CHE 480: Chemical Process and Plant Design*
Units: 4
Spring 2022

Location: Taper Hall (THH) 116

Instructor: Maria Balmas
Office: XXX
Office Hours: Will be posted in Blackboard
Contact Info: email: XXX (preferred) phone: 714 732 9736

TA: XXX
Office Hours: Will be posted on BlackBoard/SLACK
Contact Info: XXX

Course Producer/Grader: TBD
Office Hours: Will be posted on BlackBoard/SLACK
Contact Info: tbd

IT Help: Viterbi IT
Services Hours of Service: Normal: M-F 8a to 5p
Other time limited to server and infrastructure support
Contact Info: email: engrhelp at usc.edu
Phone: 213-740-0517
Walk-in: DRB-20

*Credit to Dr. Robert Young for helping/providing past instruction materials for this course.

Course Description
This is the senior chemical engineering design course. The students will design a chemical process/plant using the concepts and skills developed in the chemical engineering curriculum. Process/plant design problems are drawn from representative chemical, petroleum, bio-chemical and related industries.

Expected Learning Outcomes
In Process and Plant Design, students are expected to demonstrate that they are capable of the following:
• Design a chemical process/plant to meet stated specification using:
  - The engineering, science, and math skills learned during their academic career;
  - The learning skills to research material that has been explicitly taught in their coursework (life-long learning skills);
  - Teamwork and Project Planning/Scheduling skills; and
  - Problem solving and analysis skills to define the requires for the design problem, understand what information is needed and methods to solve problems and analyze solutions for quality.
• Estimate capital and manufacturing costs and perform economic analysis suitable for decision making.
• Analyze alternatives based on data and make recommendations based on the data and analysis.
• Communicate the results of their design and analysis in both written and verbal forms.
• Conduct a hazard/safety for their process/plant design.
• Communicate appropriate decision making and conduct for professional activities consistent with the engineering code of ethics.

Prerequisite(s): CHE 485
Co-Requisite(s): none
Concurrent Enrollment: none

Recommended Preparation: Students are expected to be able to formulate conservation balances for fluid mechanics, heat transfer and mass transfer and use these along with chemistry, reaction kinetics, and thermodynamics to solve chemical engineering problems. This includes

1. Set-up and solve macroscopic mass and energy balances
2. Size piping networks, valves, pumps, compressors, and flow meters for simple and branched flow systems.
3. Determine heat transfer coefficients and size heat exchangers
4. Calculate physical and chemical equilibrium for ideal and non-ideal systems
5. Size various separations systems, specifically distillation, absorption, adsorption extraction, and membrane separation processes.

6. Analyze various reaction systems and size chemical reactors for specific reaction systems. Additionally, students are expected to possess basic computer skills to
7. Use process simulation models to model flow sheets. 8. Write reports and make oral presentation

Course Notes
Grading is by letter grade. Course information is distributed via Blackboard and via email. Typically, assignments are submitted electronically with specifics provided in the in the assignment or on the course calendar or handed out during class sessions.

Technological Proficiency and Hardware/Software Required
Students will need to be able to access materials from Blackboard and use materials available on-line through the USC Library. Students will need to be able to access materials from Blackboard and use materials available on-line through the USC Library. Blackboard will be used to post assignments, post materials to be used by students in the course, and for the Instructor to communicate to the class.

This course requires significant independent learning. You will need to be able to make use of the USC library resources. Additionally, the students will need to use Excel, Matlab, AVEVA simulation, PRO/II, and SuperPro Designer (or similar process simulation/design software). AVEVA Simulation, PRO/II and SuperPro Designer are available on the Viterbi MyDesktop (VDI). It is also possible that student may want to use Microsoft Project and Visio as part of their work also available on Viterbi MyDesktop or for download via Viterbi ITS.

Required Readings and Supplementary Materials:
There is no required course textbook. Necessary materials for instruction will be supplied by the Instructor.

