# CHEMICAL ENGINEERING (CHEG)

**CHEG 2103. Introduction to Chemical Engineering. (3 Credits)**
Application of the principles of chemistry and physics to chemical processes; units, dimensions, and process variables; material balances; equations of state (ideal and real); single component equilibria; energy balances; non reactive and reactive processes; combined mass and energy balances.
**Enrollment Requirements:** CHEM 1128, or CHEM 1125 and 1126; MATH 1132. Recommended preparation: CSE 1010.

**CHEG 2111. Chemical Engineering Thermodynamics I. (3 Credits)**
First and second law of thermodynamics; thermal and PVT properties of matter; exact differentials and thermodynamic identities; design and analysis of power cycles; analysis of refrigeration and liquefaction processes.
**Enrollment Requirements:** Recommended preparation: MATH 2110, CHEM 1128, and CHEG 2103, or consent of Chemical Engineering Program Director.

**CHEG 2193. International Study. (1-6 Credits)**
Special engineering topics taken in an international study program. May count toward the major with consent of the advisor and approved plan of study.
**Enrollment Requirements:** Consent of Department Head or Designee required, normally to be granted prior to the student's departure.
May be repeated for a total of 6 credits

**CHEG 2201. Chemical Engineering Professional Skills I. (1 Credit)**
Professional skills necessary to succeed in the chemical engineering industry: written and oral technical communication; working on diverse and inclusive teams. The complexity of these skills will build over CHEG 2201, 3201, and 4101.
**Enrollment Requirements:** CHEM 1128Q or CHEM 1148Q, or CHEM 1125Q and 1126Q; MATH 1132Q; open only to Chemical Engineering students.

**CHEG 3112. Chemical Engineering Thermodynamics II. (3 Credits)**
Properties and phase equilibria for ideal and non-ideal mixtures; design of equilibrium flash separators; phase equilibria using equations of state; chemical equilibria; optimum conditions for chemical reactions; applications include chemical, electrochemical and biochemical systems.
**Enrollment Requirements:** CHEG 2111; MATH 2410Q; open only to School of Engineering students.

**CHEG 3120. Transport Phenomena I. (4 Credits)**
Overall mass, energy, and momentum balances; fluid flow phenomena; theoretical and empirical relationships for design of incompressible fluid-flow systems. Conductive heat transfer; heat transfer coefficients and design of heat exchange systems. Radiation heat transfer, evaporation.
**Enrollment Requirements:** MATH 2110Q and 2410Q; CHEM 1128Q; CHEG 2103 and 2111; open only to School of Engineering students.

**CHEG 3123. Fluid Mechanics. (3 Credits)**
Overall mass, energy, and momentum balances; fluid flow phenomena; theoretical and empirical relationships for design of incompressible fluid-flow systems.
**Enrollment Requirements:** MATH 2110Q and 2410Q; CHEM 1128Q; CHEG 2103; open only to School of Engineering students.

**CHEG 3124. Heat and Mass Transfer. (3 Credits)**
Conductive heat transfer; heat transfer coefficients and design of heat exchange systems. Radiation heat transfer, evaporation; design of mass transfer processes including distillation and extraction; analysis and design of diffusional processes such as gas absorption and humidification. Analytical and numerical methods for the solution of simple partial differential equations describing transport phenomena.
**Enrollment Requirements:** CHEG 3123 and MATH 2410Q. Corequisite: CHEG 3128, 3151; open only to School of Engineering students.

**CHEG 3128. Chemical Engineering Junior Laboratory. (2 Credits)**
Provides hands-on experience with heat, mass, and kinetics processes, including steady-state heat transfer, transient heat transfer, membrane separation, liquid-phase reaction kinetics, gas-phase polymerization kinetics, and microfluidic devices.
**Enrollment Requirements:** CHEG 3123; open only to School of Engineering students. Corequisite: CHEG 3124 and 3151.

**CHEG 3151. Process Kinetics. (3 Credits)**
Theory of chemical rate; homogeneous, heterogeneous and catalytic systems. Analysis and design of batch and flow reaction systems; analysis of rate data; temperature and catalytic effects in reactor design; mass transport effects; non-ideal reactor design.
**Enrollment Requirements:** CHEG 3112; open only to School of Engineering students. Corequisite: CHEG 3124, 3128.

