18 APR 2018 CC/ 28 MAY 2018 UC

DEPARTMENT OF CHEMICAL ENGINEERING
College of Engineering
University of the Philippines Diliman, Quezon City

COURSE SYLLABUS
ChemE 134 Particle Technology

A. Course Catalogue Description

1. **Course Number:** ChemE 134
2. **Course Title:** Particle Technology
3. **Course Description:** Particle characterization; particle dynamics; unit operations involving particulate solids; materials handling; mechanical separations for solid-fluid systems
4. **Prerequisite:** ChemE 130 Process Fluid Systems
5. **Semester Offered:** First Semester
6. **Course Credit:** 3u
7. **Number of Hours:** 3h
8. **Meeting Type:** lecture
9. **Course Goals:** To discuss the application of the principles of momentum transfer in the flow of fluids with solid particles, and in the design of process equipment for solid-fluid separation

B. Rationale

This course focuses on unit operations on particulate solids and solid-fluid systems such as sedimentation and classification, which are important concepts in the study of air and water treatment systems. In this course, the fundamentals of momentum transfer and mechanical energy balance is related to chemical equipment design principles.

C. Course Outline

1. Course Outcomes (CO)

Upon completion of the course, students must be able to:

- **CO 1.** apply material balance calculations to unit operations involving particulate solids and solid-fluid systems;
- **CO 2.** design solid-fluid/gas-liquid separation systems (e.g., classification equipment, sedimentation equipment, filters) and other operations involving particulate solids (fluidized beds, solid-fluid conveying);
- **CO 3.** specify design and operating parameters for mechanical separation process and materials handling and transport equipment; and
- **CO 4.** write a summary report, including the design procedure, for assigned equipment.

Course Outcomes and Relationship to Program Learning Objectives

Course Outcomes	Program Learning Objectives*				
	A	B	C	D	E
Apply material balance calculations to unit operations involving particulate solids and solid-fluid systems					
Design solid-fluid/gas-liquid separation systems (e.g., classification equipment, sedimentation equipment, filters) and other operations involving particulate solids (fluidized beds, solid-fluid conveying)					
Specify design and operating parameters for mechanical separation process and materials handling and transport equipment					
Write a summary report, including the design procedure, for assigned equipment					

* **A** Equip students with strong technical education in chemical engineering necessary to succeed in their chosen careers and to become responsive citizens.

B Develop the students' ability to effectively communicate technical information to any audience.

C Train students to function in multidisciplinary teams, manage projects, and take leadership roles in their respective fields.

D Engage students in research, innovation, and life-long learning to identify opportunities, and address issues and challenges in their respective spheres of influence.

E Instill in students a strong commitment to the ethical practice of their profession; to health, safety, and environment; and to service to society.

2. Course Content

Lecture Topics	No. of Hours
Particle characterization 1. Particle and bulk properties of solids 2. Particle size measurement 3. Particle size analysis 4. Screening	6
Bulk solids processing 1. Size reduction 2. Size enlargement 3. Mixing and segregation 4. Storage and conveying of solids	9
Long Examination 1	
Particle dynamics (Part 1) 1. Review of principles of momentum transfer 2. Single particle in a fluid 3. Multiple-particle systems a. Settling of a suspension b. Batch settling c. Continuous settling 4. Classification and elutriation	15

Lecture Topics	No. of Hours
Long Examination 2	
Particle dynamics (Part 2) 8. Flow through a packed bed 9. Fluidization 10. Pneumatic conveying 11. Slurry transport	4.5
Solid-fluid separations 1. Sedimentation 2. Centrifugation 3. Cyclones and air separators 4. Filtration	13.5
Long Examination 3	
Design Project	
Total number of hours	**48**

3. Course Coverage

Week	CO	TOPIC	ESSENTIAL/ KEY QUESTIONS	Suggested Teaching and Learning Activities	Suggested Assessment Tools
1-2	1	**Particle characterization** 1. Particle and bulk properties of solids 2. Particle size measurement 3. Particle size analysis 4. Screening	What is the significance of particle size and size distribution as a design parameter for solid-fluid systems?	lecture, classwork	problem set/quiz
3-5	2	**Bulk solids processing** 1. Size reduction 2. Size enlargement 3. Mixing and segregation 4. Storage and conveying of solids	What are the different unit operations for processing solids?	lecture, classwork	problem set/quiz
					Long Examination 1
6-10	2	**Particle dynamics (Part 1)** 1. Review of principles of momentum transfer 2. Single particle in a fluid 3. Multiple-particle systems a. Settling of a suspension b. Batch settling c. Continuous settling 4. Classification and elutriation	How can the principles of momentum transfer be applied to the analysis of fluid flow past solids (external flow)?	lecture, classwork	problem set/quiz
					Long Examination 2

Week	CO	TOPIC	ESSENTIAL/ KEY QUESTIONS	Suggested Teaching and Learning Activities	Suggested Assessment Tools
11-12		**Particle dynamics (Part 2)** 1. Flow through a packed bed 2. Fluidization 3. Pneumatic conveying 4. Slurry transport	How can the principles of momentum transfer be applied to the analysis flow through a bed of solids (internal flow)?	lecture, classwork	problem set/quiz
12-16	2,3,4	**Solid-fluid separations** 1. Sedimentation 2. Centrifugation 3. Cyclones and air separators 4. Filtration	How can the principles of momentum transfer be applied to the design of sedimentation tanks? of a centrifuge? of cyclones?	lecture, classwork	problem set/quiz
					Long Examination 3
					Design Project

4. Course Requirements

1. Long examinations (3)
2. Design project
3. Problem sets
4. Quizzes

REFERENCES:

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McCabe, W.L., Smith, J.C. and Harriott, P. Unit Operations of Chemical Engineering 7th Ed., Singapore: McGraw-Hill. 2005.

Ortega-Rivas, E. (2012). *Unit Operations of Particulate Solids*. Boca Raton, FL: CRC Press.

Rhodes, M. (2008). *Introduction to Particle Technology* 2nd Ed. NJ: John Wiley and Sons, Inc.

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Towler, G. and Sinnott, R. (2012). *Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design* 2nd Ed. Oxford, UK: Butterworth-Heinemann.