ChE 472: Process and Plant Design
Spring 2020

Instructor: Dr. Nellone Reid, Senior University Lecturer
Office: 364 Tiernan Hall, Phone: 973-596-2995, E-mail: nellone.e.reid@njit.edu
TA: William Ho (wh258@njit.edu); Sangah Kim (sk2656@njit.edu)
Class: ChE 472 102/HM4: Monday, 5:45 - 9:35 PM, Room: Tier 411
ChE 472 002/HM2: Wednesday, 10:00 AM - 1:15PM, Room: Tier 411
Office Hours: Tuesday, Wednesday, 2:30 PM - 4:30 PM

Course Description and Requirements

Process and Plant Design is the capstone course in Chemical Engineering, involving an open-ended process design project, including process simulation, equipment specifications and economics. Each student will be expected to bring all knowledge acquired in previous coursework (mathematics, physics, chemistry, thermodynamics, unit operations, reaction engineering, etc.) and apply it to this class.

Course Objectives

1. Develop improved understanding of the basic building blocks of process design, as well as their implementation in steady state process simulation tools
2. Design a given process (or parts of) including the selection and sizing of processing equipment and material of construction to meet desired needs and specifications within constraints.
3. Perform capital and operating cost analysis (cash flow, profitability analysis etc.) for a given project
4. Develop interpersonal project management/team work skills.
5. Deliver a successful written report and oral presentations that communicates technical results from a given process design project.
6. Evaluate a process's safety, health, and environmental impacts.

Learning Materials

Textbook Required: Chemical Engineering Design - Principles, Practice and Economics of Plant and Process Design (2nd edition) by Gavin Towler, Ray Sinnott, Elsevier (2013)
ISBN- 9780080966595)

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

Software: ASPEN PLUS, Microsoft Excel, Microsoft Visio, Microsoft PowerPoint

Assessment and Grading

Assignments:
All assignments will count equally. Reports demonstrating attention to detail and organization, as well as research invested into attaining a deeper understanding of a problem and its solution, will tend to score higher. Collaboration aimed at investigating / cross-teaching is encouraged. However, plagiarism will be dealt with harshly, per the Academic Integrity policy explained below.

Assignments/Groupwork	35%
Exams	20%
Final Presentation	15%
Final Project	30%

Each assignment will be graded according to the following criteria:

- Title / Table of contents / Keywords
- Theory / background research
- Governing equations and mathematics
- Results, Analysis and conclusions
- Recommendations
- Comprehension / out-of-box thinking
- Graphs and visual aids
- Appendix
- Adherence to format
- Organization, language, clarity

Quality of work in each item of the criteria matters. Accordingly, just the inclusion in the report, of a particular item from the above template, does not ensure a full score on that item. Also notice the deliberate overlap between several items in the template, and that some of items emphasize planning and awareness. It is evident that well-defined approach to assembling the report, along with a strong technical effort, will merit a high score on an assignment.

Final Project: Final Project grading will be heavily based on the effective and judicious use of process simulation tools and self-developed excel spreadsheets for equipment sizing and economic evaluation, and others:

- Entering components appropriately and entering conditions/stream properties correctly
- Selecting appropriate thermodynamic/physical properties method(s)
- Obtaining not just converged, but correct/appropriate solutions for a given problem
- Present (written and oral) overall stream tables using requested units of measurement
- Develop block flow diagrams, process flow diagrams and piping and instrumentation diagrams
- Develop economic assessments for a given process

A final project report will consist of the following items (detailed handout will be provided):

1. Title Page
2. Table of Contents
3. Executive Summary
4. Introduction - referencing project scope and constraints required as appendices
5. Project Description and Background
6. Project Premises and Constraints
7. Approach
8. Process Flow Diagram (PFD)
9. Stream Attributes
10. Process Description
11. Safety
12. Environmental
13. Utility Summary
14. Operating Cost Summary
15. Equipment Information Summary
16. Capital Estimate
17. Economic Analysis
18. Innovation and Optimization
19. References
20. Appendices
21. Group Charter
22. Project Description (given)
23. Constraints (given)
24. Hand Calculations
25. Computer Programs
26. Computer Process Simulations

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.

Course Outline

Week	Topic
1	Introduction
2	Process Flowsheet Development
3	Utilities and Energy Efficient Design
4	Process Simulations
5	Instrumentation and Process Design
6	Materials of Construction
7	Exam 1
8	Capital Cost Estimation
9	Estimating Revenues and Production Cost
10	Financial Operating Model
11	Safety and Loss Prevention
12	Exam 2
13	General Site Considerations
14	Last Day of Class; Open
15	Final Presentations/Reports

Specific goals for the course

The student will be able to

1. perform literature review and market analysis on assigned chemical processing industry.
2. prepare heat and mass balances over an integrated continuous process by hand.
3. develop a simulation model to generate heat and material balance of a process, including utility consumption and design of heat exchanger, reactor, and pipe sizing.
4. conduct preliminary feasibility study of the plant design assigned.
5. address complex engineering problems involving wide-ranging or conflicting technical issues, no obvious solution, problems not encompassed by current standards and codes, or involving diverse groups of stakeholders.
6. produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
7. formulate economic analysis based on the calculated capital cost estimation and annual operating cost.
8. identify interrelationship between equipment in the process, economic analysis, process/equipment constraints, and optimization methods to obtain optimum solution.
9. communicate research, calculations, simulations, results and conclusions via oral and written text, equations, graphical data presentation, drawings, and computer display of results.
10. identify effects of particular chemical process on political, social, legal, environmental, health, safety, loss prevention, cultural, and demographic situations.
11. apply the concepts of hazard and risk to the analysis of chemical processes, infrastructure, plant site, etc., informed by engineering ethics.

12. lead/participate the main tasks and project scheduling while learning to work in teams.
13. function professionally and behave ethically.

This course explicitly addresses the following student outcomes: 1, 2, 3, 4, 5, 7

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
• Cell phones 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 are strongly encouraged to attend Office Hours held bi-weekly. 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 "ChE472" 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.

Written Reports

The written reports are to be prepared to professional standards. The title page must show the names of all team members, along with their email addresses. The report title includes the name of the design project and the specific contents of the report. The appendices should incorporate all pertinent information not included in the body of the report, including but not limited to the project description, scope,

constraints, and program code. The final report should be bound in an inexpensive folder. Written reports that are unacceptable must be rewritten until they are acceptable. Occasionally students ask to rewrite reports to improve their grade. This may be permitted at the discretion of the instructor. If a report is rewritten for any reason, the final grade for the report will be the average of the grade originally assigned and the grade assigned after rewriting.

Exams 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.
• Students will get 0 for not showing to 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 this case of official approval from the Dean of Students' office, may a makeup be given at the discretion of the instructor.
• A student must show as many details when solving a problem during an exam. 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 quizzes.
• 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 assignment