**CHEG 3156. Polymeric Materials. (3 Credits)**
(Also offered as MSE 3156.) Structure, properties, and chemistry of high polymers; solution and phase behavior; physical states, viscoelasticity and flow; production and polymer processing; design of polymers for specific applications.
**Enrollment Requirements:** Open only to School of Engineering students. Recommended preparation: CHEM 2444. Not open to students who have passed CHEM 3661.

**CHEG 3173. Introduction to Biochemical Engineering. (3 Credits)**
Enzyme and fermentation technology; microbiology, biochemistry, and cellular concepts; biomass production; equipment design, operation, and specification; design of biological reactors; separation processes for bio-products.
**Enrollment Requirements:** CHEG 3151; open only to School of Engineering students.

**CHEG 3175. Introduction to Computational Biomolecular Engineering. (3 Credits)**
This course offers students an introduction to the growing field of computational biomolecular engineering, which combines concepts from biology, engineering, and computer science. Students will gain foundational knowledge of relevant topics such as biomolecular modeling, simulation, and design. The course provides a broad overview of key ideas and technologies that are advancing this interdisciplinary area. While being an introductory class, it will equip students with an understanding of current techniques and prepare them for more advanced study at the intersection of these important scientific fields.
**Enrollment Requirements:** Recommended Preparation: CHEG 3151.

**CHEG 3193. International Study. (1-6 Credits)**
Special engineering topics taken in an international study program.
May be repeated for a total of 6 credits

**CHEG 3201. Chemical Engineering Professional Skills II. (1 Credit)**
This course will focus on building the professional skills necessary to succeed in chemical engineering industry. Covers written and oral technical communication skills and the skills necessary to work on diverse and inclusive teams. The complexity of these skills will build over CHEG 2201, 3201, and 4101.
**Enrollment Requirements:** CHEG 2201 and 2111.

**CHEG 3220. Transport Phenomena II. (4 Credits)**
Analysis and design of separation processes including distillation and extraction with graphical and computational solution approaches; Analytical and numerical methods for the solution of simple partial differential equations describing transport phenomena.
**Enrollment Requirements:** CHEG 3120 and 3112; MATH 2410Q; open only to School of Engineering students.

**CHEG 3240. Junior Design and Process Safety. (3 Credits)**
Introduction to the design of chemical engineering processes and/or products. Major topics include comparison of alternative processing steps, cost estimation and economic analysis, safety and environmental concerns in design, and ethical and societal considerations.
**Enrollment Requirements:** Junior standing; CHEG 2103, 2111, 3112 and 3120.

**CHEG 3376. Bioseparations. (3 Credits)**
Introduction to bioseparations, review of mass transport, adsorption, chromatography, filtration, extraction, electrophoresis, and field flow fractionation.
**Enrollment Requirements:** BIOL 1107 or 1108; MATH 2410Q.

**CHEG 4101. Chemical Engineering Professional Skills III. (1 Credit)**
This course will focus on building the professional skills necessary to succeed in chemical engineering industry. The course will cover written and oral technical communication skills and the skills necessary to work on diverse and inclusive teams. The complexity of these skills will build over CHEG 2201, 3201, and 4101.
**Enrollment Requirements:** CHEG 3201 and 3151.

**CHEG 4139. Chemical Engineering Senior Laboratory. (2 Credits)**
Open-ended laboratory investigations in chemical engineering focusing on reaction kinetics, reactor design, process control, and mass transfer; emphasis on student teamwork and on design of experiments to meet objectives; technical report writing; oral presentations.
**Enrollment Requirements:** CHEG 3112; CHEG 3123; CHEG 3124; open only to Chemical Engineering majors. Recommended preparation: CHEG 3151, 4137 and 4147.

**CHEG 4140. Chemical Engineering Capstone Design I. (3 Credits)**
Theoretical treatment and design of chemical engineering processes and/or products. Comparison of alternative processing steps; instrumentation; cost estimation; economic analysis; process optimization; safety and environmental concerns in design; ethical considerations in chemical engineering design. Emphasis on the application of chemical engineering principles to conceptual design.
**Enrollment Requirements:** CHEG 3112, 3123, 3124, and 3151; open only to Chemical Engineering majors. Corequisite: CHEG 4142

**CHEG 4142. Unit Operations and Process Simulation. (3 Credits)**
Design and analysis of chemical engineering unit operations and process equipment, computer-aided design of equipment and flow sheets; design and analysis of complete process plants. Computer-based simulation of chemical engineering processes and integration of multiple processes into a holistic plant design using modern chemical engineering process design tools.
**Enrollment Requirements:** Open only to School of Engineering students. Corequisite: CHEG 4140.

