CHEMICAL AND BIOLOGICAL ENGINEERING (CBE)

CBE 1 – COOPERATIVE EDUCATION PROGRAM
1 credit.

Work experience which combines classroom theory with practical knowledge of operations to provide students with a background upon which to base a professional career.
Requisites: Sophomore standing
Course Designation: Workplace - Workplace Experience Course
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2026
Learning Outcomes: 1. Identify and respond appropriately to real-life engineering ethics cases relevant to co-op work
Audience: Undergraduate

2. Synthesize and apply appropriate technical education to real world technical work
Audience: Undergraduate

3. Communicate effectively in writing and speaking with a range of audiences in the workplace, including those without disciplinary expertise
Audience: Undergraduate

4. Develop professional and transferable habits like time management skills, collaborative problem-solving skills, and research skills for learning new information
Audience: Undergraduate

CBE 150 – INTRODUCTION TO CHEMICAL ENGINEERING
1 credit.

Overview of the field of chemical engineering, including types of careers, industries, and skills required for successful completion of the degree and entry into the chemical engineering profession.
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. describe industries and career paths available to B.S. chemical engineers
Audience: Undergraduate

2. describe skills required for successful completion of the chemical engineering degree program, and entry into the chemical engineering profession
Audience: Undergraduate

CBE 250 – PROCESS SYNTHESIS
3 credits.

An introduction to the invention of processes for the large scale, low cost processing of materials such as water, chemicals, petroleum products, food, drugs and wastes.
Requisites: CHEM 116, 329, or concurrent enrollment
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Create and interpret simplified chemical process flowsheets
Audience: Undergraduate

2. Apply mass and energy balances to chemical processes and unit operations
Audience: Undergraduate

3. Use phase equilibrium data and equations to calculate performance of simple separation processes
Audience: Undergraduate

4. Use reaction equilibrium concepts to calculate the performance of simple chemical reactors
Audience: Undergraduate

CBE 255 – INTRODUCTION TO CHEMICAL PROCESS MODELING
3 credits.

Introduction to modeling of chemical processes and introduction to using modern computational tools to analyze the models.
Requisites: (CBE 250 or concurrent enrollment) and (MATH 319, 320, 376, or concurrent enrollment)
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Use modern computational software for numerical problem solving
Audience: Undergraduate

2. Explain concepts for numerical problem-solving strategies including logic statements and DO loops
Audience: Undergraduate

3. Use programming tools to solve systems of equations relevant to chemical engineering
Audience: Undergraduate

CBE 310 – CHEMICAL PROCESS THERMODYNAMICS
3 credits.

Introduction to thermodynamics, energy balances, applications to steady state and unsteady state processes, behavior of pure fluids, chemical reaction equilibria.
Requisites: (MATH 234 or 376), (PHYSICS 201, 207, 247, E M A 202 or M E 240), CBE 250, and (CBE 255 or concurrent enrollment), or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Describe the relationship between heat and work through the first law of thermodynamics
Audience: Undergraduate

2. Determine limitations imposed by the second law of thermodynamics on the conversion of heat to work
Audience: Undergraduate

3. Describe the definitions and relationships among the thermodynamic properties of pure materials, such as internal energy, enthalpy, and entropy

Audience: Undergraduate

4. Obtain or estimate the thermal and volumetric properties of real fluids
Audience: Undergraduate

5. Employ energy balances in the analysis of batch, flow, and cyclical processes, including power cycles and refrigeration
Audience: Undergraduate

CBE 311 – THERMODYNAMICS OF MIXTURES
3 credits.

Properties of ideal and non-ideal vapors and liquids, ideal and non-ideal multicomponent vapor-liquid and liquid-liquid equilibria, complex chemical reaction equilibria, electrolytic solutions, surface thermodynamics, solid phase thermodynamics.
Requisites: CBE 310
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Explain the terminology, theory and models that describe multicomponent, multiphase systems at equilibrium
Audience: Undergraduate

2. Explain the terminology, theory and models that describe chemical reacting systems at equilibrium
Audience: Undergraduate

3. Apply chemical thermodynamic principles to describe, analyze data, and predict properties of multicomponent systems at phase and/or chemical reaction equilibrium
Audience: Undergraduate

CBE 320 – INTRODUCTORY TRANSPORT PHENOMENA
4 credits.

