The Hong Kong University of Science and Technology

UG Course Syllabus

Course title: CENG 3210 Separation Processes
Schedule: Lecture L1 MoWe 10:30 - 11:50AM Rm 4504
T1 Mo 09:30AM - 10:20AM LG4103, Teaching Hub
[No. of Credits]: 3 credits

Prerequisite:
CENG 1110, CENG 2210, or any undergraduate-level physical chemistry or engineering thermodynamics course.

Instructor: Zhengtang Tom Luo,
Rm 4557 (office, lift 27-28)
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TA:

Undergraduate TAs: to be determined.
Office hours: Wednesday thru Friday early afternoon (by appointment please)

Course description:

CENG 3210 covers the fundamental principles of separation process that are essential in traditional chemical engineering education and the recent emergence of industries such as biotechnology and nanotechnology. The objective of this course is to familiarize the chemical engineering students with how separation processes works, and more importantly to further develop their ability to apply those basic principles to the solution of important problems. We will focus on both equilibrium controlled separation processes as well as separation processes that involve both mass transport and equilibrium considerations. Specific processes considered will include evaporation, distillation, absorption, liquid-liquid extraction, membrane processes, drying. Besides the fundamental principles involved in the unit operations, we will also introduce the students to specific subtleties associated with different separation processes both old and new.

Teaching Objectives and expected outcomes:

The objectives of this course are to provide students an overview of separation process and a deep understanding of selected topics. The contents of this course will cover basic concepts and definitions, evaporation, distillation, absorption, liquid-liquid extraction, membrane processes, drying, adsorption. After this course students should be familiar with fundamental principles for separation processes.

Specifically, they will be able to:

1) Understand concepts, principles, relations and experimental basis of the separation processes.
2) Understand key concepts of separation processes and unit design including equilibrium stages, reflux, countercurrent contacting, limiting cases, efficiency and mass transport effects.
3) Model and solve problems related to flash distillation, liquid-liquid extraction, batch distillation, cascades, simple and complex binary distillation systems and absorption in packed towers.
4) Understand the basic principles of evaporation, absorption, liquid-liquid extraction, membrane, drying processes.
5) Understand scientific literature in a range of fields that uses concepts in separation processes.

In addition, I will also try to guide your academic and personal development aiming to reinforce your interest for learning, experiencing pleasure in acquiring knowledge, skills. To achieve this goal, I will work with you to help you learn new skills for your career after you graduate.

Requirements:
Students are expected to attend all lectures and complete all readings. ALL exam questions are derived DIRECTLY from lectures and supplemental readings. Furthermore, you will be undertaking in-class tasks, and such attendance is required.

Course requirements

Lectures

The lectures will introduce the principles and concepts of separation process. We will also formulate and solve some illustrative example problems together. Lecture notes will be posted on the website beforehand.

Tutorials

The tutorial will tackle confusions or difficulties encountered in the lectures, the homework and the exams in a more informal and interactive manner.

In-class Exercises

There will be graded in-class exercises. These will usually take place during the lectures, and serve as a chance for students to quickly refresh the materials learned during that lecture. The exercises are open-book, open notes but discussion among students is forbidden. For grading purpose, the 2 worst scores obtained among all in-class exercises will be dropped.

Reading Assignments

Reading assignment maybe given.

Homework

Homework will be distributed throughout the semester. A major component of the grade will be awarded based on the formulation of the problem and the presentation of the solution. Late submission of homework will be discounted as 75%.

Exams

There will be 1 mid-term exam and 1 final exam.

References:

C.J. Geankoplis, “Transport Processes and Separation Process Principles”, 4th ed., Prentice Hall, NJ, 2003.

P.C. Wankat, “Equilibrium Staged Separations”, Prentice Hall, Englewood Cliffs, NJ, 1988.

W.L. McCabe, J.C. Smith, P. Harriott, "Unit Operations of Chemical Engineering", 7th ed., McGraw-Hill, New York, 2005; 6th ed., 2001; 5th ed., 1993.

Grading:

	type	Time	comprising	format
Participation	individual	Each class, meeting with Tom at least once	5%	Attendance and answering questions
Homework	individual	Due on Monday before class	10%	Problem solving
In-class quiz	individual	Random	15%	Problem solving
Mid term exam	individual	Mid of October	20%	Multiple Choice Questions and Short/Long Answer Questions
Final exam	individual	End of the semester	40%	Multiple Choice Questions and Short/Long Answer Questions
Presentation	Group	End of the semester	10%	Video Report

1. Reading assignment will be provided from time to time.
2. All evaluation and exams will be based on some combination of the following:
    a) Lecture notes/material
    b) Assigned readings
3. The final exam will be cumulative in terms of its coverage, i.e. including everything we have learnt.
4. Homework older than the current unit will not be accepted. Doing all assigned problems is essential to success in this course. If you have questions about the homework you can raise them during class.

Final project presentation and report

Video Student will form a group by themselves, and make a video presentation, which covered the following component of the research report. All students are required to watch the video before the class; during the class each student are required to ask at least one technical question.

Report Student group will prepare a research proposal on a topic related to nanomaterials and/or nanotechnology. The topic area should not be the subject of the thesis/FYP research of any student.

