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

COURSE SYLLABUS
ChemE 130 Process Fluid Systems

A. Course Catalogue Description

1. **Course Number:** ChemE 130
2. **Course Title:** Process Fluid Systems
3. **Course Description:** Fundamentals of momentum transport in fluid systems; mechanical energy balance of flow systems and design of piping systems
4. **Prerequisites:** Math 23 Elementary Analysis III and
   ChemE 106 Mathematical Methods in Chemical Engineering II
5. **Semester Offered:** Second Semester
6. **Course Credit:** 3u
7. **Number of Hours:** 2h lec, 3h lab
8. **Meeting Type:** lecture, laboratory
9. **Course Goals:** To introduce the concept of momentum transfer as the fundamental basis of fluid mechanics, and to apply the principles of momentum and mechanical energy balance in the design of piping systems and fluid motive devices

B. Rationale

This course serves as an introduction to the key concepts of fluid mechanics that are relevant to chemical engineering. The discussions focus on the principles of momentum transport and mechanical energy balance and how chemical engineers apply these concepts to the design of piping networks, agitation tanks, pumps, etc., which are vital components of an industrial chemical process.

C. Course Outline

1. **Course Outcomes (CO)**

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

   CO 1. demonstrate a good understanding of the mechanism and mathematics governing momentum transfer;
   CO 2. solve appropriate mathematical equations arising from the analysis of momentum transfer;
   CO 3. apply momentum transport to the mechanical energy balance of steady-state systems;
   CO 4. select simple agitation equipment and fluid motive devices to meet process objectives; and
   CO 5. design a piping system that provides a solution to a specific engineering problem.

Course Outcomes and Relationship to Program Learning Objectives

Course Outcomes	Program Learning Objectives*				
	A	**B**	**C**	**D**	**E**
Demonstrate a good understanding of the mechanism and mathematics governing momentum transfer					
Solve appropriate mathematical equations arising from the analysis of momentum transfer					
Apply momentum transport to the mechanical energy balance of steady-state systems					
Select simple agitation equipment and fluid motive devices to meet process objectives					
Design a piping system that provides a solution to a specific engineering problem					

* **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	
	Lec	**Lab**
Introduction and review 1. Material balances 2. Dimensional analysis 3. Mathematical methods	2	0
Principles of momentum transfer 1. Molecular momentum transport 2. Types of fluid flow 3. Shell momentum balance 4. Velocity profiles in laminar flow 5. Non-Newtonian fluids 6. Differential equations of continuity and momentum transfer 7. Turbulent momentum transport 8. Interphase momentum transport: Friction factor 9. Dimensional analysis	10	18
Long Examination 1		

Lecture Topics	No. of Hours	
	Lec	Lab
Momentum transport applications 1. Overall momentum balance 2. Pipes and tubings 3. Fittings and valves 4. Mechanical energy balance of flow systems a. Incompressible fluids b. Compressible fluids 5. Fluid metering 6. Agitation and mixing of fluids	10	15
Long Examination 2		
Design of piping systems 1. Pipe sizing 2. Fluid motive devices a. Liquids (pumps) b. Gases (fans, blowers and compressors) 3. Fluid motive device sizing and selection 4. Pipe networks	10	15
Long Examination 3		
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	**Introduction and review** 1. Material balances 2. Dimensional analysis 3. Mathematical methods	How are mass and energy balance calculations performed for fluid flow systems?	lecture, classwork	problem set/quiz
1-6	1,2	**Principles of momentum transfer** 1. Molecular momentum transport 2. Types of fluid flow 3. Shell momentum balance 4. Velocity profiles in laminar flow 5. Non-Newtonian fluids 6. Differential equations of continuity and momentum transfer 7. Turbulent momentum transport 8. Interphase momentum transport: Friction factor 9. Dimensional analysis	What is Newton's law of viscosity? What are the different fluid flow regimes? How is momentum transferred from a flowing fluid to a solid surface?	lecture, classwork	problem set/quiz
					Long Examination 1

Week	CO	TOPIC	ESSENTIAL/ KEY QUESTIONS	Suggested Teaching and Learning Activities	Suggested Assessment Tools
7-11	3	**Momentum transport applications** 1. Overall momentum balance 2. Pipes and tubings 3. Fittings and valves 4. Mechanical energy balance of flow systems a. Incompressible fluids b. Compressible fluids 5. Fluid metering 6. Agitation and mixing of fluids	How are the principles of momentum transport applied to the analysis of fluid flow systems?	lecture, classwork	problem set/quiz
					Long Examination 2
12-16	4,5	**Design of piping systems** 1. Pipe sizing 2. Fluid motive devices a. Liquids (pumps) b. Gases (fans, blowers and compressors) 3. Fluid motive device sizing and selection 4. Pipe networks	What are the criteria for designing piping systems, taken into account safety and economic considerations?	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:

Agutaya, J. K. C. N. (2015). Transient isothermal gas flows in a pipeline using semi-discrete finite difference method and finite volume method (Master's thesis). University of the Philippines Diliman.

Bird, R. B., Stewart, W. E., Lightfoot, E. N., and Klingenberg. D. J. (2014). *Introductory Transport Phenomena*. NJ: John Wiley and Sons Inc.

Geankoplis, C. J., Hersel, A. H., and Lepek, D. H. (2018). *Transport Processes and Separation Process Principles* 5th Ed. London, UK: Pearson Higher Education.

Mott, R. (2016). *Applied Fluid Mechanics* 7th Ed. London, UK: Pearson Education, Ltd.