UCONN
UNIVERSITY OF CONNECTICUT

CHEG 5001
Adv. Chem. Eng. Fundamentals
Process Engineering Certificate

Syllabus - Fall 2021

Excluding materials for purchase, syllabus information may be subject to change. The most up-to-date syllabus is located within the course in HuskyCT.

Program Information

The Chemical and Biomolecular Engineering Department offers a fully online with synchronous and asynchronous coursework, 12-credit advanced engineering **certificate program in Process Engineering**. Process engineering is the merger of fundamental engineering science and knowledge along with empirical information to develop and optimize processes. Process Engineering is primarily grounded in the discipline of Chemical Engineering and its core areas, including thermodynamics, transport phenomenon, and kinetics. The fundamental knowledge for Process Engineering is encoded in mathematical models, whereas the empirical information is represented by data science/machine learning models.

To be an effective process engineer, one must develop a familiarity with both of these areas, as well as the ability to integrate them and through this certificate the student will be introduced to these concepts within the context of real-world case studies. Add the Process Engineering Certificate to your credentials today.

All students apply and are admitted to the UConn Graduate School. Credits earned within the certificate can be applied towards a Master of Engineering (MENG).

Course and Instructor Information

Course Title: Advanced Chemical Engineering Fundamentals
Credits: 3
Format: Online
Prerequisites: Instructor consent required.
Professor: Jennifer Pascal, Ph.D.

Email: jennifer.pascal@uconn.edu (email preferred method of communication)
Telephone: N/A, please email me
Office Hours/Availability: This course will have synchronous meetings on WebEx (https://uconn-cmr.webex.com/meet/jep16119) every other Monday from 6:00 - 8:00 PM ET. Please allow up to 24 hours for responses to emails M - F and up to 48 hours for emails on Saturdays and Sundays.

Course Materials

Required course materials should be obtained before the first day of class.

Required textbooks are available for purchase through the UConn Bookstore (or use the Purchase Textbooks tool in HuskyCT). Textbooks can be shipped (fees apply).

Required Materials:

1. Felder, Rousseau, & Bullard, “Elementary Principles of Chemical Processes,” 4th edition.
2. Smith, Van Ness, Abbott, & Swihart, “Chemical Engineering Thermodynamics,” 9th edition
3. Bird, Stewart, & Lightfoot, “Transport Phenomena,” Revised 2nd edition.
4. Fogler, “Essentials of Chemical Reaction Engineering,” 2nd edition.

Additional course readings and media are available within HuskyCT, through either an Internet link or Library Resources

Course Description

This course will provide graduate-level introduction to thermodynamics, transport phenomena, and kinetics within the context of chemical engineering applications. Primary attention will be paid to developing an understanding of the fundamentals of each of these topic areas. As the course progresses, integration and application of

thermodynamics, transport phenomena, and reaction kinetics will be discussed.

Course Objectives

By the end of the semester, students should be able to:

1. Apply mathematical tools (e.g., calculus, differential equations) to solve chemical engineering problems using appropriate units and assumptions.
2. Solve basic chemical engineering problems using material and energy balances.
3. Calculate physical properties of a system, as well as heat and work of a process, through the application of fundamental thermodynamic equations.
4. Solve chemical engineering problems in which multiple phases are present by applying thermodynamic equations.
5. Apply mathematical tools (e.g., differential equations) to solve heat and mass transport problems, including transfer by conduction, diffusion, and convection, at differing levels of complexity.
6. Apply chemical reaction engineering principles to calculate the design parameters (reactor size, flow rates, concentrations, and conversions) for ideal chemical reactors (batch, CSTR, PFR, and PBR).
7. Calculate the impacts of temperature and pressure on reaction equilibrium, rate, and conversion.
8. Synthesize mass, momentum, energy balances, thermodynamics and reactor kinetics to solve complex industrial chemical engineering problems.

