

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 × 5Q = 20 M)

S. No.	Questions	Marks	CO
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 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.	2+2	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

SECTION B (10M × 4Q = 40 M)

Q 6	<p>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 m³/day. The underflow contains 10% solids. Determine the area of the clarifier required. The batch sedimentation data is provided below.</p> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Height of interface (cm)</th> <th>42</th> <th>27</th> <th>17</th> <th>8</th> <th>5</th> <th>3</th> <th>1.8</th> <th>1.6</th> </tr> </thead> <tbody> <tr> <td>Time (min)</td> <td>0</td> <td>5</td> <td>12</td> <td>24</td> <td>40</td> <td>70</td> <td>250</td> <td>Infinity</td> </tr> </tbody> </table>	Height of interface (cm)	42	27	17	8	5	3	1.8	1.6	Time (min)	0	5	12	24	40	70	250	Infinity	10	CO3 [5] CO4 [5]
Height of interface (cm)	42	27	17	8	5	3	1.8	1.6													
Time (min)	0	5	12	24	40	70	250	Infinity													
Q 7	<p>A particle of square shape having 2.3 mm × 2.3 mm face with a thickness of <i>b</i> mm falling in water. Compute the terminal settling velocity (<i>V_t</i>) in m/s. Given data: Density of particle (ρ_p) = 3500 kg/m³, acceleration due to gravity (<i>g</i>) = 9.8 m/s². Here <i>b</i> = (last digit of your roll number + 3) × 0.01 (in mm)</p>	10	CO3 [5] CO4 [5]																		
Q 8	<p>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.</p>	10	CO2 [5] CO3[5]																		

APPENDIX- 1 (Instruction: Submit the Appendix- 1 page along with your answer script.)

Roll number:

Name:

Signature of the invigilator:

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

Mesh size, in μm	Mass fraction							
	F	R	P ₁					
-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					

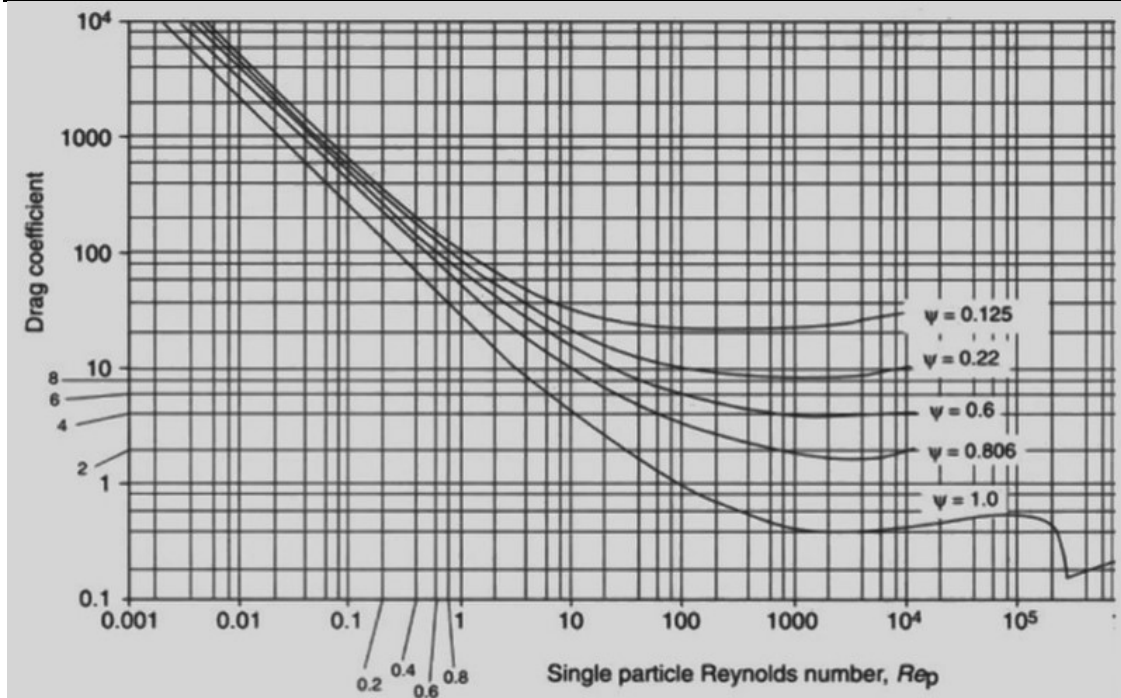


Fig. 1: Relationship of drag coefficient (C_D) with particle Reynolds number (Re_p) for particle with various values of sphericity (ψ).

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				

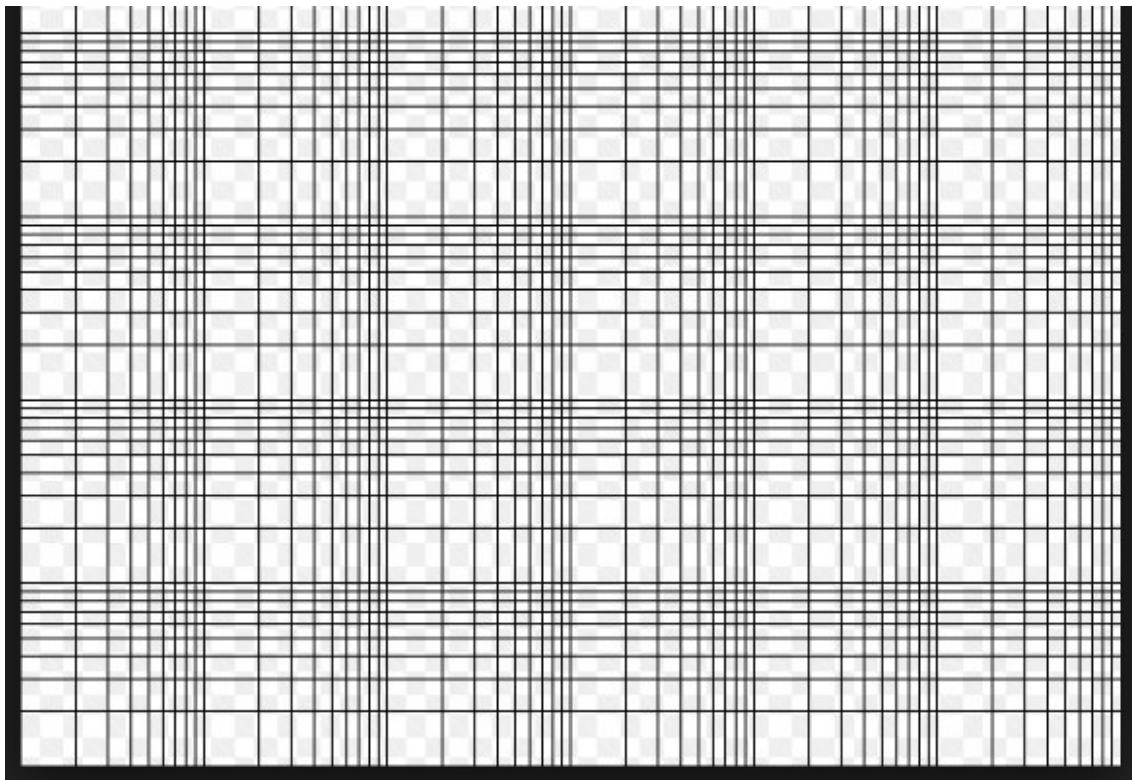


Fig. 2: Empty log-log graph paper