Mass, momentum, and energy transport; calculation of transport coefficients; solution to problems in viscous flow, heat conduction, and diffusion; dimensional analysis; mass, momentum, and heat transfer coefficients; over-all balances; elementary applications.
Requisites: (PHYSICS 201, 207, 247, or E M A 201) and (MATH 319, 320 or 376), or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Setup and solve shell balances for conservation of momentum, energy, and mass
Audience: Undergraduate

2. Reduce and solve the appropriate equations of change to obtain desired profiles for velocity, temperature and concentration
Audience: Undergraduate

3. Reduce and solve appropriate macroscopic balances for conservation of momentum, energy and mass
Audience: Undergraduate

4. Utilize information obtained from solutions of the balance equations to obtain engineering quantities of interest
Audience: Undergraduate

CBE 324 – TRANSPORT PHENOMENA LAB
3 credits.

Determination of thermodynamic properties, transport properties, and transfer coefficients; study of related phenomena.
Requisites: CBE 310, (CBE 320 or concurrent registration), and STAT 324
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Conduct laboratory experiments using engineering lab practices
Audience: Undergraduate

2. Communicate experimental results through written and visual methods
Audience: Undergraduate

3. Apply macroscopic balances of mass, energy, and chemical species to analyze experimental data
Audience: Undergraduate

4. Design experiments for measuring transport properties
Audience: Undergraduate

CBE 326 – MOMENTUM AND HEAT TRANSFER OPERATIONS
3 credits.

Analysis of chemical engineering operations involving fluid flow and heat transfer. Flow of fluids through ducts and porous media; motion of particulate matter in fluids; general design and operation of fluid-flow equipment. Conductive, convective and radiative heat exchange with and without phase change; general design and operation of heat-exchange equipment.
Requisites: (CBE 310 and 320) or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Apply thermodynamics and transport phenomena to analyze and design process equipment used for fluid transport and heat transfer
Audience: Undergraduate

2. Explain the theory and design equations that describe common process equipment used for fluid transport and heat transfer
Audience: Undergraduate

CBE 355 – STATISTICS FOR CHEMICAL ENGINEERS
3 credits.

Concepts and techniques from statistics, data science, and machine learning applied to problems in chemical engineering. Random variables, estimation, statistical data analysis and learning, and decision-making under uncertainty.
Requisites: (MATH 234 or 375) and CBE 255
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Identify, formulate, and solve chemical engineering problems by applying principles and methods of statistics, data science, and machine learning
Audience: Undergraduate

2. Use principles of statistics, data science, and machine learning to analyze chemical engineering data, to develop models from data, to quantify uncertainty, and to make decisions under uncertainty
Audience: Undergraduate

CBE 424 – OPERATIONS AND PROCESS LABORATORY
5 credits.

Experiments in unit operations, and supervised individual assignments selected from areas such as: fluid dynamics, analytical methods, reaction kinetics, plastics technology, and use of computers in data processing and simulation.
Requisites: CBE 324, 326, 426, and 430
Course Designation: Gen Ed - Communication Part B
Repeatable for Credit: No
Last Taught: Summer 2025
Learning Outcomes: 1. Demonstrate knowledge of operation of common chemical engineering process equipment by conducting experiments on pilot-scale apparatus and analyzing data
Audience: Undergraduate

2. Take a novel project assignment, define an investigation, design and construct experimental apparatus, collect and analyze data, and present conclusions and recommendations in oral or written formats
Audience: Undergraduate

CBE 426 – MASS TRANSFER OPERATIONS
3 credits.

