Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: Particulate Technology | **Semester:** 4
Program: B. Tech (Chemical Engineering) | **Time:** 03 hrs.
Course Code: CHCE 2007 | **Max. Marks:** 100

Instructions: Please submit the **APPENDIX- 1** along with the answer script.

SECTION A

S. No.		Marks	CO
Q 1	What is flow separation?	5	**CO1**
Q 2	What is closed circuit crushing?	5	**CO2**
Q 3	**(a)** Define mesh and pitch of screens. **(b)** What does **TSS** stands for, w.r.t. to particle characterization?	4 1	**CO3**
Q 4	What is shear-mixing mechanism?	5	**CO4**
Q 5	Give two examples of fluid flow through beds of solids.	5	**CO5**

SECTION B

Q 6	Differentiate between free settling and hindered settling of particles in a fluid.	8	**CO1**
Q 7	Derive the critical rotation speed (N_c) for a ball mill and calculate the critical speed in **revolution/minute**, of a ball mill with an internal diameter of 1200 mm loaded with balls of 70 mm diameter. **OR** Describe the working of any **(one)** comminution equipment for crushing a feed of intermediate size materials, along with a proper-labelled **diagram**.	8 8	**CO2**
Q 8	The screen analysis representing size distribution of particles is shown in **Fig. 1**. Using Gates-Gaudin-Schumann method, compute the particle size distribution of the particles (**for three sizes**) present in the pan.	8	**CO3**
Q 9	What is agglomeration? What are the different stages of agglomeration of particulate matter? **OR** Describe in brief the dense phase pneumatic conveying system with a proper-labelled diagram.	8 8	**CO4**
Q 10	What are nanoparticles? Give three applications of nanoparticle w.r.t. its properties.	8	**CO5**

SECTION C

Q 11	**(i)** Derive the expression of terminal settling velocity (V_t) of a particle falling in a fluid with very low Reynolds number. **(ii)** How does the size of a container (or vessel) affect the terminal settling velocity (V_t) of a particle? Give the expression for terminal settling velocity when the ratio of the size of particle **to** that of the size of container is significant. **OR** A cyclone separator is used to remove sand grains from an airstream at 150 ºC. If the cyclone body is 0.6 m in diameter and the average tangential velocity is 16 m/s, what is the radial near the walls for a particle of 20 µm in size? How much are these values greater than the terminal velocity in gravity settling? **Given data:** You can make use of **Fig. 2** and **3**. While, specific gravity of particles = 2.2.	**10** **10** **20**	**CO1**
Q 12	Derive Ergun equation for flow of liquid through packed bed. Mention all the assumptions wherever necessary.	**20**	**CO5**

APPENDIX- 1

This sheet (containing Fig. 1 - 3) needs to be submitted along with the answer script.	
Roll number:	**SAP ID:**

Fig 1: Particle size distribution results of a screen analysis.

