Name:

Enrolment No:



UNIVERSITY OF PETROLEUM AND ENERGY STUDIES End Semester Examination, Dec 2023

Course: Particle and Fluid Particle Processing Program: B. Tech (Chemical Engineering)

Course Code: CHCE 3030

Semester: 5 Time: 03 hrs.

Max. Marks: 100

Instructions:

- 1. This is a **closed book** examination. Possessing a mobile phone or any form of communicating devices will be considered unfair means.
- 2. In case of any missing data or information, make necessary assumptions with proper reason.
- 3. Make sure you have Appendix-1, and submitted along with your answer script.

SECTION A (4M \times 5Q = 20 M)

S. No.	Questions										Marks	СО
Q 1	Write an expression of a parameter that can be used represent the (i) particle size and (ii) particle shape of an irregular shape objects or particle. $(4 - 5 \text{ lines of accurate answers is enough for Section A})$										2+2	CO1
Q 2	Write the statement and expression of Kick's law of comminution.											CO1
Q 3	Write the force balance equation for a particle settling in a stationary medium or fluid.										2+2	CO1
Q 4	Draw a labeled schematic diagram of a ball mill.									2+2	CO1	
Q 5	Differentiate between a clarifier and a thickener using a table. (minimum 2 points each)										2+2	CO2
			SEC	CTIO	N B	(10M	× 4Q	9 = 40	M)		ı	1
Q 6	A slurry has a concentration of 5% by weight of solids with specific gravity = 2.4, needs to be clarified using continuous sedimentation. The feed to the clarifier is 5000 m ³ /day. The underflow contains 10% solids. Determine the area of the clarifier required. The batch sedimentation data is provided below.									10	CO3 [5] CO4 [5]	
	Time (min)	0	5	17 12	24	5 40	70	250	1.6 Infinity			CO4 [3]
Q 7	A particle of square shape having 2.3 mm \times 2.3 mm face with a thickness of b mm falling in water. Compute the terminal settling velocity (V_t) in m/s. Given data: Density of particle (ρ_p) = 3500 kg/m³, acceleration due to gravity (g) = 9.8 m/s². Here b = (last digit of your roll number + 3) \times 0.01 (in mm)									10	CO3 [5] CO4 [5]	
Q 8	With the help of five (5) examples and applications, elaborate in detail about the various unique properties of nanoparticles or nanotechnology that have played important role in the improvement of modern human civilization.									10	CO2 [5] CO3[5]	

			OR						
	Based on similar poi								
	and hindered settling.								
Q 9	With the help of suita derive an expression to Using appropriate ass	10	CO2						
	for calculating the pre bed of solid particles.	10							
	,			$(20M \times 2Q = 40 N$	*				
Q 10	Powdered coal with a The particle size distributed Determine (i) effective (ii) ratio of quantity of effectiveness of an acceptable of the particle of the par	10+5+5							
	Compute the particle fraction). The screen a graph (Fig. 2) to answ	20							
		Mesh	$D_{ m pi}$, $\mu m m$	Mass retained (g)					
		4	4760	10					
		6	3353	30			CO3 [5] CO4 [5]		
		8	2399	40			CO4 [3]		
		10	2032	60					
		20	842	80					
		25	708	70					
		50	296	40					
		70	211	30					
		140	104	20					
		Pan		10					
Q 11	using a screen of 290 (i) Draw the schem consumption of the base	A ball mill is fed with fresh feed (F) as 30×10^3 kg/h and the product (P) is screene using a screen of 290 μ m aperture size. Oversize are recycled at a rate of 60×10^3 kg/h. Draw the schematic diagram of the whole operation. Calculate the energy consumption of the ball mill for (ii) closed circuit as well as (iii) open circuit grinding. Given data: Work index = b kW hr/ton. The screen analysis data for feed, recycles.							
	(oversize) and desired $b = (last digit of your)$								

Roll number: Name:

Signature of the invigilator:

0.1 1

0.01

0.1

0.2 0.4 0.8

Table 1: Screen analysis data for Feed (F), Recycle (R), and product (P_1) stream in a ball mill.

Mesh size,	Mass fra	action			
in μm	F	F R			
-833 +589	0.804	0.868	0		
-589 +417	0.026	0.036	0.051		
-417 +295	0.019	0.026	0.125		
295 +208	0.021	0.014	0.19		
208 +147	0.017	0.011	0.131		
147 +104	0.113	0.045	0.503		
104	73				
1000					
Drag coefficient					w = 0.125
8 10					ψ = 0.22 ψ = 0.6
,					ψ = 0.806

Fig. 1: Relationship of drag coefficient (C_D) with particle Reynolds number (Re_p) for particle with various values of sphericity (ψ) .

10

100

1000

Single particle Reynolds number, Rep

104

105

Table 2: Screen analysis data for Feed (F), oversize, and undersize in %.

Mesh	% mass feed	% retained overflow	% retained underflow		
-20 +28	61.19	80.4	0		
-28 +35	10.77	10.4	11.95		
-35 +48	10.13	6.5	21.98		
-48 +65	7.46	2.5	23.91		
-65 +100	5.01	0.2	18.77		
-100 +150	5.42	0	23.39		

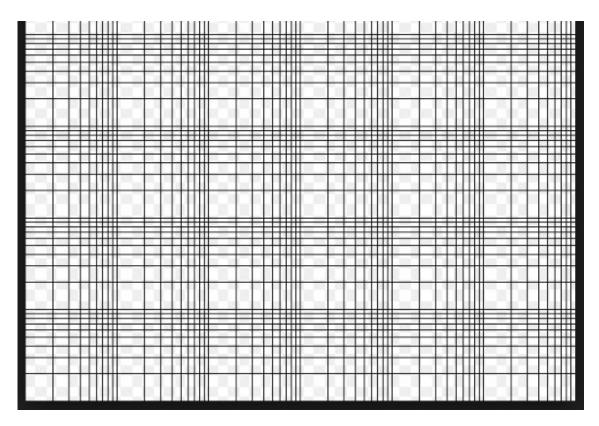


Fig. 2: Empty log-log graph paper