHN13105 **Course Name:** Fluid Particle Mechanics & Mechanical Operations

Branch: Chemical Engineering **Student Reg. No.:** 2 0 2 2 2 0 6 8

Duration: 2½ Hour (2:30 PM – 5:00 PM) **Max. Marks:** 40

Instructions to the students:

1. *Write neatly. Attempt all questions and be precise in your answers.*
2. *Marks for each question given on right hand side. Draw neat and labelled diagrams wherever necessary.*

		Marks	COs.
Q.1.	**Differentiate between:**	[2×1=2]	
a)	Mass flow pattern and funnel flow pattern		CO2 CO5
b)	Filter media and filter aids		
Q.2.	**Attempt all the questions.**	[4×4=16]	
a)	Describe the principle of operation of a screw conveyor. In what industries are screw conveyors particularly suitable, and why?		CO2
b)	Explain the working principle of an attritor mill used in size reduction processes. How does it effectively reduce the particle size of materials?		CO3
c)	Explain the significance of material flow characteristics in bulk solids weighing. How can flow problems, such as bridging or arching, affect weighing accuracy, and what solutions are available?		CO2
d)	Explain the design and operational principles of a ribbon blender. Discuss its applications, advantages, and limitations in industrial mixing processes.		CO4
Q.3.	**Attempt all the questions.**	[6×2=12]	
a)	Discuss the importance of sedimentation in water treatment processes.		CO5
b)	Explain the basic principle of operation of a vibrating screen.		CO1
c)	Explain the term "filtration rate". What factors can affect the filtration rate?		CO5

d) Describe the methods commonly used to measure or characterize particle size and their respective advantages. CO1

e) Elucidate how the Bond's law differs from Rittinger's law in predicting the energy requirements for size reduction. CO3

f) Define the term "solid mixing" and explain its significance in various industries. CO4

Q.4. Solve the following problem. Take necessary assumptions, if required. **[2×5=10]**

a) A certain crusher takes rock whose average particle diameter is 0.025 m and crushes it to a product whose average particle diameter is 0.018 m, at the rate of 20 tonnes/hour. At this rate, the mill takes 9 HP of power is required to run it empty. 5 CO3

i) What would be the power consumption for same capacity, if average particle diameter in the product is 0.08 m.

ii) How much power would be required under conditions (i) by Kick's law?

b) Find the sphericity of a cylinder of 1 mm diameter and 3 mm length. Calculate the mean diameter for material of the following size distribution: 2 CO1

Weight % of material	*0*	*3*	*8*	*16*	*90*	*97*	*100*
With diameter smaller than dp (μ)	*10*	*20*	*30*	*40*	*80*	*100*	*150*

---------- *Best of Luck* ----------