Analysis of chemical engineering operations involving mass transfer. Differential and stagewise separation processes; simultaneous heat and mass transfer; mass transfer accompanied by chemical reaction; general design and operation of mass-transfer equipment.
Requisites: CBE 311 and 320
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Describe major chemical process separations units
Audience: Undergraduate

2. Apply appropriate criteria for selecting among alternative separation technologies
Audience: Undergraduate

3. Complete design calculations for equilibrium staged separation processes (e.g., distillation, absorption)
Audience: Undergraduate

4. Complete design calculations for differential contactors
Audience: Undergraduate

5. Apply mass transfer fundamentals to calculate rates of mass transfer for practical situations and to identify rate-limiting processes
Audience: Undergraduate

CBE 430 – CHEMICAL KINETICS AND REACTOR DESIGN
3 credits.

Analysis and interpretation of kinetic data and catalytic phenomena; application of basic engineering principles to chemical reactor design.
Requisites: CBE 311 and 320
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Analyze kinetic data and determine rate laws
Audience: Undergraduate

2. Apply ideal reactor models to solve mass and energy balances for chemical reactors
Audience: Undergraduate

3. Analyze the performance of reactors in which multiple reactions are occurring
Audience: Undergraduate

4. Analyze non-ideal flow conditions in reactors and utilize simple models to characterize the performance of such reactors
Audience: Undergraduate

5. Analyze data for heterogeneous catalytic reactions and employ the results of such analyses in designing simple reactors
Audience: Undergraduate

CBE 440 – CHEMICAL ENGINEERING MATERIALS
3 credits.

Structure and properties of metallic and nonmetallic materials of construction; interrelations between chemical bonding, structure, and behavior of materials.
Requisites: CBE 310 and CHEM 345, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Describe how atomic-level composition, structure, and chemical bonding determine macroscopic properties of a material
Audience: Undergraduate

2. Explain the differences in functional properties among classes of materials
Audience: Undergraduate

3. Interpret the results of common materials characterization techniques
Audience: Undergraduate

4. Analyze phase diagrams and explain effects of processing conditions on material properties
Audience: Undergraduate

CBE 450 – PROCESS DESIGN
3 credits.

Analysis and design of chemical processing systems and equipment.
Requisites: CBE 326, 426, and 430
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Demonstrate integrated application of chemical engineering knowledge acquired in prior courses
Audience: Undergraduate

2. Solve a complex engineering design problem using modern computational tools
Audience: Undergraduate

3. Perform an economic evaluation of a chemical process and capital projects
Audience: Undergraduate

4. Use professional conventions and formats for representing engineering results
Audience: Undergraduate

CBE 470 – PROCESS DYNAMICS AND CONTROL
3 credits.

A systematic introduction to dynamic behavior and automatic control of industrial processes; lab includes instrumentation, measurement and control of process variables by using conventional hardware and real-time digital computers.
Requisites: CBE 326 and (CBE 430 or concurrent enrollment)
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Identify, formulate, and solve linear chemical process dynamics problems
Audience: Undergraduate

2. Use techniques, skills, and modern engineering tools necessary for the practice of chemical engineering
Audience: Undergraduate

3. Design and conduct laboratory experiments, as well as analyze and interpret data, in particular to determine the efficacy of control designs
Audience: Undergraduate

4. Design a control system to meet desired needs for a given process
Audience: Undergraduate

5. Communicate effectively, through laboratory experiences
Audience: Undergraduate

CBE 489 – HONORS IN RESEARCH
1-3 credits.

Undergraduate honors research projects supervised by faculty members. Declared in Chemical Engineering Honors in Research Program
Requisites: Consent of instructor
Course Designation: Honors - Honors Only Courses (H)
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

CBE/CHEM 505 – ASPECTS OF INDUSTRIAL CHEMISTRY AND BUSINESS FUNDAMENTALS
3 credits.

