IV CHE244 Fluid and Particle Mechanics - II

Course Outlines

- **Title:** Fluid and Particle Mechanics - II
- **Code Number:** CHE244
- **Semester:** 4th
- **Credit hours:** 3
- **Pre-requisites course requirements/ skills:** PHY115
- **Learning Outcomes:**

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

  1. Describe particles and systems of particles
  2. Understand the flow behaviour of particles
  3. Familiarize with the unit operations in particle separation, solid-liquid separation, fluidization and flow through packed beds.
  4. Solve problems related to the unit operations associated with pharmaceuticals and minerals processing industries

- **Contents**

  Unit I: Liquid Filtration

  1.1 Introduction
  1.2 Relation between thickness of cake and volume of filtrate
  1.3 Flow of liquid through the cloth
  1.4 Flow of filtrate through the cloth and cake combined
  1.5 Compressible filter cakes
  1.6 The filter medium
  1.7 Blocking filtration
  1.8 Effect of particle sedimentation on filtration
  1.9 Delayed cake filtration
  1.10 Crossflow filtration
  1.11 Preliminary treatment of slurries before filtration
  1.12 Washing of the filter cake
  1.13 Pressure filtration equipment
  1.14 Vacuum filtration equipment
  1.15 Membrane filtration

Unit II: Gas Cleaning Equipment

2.1 Gravity separators
2.2 Centrifugal separators
2.3 Inertia or momentum separators
2.4 Fabric filters
2.5 Electrostatic precipitators
2.6 Liquid Washing
2.7 Agglomeration and coalescence
2.8 Odour removal

Unit III: Flow of fluids through granular beds and packed columns

3.1 Introduction
3.2 Darcy's law and permeability
3.3 Specific surface and voidage
3.4 Streamline flow—Carman–Kozeny equation
3.5 Use of Carman–Kozeny equation for measurement of particle surface
3.6 Design of packed columns
3.7 Type of packings and liquid distributors in packed columns
3.8 Fluid flow in packed columns

Unit IV: Fluidization

4.1 Introduction
4.2 Fluidization Regimes
4.3 Geldart's Classic Classification of Powders
4.4 Minimum Fluidization Velocity
4.5 Bubble Flow Rate and the Two-Phase Theory
4.6 The Davidson Model
4.7 Flow Pattern of Fluidization Bubbles
4.8 Bed Expansion
4.9 Particle Transportation
4.10 Solid Circulation
4.11 Dispersion
4.12 Particle Mixing and Segregation

Unit V: Agitation and Mixing

5.1 Introduction
5.2 Design of an agitated vessel
5.3 Flow patterns in agitated vessel
5.4 Propellers and Turbines

5.5 Formation and prevention of vortex

- **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 aides.
  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. Chhabra, R., Basavaraj, M.G. (2019), “Coulson and Richardson's Chemical Engineering: Volume 2a: Particulate Systems and Particle Technology”, 6th Edition, Butterworth-Heinemann.
2. McCabe W.L., Smith J.C., Harriott P. (2005), “Unit Operations of Chemical Engineering” 7th Edition, McGraw Hill
3. Daugherty, R.L., Franzini, J.B., Finnemore, E.John (1989), “Fluid mechanics with engineering applications”, McGraw Hill
4. Holland, F.A., Bragg, R. (1995), “Fluid flow for Chemical Engineers”, 2nd Edition Butterworth-Heinemann

5. White, F. M., Xue, H. (2022), Fluid Mechanics, (9th ed.), McGraw Hill.
6. de Nevers, N. (2004), “Fluid Mechanics for Chemical Engineers”, 3rd Edition McGraw Hill.
7. Pritchard, P.J., Mitchell, J.W. (2016) “Fox and McDonald’s Introduction to Fluid Mechanics”, 9th Edition, Wiley.
8. Som, S K., Biswas, G., Chakraborty, S. (2017) “Introduction to Fluid Mechanics and Fluid Machines”, McGraw Hill.
9. Wilkes, J.O. (2018) “Fluid Mechanics for Chemical Engineers: with Microfluidics, CFD, and COMSOL Multiphysics”, 3rd Edition, Pearson