Fall 2019

CHE 210-003: Chemical Process Calculations I

Piero Armenante

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
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Class: Tuesday, Thursday, 1-2:20 PM; Room: Tiernan Lecture Hall 1
Office Hours: TBA

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

Other Learning Material: 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.
Calculator: A high-end calculator (TI-83, TI-84 or TI-84SE) is required for solving exam problems.
Software: Use of Excel, Matlab, Python or other computational software is strongly recommended for working on homework assignments.

Course Outline

	Date	**Topic (subject to change)**
1.	Sep. 3-5	Ch. 1, 2.1-3
2.	Sep. 10-12	Ch. 2.4, 2.6
3.	Sep. 17-19	Ch. 3.1-2
4.	Sep. 24-26	Ch. 3.3-4
5.	Oct. 1-3	Ch. 3.4-5
6.	Oct. 8-10	Ch. 2.5, 2.7, Appendix A
7.	Oct. 15-17	Exam 1, Appendix A
8.	Oct. 22-24	Ch. 4.1-2
9.	Oct. 29-31	Ch. 4.3
10.	Nov. 5-7	Ch. 4.3
11.	Nov. 12-14	Ch. 4.4-4.5
12.	Nov. 19-21	Exam 2, Ch. 4.6
13.	Nov. 26	Ch. 4.6-7
14.	Dec. 3-5	Ch. 4.7-8
15.	Dec. 10	Ch. 10.1-2

Assessment and Grading

Homework: Homework assignments will be posted on Canvas regularly, (typically on a weekly basis) depending on the material covered that week. The homework (including both reading and problems assignments) must be completed by Tuesday's class of the week following the assignment, 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(s): A computer-based team project will be assigned in the second half of the semester. A second group project will be similar to one of the more advanced homework problems, but requiring use of a computer to be solved.
Individual Accountability on Projects - Peer Evaluation: You will use the Comprehensive Assessment of Team Effectiveness (CATME, `www.catme.org`) to evaluate the teaming behaviors of yourself and your teammates. These evaluations will be incorporated into the assignment of final project grades.

Upon evaluation, each student is assigned a multiplier related to how you and your teammates rated your performance. Your multiplier ranges from 0 to 1.05 and is related to the team's average evaluation score. If your multiplier $= 1 \Rightarrow$, your rating is the same as the team average; $< 1 \Rightarrow$ your rating is less than the team average; $> 1 \Rightarrow$ your rating is greater than the team average. Your final team project score is then weighted by this multiplier:
e.g. 90% total Team Project score $\times$ (1.05) = 94.5%
Conflict Resolution: Consult with your instructor immediately if a conflict arises that cannot be worked through by the team.
Firing: If a team member refuses to cooperate on an assigned project, their name should not be included on the final product. If the non-cooperation continues, the team should meet with the instructor so that the problem can be resolved, if possible. If no resolution is achieved the cooperating team members may notify the uncooperative team member in writing (by email, cc the instructor) that they are in danger of being fired. If there is no subsequent improvement, the team should notify the uncooperative team member in writing (by email, cc the instructor) that they are no longer with the team.
Quitting: Students who are consistently doing all the work for their team may issue a warning (by email, cc the instructor) that they will quit unless they start getting cooperation and a second memo (by email, cc the instructor) quitting the team if things do not improve.

Students who are fired or quit must meet with the instructor immediately, or they will get zeros for the remaining project assignment(s). Students who quit will be allowed to join another team (cannot exceed 4 members) or to work alone, by their own choice. If a student decides to work alone, they may not later ask to join a team. Students who are fired may work together (if there is more than one at any time). Otherwise, they must work alone.
Quizzes: Regular quizzes will be given based on the homework material, including both concepts and problems, and will be short (10-15 min). No make-up quizzes will be allowed. All quizzes will be closed book with no material allowed. The quizzes will often take place at the beginning of the class, so being on time is strongly encouraged.
Exams: There will be two midterm exams (1.5 hours long) and one final exam (2.5 hours long). All exams will be closed book, however a handwritten sheet (double-sided, letter size) with materials used to prepare for midterm exams will be allowed. For the final exam two sheets are allowed. Shared or copied preparation sheets, as well as use of any 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.

Projects (team)	5%
Homeworks	10%
Quizzes	15%
Midterm #1	20%
Midterm #2	20%
Final Exam	30%
	100%

Percent	Grades
above 90%	A
75-90%	B/B+
60-75%	C/C+
50-60%	D
below 50%	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 50% will receive an F. Students whose grades cluster between approximately 75% and 90% 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 75% and 60% 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 50-60% are considered near-failing, and a D will only be given sparingly, based upon observed student effort. A student with a grade in the 50-60% range who shows minimal effort may be given an F.

Important Dates

- Midterm exam #1: Oct. 15th, 2019
- Midterm exam #2: Nov. 19th, 2019
- Final exam: between December 14 and 20, 2019
- Withdraw Deadline: November 11, 2019

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 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

- Attendance is strongly recommended. Attendance sheet has to be signed at the beginning of each class. The examples discussed in the class are not necessarily from the main textbook and therefore missing a class will have consequences for preparation to quizzes and exams.

- The classes start at 1 PM, and the students must be in class by that time. Being late to class may have consequences for the grade, since many of the classes will start from quizzes.
- Electronic devices other than calculators (laptops, tablets, cell-phones etc.) are not permitted during the classes. No audio or video recording is allowed.
- Cellphones should be turned off during both lectures and exams and not allowed under any circumstances.
- Laptops will be permitted only if necessary for class activities.
- No eating any time during the classes.

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.
- The students have to upload a professional-looking head shot for their Canvas profile.
- The 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 be disputed during the official Office Hours, not during class time or via email.
- The graded exams must be returned within a week to be saved for the department course assessment initiative. If a student does not return the exam, the grade for this exam is zeroed.
- 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 as many details when solving a problem during an exam of a quiz. Not showing the work will cause losing points even if the final answer is correct.
- Partial credits can be given for solving the exams problems.
- No partial credit will be given if there is 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.
- There will be no partial credits for the questions/problems on quizzes.

- If a student misses a quiz due to a legitimate reason (absence approved by the Dean of Students), this quiz is excluded from the calculation, and the weights of the quizzes are scaled proportionally.
- Student handwriting must be legible in order to receive points.
- A student coming to dispute a grade has to bring completed homework sheets. No discussion of grades will be held without completed homework.

Homework Format: WARNING! failure to observe the following homework conventions will result in an automatic penalty of 25% of that homework's value.

- Staple a cover sheet (does not need to be engineering paper) with your name, the date and the homework assignment number as the first page of each homework set.
- 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 in pencil. 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.