Performance Table

<table>
<tr><th>Outstanding, >90</th><th>Acceptable, 80</th><th>Unacceptable, <60</th></tr>
<tr><td colspan="3">(1) Apply mathematical tools (e.g., calculus, differential equations) to solve chemical engineering problems using appropriate units and assumptions.
(2) Solve basic chemical engineering problems using material and energy balances.
(3) Calculate physical properties of a system, as well as heat and work of a process, through the application of fundamental thermodynamic equations.
(4) Solve chemical engineering problems in which multiple phases are present by applying thermodynamic equations</td></tr>
<tr><td>Almost no errors in system conception or applying correct equations and solving.</td><td>Correct formulation of the problem, though students may arrive at an incorrect solution or neglect necessary information.</td><td>Significant errors in problem formulation and/or incorrect solution approach, and/or neglect of critical process steps.</td></tr>
<tr><td colspan="3">(5) Apply mathematical tools (e.g., differential equations) to solve heat and mass transport problems, including transfer by conduction, diffusion, and convection, at differing levels of complexity.
(6) Apply chemical reaction engineering principles to calculate the design parameters (reactor size, flow rates, concentrations, and conversions) for ideal chemical reactors (batch, CSTR, PFR, and PBR).
(7) Calculate the impacts of temperature and pressure on reaction equilibrium, rate, and conversion</td></tr>
<tr><td>Students are able to identify correct system variables, formulate and solve independent equations; Students are also able to connect unit operations to construct new chemical processes taking into account global, cultural, social, environmental, and economic factors.</td><td>Students generally identify system variables and construct appropriate solution systems; Students may have difficulty in using the energy balance as a constraining equation or do not take into consideration all factors.</td><td>Students are unable to identify correct mass and energy balance sources and/or do not have a working knowledge of how to formulate solutions.</td></tr>
<tr><td colspan="3">(8) Synthesize mass, momentum, energy balances, thermodynamics and reactor kinetics to solve complex industrial chemical engineering problems.</td></tr>
</table>

Students are able to seek and find solutions to problems by finding resources outside of the classroom.	Students are able to seek and find solutions to problems by finding resources outside of the classroom, but may not be able to effectively apply material from these resources.	Students are not able to seek and find solutions to problems by finding resources outside of the classroom and rely heavily on the instructor and/or teaching assistants.

Course Outline

Module 1: Material and Energy Balances (Weeks 1 - 2)
Module 2: Chemical Engineering Thermodynamics (Weeks 3 - 6)
Module 3: Transport Phenomena (Weeks 7 - 12)
Module 4: Chemical Engineering Reactor Kinetics (Weeks 13 - 14)

Synchronous sessions will be held every other Monday from 6:00 PM - 8:00 PM Eastern time in WebEx here. See the course schedule for details. Attendance in these sessions is not required, but strongly encouraged to foster interactions with the instructor and your classmates.

Course Requirements and Grading

Summary of Course Grading:

Course Components	Weight
Perusall Annotation Assignments	15%
Quizzes	25%
Practice Problem Sets	40%
Midterm Exam	10%
Final Project	10%

There is not necessarily one correct approach to solving these problems and that will be reflected in the grading by being able to earn partial credit on quizzes, practice problem sets, and the midterm exam. More weight (80%) will be given to the problem solving process and not the final answer, however, arriving at a numerical answer that is reasonable and makes sense is still important (20%).

Promotion of an Inclusive Learning Environment

I wanted to also say something about the type of environment I like to have in my courses. I want this to be a safe space and affirming for everyone. As a cishet, white, able-bodied female, I walk around with a ton of privilege. I try to be an ally to people who don't have the same privilege and I am trying to educate myself every single day by reading, attending workshops, and listening, because I also have biases. So, if something in this course is not affirming or makes you feel excluded or offended in any way, please bring it to my attention.

You might ask how all of this is related to engineering. Think about some of the power structures that exist in our everyday lives (e.g., engineers and technicians, professors and students). Additionally, think about who teaches most of your engineering courses and who wrote the majority of the textbooks for them. I think that everyone can and should be welcomed and included in engineering. Thus, understanding and being sensitive to the systematic role that these power structures play in our lives as engineers can help us come up with better solutions to societal problems, which is our job. In the context of the material in this course we will sometimes discuss how we, as engineers, can help promote inclusiveness and fairness in our field through our work. I have chosen to highlight some of the engineers from traditionally underrepresented groups from UConn and beyond in the modules, because I think they are good role models and provide some representation.
I also believe in growth mindset, or that we are malleable and can learn anything, despite “not being good at math,” for example. I was placed in Pre-Calculus my freshman year of college when nearly all of my peers in

engineering were placed in Calculus I or above. I felt very inadequate at the time, but looking back, it gave me a solid foundation in math. So, I don't think we have fixed abilities or talents. You can all be successful engineers, if that is what you want to do. I don't believe any of you "just can't cut it."

