Chemical and Biochemical Engineering 427 (14:155:427)
Chemical and Biochemical Engineering Design and Economics I
Fall 2016 (3 credits)
Lectures: (A) Monday 5:00 – 6:20 pm (BME-102 – Prof. Celik)
(B) Wednesday 6:40 – 8:00 pm (FBO-EH AUD – Dr. Sen)

Instructors: (A) Professor Fuat E. Celik (C-215 Engineering, 5-5558, fuat.celik@rutgers.edu)
Office hours: Mondays 3:30 – 5:00 pm, after Monday class, and by appointment

(B) Professor Sabyasachi Sen (sabyasachi.sen@rutgers.edu)
Office hours: Wednesdays 8 – 9 pm (FBO-EH AUD)

TAs: Clara Hartmannshenn (ch735@scarletmail.rutgers.edu)
Office hours: @ C-254 Mondays 1:30 – 13:30 pm

Nirupa Metta (metta.nirupa@gmail.com)
Office hours: @ C-254 Wednesdays 2 – 4 pm and by appointment

Course info: https://sakai.rutgers.edu

Text: M. S. Peters, K. D. Timmerhaus and R. E. West, Plant Design and Economics for Chemical Engineers, 5th Edition, McGraw-Hill Book Company, New York (2003).

Class meeting locations / times (unless otherwise announced):
(Part-A) Mondays 5:00 – 6:20 pm (BME-102 – Prof. Celik)
(Part-B) Wednesdays 6:40 – 8:00 pm (FBO-EH AUD – Dr. Sen)

Tentative Class Schedule (Fall 2016)

	Part-A (Mondays)	Part-B (Wednesdays)	Presentations (Part-A)
September	12*, 19, 26	7, 21, 28	
October	3, 10, 17, 24, 31	5, 12, 19, 26	
November	7, 21, 28	2, 9, 14§, 16, 30	
December	5		7, 12, 14

Note(s):
* Double lecture (5-8 pm) on Monday 12th Sept. (no class on 14th Sept.)
§ 14th November is a Monday

Software & computers: For both parts of the course, you will use the aspenONE suite of process design and analysis software (which includes ASPEN PLUS and cost estimation software), currently installed in Microlab I and Microlab II (C-233, C-241), DSV (B-125), and EIT (D-110) computer labs. Additionally, you will also use Microsoft Excel and MATLAB.

ASPEN PLUS installation files and instructions are available on Sakai under resources. You may install the aspenONE software suite (including ASPEN PLUS) on your personal Windows computers for the duration of the academic year. You will configure ASPEN PLUS to connect to the on-campus license server for authentication. (Note: Although not officially supported by Aspen Technology on Windows10, aspenONE software suite can be configured to run on Windows10, including Windows emulation of Mac computers.)

Course description: This is the first of a two-semester course (155:427 & 428) that covers the principles of process and product design, and economic considerations for building and operating chemical or biochemical plants, employing basic principles and modern computer software.

Course objectives: This is the capstone course, which utilizes the fundamentals of chemical and biochemical engineering (material balances, energy balances, transport phenomena, thermodynamics, kinetics, separations, unit operations, control, and safety) in the design and operation of chemical/biochemical plants. The course introduces the concepts and methods of plant design and economic evaluation: planning, cost estimation, fixed capital investments, working capital, production costs, depreciation, rate of return, profitability analysis, discounted cash flow analysis. Students will use state-of-the-art computational tools for process flow design (steady-state process simulation) and economic evaluation.

The expectation for this design project is that each team will assemble a **working simulation** of a chemical process plant of **their own design** for the topic selected. That Aspen process flowsheet will model the unit operations necessary to convert raw materials into finished products. To the greatest extent possible, the models for the unit operations must be physics- and chemistry-based, and all models must operate within the limitations of what is feasible in the real world. This requires understanding how the real world processes work, understanding how Aspen works, and fitting the available Aspen models to the real world processes in the simulation.

Prerequisites:
14:155:303: Transport Phenomena in Chemical Engineering I
14:155:307: Chemical Engineering Analysis II
14:155:324: Design of Separation Processes

Discussion Forum: This course will include the discussion forum feature available in Sakai for answering routine course and project related questions. All such questions should be addressed to the relevant thread in the forum, where the instructors will answer them, and all students will have access to the questions and answers. Any questions emailed to the instructor will not be answered unless also posted to the forum. Students are encouraged to ask questions in the forum and answer each other's questions.