Learn the chemistry and chemical engineering that defines societies' standard of living. Commercial chemical processes will be reviewed. Practical realities of how a discovery moves from research to commercial product will be taught through examples and case studies. Financial concepts that guide investment will be reviewed.
Requisites: Junior standing and CHEM 345, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Describe the most important value-chains in the chemical industry
Audience: Undergraduate

2. Connect the fundamental chemistry and chemical engineering principles learned in other courses with real-world applications
Audience: Undergraduate

3. Evaluate how laboratory discoveries can be legally protected and successfully commercialized
Audience: Undergraduate

4. Assess and compare alternative technologies against current state-of-the-art technologies
Audience: Undergraduate

CBE 512 – ENERGY TECHNOLOGIES AND SUSTAINABILITY
3 credits.

Chemical engineering principles of material and energy balances, chemical process design, and chemical engineering economics are used to analyze a wide variety of energy systems and their impact on the economy, the environment, society, and the chemical process industry.
Requisites: CBE 310, CIV ENGR 324, M E 361, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Describe present and future technologies for energy production and use
Audience: Both Grad & Undergrad

2. Use mass and energy balances to evaluate energy options, understand historical progression and development of energy sources
Audience: Both Grad & Undergrad

3. Evaluate technical issues, scale, and economic practicality of energy alternatives
Audience: Both Grad & Undergrad

4. Critique popular media descriptions with quantitative, factual analyses
Audience: Both Grad & Undergrad

5. Propose research to improve existing energy technologies
Audience: Graduate

CBE 535 – HETEROGENEOUS CATALYSIS: PRINCIPLES AND APPLICATIONS
3 credits.

Discusses catalytic phenomena, with extensions to reactor design and catalyst characterization. Examples will be drawn from current problems in catalysis.
Requisites: CBE 430, graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Describe catalytic phenomena
Audience: Undergraduate

2. Describe catalytic design
Audience: Undergraduate

3. Explain methods of catalyst characterization
Audience: Undergraduate

CBE 538 – PROCESSES FOR THE PRODUCTION OF RENEWABLE FUELS AND CHEMICALS FROM BIOMASS
3 credits.

Various options for conversion of biomass into fuels and chemicals. Evaluation of different biofuel technologies from a chemical engineering perspective, and a holistic overview of the current technical, legal, business, and financial challenges, and opportunities for the production of fuels and chemicals from biomass. Several case studies on biomass conversion provide an overview of how technology is developed.
Requisites: CBE 250 and 310, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2025
Learning Outcomes: 1. Understand processes and process flowsheets for chemical processes for converting biomass to fuels and chemicals
Audience: Both Grad & Undergrad

2. Describe and utilize the chemical engineering tools for designing the processes including material balances, energy balances, and economic models
Audience: Both Grad & Undergrad

3. Create quantitative reactor models of a process for converting biomass to fuels and chemicals
Audience: Graduate

CBE 540 – POLYMER SCIENCE AND TECHNOLOGY
3 credits.

Synthesis, properties, and fabrication of plastic materials of industrial importance.
Requisites: CHEM 345, graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Explain factors that influence the synthesis and structure of polymers
Audience: Undergraduate

2. Describe methods used to analyze and characterize polymer properties
Audience: Undergraduate

3. Describe the breadth of polymer properties and applications
Audience: Undergraduate

4. Explain in depth the use of polymers in a particular application area
Audience: Undergraduate

CBE 547 – INTRODUCTION TO COLLOID AND INTERFACE SCIENCE
3 credits.

Introduction to topics in colloid and interface science, including sedimentation and diffusion, solution thermodynamics, rheology, light scattering, surface tension and contact angle, adsorption, association colloids, particle interactions, electrokinetics, and colloidal stability.
Requisites: (CBE 311, CHEM 561, or 562), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Describe the various colloidal forces and phenomena
Audience: Both Grad & Undergrad

2. Employ standard mathematical models of colloidal forces and phenomena
Audience: Both Grad & Undergrad

3. Critically evaluate the interpretation of colloidal phenomena and the application of mathematical models in published literature
Audience: Graduate

CBE 554 – CHEMICAL ENGINEERING AND THE COMMUNITY
1 credit.

