

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular), Nov.-Dec. 2015

B. Tech in Chemical Engineering, 7th Semester

Roll No.....

COURSE CODE: CHE731

Time: 3 hours

Max. Marks: 100

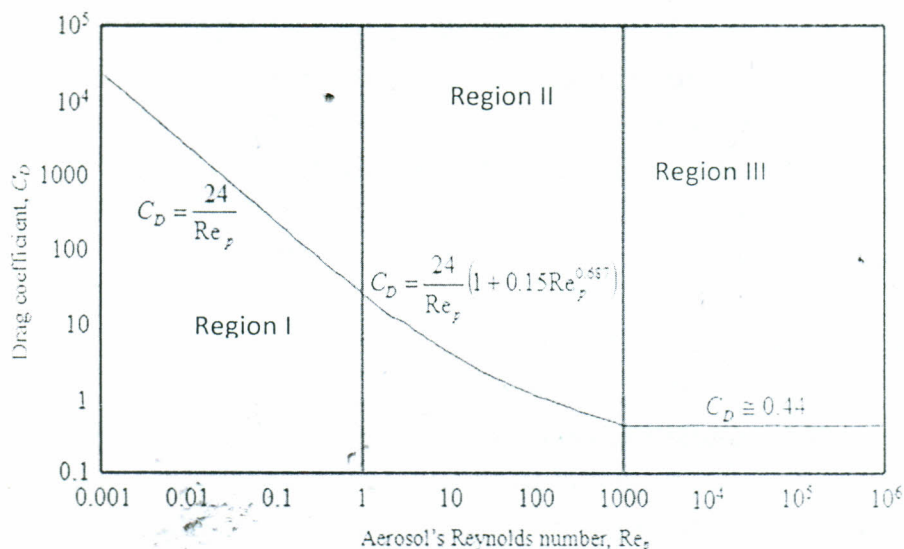
Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark)

10

- i. A flow in which each liquid particle has a definite path and their paths do not cross each other, is called
(a) Steady flow, (b) Uniform flow, (c) Streamline flow, (d) Turbulent flow
- ii. For a particle settling in water at its terminal settling velocity, which of the following is true
(a) buoyancy = weight + drag, (b) buoyancy = weight
(c) buoyancy + drag = buoyancy, (d) drag = buoyancy + weight



Question iii to v related to this Figure

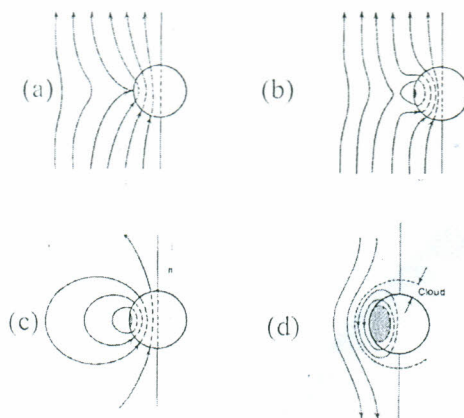
- iii. Region I called as
(a) Stokes law, (b) Newton flow regime, (c) intermediate regime, (d) Idea flow
- iv. Region II called as
(a) Stokes law, (b) Newton flow regime, (c) intermediate regime, (d) Idea flow
- v. Region II called as
(a) Stokes law, (b) Newton flow regime, (c) intermediate regime, (d) Idea flow

