SEE4122: CHEMICAL SEPARATIONS FOR ENERGY AND ENVIRONMENTAL APPLICATIONS

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Chemical Separations for Energy and Environmental Applications

Subject Code
SEE - School of Energy and Environment
Course Number
4122

Academic Unit
School of Energy and Environment (E2)

College/School
School of Energy and Environment (E2)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
SEE2101 Engineering Thermofluids I; and
SEE3101 Engineering Thermofluids II

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to educate students on the fundamental principles of chemical separation technologies essential to energy and environment-related applications that enable to achieve sustainable development. The course will include both equilibrium-controlled separation processes and separation processes that involve both mass transport and equilibrium considerations. The students will learn the basic concepts in molecular separation (especially for mixtures of gases and vapours) and how separation processes work as well as develop ability to use the basic knowledge learned to provide solutions to timely important separation problems in the field of energy and environment.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the importance of chemical separation and its relevance to enabling key energy and environmental applications for building a sustainable society	20	x		
2	Describe the concepts and principles of chemical separation processes with both equilibrium and non-equilibrium considerations.	40		x	
3	Apply the concepts and principles of chemical separation technologies to provide solutions to key energy and environment-related applications	40		x	

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Students will engage in lectures with facilitated discussion to understand fundamentals, key concepts, working principles, and important energy-environment applications of chemical separation technologies.	1, 2, 3	

2	Tutorials	Students will work with the advisor teaching assistant to solidify their understanding of key concepts and principles via practice and tacking confusions or difficulties encountered in the lectures and exercises.	1, 2, 3	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignments Several assignments will be given throughout the semester. Through the assignments, students will demonstrate their understanding of the underlying concepts and principles of chemical separation processes.	1, 2, 3	25	
2	In-class presentation A Separation News presentation will be given by the students to relate the concepts in class to real-world applications of separations.	1, 2, 3	5	
3	Test Students will complete a mid-term test to demonstrate their ability to apply their knowledge to analyze and solve problems related to chemical separation processes.	1, 2, 3	20	

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Additional Information for ATs

Examination duration: 2 hrs
Percentage of continuous assessment, examination, etc.: 50% by continuous assessment; 50% by exam

To pass a course, a student must do ALL of the following:

1) obtain at least 30% of the total marks allocated towards continuous assessment (combination of assignments, pop quizzes, term paper, lab reports and/ or quiz, if applicable);
2) obtain at least 30% of the total marks allocated towards final examination (if applicable); and
3) meet the criteria listed in the section on Assessment Rubrics.

Assessment Rubrics (AR)

Assessment Task

1. Assignments

Criterion

Ability to explain concepts, analyze and solve problems related to chemical separation processes

Excellent (A+, A, A-)

Excellent understanding of concepts and ability to analyze and solve problems related to chemical separation processes

Good (B+, B, B-)

Good understanding of concepts and ability to analyze and solve problems related to chemical separation processes

Fair (C+, C, C-)

Acceptable understanding of concepts and ability to analyze and solve problems related to chemical separation processes

Marginal (D)

Marginally acceptable understanding of concepts and ability to analyze and solve problems related to chemical separation processes

Failure (F)

Poor understanding of concepts and ability to analyze and solve problems related to chemical separation processes

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Assessment Task

2. Test

Criterion

Ability to explain concepts, analyze and solve problems related to chemical separation processes

Excellent (A+, A, A-)

Excellent understanding of concepts and ability to analyze and solve problems related to chemical separation processes

Good (B+, B, B-)

Good understanding of concepts and ability to analyze and solve problems related to chemical separation processes

Fair (C+, C, C-)

Acceptable understanding of concepts and ability to analyze and solve problems related to chemical separation processes

Marginal (D)

Marginally acceptable understanding of concepts and ability to analyze and solve problems related to chemical separation processes

Failure (F)

Poor understanding of concepts and ability to analyze and solve problems related to chemical separation processes

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Assessment Task

3. Presentation

Criterion
Ability to explain concepts, analyze and solve problems related to chemical separation processes

Excellent (A+, A, A-)
Excellent understanding of concepts and ability to analyze and solve problems related to chemical separation processes

Good (B+, B, B-)
Good understanding of concepts and ability to analyze and solve problems related to chemical separation processes

Fair (C+, C, C-)
Acceptable understanding of concepts and ability to analyze and solve problems related to chemical separation processes

Marginal (D)
Marginally acceptable understanding of concepts and ability to analyze and solve problems related to chemical separation processes

Failure (F)
Poor understanding of concepts and ability to analyze and solve problems related to chemical separation processes

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Assessment Task
4. Examination

Criterion
Ability to explain concepts, analyze and solve problems related to chemical separation processes

Excellent (A+, A, A-)
Excellent understanding of concepts and ability to analyze and solve problems related to chemical separation processes

Good (B+, B, B-)
Good understanding of concepts and ability to analyze and solve problems related to chemical separation processes

Fair (C+, C, C-)
Acceptable understanding of concepts and ability to analyze and solve problems related to chemical separation processes

Marginal (D)
Marginally acceptable understanding of concepts and ability to analyze and solve problems related to chemical separation processes

Failure (F)
Poor understanding of concepts and ability to analyze and solve problems related to chemical separation processes

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Part III Other Information

Keyword Syllabus

- Fundamentals of thermodynamics in separations;
- Conventional distillation;
- Absorption in gas-phase separations and solvent-extraction applications;
- Adsorption;
- Membrane technologies;
- Ion-exchange;

- Selectivity-permeability tradeoff;
- Emerging separation technologies

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Wankat, Phillip C., Separation Process Engineering Second Edition, Pearson Education, Inc. 2007
2	Seader, Henley and Roper, Separation Process Principles with Applications Using Process Simulators, 4th Edition, John Wiley and Sons, Inc. 2016
3	Giddings, J. Calvin, Unified separation science, Wiley, New York, 1991