Fall 2020

CHE 210-003: Chemical Process Calculations I

Richard Cimino

1. **ChE 210 - Chemical Process Calculations I**
2. **Credits and contact hours:** 3-0-2 (3 lecture hr/wk - 0 lab hr/wk - 2 course credits)
3. **Course Coordinator:** Dr. Piero Armenante
4. **Course Instructor:** Dr. Richard T. Cimino
5. **Textbook:** Elementary Principles of Chemical Processes, 4th Ed., R. M. Felder, R. W. Rousseau & L. G. Bullard, Wiley, (2016). ISBN: 0470616296
6. **Specific course information**
    a. **Description:** Analysis of chemical processes is introduced, emphasizing steady and unsteady-state mass and species balances. This course uses primarily chemistry and algebra to determine, for a wide variety of processes and applications, the flow and concentrations of different chemical species.
    b. **Prerequisites:** Chem 126, Math 112
    c. **Co-requisites:** CS 115
    d. **Required, Elective, or Selective Elective** - Required
7. **Specific goals for the course**
    a. A student should be able to:
        1. Perform basic engineering calculations
        2. Perform material balance calculations
        3. Perform applied physical chemistry calculations
        4. Use basic computational tools
        5. Begin to understand the importance of safety issues
        6. Work in problem-solving teams
    b. This course explicitly addresses the following ABET student outcomes:
        1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
8. **Topics**
    1. Career Opportunities for Chemical Engineers
    2. Principles of Chemical Process Calculations
    3. Numerical Calculation and Estimation
    4. Computational Techniques
    5. Processes and Process Variables
    6. Steady State and Transient Material Balances

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Instructor: Dr. Richard T. Cimino, Senior Lecturer
Contact Email: cimino@njit.edu
Class: M 2:30-3:50 PM, Th 11-12:30 PM; Converged Classroom
Office Hours: By arrangement online. Book at https://drcimino.youcanbook.me

Course Description and Requirements

Analysis of chemical processes is introduced, emphasizing steady and unsteady-state mass and species balances. This course uses primarily chemistry and algebra to determine, for a wide variety of processes and applications, the flow and concentrations of different chemical species.
Course Purpose: ChE 210 prepares students to formulate and solve material balances on chemical process systems and lays the foundation for subsequent courses in thermodynamics, unit operations, kinetics, and process dynamics and control. More fundamentally, it introduces the engineering approach to problem solving: breaking a process down into its components, establishing the relations between known and unknown process variables, assembling the information needed to solve for the unknowns, and finally obtaining the solution using appropriate computational methods.
Overall Course Objective: As the first true course in chemical engineering, ChE 210 introduces students to the fundamentals of chemical process analysis. In this course students will learn how to perform material balances, unquestionably the first and most important quantitative element in the analysis of any process. Together with ChE 240-Chemical Process Calculations II (its companion course dealing with energy balances, to be taken next semester) ChE 210 provides the key foundation to all ChE courses that will follow.
Prerequisites: Chem 126, Math 112 **Co-requisites:** CS 115

Course Objectives

Taking this course, a motivated student will learn to:

- Perform basic engineering calculations:
  - Convert quantities from one set of units to another quickly and accurately
  - Define, calculate, and estimate properties of process materials including fluid density, flow rate, chemical composition variables (mass and mole fraction, concentration), fluid pressure, and temperature
- Perform material balance calculations:
  - Draw and label process flowcharts from verbal process descriptions;
  - Carry out degree-of-freedom analyses
  - Write and solve material balance equations for single-unit and multiple-unit processes, processes with recycle and bypass, and reactive processes
- Perform applied physical chemistry calculations:

  - Use basic equations of state to calculate molar flow rates based on data for volumetric flow rate, temperature and pressure
  - Calculate the partial pressure of a constituent of a gas mixture
- Use basic computational tools:
  - Use spreadsheets (Excel) to solve problems
- Begin to understand the importance of safety issues
  - Become aware and start evaluating potential safety hazards in processes, in particular, chemical processes
- Work in problem-solving teams

Learning Materials

Textbook Required: Elementary Principles of Chemical Processes, 4th Ed., R. M. Felder, R. W. Rousseau & L. G. Bullard, Wiley, (2016). ISBN: 0470616296

Required Hardware: A working computer equipped with a working webcam and a working microphone. Note - tablet devices are not acceptable for this course.

Required Software: Google Chrome browser or Firefox browser; Respondus Lockdown Browser, Microsoft Word, Microsoft Excel (not the equivalent Google products).

Internet Access: You must have a reliable internet connection for your device.

