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 145 Chemical Plant and Process Economics

A. Course Catalogue Description

1. **Course Number:** ChemE 145
2. **Course Title:** Chemical Plant and Process Economics
3. **Course Description:** Engineering economics as applied to chemical process industries; market study and market trends
4. **Prerequisite:** ChemE 128 Chemical Reaction Engineering
   ChemE 132 Separation Processes I and
   ChemE 134 Particle Technology
5. **Semester Offered:** Second Semester
6. **Course Credit:** 2u
7. **Number of Hours:** 2h
8. **Meeting Type:** lecture
9. **Course Goals:** To introduce the fundamental concepts of engineering investments and economics in the context of designing a chemical processing plant

B. Rationale

This course provides a comprehensive coverage of the fundamental principles, skills, and tools of engineering economics in relation to chemical processes, plant operations, and market feasibility studies. These concepts are required in the design and optimization of a chemical process.

C. Course Outline

1. **Course Outcomes (CO)**

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

   CO 1. integrate the basic concepts of engineering economics and their applications to the chemical process industries;

   CO 2. survey market data and technical literature related to any assigned chemical industry.

   CO 3. appraise total capital investment, total product cost, gross and net profit, and cash flow;

   CO 4. discuss the effects of interest, taxes, and other economic parameters that impact profit; and

   CO 5. consider economic evaluation principles and methods in making investment decisions.

Course Outcomes and Relationship to Program Learning Objectives

Course Outcomes	Program Learning Objectives*				
	A	B	C	D	E
Integrate the basic concepts of engineering economics and their applications to the chemical process industries	■		■		
Survey market data and technical literature related to any assigned chemical industry	■		■		
Appraise total capital investment, total product cost, gross and net profit, and cash flow	■		■		
Discuss the effects of interest, taxes, and other economic parameters that impact profit	■	■	■		
Consider economic evaluation principles and methods in making investment decisions	■	■	■		

* **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
Introduction to the economic environment 1. Consumer and producer goods and services 2. Law of supply and demand 3. Basic economic indicators 4. Competition, monopoly and oligopoly 5. Factors affecting investments and production costs 6. The economic design in a plant design process 7. General and financial considerations in making engineering economic decision a. Cost estimation b. Profitability analysis of investments	4
Fundamentals of engineering economy 1. Interest: cost of money a. Time value of money b. Elements of transaction involving interest c. Methods of calculating interest 2. Economic equivalence a. Definition and simple calculations b. Equivalence calculations on a common time basis	8

Lecture Topics	No. of Hours
3. Interest formulas for single cash flows a. Compound amount factor b. Present worth factor (discount factor) c. Solving for time and interest rates 4. Uneven payment series 5. Equal payment series a. Compound amount factor b. Present worth factor c. Sinking-fund factor d. Capital recovery factor (annuity factor) e. Present value of perpetuities	
Long Examination 1	
Estimation of capital and operating costs 1. Accuracy and purpose of capital cost estimates 2. Rapid cost estimates a. Historical cost data b. Step count method 3. Factorial method of cost calculations 4. Estimating purchased equipment cost 5. Cost escalation 6. Factors to consider in the analysis of cost estimation a. Fixed capital investment b. Working capital 7. Variable costs of production 8. Fixed costs of production 9. Revenues and profits 10. Taxes 11. Investment incentives 12. Depreciation charges	8
Profitability and sensitivity analyses 1. Minimum attractive rate of return (MARR) 2. Payback period 3. Present worth analysis 4. Annual worth analysis 5. Internal rate of return (IRR) 6. Sample profitability analysis 7. Depreciation calculations a. Straight line method b. Declining balance method c. Sum of the years digits (SOYD) method d. Modified accelerated cost recovery systems (MACRS) method 8. Income and cash flow statements 9. Sensitivity and breakeven analysis	8
Long Examination 2	
Case study report	4
Total number of hours	**32**

3. Course Coverage

Week	CO	TOPIC	ESSENTIAL/ KEY QUESTIONS	Suggested Teaching and Learning Activities	Suggested Assessment Tools
1-2	1	**Introduction to the economic environment** 1. Consumer and producer goods and services 2. Law of supply and demand 3. Basic economic indicators 4. Competition, monopoly and oligopoly 5. Factors affecting investments and production costs 6. The economic design in a plant design process 7. General and financial considerations in making engineering economic decision a. Cost estimation b. Profitability analysis of investments	What is engineering economy? What are the general and financial considerations in making an economic decision in relation to the design of a chemical plant?	lecture, classwork	quiz
3-6	1	**Fundamentals of engineering economy** 1. Interest: cost of money a. Time value of money b. Elements of transaction involving interest c. Methods of calculating interest 2. Economic equivalence a. Definition and simple calculations b. Equivalence calculations on a common time basis 3. Interest formulas for single cash flows a. Compound amount factor b. Present worth factor (discount factor) c. Solving for time and interest rates	What are the different ways of calculating interest in cash flows?	lecture, classwork	quiz

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Week	CO	TOPIC	ESSENTIAL/ KEY QUESTIONS	Suggested Teaching and Learning Activities	Suggested Assessment Tools
		4. Uneven payment series 5. Equal payment series a. Compound amount factor b. Present worth factor c. Sinking-fund factor d. Capital recovery factor (annuity factor) Present value of perpetuities			
					Long Examination 1
7-10	3	**Estimation of capital and operating costs** 1. Accuracy and purpose of capital cost estimates 2. Rapid cost estimates a. Historical cost data b. Step count method 3. Factorial method of cost calculations 4. Estimating purchased equipment cost 5. Cost escalation 6. Factors to consider in the analysis of cost estimation a. Fixed capital investment b. Working capital 7. Variable costs of production 8. Fixed costs of production 9. Revenues and profits 10. Taxes 11. Investment incentives 12. Depreciation charges	What are the different types of costs associated with the construction and operation of a chemical plant?	lecture, classwork	quiz
11-14	4	**Profitability and sensitivity analyses** 1. Minimum attractive rate of return (MARR) 2. Payback period 3. Present worth analysis 4. Annual worth analysis 5. Internal rate of return (IRR)	How are profitability and sensitivity analyses used in determining the market feasibility of a designed chemical process?	lecture, classwork	quiz

Week	CO	TOPIC	ESSENTIAL/ KEY QUESTIONS	Suggested Teaching and Learning Activities	Suggested Assessment Tools
		6. Sample profitability analysis 7. Depreciation calculations a. Straight line method b. Declining balance method c. Sum of the years digits (SOYD) method d. Modified accelerated cost recovery systems (MACRS) method 8. Income and cash flow statements 9. Sensitivity and breakeven analysis			
					Long Examination 2
15-16	2,5	**Case study report**	What are the current and potential market trends for a designed chemical process?	oral presentation	market study report

4. Course Requirements

1. Long examinations (2)
2. Quizzes
3. Market study report

REFERENCES:

Blank, L. T. and Tarquin, A. (2018). *Engineering Economy* 8th Ed. Boston, NY: McGraw-Hill.

Pagoso, C. M., Dinio, R. P., and Villasis, G. A. (2008). *Principles of Economics*. Manila: Rex Publishing.

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

Peters, M. S., Timmerhaus, K. D., and West, R. E. (2003). *Plant Design and Economics for Chemical Engineers* 5th Ed. NY: McGraw-Hill.

Smith, R. (2016). *Chemical Process Design and Integration* 2nd Ed. London, NJ: John Wiley and Sons Ltd.

Sullivan, W. G., Wicks, E. M., and Koelling, C. P. (2014). *Engineering Economy* 16th Ed. London, UK: Pearson Education Ltd.

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