Finally, I believe in asset-based approaches, or that every single person in the class comes to class with knowledge and their own lived experiences that should not be diminished or discounted. Every single person brings something to the table in this class and has experiences they can share that can help us solve problems. So, instead of focusing on what students don't have (e.g, "the students can't solve differential equations."), I do my best (sometimes I fail, so call me out) to approach things with an asset-based attitude (e.g., "one of the students in class makes their own lip gloss, so they already know a thing or two about fluids"). I remember when I started college and met a lot of students who had already worked at Oak Ridge National Lab, or who had done research, and I kept thinking, "I have done NONE of this, I don't even know what a chemical engineers is, I'm in precalc, and I feel incredibly inadequate. Will I even be able to do this?"). I'm sure many or even all of you have probably felt this way in engineering before. I don't want anyone in this class to feel that way. We need to change the culture. You can help do this.

Perusall Annotation Assignments
In this course, we will be using Perusall. Perusall is a "social annotation" tool that supports engagement with course material & other students in class groups. In this course Perusall has been integrated with HuskyCT to create reading & viewing assignments associated with class materials. In these assignments, you will be asked to create & share your own annotations and respond to each other's comments & questions.

Perusall provides the instructor analytics about student engagement with the material and a compilation of the concepts that generate the most questions & discussion. The learner analytics, along with instructor-determined engagement parameters, will assist the instructor to assess student performance on these assignments.

Quizzes
There will be biweekly quizzes in HuskyCT covering material from each module and submodule. These quizzes will be a mixture of multiple choice conceptual questions and problems that need to be worked out. Each quiz will have a time limit of 1 hour and will be available 48 hours before the time it is due. Quizzes are "open resource" (i.e., you can use any resource to help you on the quiz).

Practice Problem Sets
There are biweekly practice problem sets covering the material from each module and submodule. These practice problem sets are intended to reinforce what you have learned and give you the opportunity to practice and apply your problem solving skills.

Project - from Fogler and LeBlanc "Strategies for Creative Problem Solving" There is no right or wrong approach to this, as it is open ended. I will give feedback and assess based on effort. There are two project checkpoints on Mondays (9/20 and 11/1) during the synchronous session times. During these checkpoints, you can discuss with your peers and the instructor any challenges you are facing with respect to the project and ask questions.

Grading Scale:

Grade	Letter Grade	GPA
93-100	A	4.0
90-92	A-	3.7
87-89	B+	3.3
83-86	B	3.0
80-82	B-	2.7
77-79	C+	2.3
73-76	C	2.0
70-72	C-	1.7
67-69	D+	1.3
63-66	D	1.0
60-62	D-	0.7
<60	F	0.0

Due Dates and Late Policy

All course due dates are identified in the course schedule. Deadlines are based on Eastern Time; if you are in a

different time zone, please adjust your submittal times accordingly. *The instructor reserves the right to change dates accordingly as the semester progresses. All changes will be communicated in an appropriate manner.*

Late Policy: If you need to submit an assignment late, please let me know in advance (even if it is just a few minutes ahead of the deadline). I will do my best to accommodate unforeseen circumstances and be flexible.

Feedback and Grades

I will make every effort to provide feedback and grades in within 1 week of submission. To keep track of your performance in the course, refer to My Grades in HuskyCT.

Weekly Time Commitment

You should expect to dedicate 12 - 15 hours a week to this course. This expectation is based on the various course activities, assignments, and assessments and the University of Connecticut's policy regarding credit hours. More information related to hours per week per credit can be accessed at the Online Student website.

Student Authentication and Verification

The University of Connecticut is required to verify the identity of students who participate in online courses and to establish that students who register in an online course are the same students who participate in and complete the course activities and assessments and receive academic credit. Verification and authentication of student identity in this course will include:

1. Secure access to the learning management system using your unique UConn NetID and password.
2. Assessment/Exam Proctoring

IMPORTANT: This course requires students to use the online service ProctorU for the real time proctoring and recording exam sessions. In order to use ProctorU, you must meet certain technical, software, location, and identity verification requirements.