**CHEG 4143W. Chemical Engineering Capstone Design II. (3 Credits)**
Continuation of work on chemical process and simulation projects assigned in CHEG 4140. Group work, written and oral communication, and presentation of the final project, which analyzes a chemical process from technical, economic, safety, and environmental perspectives.
**Enrollment Requirements:** CHEG 4140 and 4142; ENGL 1007 or 1010 or 1011; open to juniors or higher; open only to Chemical Engineering majors.
**Skill Codes:** COMP. Writing Competency

**CHEG 4144. In Silico Chemical Engineering Senior Laboratory. (2 Credits)**
Various computation tools and software used to approximate the solution of chemical engineering problems focusing on reaction kinetics, reactor design, process control, fluid, and mass transfer; for data analysis and visualization; emphasis on student teamwork and on use of computational tools and software to meet the course objectives.
**Enrollment Requirements:** CHEG 3112, 3220, 3240; open only to Chemical Engineering majors.

**CHEG 4145. Chemical Engineering Analysis. (3 Credits)**
Mathematical and numerical methods for solving engineering problems; description and computer modeling of physical and chemical processes with ordinary and partial differential equations; treatment and interpretation of engineering data.
**Enrollment Requirements:** CHEG 3151, 3220, 3240, and MATH 2110Q, 2210Q, 2410Q; open only to School of Engineering students.

**CHEG 4147. Process Dynamics and Control. (3 Credits)**
Chemical process modeling, dynamics, and analysis. Measurement and control of process variables,design, and computer simulation of simple processes and control systems.
**Enrollment Requirements:** CHEG 3112 and 3124 and MATH 2110 and 2410; open only to School of Engineering students.

**CHEG 4230. Brewery Engineering. (3 Credits)**
Introduction to chemical engineering principles of brewing science. History of beer, beer styles, analytical characterization, fermentation kinetics, unit operations, brewery process design and economics. Process safety and recipe formulation will also be discussed.
**Enrollment Requirements:** Open only to Chemical Engineering majors; must be at least 21 years of age by the first day of the class.

**CHEG 4235. Air Pollution and Communities. (3 Credits)**
This course will provide an overview of the principles of air pollution through community-based projects. We will cover the source and impacts of air pollutants, physical and chemical processes governing air pollutant concentrations, associations between climate change and air pollution, air pollution exposure, and indoor air quality. This course will focus on these topics through an environmental justice lens.

**CHEG 4341. Sustainable Fuel Processing. (3 Credits)**
Concepts and principles of energy and fuel resources, production and processing by applying energy and mass balances. Fundamentals of fuels processing in refinery and biorefinery processes and industrial (catalytic and non-catalytic) processes by constructing and analyzing systems level flow diagrams. Develop, solve and analyze chemical engineering systems and processes by applying fundamental concepts of thermodynamics and reaction kinetics as well as fundamental concepts from physics, biology, chemistry and mathematics. Analyze, propose solutions and present modern challenges in chemical engineering processes which involve fuel processing.
**Enrollment Requirements:** CHEG 2111.

**CHEG 4450. Membrane Separations. (3 Credits)**
This course provides an overview of how membrane technology impacts various parts of our industrial and commercial sector. The course will cover the following: Fundamentals of liquid and gas separations, membrane fabrication and manufacturing, membrane characterization, introductory membrane systems engineering, conventional and emergent applications in membrane technology. The course will include reviews of the refereed literature, in-class presentations, and laboratory tours/ demonstrations when appropriate.
**Enrollment Requirements:** Recommended preparation: CHEG 2103, CHEG 2111, CHEG 3124.

**CHEG 4989. Introduction to Research. (1-6 Credits)**
Methods of conducting research; design of laboratory investigations and experiments; correlation and interpretation of experimental results; writing of formal, technical reports; oral presentations; independent student effort, initiative and resourcefulness are required.
**Enrollment Requirements:** Instructor consent; open only to School of Engineering students.
May be repeated for credit

**CHEG 4995. Special Topics in Chemical Engineering. (1-6 Credits)**
A classroom course on special topics as announced.
**Enrollment Requirements:** Announced separately for each course; open only to School of Engineering students.
May be repeated for credit