Connect with a local community through the development and implementation of two research based hands-on inquiry engineering demonstrations for middle school level after-school science programs.
Requisites: CBE 250
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2026
Learning Outcomes: 1. Communicate complex science and engineering topics
Audience: Undergraduate

2. Work with a diverse group of middle school students
Audience: Undergraduate

3. Use best practices for the development and implementation of after-school STEM lessons
Audience: Undergraduate

CBE 555 – SEMINAR-CHEMICAL ENGINEERING CONNECTIONS
1 credit.

Considers a variety of current engineering applications and problems. Investigate background information on topics of their choice, and present seminars to describe how engineering fundamentals interact with societal impact and how chemical engineering is relevant to societal concerns at large.
Requisites: Senior standing or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Describe how engineering fundamentals interact with societal impact and how our undergraduate education in chemical engineering is relevant to societal concerns at large
Audience: Undergraduate

CBE/B M E 560 – BIOCHEMICAL ENGINEERING
3 credits.

Properties of biological molecules; enzyme kinetics, enzyme reactors, and enzyme engineering; metabolic engineering; microbial growth kinetics; bioreactor design; bioseparations.
Requisites: Junior standing and (ZOOLOGY/BIOLOGY 101 and 102, ZOOLOGY/BIOLOGY/BOTANY 151, ZOOLOGY 153, or BIOCORE 383), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Apply principles of chemical engineering in the analysis and design of industrial biochemical processes
Audience: Both Grad & Undergrad

2. Describe the role chemistry plays in understanding how bio-molecules and bio-molecular systems work
Audience: Both Grad & Undergrad

3. Extract, communicate and critique key idea(s) from any work of the current technical literature
Audience: Both Grad & Undergrad

4. Identify opportunities for biochemical engineering to address societal needs (e.g., energy, health, materials, food, and the environment)
Audience: Both Grad & Undergrad

5. Demonstrate how chemical engineering principles can be applied to alter the molecular properties of a biological system
Audience: Graduate

CBE 562 – SPECIAL TOPICS IN CHEMICAL ENGINEERING
1-3 credits.

Topics of specialized interest to majors in chemical engineering. Given on demand.
Requisites: Junior standing or member of Engineering Guest Students
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2026
Learning Outcomes: 1. Identify and describe key theories, concepts, and methods in chemical engineering
Audience: Undergraduate

CBE/M E 567 – SOLAR ENERGY TECHNOLOGY
3 credits.

Radiant energy transfer and its application to solar exchangers; energy balances for solar exchangers, review of theory, economics, and practice of solar energy applications.
Requisites: (M E 364, CBE 326, or concurrent enrollment), or graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2025
Learning Outcomes: 1. Predict available solar radiation at a given location and time, for a given surface orientation
Audience: Undergraduate

2. Predict and model thermal and optical losses for solar thermal systems
Audience: Undergraduate

3. Calculate the load on a solar system
Audience: Undergraduate

4. Predict and model long term performance of solar thermal systems
Audience: Undergraduate

CBE 575 – INSTRUMENTAL ANALYSIS FOR CHEMICAL ENGINEERS
3 credits.

Instrumental methods as applied to chemical and physical processes in chemical engineering. Spectroscopic, optical, and electrochemical methods; chromatography, differential thermal analysis, and microscopy.
Requisites: CBE 324 or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Analyze measurement devices and circuits
Audience: Undergraduate

2. Interface sensors to electronic systems
Audience: Undergraduate

3. Use electromechanical devices to automate chemical engineering equipment
Audience: Undergraduate

4. Fabricate instrumentation for processes and research
Audience: Undergraduate

CBE 599 – SPECIAL PROBLEMS
1-4 credits.

Research or independent study.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2026
Learning Outcomes: 1. Conduct and report on independent chemical engineering research
Audience: Undergraduate

CBE 620 – INTERMEDIATE TRANSPORT PHENOMENA
3 credits.