Calculator: A high-end calculator (TI-83, TI-84 or TI-84SE) is required for solving problems.

Other Learning Materials: The textbook is the main source for preparing for classes and reading the textbook before each class is necessary. Additional materials will be posted on Canvas.

Note: If you do not meet all of these requirements you cannot take the course online and must instead take it in person at another time.

Course Outline

Date	Tentative Material (subject to slight changes)
9/3 (Th)	Ch. 1
9/8-10 (**T**,Th)	Ch. 2.1-3, 2.4
9/14-17 (M,Th)	Ch 2.6, 3.1-2
9/21-24 (M,Th)	Ch. 3.3, 3.4
9/28-10/1 (M,Th)	Ch. 3.5, Exam Review
10/5-8 (M,Th)	Exam 1, Ch. 2.5
10/12-15 (M,Th)	Ch. 2.7, Project Intro
10/19-22 (M,Th)	Ch. 4.1-2, 4.3
10/26-29 (M,Th)	Ch.4.3, 4.4
11/2-5 (M,Th)	Ch. 4.4, Exam 2 Review
11/9-12 (M,Th)	Exam 2, Ch. 4.5
11/16-19 (M,Th)	Ch. 4.5, Ch. 4.6
11/23 (M)	Ch. 4.6
11/30-12/3 (M,Th)	Ch. 4.7
12/7-12/10 (M,Th)	Ch. 10.1-2, Final Review

Assessment and Grading

Homework: Homework assignments will be posted on Canvas weekly, based on the material covered that week. The homework must be completed by the following Wednesday night at 11:59 PM, unless otherwise is explicitly stated. No late homework will be accepted without a documented and University authorized absence. All homework assignments will be individual assignments. Please see **Homework Format** below for guidelines and details of homework submission.
Project: A computer-based project will be assigned midway through the semester. This project will require the use of MS Excel and Word.
Quizzes: Regular quizzes will be given based on the lecture material and will be short (10-15 min) offline (asynchronous)in Canvas. No make-up quizzes will be allowed. All quizzes will be announced in advance.
Exams: There will be two midterm exams (80 min) and one final exam (2.5 hrs). All exams will be open book (hardcopy only), and you may also prepare a handwritten formula sheet (double-sided, letter size) with materials used to prepare for midterm exam. Shared or copied preparation sheets, as well as use of any unauthorized electronic materials will be considered as a violation of academic integrity. Students will only be allowed to make up an exam with documented and University authorized absence.
Proctoring: All quizzes and exams will be proctored using Respondus Lockdown Browser and Respondus Monitor automated proctoring services. These services record your webcam and microphone feed and monitors your behavior. Suspicious behavior will be flagged for review and will be reported to the instructor.

ALL EXAMS WILL TAKE PLACE REMOTELY - DO NOT COME TO THE PHYSICAL CLASSROOM ON EXAM DAY!

Homework will be evaluated using the following scale:
✓+ = The solution is 100% correct and presented in a thorough, logical fashion. (100%)

✓= Solutions contain some errors but present a reasonable attempt at solving all problems. (80 OR 90%)

✓− = Solutions contain multiple substantial conceptual errors, and/or give only a cursory attempt at solving some problems. (50, 60, OR 70%)

Zero - No submission. (0%)

Final Course Grades: Your grade for the class will be determined from your homework, quiz, exam, and project grades, as follows:

Homework	10%
Quizzes	15%
Project	5%
Midterms (2)	40%
Final	30%
	100%

Letter grades corresponding to your numerical score will be assigned according to the following:

Percent	Grades
90% and above	A
80-89%	B/B+
70-79%	C/C+
60-69%	F/D
below 60%	F

Grading Scale: The grading scale for this course has both curved and absolute elements. The requirement for an A in this class is 90% or above. Students with less than 60% will receive an F. Students whose grades cluster between 80% and 89% will receive a B or B+ based upon the natural break in the sub-clusters, with the higher cluster receiving a B+ and the lower a B (may vary slightly based on class performance). Students whose grades cluster between about 70% and 79% will receive a C+ or C based upon the natural breaks in the sub-clusters, with the higher receiving a C+, and the lower a C. Grades between 60-69% are considered near-failing, and a D will only be given sparingly, based upon observed student effort. If a student in the 60-69% range shows minimal effort, they may receive an F.

Important Dates

- Midterm Exam 1: Oct. 5th, 2020
- Midterm Exam 2: Nov. 9th, 2020
- Final Exam: Dec. 14-18th, 2020
- Withdraw Deadline: Nov 9th, 2020

Policies

NJIT Honor Code: The NJIT Honor Code will be upheld and any violations will be brought to the immediate attention of the Dean of Students.

