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 146 Chemical Process Development and Simulation

A. Course Catalogue Description

1. **Course Number:** ChemE 146
2. **Course Title:** Chemical Process Development and Simulation
3. **Course Description:** Application of engineering economics to process flow development and industrial plant design; general chemical process design considerations; simulation and optimization of processes
4. **Prerequisite:** ChemE 145 Chemical Plant and Process Economics
5. **Semester Offered:** First Semester
6. **Course Credit:** 3u
7. **Number of Hours:** 2h lec, 3h lab
8. **Meeting Type:** lecture, laboratory
9. **Course Goals:** To develop, simulate and optimize a chemical process for a proposed plant design using commercially available design software, applying the concepts of process equipment design, engineering economics, and health, safety and environmental design

B. Rationale

The course focuses on computer-aided design and optimization of chemical processes, incorporating engineering decision-making based on principles of technical and economic feasibility. The skills and competencies developed by students in this course are essential to chemical engineering design.

C. Course Outline

1. Course Outcomes (CO)

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

- **CO 1.** translate a market study of a high value product or commodity into a design basis;
- **CO 2.** prepare a database of physico-chemical and other relevant material properties;
- **CO 3.** conduct a survey of related literature on pertinent chemical processes;
- **CO 4.** describe the design process for commodity chemicals and for specialty and chemical products;
- **CO 5.** generate a process flow diagram that abides to industry-accepted standards;
- **CO 6.** integrate health, safety, and environmental considerations in the process design; and
- **CO 7.** prepare a technical and feasibility report considering the results of engineering economic evaluation.

Course Outcomes and Relationship to Program Learning Objectives

Course Outcomes	Program Learning Objectives*				
	A	B	C	D	E
Translate a market study of a high value product or commodity into a design basis		■	■	■	
Prepare a database of physico-chemical and other relevant material properties	■		■		
Conduct a survey of related literature on pertinent chemical processes				■	
Describe the design process for commodity chemicals and for specialty and chemical products		■	■		
Generate a process flow diagram that abides to industry accepted standards	■		■		
Integrate health, safety, and environmental considerations in the process design	■				■
Prepare a technical and feasibility report considering the results of engineering economic evaluation	■	■	■		

* **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

Topics	No. of Hours	
	Lec	Lab
Introduction to the design process: the design basis	2	3
The process flow diagram	2	3
General design considerations	2	3
Introduction to process hazard analysis (PHA)	1	3
Heuristics for process synthesis 1. Input-output structure 2. Reactor structure 3. Separation structure 4. Heat exchanger network 5. Process control	9	12
Long Examination		

Topics	No. of Hours	
	Lec	Lab
Process simulation using suitable software 1. Essentials for smooth transition from steady state to dynamic 2. Dynamic simulation and control of single unit system 3. Dynamic simulation and control of multi-unit systems	16	24
Oral Presentation		
Total number of hours	**32**	**48**

3. Course Coverage

Week	CO	TOPIC	ESSENTIAL/ KEY QUESTIONS	Suggested Teaching and Learning Activities	Suggested Assessment Tools
1	1,2,3	**Introduction to the design process: the design basis**	What is process design? What are the information needed in designing a chemical process?	lecture, classwork	group and individual evaluation
2	3,4,5	**The process flow diagram**	What is a block flow diagram? What is a process flow diagram?	lecture, classwork, laboratory consultations	group and individual evaluation
3	4,5	**General design considerations**	What are the technical and economic considerations that must be factored in the design of a process? What are the inherently safer design options that may be considered?	lecture, classwork, laboratory consultations	group and individual evaluation
4	6	**Introduction to process hazards analysis (PHA)**	What is PHA? How is PHA conducted for a proposed chemical plant process?	lecture, classwork, laboratory consultations	technical study report, group and individual evaluation
4-8	5,6,7	**Heuristics for process synthesis** 1. Input-output structure 2. Reactor structure 3. Separation structure 4. Heat exchanger network 5. Process control	What are heuristics? What are the heuristic information that can be used in designing a chemical process?	lecture, classwork, laboratory consultations	group and individual evaluation
					Long Examination
9-16	6,7	**Process simulation using suitable software** 1. Essentials for smooth transition from steady state to dynamic 2. Dynamic simulation and control of single unit system	What are the different functions of the design software? How can the design software be used to simulate and optimize a designed chemical process?	lecture, machine exercise, laboratory consultations	technical study report, oral presentation, group and individual evaluation

Week	CO	TOPIC	ESSENTIAL/ KEY QUESTIONS	Suggested Teaching and Learning Activities	Suggested Assessment Tools
		3. Dynamic simulation and control of multi-unit systems			
					Oral Presentation

4. Course Requirements

1. Technical study report
2. Oral presentation
3. Group evaluation
4. Individual evaluation
5. Long examination
6. Seatwork

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Park, C. S. (2016). *Contemporary Engineering Economics* 6th Ed. London, UK: Pearson Education Ltd.

Seider, W. D., et al. (2017). *Product and Process Design Principles* 4th Ed. NJ: John Wiley and Sons Inc.

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Towler, G. and Sinnott, R. (2013). *Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design* 2nd Ed. NY: Elsevier.