It is critical that you review these requirements and fully test the computer on which you will take your exam prior to the official start of classes and no later than the second day of the course. Please complete the following:

- Review the Welcome to ProctorU page.
- Review the ProctorU FAQ's
- Sign-up for your exam time slot at least 1 week in advance of the exam's scheduled time. If you choose to sign-up later, you risk not finding an available appointment and you may be charged a late fee (within 72 hours prior to the exam start you WILL be charged a late fee, even if you can find an appointment). The University of Connecticut will not pay for student late fees incurred as a result of your failure to meet this deadline.
- Use either Chrome or Firefox as your browser. You will be prompted to download a browser extension.
- Prepare your workspace before taking a test (clear and quiet area, no unpermitted resources, good lighting and not back-lit), and be prepared to sow the area to the proctor.
- Know the technical requirements.
    - Chromebooks and tablets are not supported devices.
    - The computer must have a working webcam and microphone.
    - You should take priority over your network during an exam. Other high-bandwidth activities on your network can disrupt the test taking experience.

- ProctorU Technical Specifications (See "Requirements")
- ProctorU System Test (See "Test your equipment" under System Requirements)
- ProctorU Privacy Policy
- ProctorU Accessibility and Compliance Information

Student Responsibilities and Resources

As a member of the University of Connecticut student community, you are held to certain standards and academic policies. In addition, there are numerous resources available to help you succeed in your academic work. Review these important standards, policies and resources, which include:

- The Student Code

    - Academic Integrity
    - Resources on Avoiding Cheating and Plagiarism
- Copyrighted Materials
- Credit Hours and Workload
- Netiquette and Communication
- Adding or Dropping a Course
- Academic Calendar
- Policy Against Discrimination, Harassment and Inappropriate Romantic Relationships
- Sexual Assault Reporting Policy

Students with Disabilities

The University of Connecticut is committed to protecting the rights of individuals with disabilities and assuring that the learning environment is accessible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, please let me know immediately so that we can discuss options. Students who require accommodations should contact the Center for Students with Disabilities, Wilbur Cross Building Room 204, (860) 486-2020 or http://csd.uconn.edu/.

Blackboard measures and evaluates accessibility using two sets of standards: the WCAG 2.0 standards issued by the World Wide Web Consortium (W3C) and Section 508 of the Rehabilitation Act issued in the United States federal government." (Retrieved March 24, 2013 from Blackboard's website)

Software/Technical Requirements (with Accessibility and Privacy Information)

The software/technical requirements for this course include:

- HuskyCT/Blackboard (HuskyCT/ Blackboard Accessibility Statement, HuskyCT/ Blackboard Privacy Policy)
- Adobe Acrobat Reader (Adobe Reader Accessibility Statement, Adobe Reader Privacy Policy)
- Google Apps (Google Apps Accessibility, Google for Education Privacy Policy)
- Microsoft Office (free to UConn students through uconn.onthehub.com) (Microsoft Accessibility Statement, Microsoft Privacy Statement)
- Dedicated access to high-speed internet with a minimum speed of 1.5 Mbps (4 Mbps or higher is recommended).
- Scanning Apps such as google drive, camscanner, Adobe scan

For information on managing your privacy at the University of Connecticut, visit the University's Privacy page.

NOTE: This course has NOT been designed for use with mobile devices.

Help

Technical and Academic Help provides a guide to technical and academic assistance.

This course is completely facilitated online using the learning management platform, HuskyCT. If you have difficulty accessing HuskyCT, you have access to the in person/live person support options available during regular business hours through the Help Center. You also have 24x7 Course Support including access to live chat, phone, and support documents.

Minimum Technical Skills

To be successful in this course, you will need the following technical skills:

- Use electronic mail with attachments.
- Save files in commonly used word processing program formats.
- Copy and paste text, graphics or hyperlinks.
- Work within two or more browser windows simultaneously.
- Open and access PDF files.
- Scan using a mobile app or scanner

University students are expected to demonstrate competency in Computer Technology. Explore the Computer Technology Competencies page for more information..

Evaluation of the Course

Students will be provided an opportunity to evaluate instruction in this course using the University's standard procedures, which are administered by the Office of Institutional Research and Effectiveness (OIRE).

Additional informal formative surveys may also be administered within the course as an optional evaluation tool.