The following are reference materials that students may also find the useful (available on-line at USC Libraries):

- Gavin Towler and Ray Sinnott, **Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design**, (2nd Edition), Elsevier, Amsterdam (2013), ISBN 13: 978-0-7506-8423-1.
- Couper, Penney and Fair; **Chemical Process Equipment Selection and Design** (3rd Edition), Elsevier, Amsterdam (2012) ISBN (print) 9780123969590 (ebook) 9780123972361.
- Green and Perry; **Perry's Chemical Engineer's Handbook**.
- Peters, Timmerhaus, and others: **Plant Design and Economics for Chemical Engineers**
- Turton and Shaeiwitz; **Chemical Process Equipment Design** (1st edition), Prentice Hall (2017), ISBN-13: 978-0133804478.
- Woods, D, **Rules of Thumb in Engineering Practice**
- Smith, R: **Chemical Process Design and Integration** (2nd Edition)

Description and Assessment of Assignments

Process Design:

The course will be taught per the principles of industry project execution which is normally broken down in various phases. Like in major industries, the final product of the in-house engineering design team (Your Team) is the process design package (PDP). To ensure that the project team is following the design requirement, project deliverables will be reviewed at certain milestone. These deliverables include: A Technology Evaluation, a Project Plan and Schedule, a Preliminary Design Report, the Final Design Report and Project Presentation. The required project update meetings will be scheduled during the week group meetings held during the group specific discussion time.

Process Economics:

As part of this course, students will learn to evaluate the cost and economics of projects. There is some homework associated with this part of the course as well as a mid-term exam.

Process Safety:

There are in-class workshops. A team assignment will be given for this topic.

The project in the course represents a significant amount of work outside of lecture. The project is completed in groups of 6 students per group.

Grading Breakdown

Design Project	
Alternatives Evaluation	5%
Project Plan	5%
Flowsheet Status Report	5%
Preliminary Report	10%
Final Report	30%
Final Presentation	10%
Process Safety Competency	10%
Mid-Term Exam	15%
Other Items:	10%
Homework and other In-Class Exercises	
Group Peer Evaluation	

Note that each member of the group typically receives the same score for assignments completed as a group. The instructor will adjust in cases where the instructor identifies that one or more group members is not contributing to the work product.

Group Peer Evaluation:

Each group member will evaluate the contributions of their team-mates.

Assignment Submission Policy
Assignments will be submitted electronically. The details will for the electronic submission will be provided on Blackboard. These requirements will also be specified in the assignment. If possible, a printed copy of the final design report will need to be submitted but that will be determined later in the semester

Assignments must be neatly presentable and easy to understand and evaluate. Work that is hard to read or poorly presented in the opinion of the instructor will not be graded.

You will receive credit for submitting completed homework assignments and homework solutions will be provided so that you can determine how well you did on the assignment. Homework is intended to provide you with practice problems to prepare to for the mid-term and to enable you to succeed on the project.

Late work is not accepted. If you think you are going to miss submitting an assignment by the due date, communicate the instructor as early as possible. There are three dates that will be hard deadlines – The preliminary project report, the final project report and final presentation. Specifically, for the preliminary and final design reports, submissions will be penalized at a rate of 1% of credit/minute that the submission is late.

Grading Timeline
Every effort is made to provide feedback within 10 days of when the assignment is submitted.

Additional Policies
Classroom Norms
As course instructor

- I will come prepared to present the material for the course and work problems in lecture to assist students in learning.
- I will make the effort to learn everyone's name – this is a challenge and will be more so with remote lectures/office hours.
- I will respect all questions asked by students, but I may reserve the right to ask to answer questions later or in a one-on-one discussion.
- I recognize that you have many competing priorities and will not hold it against you if you are not able to attend class upon occasions.
- If I don't know the answer, I will get back with you with a thoughtful answer.
- I will attempt to provide a diverse learning environment so that student with different learning styles can be successful in the course.
- I do set high standards because I want to see each student succeed in the course and as an engineer