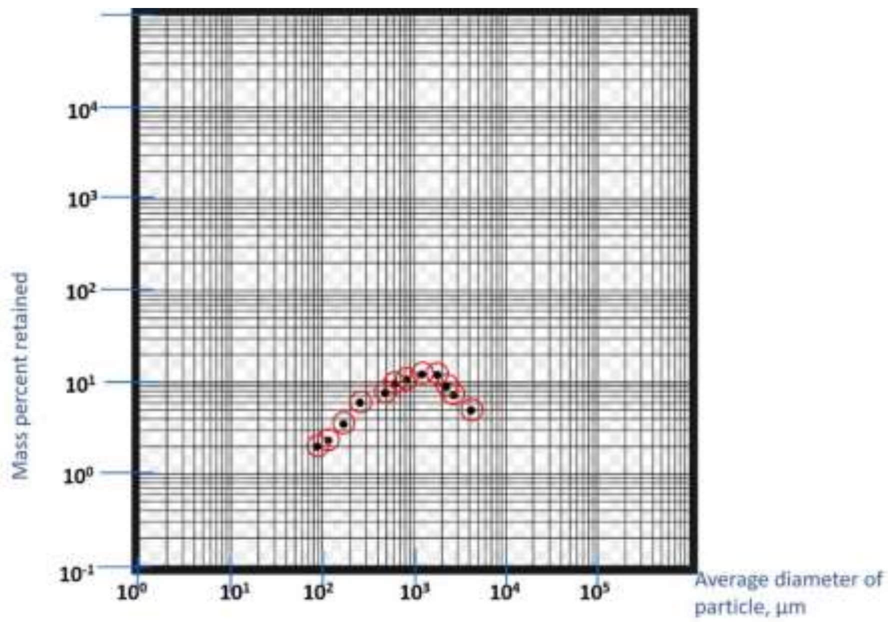
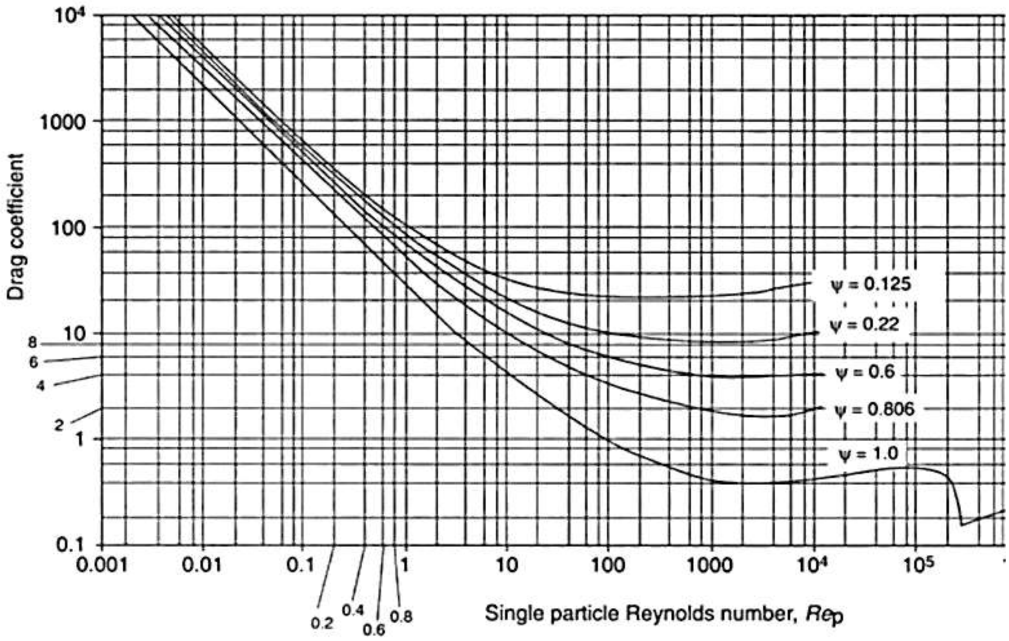


Fig 2: Plot for drag coefficient vs Reynolds number of single particle.



No.	Gas	X	Y
1	Acetic acid	7.7	14.3
2	Acetone	8.9	13.0
3	Acetylene	9.8	14.9
4	Air	11.0	20.0
5	Ammonia	8.4	16.0
6	Argon	10.5	22.4
7	Benzene	8.5	13.2
8	Bromine	8.9	19.2
9	Butene	9.2	13.7
10	Butylene	8.9	13.0
11	Carbon dioxide	9.5	18.7
12	Carbon disulfide	8.0	16.0
13	Carbon monoxide	11.0	20.0
14	Chlorine	9.0	18.4
15	Chloroform	8.9	15.7
16	Cyanogen	9.2	15.2
17	Cyclohexane	9.2	12.0
18	Ethane	9.1	14.5
19	Ethyl acetate	8.5	13.2
20	Ethyl alcohol	9.2	14.2
21	Ethyl chloride	8.5	15.6
22	Ethyl ether	8.9	13.0
23	Ethylene	9.5	15.1
24	Fluorine	7.3	23.8