The research proposal should: 1) Summarize the state of knowledge of the topic, 2) Identify critical unresolved science and/or technology issues, and 3) Propose specific new research to resolve these critical issues. The proposal text should be organized as follows:

i) Introduction and Background (1 pages, explain the significance of proposal)

ii) Critical Unresolved Issues (1/2 pages, what is the most important problem)

iii) Proposed Research (2 pages, innovative methodologies, rationale, of 3-5 tasks)

iv) References (numbered sequentially as cited in the text, not included in text limit)

The proposal must be typed in Times New Roman font (12 point) with single spacing and with one inch margins (top, bottom, sides). Each page should be numbered at the bottom center of the page. Reports are 3-page, single space, type-written, in 12-point Times New Roman font, with 1" margins. Reference pages will not counted. The paper is tentatively due on **5pm on Nov 29th.**

Grading Rubrics

Grade Level	Problem Solving & Methodology (Exams, Quizzes, Homework)	Technical Content & Data Analysis (Reports, Projects)	Communication & Execution
A (Excellent)	Consistently selects and flawlessly applies the most efficient analytical methods. Demonstrates deep mastery of all concepts.	Data is analyzed rigorously. Highly detailed, accurate, and provides insightful synthesis going beyond basic requirements.	Exceptionally well-structured and concise. Calculations are fully accurate with zero or negligible errors.
B (Good)	Generally applies correct methods, though occasionally uses less efficient approaches. Solid core understanding.	Data is analyzed correctly. Sound interpretations but may overlook subtle trends or complex edge cases.	Well-organized and readable. Mostly accurate calculations with only minor execution or mathematical errors.
C (Satisfactory)	Applies basic methods to standard problems but struggles with unfamiliar, integrated, or complex topics.	Covers basic requirements but lacks depth. Interpretations are superficial or rely on unsupported assumptions.	Acceptable structure but may be disorganized. Multiple execution errors; final answers may be incorrect despite partial understanding.
D (Marginal)	Frequently applies incorrect formulas, methods, or assumptions. Demonstrates limited	Missing key technical components. Content is descriptive without academic rigor;	Poorly structured and difficult to follow. Highly inaccurate calculations that fail to reach logical conclusions.

	grasp of fundamental concepts.	interpretations are flawed.	
F (Fail)	Unable to formulate viable approaches to basic problems. Shows no meaningful understanding of material.	Content is irrelevant, entirely inaccurate, or fails to address the prompt. No meaningful data analysis.	Unreadable, plagiarized, or shows a complete lack of effort. Calculations are entirely missing or incorrect.

Assessment Policy: Criterion-Referenced Assessment

This course adopts a Criterion-Referenced Assessment (CRA) approach. This means your final grade will be determined by your ability to demonstrate mastery of the course learning outcomes, based on predefined performance standards and grading rubrics.

Your performance is evaluated strictly against these objective criteria, not relative to the performance of your peers in the class. As such, the course does not employ norm-referencing or "grading on a curve." Detailed grading rubrics for all assignments and exams are provided in this syllabus so you know exactly what is expected to achieve a specific grade.

Class Courtesy Rules

1. Come to the lecture on time
2. If you are late, come in discreetly and sit down quietly
3. Turn off your mobile phones, notebook computer and other electronic devices
4. No talking except during class discussion or in-class exercise

Course AI Policy

The use of Generative AI is permitted and requested to assist students with brainstorming, drafting, and writing their papers. However, Declaration are required if content are AI-generated.

Academic Honesty:

HKUST as an institution demands academic integrity and has introduced regulations to back this up. As your instructor, I will apply these regulations as conscientiously and strictly as possible. To the following website provides assistance for students in avoiding plagiarism, and sets out the role of faculty and staff when a case of cheating or plagiarism comes to their attention: http://www.ust.hk/provost/integrity.

Tentative Course Schedule

This is subject to revision throughout the semester. Updated schedules will be announced and posted on the course website.

week	Date		Chapter	
1	2/9	Wed	**Topic 1:** Introduction to separation process	
2	7/9	Mon	**Topic 2:** Evaporation	
	9/9	Wed	**Topic 3:** Single equilibrium stages and flash calculations	
3	14/9		Topic 3	
	16/9		**Topic 4:** Distillation of binary mixtures	HW1 due by 11 am,
4	21/9		Topic 4	
	23/9		**Topic 5:** Absorption and stripping	
5	28/9		Topic 5	
	30/9		**Topic 6:** Liquid-liquid extraction 1	
6	5/10		Topic 6	HW2 due by 11 am,
	7/10		**Topic 7:** Liquid-liquid extraction 2	
7	12/10		Topic 7	
	14/10		Topic 8**:** Membranes	
8	19/10		*holiday*	HW3 due by 11 am
	21/10		**Midterm examination (tentative)**	
9	26/10		Topic 8	
	28/10		*Holiday*	
10	2/11		**Topic 9:** Rate-based method	
	4/11		Topic 9	
11	9/11		*AICHE meeting, switch with tutorial*	
	11/11		*AICHE meeting, switch with tutorial*	HW4 due by 11 am
12	16/11		Topic 10: Filtration	
	18/11		Topic 10	
13	23/11		**Topic 11:** Membrane	HW5 due by 11 am
	23/11	Tutorial	Topic 11 (switch with lecture)	
	25/11		Topic 12 Adsorption	
	30/11		Topic 13 Student project presentation	
	30/11	Tutorial	Topic 13 Student project presentation(switch with lecture)	