Mass, momentum, and energy transport; kinetic theory of transport properties; analytical and approximate solutions to the equations of change; boundary layer theory; turbulence; simultaneous heat and mass transfer; multicomponent diffusion.
Requisites: Declared in a Chemical Engineering graduate program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Explain the mechanisms of diffusion and convection of momentum, energy and mass
Audience: Graduate

2. Describe the concepts of conservation of momentum, energy, and mass

Audience: Graduate

3. Reduce and solve the appropriate equations of change and/or use dimensional analysis and scaling arguments to predict desired features (fluxes and/or distributions) of velocity, temperature and concentration
Audience: Graduate

CBE 648 – SYNTHETIC ORGANIC MATERIALS IN BIOLOGY AND MEDICINE
2-3 credits.

Introduction to topics relevant to the design, synthesis, fabrication, engineering, and characterization of organic materials currently used in or being designed for use in medical and biotechnological applications.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2025
Learning Outcomes: 1. Describe the physical, chemical, and engineering principles that form the foundation for the design of advanced organic materials for medical applications.
Audience: Graduate

2. Describe the structure and function or selection of a material required for the specific requirements of different applications
Audience: Graduate

3. Read the scientific literature critically, think creatively, and present and discuss scientific ideas in both written and verbal formats
Audience: Graduate

CBE 660 – INTERMEDIATE PROBLEMS IN CHEMICAL ENGINEERING
3 credits.

Illustrations of solving chemical engineering problems by using a variety of mathematical topics such as ordinary and partial differential equations, Laplace transform, Bessel functions, matrices, and tensor analysis. Problem formulation and interpretation of results emphasized.
Requisites: Declared in a Chemical Engineering graduate program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2025
Learning Outcomes: 1. Formulate chemical engineering problems in appropriate mathematical frameworks
Audience: Graduate

2. Solve chemical engineering problems involving linear algebra
Audience: Graduate

3. Solve chemical engineering problems involving differential equations
Audience: Graduate

CBE 699 – ADVANCED INDEPENDENT STUDIES
1-6 credits.

Research on assigned topics under the guidance of a qualified instructor.
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2024
Learning Outcomes: 1. Conduct and report on independent chemical engineering research
Audience: Graduate

2. Independently develop researchable chemical engineering questions
Audience: Graduate

3. Appropriately utilize online and library resources
Audience: Graduate

4. Connect their research clearly to other research in their field of study
Audience: Graduate

CBE 702 – GRADUATE COOPERATIVE EDUCATION PROGRAM
1-2 credits.

Work experience that combines classroom theory with practical knowledge of operations to provide students with a background on which to develop and enhance a professional career. The work experience is tailored for MS students from within the U.S. as well as eligible international students.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2025
Learning Outcomes: 1. Identify and respond appropriately to real-life engineering ethics cases relevant to co-op work
Audience: Graduate

2. Synthesize and apply appropriate technical education to real world technical work
Audience: Graduate

3. Communicate effectively in writing and speaking with a range of audiences in the workplace, including those without disciplinary expertise
Audience: Graduate

4. Develop professional and transferable habits like time management skills, collaborative problem-solving skills, and research skills for learning new information
Audience: Graduate

CBE 710 – ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS
3 credits.

Application of thermodynamic principles to selected topics, including equations of state, non-ideal solutions, and complex physical and chemical equilibria.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2025
Learning Outcomes: 1. Explain molecular-level descriptions of thermodynamics
Audience: Graduate

2. Explain how to obtain thermodynamic properties using molecular simulation
Audience: Graduate

3. Explain continuum-level descriptions of thermodynamics
Audience: Graduate

CBE 720 – MICROHYDRODYNAMICS, BROWNIAN MOTION, AND COMPLEX FLUIDS
3 credits.

