CHE 423/424 Engineering Design VII/VIII Syllabus (2024F-2025S)

Couse Description:

Senior Design provides, over the course of two semesters, collaborative design experiences with problems of industrial or societal significance. Projects can originate with an industrial sponsor, from an engineering project on campus, or from other industrial or academic sources. In all cases, a project is a capstone experience that draws extensively from the students' engineering and scientific background and requires independent judgments and actions. Advice from the faculty and industrial sponsors is made readily available. The projects generally involve a number of unit operations, a detailed economic analysis, simulation, use of industrial economic and process software packages, experimentation, and/or prototype construction. The economic thread initiated in Design VI is continued in Senior Design by close interaction on a project basis with IDE 401/IDE 402. Leadership and entrepreneurship are nourished throughout all phases of the project. The project goals are met stepwise, with each milestone forming a part of a final report with a common structure.

Student Outcomes – Course Learning Outcomes:

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SO7 (Ability to Learn) – CLO1: Students are able to identify a socially or industrially significant problem and define design scope through literature search and review.

SO4 (Ethical & Professional Conduct) – CLO2: Students are able to prepare an agenda for a weekly team meeting, participate in discussion on agenda items, summarize team discussion in the meeting minutes, and incorporate conclusions from the meeting into an action plan to accomplish project tasks.

SO5 (Teamwork & Leadership) – CLO3: Students are able to function on a team, provide leadership, and create a collaborative and inclusive environment to address a design problem by establishing a goal, planning tasks, and meeting objectives.

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SO8 (Entrepreneurial Thinking) – CLO1: Students are able to analyze and optimize the economics of a conceptual chemical engineering design for potential industrial collaboration and commercialization.

SO2 (Design) – CLO2: Students are able to apply the basic chemical engineering concepts, tools, methods as well as industrial codes to design chemical engineering units and

systems and to develop and assess alternative designs incorporating considerations such as economic feasibility, safety, environmental regulations, and societal impacts.

SO3 (Communication) – CLO3: Students are able to prepare a professional Power Point presentation, effectively deliver the presentation to a wide range of audiences, and quickly address audience questions about the project.

Senior Design Roadmap:

Timeline	SD Tasks	Student Outcomes	Assessment Tools	IDE Topics
Phase I (Define)	Design requirements Applicable codes, standards, regulations	SO7 Ability to learn	Literature review	Mission statement Stakeholders & needs needs analysis
Early October	Milestone #1: Customers, Needs, Requirements, Needs-Requirements Mapping			
Phase II (Innovate)	Concept generation Design evaluation frameworks: with modeling, testing, prototyping	SO4 Ethical & professional conduct	Team meeting agenda & minutes	Project schedule Canvas business plan
Mid November	Milestone #2: Project Plan, Concepts, Concept Selection, Analysis and Testing Plan			
Phase III (Design)	Design – analysis – redesign loop using simulations and prototypes	SO5 Teamwork & leadership	Term PPT presentation	Competitive intelligence Financial analysis
Late January	Milestone #3: Design Performance and Cost Review with Alpha Prototype Demonstration			
Phase IV (Optimize & Demo)	Design optimization and prototype refinement (More design loops)	SO8 Entrepreneurial thinking	Economic analysis	Intellectual property evaluation Pitch presentation preparations
Late March	Milestone #4: Optimized Design with Beta Prototype Demonstration			
Phase V (Document)	Design documentation, design rationale, BOM and all specifications	SO2 Design SO3 Communication	Design report Final PPT presentation Poster Presentation	Invention disclosures Innovation expo preparation
Last Week of Classes	Milestone #5: Final report submission, Innovation Expo.			

General Course Information:

Course Instructor (Coordinator): Yujun Zhao (yzhao@stevens.edu)

Textbook (Option): Product and Process Design Principles, Warren D. Seider, et al., 3rd Edition, John Wiley & Sons, Inc., ISBN 978-0-470-04895-5

Course Work: Capstone Chemical Engineering Process Design or Product Design Projects

Project Advisors: A Lawal, A Hensley, B Paren, J Gissinger, J Kim, M Libera, P Akcora, P-K Lai, Y Zhao

Instructional Format: Class Meetings, Weekly Team Meetings, Semester-End In-Class Presentation, Innovation Expo Poster Presentation

Meeting Pattern: Tuesday & Thursday 2:30PM-4:20PM

Classroom: Babbio 321 for CHE 423, TBA for CHE 424

Deliverables: Student Outcome Assessment Tools for ABET accreditation (To be submitted as assignments in CHE 423 & CHE 424 Canvas shells)

Grading Policy: Grades are to be given by project advisors.

Class Meeting Schedule:

CHE 423

Sep. 3rd (T), 2:30-3:30 PM, Babbio 321: Course Introduction

Sep. 17th (T), 2:30-3:30 PM, Babbio 321: Library Research Resources (by Librarian Victoria Orlofsky)

Dec. 10th (T), 2:30-4:30 PM, Babbio 321: Term Presentations

Dec. 12th (R), 2:30-4:30 PM, Babbio 321: Term Presentations (Cont.)

CHE 424

Apr. XX (T) 2025: Final Presentations

Apr. XX (R) 2025: Final Presentations (Cont.)

End of April 2025: Innovation Expo Poster Presentations

Team Meeting Schedule:

Each team should reach out to the project advisor ASAP to set up the first team meeting with the advisor for Sep. 5th (R) 2:30PM-4:20 PM and a general team meeting schedule.

2024-2025 Senior Design Projects & Teams:

Advisor	Project	Students	#
Pinar Akcora	Manufacturing Crosslinked Cellulose-Based Polymeric Ion Exchange Membranes	Anthony Addeo, Brian Galasso, Bryan Valerio, Kirk Kinzler	4
Jacob Gissinger	Molecular Modeling of Chemical Synthesis Processes	Meredith Carson, Matthew Hartzler, Nicole Pereira, Jake Porco	4
Alyssa Hensley	Green H2 Production from Biorefinery Waste Streams via Catalytic Aq Phase Reforming	Julia Munger, Sarah Pasqualetto, Anthony Migliaro, Daisy Morgan	4
Jae Chul Kim	Rejuvenating Spent Lithium-Ion Battery Cathode Materials	Lina Caggiano, Erica Strojny, Leia Tam, Adriana Aguirre	4
	Designing Functionalized Fiber Constructions for Batteries	Daniel Caracitas, Christopher Lydon, Blaise Wagner	3
Pin-Kuang Lai	Machine Learning for Molecular Design	Keerthika Mohan, Katelyn Connelly, Joyce Sundo	3
Adeniyi Lawal	Synthesis of Sustainable Aviation Fuels Derived from Algal Oil	Brian Katat, Luke Manzutto, Dennis Wolownik	3
	Ultrasonic atomization (Interdisciplinary)	William Allen, Nate Dawson (EE)	2
Matthew Libera	Aerosolizing System to Mimic Bacterial Contamination in the Operating-Room Envir	Gaby Campos, Nicholas Focarazzo, Jennifer Gonzales-Pasion, Gabriel Costa	4
Benjamin Paren	Ion Transport in Polymer Electrolytes	Stevensky Mertyl, Angelie Saucedo, Sara Wolf, Yea Chai	4
Yujun Zhao	A Vaccine Product Process Design	Olivia Kain, Katie Kunz, Charlotte Lee	3
	Blue Hydrogen Production Process Design	Sara Hoffer, Hannah McCormick, Urja Patel, Danielle Wojcik	4