- vi. U_{mf} is the minimum fluidization velocity for a bed of particles. An increase in the superficial gas velocity from, $2U_{mf}$ to $2.5U_{mf}$ results in (all velocities are smaller than the entrainment velocity of the particles) no change in
- drag on particles,
 - drag on column walls
 - the bed height,
 - the bed voidage
- vii. The cumulative mass fraction of particles smaller than size d_j for a collection of N_i particles of diameter d_i and mass m_i ($i = 1, 2, 3, \dots, \infty$) is given by
- $$(a) \frac{\sum_{i=1}^j N_i d_i^3}{\sum_{i=1}^{\infty} N_i d_i^3} \quad (b) \frac{\sum_{i=1}^j N_i m_i d_i^3}{\sum_{i=1}^{\infty} N_i m_i d_i^3} \quad (c) \frac{\sum_{i=1}^j N_i m_i d_i^2}{\sum_{i=1}^{\infty} N_i m_i d_i^2} \quad (d) \frac{\sum_{i=1}^j N_i m_i d_i}{\sum_{i=1}^{\infty} N_i m_i d_i}$$
- viii. A particle Reynolds number defined by
- $$(a) Re_p = \frac{\rho_f u d_p}{\mu}, (b) Re_p = \frac{\rho_p u d_p}{\mu}, (c) Re_p = \frac{\rho_f u^2 d_p}{\mu}, (d) Re_p = \frac{\rho_d u^2 d_p}{\mu}$$
- ix. The terminal velocity of a small sphere settling in a viscous fluid varies as the
- first power of its diameter.
 - inverse of the fluid viscosity.
 - inverse square of the diameter.
 - square of the difference in specific weights of solid & fluid.
- x. A particle A of diameter 10 microns settles in an oil of specific gravity 0.9 and viscosity 10 poise under Stoke's law. A particle B with diameter 20 microns settling in the same oil will have a settling velocity
- same as that of A.
 - one fourth as that of A.
 - twice as that of A.
 - four times as that of A.

Q.2 Short answer type questions (4 questions @ 2.5 marks)

10

- What is fluidization? Why is it important for chemical engineering student?
- Write down the short notes on bubble flow rate and two film theory.
- Write down the definitions of sphericity and porosity.
- Identify the correct figure for slow bubble motion



- Q.3A Different types of fluidized beds based on fluid velocity or flowrate. 05
- Q.3B Described any one of the applications of fluidization technique in chemical process industries with help of Figure. 05
- Q.4A Advantages and disadvantages of Fluidized beds for industrial operations. 05
- Q.4B In the fluidization, different definition of average particles diameters have been used to characterized an assemblage of particles. So write down the some definition 05
- (a) Arithmetic mean diameter (b) Surface mean diameter
- Q.5A Explain the pressure distribution near the bubble with help of diagram and formula. 05
- Q.5B Derive the Kozney-Carman equation for packed bed. 05
- Q.6A Explain the bubble formation above the distributor at low and high gas flow rate. 05
- Q.6B Two identically sized spherical particles A and B having densities ρ_A and ρ_B respectively, are setting in a fluid of density ρ . Assuming free setting under turbulent flow conditions, calculate the ration of the terminal velocity of particle A to that of the particle B. 05
- OR
- Q.6B Write down the slugging criteria and assumption based on criteria. 05
- Q.7A Discuss the effects of Temperature and Pressure on Fluidized Bed. 05
- Q.7B Write the short notes on Davidson Bubble. 05
- OR
- Q.7B A bed of spherical glass beds (density = 3000kg/m^3 , diameter 1mm, bed porosity = 0.5) is to be fluidized by a liquid of density 1000kg/m^3 and viscosity 0.1Pa.s . Assume that the Reynolds number based on particles diameter is very small compared to one. If $g=10\text{m/s}^2$ than calculate the minimum fluidize velocity to fluidize the bed. 05
- Q.8A Write the mathematical expression of flow through packed bed. From the base model derive the formula to obtain minimum fluidization velocity in case of a Fluidized Bed. 10
- Q.9A Write a short note on Geldart's classification of particles and their important characteristics. Provides suitable examples as well. 10
- Q.9B A fluidized bed (0.5m diameter, 0.5m height) of spherical particles (diameter = $2000\mu\text{m}$, specific gravity = 2.5) uses water as the medium. The porosity of the 10

bed is 0.4. The Ergun equation for the system is

$$\frac{\Delta P}{L} = 3 \times 10^5 \bar{V}_{om} + 1 \times 10^7 \times \bar{V}_{om}^2$$

Calculate the pressure drop and velocity at minimum fluidization condition.

OR

- Q.9B Discuss important assumptions of Kunii Levenspiel model. Explain the model with help of suitable example. 10

