I CHE 241 Particulate Technology

Course Outlines

- **Title:** Particulate Technology
- **Code Number:** CHE 241
- **Semester:** 4th
- **Credit hours:** 3
- **Pre-requisites course requirements/skills:** N.A.
- **Learning Outcomes:**

  Upon successful completion of the course, the students will be able to:

  1. Understand the fundamental concepts of particle characterization, handling and processing of particulate solids.
  2. Describe the operation of various particle processing equipment.
  3. Comprehend the selection criteria for handling of solids.
  4. Solve particulate technology related problems involving simple analytical and sizing calculations.
- **Contents**

  Unit I: Particle Size Analysis

  1.1 Introduction
  1.2 Describing the size of a single particle
  1.3 Description of the populations of particles
  1.4 Conversion between distributions
  1.5 Common methods of displaying size distributions
  1.6 Methods of particle size measurement

  Unit II: Properties, Handling, Mixing and Segregation of Particulate Solids

  2.1 Characterization of solid particles
  2.2 Mixing mechanism
  2.3 Types of solid mixing machines, operational limitations and benefits
  2.4 Energy consumption and mixing indices
  2.5 Segregation
  2.5.1 Causes and consequences of segregation.
  2.5.2 Mechanisms of segregation
  2.6 Reduction of segregation
  2.7 Assessing the mixture

2.7.1 Quality of a mixture
2.7.2 Sampling
2.7.3 Statistics relevant to mixing

2.8 Storage and flow of powders
2.8.1 Flow patterns and stress in a hopper and silo
2.8.2 Flow criterion
2.8.3 Shear cell test
2.8.4 Pneumatic transport

Unit III: Particle Size Reduction

1.1 Particle fracture mechanisms
1.2 Energy requirement and principles of mechanical size reduction
1.3 Types of comminution equipment
1.3.1 Factor affecting size reduction
1.3.2 Stressing mechanisms
1.3.3 Material properties
1.3.4 Carrier medium
1.3.5 Mode of operation
1.3.6 Combination with other operations
1.3.7 Types of milling circuit

Unit IV: Particle Size Enlargement

4.1 Inter-particle forces
4.2 Granulation-agglomeration

Unit V: Flow Past Immersed Bodies

5.1 Motion of particle in fluid
5.2 Forces on a particle moving though a fluid
5.3 Mechanics of particles in a centrifugal field

Unit VI: Solid-Solid Separation, Colloids and Sedimentation

6.1 Types of solid-solid separation equipment
6.2 Physics of precipitation, sedimentation of fine and coarse particles, colloids, solid-water slurries.
6.2.1 Batch settling, continuous settling, worked examples
6.2.2 Homogeneous-Heterogeneous slurries, components of a slurry flow system

6.2.3 Sedimentation, sedimentation rate, suspension rheology, influence of surface forces on suspension flow

- **Teaching-learning Strategies**

  The teaching and learning strategy has been designed on the understanding of concepts and the ability to critically analyze and apply the learned content through lectures, discussion, activities, case studies using computer, multi-media and writing board instructional aids.

  Lectures: 3 hours per week

- **Assignments- Types and Number with calendar**

  A minimum of two assignments to be submitted before the written exam of final term

- **Assessment and Examinations**

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written examination at the mid-point of the semester.
2.	Formative Assessment	25%	It includes: classroom participation, attendance and assignments.
3.	Final Assessment	40%	Written examination at the end of semester.

- **Textbooks and reference readings**

1. Ortega-Rivas E., (2011), “Unit Operations of Particulate Solids- Theory and Practice”, Taylor & Francis.
2. Rhodes M., (2008), “Introduction to Particle Technology”, Wiley & Sons.
3. Harker, J. H., Backhurst, J. R., Richardson, J. F., (2013), “Chemical Engineering”, Vol-II, 5th Edition, Butterworth-Heinemann
4. McCabe, W.L., Smith, J.C., Harriott, P., (2005),”Unit operations of Chemical Engineering”. 7th Edition McGraw Hill
5. Holdich R.G., (2002),” Fundamentals of Particle Technology”, Midland.
6. Maynard E., (2013), “Ten Steps to an Effective Bin Design”, American Institute of Chemical Engineers.
7. Jonathan P.K., Chuan Y.W.,(2016), “Particle Technology and Engineering: An Engineer's Guide to Particles and Powders”, Butterworth-Heinemann, Elsevier