Special Needs: If you need accommodations due to a documented disability please contact Chantonette Lyles, Associate Director of Disability Support Services, Fenster Hall Room 260 to discuss your specific needs. A Letter of Accommodation Eligibility from the Disability Support Services office authorizing your accommodations will be required.

Lectures

- This course is a converged course. This means that each lecture will take place both in person and online during the class hours. Attending the class sessions either in person, or online is mandatory, **and you always have the option of attending online, rather than in person**. Failure to attend the sessions at all may result in being marked as "unattended" for the course, which may negatively impact your financial aid status.
- Days when you may attend in person are determined by the phone app. You will be required to sit in a seat which matches your color code when you come to class.
- Please ensure proper social distancing at all times when in the classroom.
- Food and drink is expressly prohibited in the classroom, due to the risk of viral transmission.
- Students are expected to be in the classroom or logged in to the WebEx online meeting room by the start time of each class.
- No audio or video recording is allowed. All sessions will be automatically recorded for you to review at a later date.
- Cellphones should be turned off during lectures.

Course materials, office hours and correspondence

- The course Canvas page is the main platform for delivering information about the course. All relevant course materials and assignments will be posted on Canvas, so a student should check it regularly.
- Students must upload a professional-looking head shot for their Canvas profile.
- Students are strongly encouraged to attend Office Hours. Long questions which require derivations will be discussed only during the Office Hours and will not be answered by email. Questions regarding grades can be discussed only during the Office Hours.
- E-mail and Canvas correspondence is intended only for quick questions. Questions which require a detailed discussion should be discussed in person during the Office Hours.
- All correspondence should be conducted in a professional style, using formal English.
- To assure quick response to your emails, please add "ChE210" in the subject of your emails.
- The instructor reserves the right not to respond to emails if the email does not have a greeting or a signature.

Exams, Quizzes, Homework and Grades

- A letter grade is based on the final score, calculated using an Excel spreadsheet in accordance with the Tables given in this syllabus. The assigned letter grade is final and cannot be negotiated.
- A student can dispute the exam scores within a week after the announcement of the score. Exam scores can only be disputed during the official Office Hours, not during class time or via email.
- Students will get zero for not coming to quizzes, exams, or any other course activity. If students miss an exam due to extreme circumstances (such as a medical problem), they need to notify the instructor via email before the beginning of the exam, and bring proof of the circumstance to the Dean of Student's office. Only in the case of official approval from the Dean of Student's office, may a make-up be given at the discretion of the instructor.

- A student must show full details when solving a problem during an exam or a quiz. Not showing the work will cause the losing points even if the final answer is correct.
- Partial credit can be given for solving the exam and quiz problems, though no partial credit will be given if there are not enough details to follow.
- The final answer should be always evaluated with respect to its reasonability. No partial credit will be given if the final answer is wrong and unreasonable, and it is not stated.
- If a student misses a quiz due to a legitimate reason (absence approved by the Dean of Students), this quiz is excluded from the quiz average calculation.
- Student handwriting must be legible in order to receive points.

Homework Format: WARNING! failure to observe the following homework conventions will result in a downgrade of 10%. The reason for this is that since CHE-210 is your first real engineering course, we make a point of teaching you "Engineering Format" that you will use for your future courses.

- Paper - all homework must be completed on engineering paper or an equivalent engineering paper simulator (for tablet users).
- Headers - The five boxes at the top of each sheet of a homework assignment must contain the following printed information from left to right:

Staple	Name	Course & Section No.	Date Due	Page number/total pages

- Writing Mechanics - All homework should be carefully and legibly printed. If it can't be read, it can't be graded.
- Calculations - All homework calculations should be consistent with the following.
  - Include complete calculations for every calculation presented to demonstrate how results were obtained.
  - Include all units for each term in each equation. The units must balance.
  - Use the appropriate number of significant figures (often two or three) for all results (but use at least two extra significant figures in calculations).
  - Clearly indicate the final solution by boxing it in with a rectangle.
- Problem Order - Problems should clearly labeled, and presented in the order assigned (one, two, three, etc.).
- Problem Essentials - Problem solutions should include the following items in order.
  - Homework problem number listed at the beginning of the problem.
  - Brief problem statement. Provide bullet points of key aspects of the problem if it is longer than a few sentences.
  - The required information - the information or solution that we are looking for.
  - A straight-edge or carefully drawn diagram(s) that clearly illustrates the problem. Optional, but often needed.
  - The boxed solution of the problem including all required steps and calculations.