Foundations for understanding microscale flow and transport phenomena in multiphase and complex fluids, as well as tools for modeling and simulation of their dynamics.
Requisites: CBE 620 and 660
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2021
Learning Outcomes: 1. Analyze transport phenomena in complex fluids
Audience: Graduate

2. Describe motions of particles and macromolecules in flow
Audience: Graduate

3. Formulate mathematical models of flows of complex fluids
Audience: Graduate

4. Analyze the relationship between structure and rheology for complex fluids
Audience: Graduate

CBE 735 – KINETICS AND CATALYSIS
2-3 credits.

Survey of kinetic principles and factors which influence reaction rates, with particular emphasis on catalysts and catalytic reactions. May include a seminar on modern catalytic research.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2025
Learning Outcomes: 1. Describe kinetic principles and factors that influence reaction rates
Audience: Graduate

2. Describe common catalysts
Audience: Graduate

3. Explain the principles of and factors that influence catalysis
Audience: Graduate

CBE 750 – ADVANCED CHEMICAL PROCESS SYNTHESIS AND OPTIMIZATION
3 credits.

Methodologies for synthesis and optimization of chemical process systems. Application of linear, nonlinear, and mixed integer programming to steady state process optimization, production planning, and flowsheet synthesis.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Explain topics from the recent and classic literature on the analysis, synthesis, design, and optimization of chemical engineering systems
Audience: Graduate

2. Apply advanced techniques and algorithms for the synthesis, design, and optimization of chemical engineering systems
Audience: Graduate

CBE 781 – BIOLOGICAL ENGINEERING: MOLECULES, CELLS & SYSTEMS
3 credits.

Protein engineering and protein-protein interactions, receptor-ligand binding, cell metabolism and signaling, metabolic engineering and synthetic biology, tissue engineering. Additional topics may be covered such as: regenerative medicine, biomaterials, microbe-host interactions.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2025
Learning Outcomes: 1. Employ quantitative perspectives and approaches to enhance the engineering of biomolecular, cellular and tissue-level systems
Audience: Graduate

2. Explain the primary biological, biomedical and bioengineering literature
Audience: Graduate

CBE/B M E 783 – DESIGN OF BIOLOGICAL MOLECULES
3 credits.

Introduction to the methodologies for engineering the structure and function of biological molecules, especially proteins. Develop an understanding for the integration of computation and experiment to address biological molecular engineering problems. Knowledge of biochemistry and cell biology [such as BIOCHEM 501 or ZOOLOGY 570] required.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2026

CBE 790 – MASTER'S RESEARCH OR THESIS
1-9 credits.

Directed study projects arranged with instructor.
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2025

CBE 890 – PRE-DISSERTATOR'S RESEARCH
1-9 credits.

Directed study projects arranged with instructor.
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2026

CBE/B M E/B M I/BIOCHEM/COMP SCI/GENETICS 915 – COMPUTATION AND INFORMATICS IN BIOLOGY AND MEDICINE
1 credit.

Participants and outside speakers will discuss current research in computation and informatics in biology and medicine. This seminar is required of all CIBM program trainees.
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2026
Learning Outcomes: 1. Discuss how methods from computer science, statistics, information science and engineering are applied to problems in biology, medicine and population health
Audience: Graduate

2. Recognize and be able to define applications in translational bioinformatics, clinical informatics and public health informatics
Audience: Graduate

CBE/BIOCHEM 932 – BIOTECHNOLOGY TRAINING PROGRAM SEMINAR
1 credit.

Biotechnology Training Program trainees will present their research for critical review by audience.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2026
Learning Outcomes: 1. Discuss research conducted by Biotechnology Training Program trainee peers' labs and the biotechnological applications thereof
Audience: Graduate

2. Examine industrial applications of biotechnology through internship presentations
Audience: Graduate

3. Communicate with a broad scientific audience
Audience: Graduate

CBE 961 – SEMINAR-CHEMICAL ENGINEERING
0-1 credits.

Seminar in Chemical Engineering.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2026

CBE 990 – THESIS-RESEARCH
1-12 credits.

Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2026

CBE 999 – ADVANCED INDEPENDENT STUDIES
1-6 credits.

Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 1997