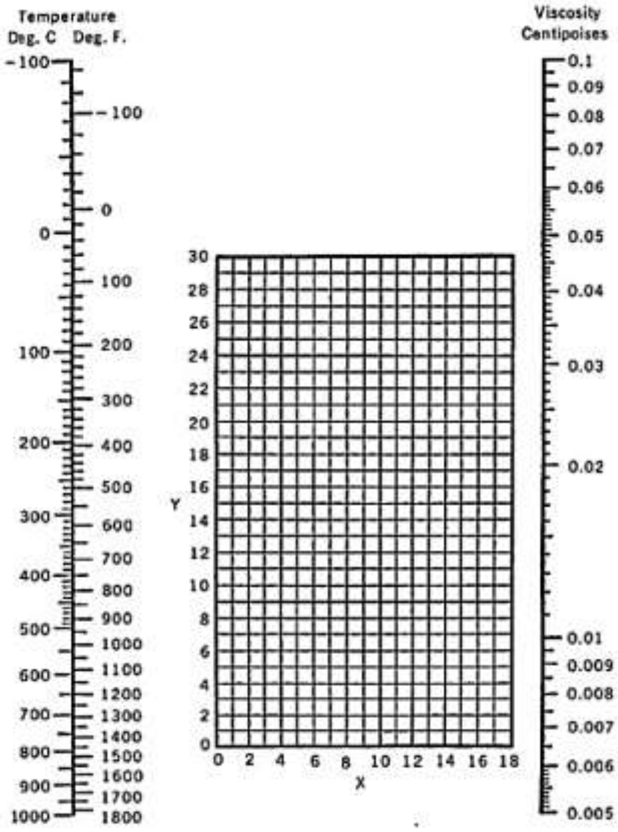


Fig. 3: Viscosity of gases.

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SECTION A

S. No.		Marks	CO
Q 1	What is terminal settling velocity? Give its mathematical expression.	5	**CO1**
Q 2	State Bond's law for size reduction of particulate matter? Give its mathematical expression.	5	**CO2**
Q 3	**(a)** Define aperture and pitch of a screen. **(b)** What does **BSS** stands for, w.r.t. to particle characterization?	4 1	**CO3**
Q 4	Explain convective mixing of solids.	5	**CO4**
Q 5	Illustrate any **two** examples of fluid flow through beds of solids.	5	**CO5**

SECTION B

Q 6	Differentiate between free settling and hindered settling.	**8**	**CO1**
Q 7	Describe in brief the working of a jaw crusher along with a proper-labelled diagram. **OR** Differentiate between a cone crusher and gyratory crusher.	**8** **8**	**CO2**
Q 8	The screen analysis of a sample of 100 g of crushed quartz is shown in **Table 1**. The density of the particles is 2,650 kg/m^3 and the shape factors are $\boldsymbol{a}$ = 2 and sphericity, ϕ_s = 0.571. For material between 5-mesh and 10-mesh in particle size, calculate the fraction of particles retained on 6/8 mesh.	8	**CO3**
Q 9	Explain the various stages of agglomeration of a particulate matter. **OR** Describe in brief the dilute phase pneumatic conveying system with a proper-labelled diagram.	**8** **8**	**CO4**
Q 10	Describe any **four** applications of a nanoparticle (or nanomaterials) in various field of science and technology.	**8**	**CO5**

SECTION-C

Q 11	**(i)** A particle of 50 µm in size is falling in a stationary fluid under the effect of gravity. Derive the expression of terminal settling velocity (V_t) of the particle. Also, include all necessary assumptions wherever needed.	**10**	**CO1**

	(ii) Describe the influence of the size of container (or vessel) on the terminal settling velocity (V_t) of a particle. Also, mention the expression for terminal settling velocity when the ratio of size of particle to that of container is significant.	**10**	
Q 12	A partial oxidation is carried out by passing air with 1.2 mole percent of propane through 40 mm tubes packed with 2 m of 3 mm by 3 mm cylindrical pellets. The air enters at 350 ºC and 2.0 atm with a superficial velocity of 1 m/s. What is the pressure drop through the packed tubes? **Given data:** Void fraction = 0.4, and viscosity of air at 350 ºC = 3.5×10^{-5} kg $m^{-1}s^{-1}$. **OR** Derive the expression of pressure drop for flow of fluids through packed beds of solids with the help of a proper-labelled diagram. Mention all the assumptions wherever necessary.	**20**	**CO5**

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Table 1: Results of screen analysis of a mixture of particles of various sizes.

Mesh No.	Mesh opening, **mm**	Mass retained, **grams**					
4	4.75	-					
5	3.35	15					
6	2.80	45					
8	2	20					
10	1.80	10					
Pan	-	10					