As students,

- I expect that you will make a solid effort in the course. This means attending lectures, coming to prepared for lecture having watched/read the preparation materials,

participating in lecture discussions, and attempting to do the workshops, submitting your own work product.
- I do not judge students based on their questions so you should ask questions to clarify your understanding of the material.
- While I understand grades are important, understand the material and being able to use the material should be every students' goal. This understanding means more than just knowing the formulae/math to solve problems.
- I also expect you to respect your fellow students, contributing equally to group assignments (don't hitchhike on assignments, workshops, or laboratories).
- If other students are waiting to ask questions when you are having significant problems understanding the material, try to be respectful of their time and consider asking for different time to ask more extensive questions.

Finally, if you think I don't know your name or am pronouncing it wrong, help me by letting know what you want to be called and how to pronounce it. Also, if you have a concern, I ask that you approach me, and we will work though and attempt to mutually resolve your concern.

Bottom line, my goals is to see each of you be successful students and, in the future, engineers. I would like is course to provide a respectful and open environment for learning.

Technology in Lecture

The use of technology in lecture is permitted as so long as it is being used for course purposes and does not distract your learning experience. Technology is used to work problems in lecture. However, if it is apparent that technology is being used for non-course purposes and becomes a distraction to the instructor or other students, the instructor will ask that it be shut down. If this occurs multiple times, the instructor will speak to the student outside of lecture to determine an appropriate course of action including the loss of credit towards the student's grade

Attendance

As seniors, the students are expected to make their own choices about attending lectures. Missed in-lecture workshops/exercises cannot be made-up.

Academic integrity and Professional Ethics

Professional behavior will be an essential aspect of your engineering career. You have been observing an important standard for ethical behavior since joining USC. We will continue to observe the academic integrity policies in this course.

> *The School of Engineering and the Department of Chemical Engineering adhere to the University's policies and procedures governing academic integrity as described in SCampus. Students are expected to be aware of and observe the academic integrity standards described in SCampus.*

As engineers you will be professionals expected uphold the profession behavior set out by the National Society of Professional Engineers and AIChE. You can find the ethical code of conduct statements at the NSPE and AIChE websites – you should consider reading them.

Sharing Course Materials Outside of the Learning Environment

USC has a policy that prohibits sharing of any synchronous and asynchronous course content outside of the learning environment.

> *SCampus Section 11.12(B) Distribution or use of notes or recordings based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study is a violation of the USC Student Conduct Code. This includes, but is not limited to, providing materials for distribution by services publishing class notes. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relationship to the class, whether obtained in class, via email, on the Internet or via any other media. (See Section C.1 Class Notes Policy).*

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, "Behavior Violating University Standards" https://policy.usc.edu/scampus-part-b/. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Support Systems:

Student Counseling Services (SCS) - (213) 740-7711 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. https://engemannshc.usc.edu/counseling/

National Suicide Prevention Lifeline - 1-800-273-8255

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. http://www.suicidepreventionlifeline.org

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 - 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender-based harm. https://engemannshc.usc.edu/rsvp/

Sexual Assault Resource Center

For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: http://sarc.usc.edu/

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086
Works with faculty, staff, visitors, applicants, and students around issues of protected class. https://equity.usc.edu/

Bias Assessment Response and Support
Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. https://studentaffairs.usc.edu/bias-assessment-response-support/

The Office of Disability Services and Programs
Provides certification for students with disabilities and helps arrange relevant accommodations. http://dps.usc.edu

Student Support and Advocacy – (213) 821-4710
Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. https://studentaffairs.usc.edu/ssa/

Diversity at USC
Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. https://diversity.usc.edu/

USC Emergency Information
Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible, http://emergency.usc.edu

USC Department of Public Safety – 213-740-4321 (UPC) and 323-442-1000 (HSC) for 24-hour emergency assistance or to report a crime.
Provides overall safety to USC community. http://dps.usc.edu