Team Communication: Design project teams are required to communicate with each other via email, and must cc fuat.celik@rutgers.edu on all team project-related emails. These emails must include 16F427 in the title of the email for sorting purposes. E-mails should be written professionally. SMS text messages between team members will not be considered sufficient or satisfactory within the context of course requirements.

Course grade: The final grade will be split between parts A and B of the course. As the semester progresses (and for informational purposes only) grades for each part will be uploaded to the "Gradebook" section of the Sakai site. Additional details are provided below.

- Design project
    - Written Report 1 10%
    - Written Report 2 20%
    - Oral Presentation 25%
- In-Class Design Memos 10%
- Take-Home Assignments 35%

Grades for assignments will be uploaded to the "Gradebook" section of the Sakai site. This is for informational purposes, and only the weighting above will be used for determining the course grade.

Design Project: The focus of the course is design, cost estimation, and profitability analysis of a complete chemical/biochemical process plant that you selected in the previous semester. Together with your group, you will work jointly in carrying out the technoeconomic analysis, including material and energy balances and plant economics, and prepare the final report.

Written Report 1: Literature review and block flow diagram: You will prepare a properly cited document detailing the real-world operation of the different technologies you will use in your processes. Be as specific as possible. You will organize the discussion with the help of a preliminary block flow diagram that will lay out the major process unit operations of your plant. It is not necessary to discuss the simulation of the processes at this point. Written Report 1 is due (on Sakai) at 11:59 pm on Monday, October 17th.

Written Report 2: Material and Energy Balances. The most important element of the second written report is the detailed process flow diagram, including mass and energy balances, and atom balances on the overall plant. This report will detail the Aspen simulation strategy that you have used to capture the real-world processes described in the first report.
The plant design will be preliminary as of this report. You will be responsible for having realistic models of your major process equipment.
The report should include a description of each process island and a summary of the design strategy (for each process unit and how they are arranged). Process variables should be summarized as tables. Stream tables should be included in the appendices. Written Report 2 is due (on Sakai) at 11:59 pm on Friday, December 9th.

Oral Presentation: Each group will present their real-world process and their simulation to the class. Presentations will take place Wednesday, December 7th, Monday, December 12th, and and Wednesday, December 14th.

The following are critical to your success in the design project:

1. Begin early and work at a steady pace. The project is a significant time requirement and you will accomplish more by working on it every week.

2. Act as a team. The project has several components and steps. It is best for all team members to contribute to each stage of the project and be knowledgeable of the overall process. Consider assigning each team member one or two sections of the process flow sheet so that each member gets experience with Aspen, cost estimation, plant design etc.

3. Utilize the textbook, the handouts, the library, the computer, the TAs, and the professor as sources of information for this project.

4. Communicate early and often. If you have questions or difficulties with any aspect of the course or project, communicate with Prof. Celik as soon as possible so solutions can be sought. If you have any questions or concerns regarding your team work dynamic, you must bring them to my attention immediately.

5. Your team effectiveness will be evaluated using CATME tools and poor contribution to your team's effort may negatively impact your grade.

Design Memos: In-class assignments will consist of design memos – short team problem solving activities on chemical engineering design. Teams will be assigned. Each team will select a team leader, who will write up the memo (normally collected at the end of class). You must be in class during attendance in order to receive credit for the Design Memo

Take-Home Assignments: The deliverable for each assignment will be in electronic format, uploaded to Sakai. Typically, all write-ups, drawings / images, tables, etc. must be consolidated into a single <.pdf>, arranged in a meaningful order and preceded by a "Table of Contents". Work done by hand must be scanned and inserted into the PDF as an Appendix with appropriate references, as necessary. In the event additional files need to be submitted (e.g., Excel, MATLAB, simulation files), they must also be uploaded to Sakai.

The filename for the submissions should follow:

Assignment #_Assignment Name_Last Name_First Name.pdf

Additional details of formats and filenames of the deliverables will be communicated separately with each assignment via Sakai.

Take-Home Assignments will be completed and graded individually. 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. You are welcome to work together on solving the problems, but any and all components of the submission must be generated by each individual in the class, and files, images, tables, and graphs may not be reused.

There will **five** take-home assignments.

Plagiarism or academic dishonesty of any kind will not be tolerated.