Chemical Engineering (CH_ENG)

CH_ENG 1000: Introduction to Chemical Engineering
Orientation course for freshmen-level students. Introduction to careers and opportunities in chemical engineering, basic engineering principles, simple calculations.

Credit Hours: 2
Prerequisites or Corequisites: MATH 1500, CHEM 1320

CH_ENG 1000H: Introduction to Chemical Engineering - Honors
Orientation course for freshmen-level students. Introduction to careers and opportunities in chemical engineering, basic engineering principles, simple calculations.

Credit Hours: 2
Prerequisites or Corequisites: MATH 1500, CHEM 1320. Honors eligibility required

CH_ENG 2225: Mass and Energy Balance
Industrial stoichiometry, material and energy balances, thermophysics, thermochemistry; related topics. Graded on A-F basis only.

Credit Hours: 3
Prerequisites or Corequisites: PHYSCS 2750, CHEM 1330

CH_ENG 2225H: Mass and Energy Balance - Honors
Industrial stoichiometry, material and energy balances, thermophysics, thermochemistry; related topics. Graded on A-F basis only.

Credit Hours: 3
Prerequisites or Corequisites: PHYSCS 2750, CHEM 1330
Prerequisites: Honors eligibility required

CH_ENG 2226: Engineering Process Computations
Introduction to the effective use of computer software with emphasis on chemical engineering applications, which include solutions for systems of algebraic equations using matrix methods; solutions of ordinary differential equations and partial differential equations and visualization of those solutions; linear, multilinear, and nonlinear regression for data analysis; 2D and 3D plotting, symbolic calculations, process control simulations, and text processing.

Credit Hours: 3
Prerequisites or Corequisites: CH_ENG 2225, MATH 2300
Prerequisites: MATH 1700

CH_ENG 3233: Chemical Engineering Fluid Dynamics
Introductory-level continuum mechanics of fluid flow (first in a two-course series on transport phenomena). Topics emphasized include buoyancy; stress; integral and differential conservation of mass, momentum, and energy; the viscous stress equations of motion; Newtonian fluids, viscosity, creeping flow, and the Navier-Stokes equations; turbulence; dimensionless parameters and correlations; and solutions to partial differential equations. Graded on A-F basis only.

Credit Hours: 3
Prerequisites or Corequisites: MATH 4100
Prerequisites: PHYSCS 2750, MATH 2300, and a grade of C- or better in CH_ENG 2225

CH_ENG 3234: Momentum, Heat, and Mass Transfer
Fluid flow, heat and mass transfer. A comprehensive treatment of the transport processes related to chemical engineering operations, with focus on both theory and applications.

Credit Hours: 4
Prerequisites or Corequisites: MATH 4100
Prerequisites: grade of C- or better in CH_ENG 2225; PHYSCS 2750, MATH 2300

CH_ENG 3235: Separation Processes
Separation processes in chemical engineering, including: Evaporation, absorption, distillation, extraction, leaching, membrane separation, and drying.

Credit Hours: 3
Prerequisites or Corequisites: CH_ENG 3262
Prerequisites: CH_ENG 2225, CH_ENG 2226

CH_ENG 3243: Chemical Engineering Laboratory I
Laboratory study of some principal unit operations of chemical engineering.

Credit Hours: 3
Prerequisites or Corequisites: CH_ENG 3235, CH_ENG 4363
Prerequisites: CH_ENG 2226, CH_ENG 3234, PHYSCS 2760
Recommended: CH_ENG 4370 or concurrent enrollment

CH_ENG 3243W: Chemical Engineering Laboratory I - Writing Intensive
Laboratory study of some principal unit operations of chemical engineering. Graded on A-F basis only.

Credit Hours: 3
Prerequisites or Corequisites: CH_ENG 3235, CH_ENG 4363
Prerequisites: CH_ENG 2226, CH_ENG 3234
Recommended: CH_ENG 4370 or concurrent enrollment

CH_ENG 3261: Chemical Engineering Thermodynamics I
Introduction to classical thermodynamics with chemical engineering applications. Heat, work, and energy; Application of the Laws of Thermodynamics to closed systems, open systems, and power and refrigeration cycles; Thermochemical calculations; Equations of state; Phase equilibrium properties of pure fluids.

Credit Hours: 3
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH_ENG 3262</td>
<td>Chemical Engineering Thermodynamics II</td>
<td>Chemical thermodynamics, with emphasis on mixtures. Multicomponent systems and phase diagrams; residual and excess properties; chemical potential, fugacity, and activity; models of non-ideal mixtures; phase and surface equilibria; chemical reaction equilibria.</td>
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<tr>
<td>CH_ENG 3307</td>
<td>Chemical Process Safety and Professional Ethics</td>
<td>A course focused on important technical fundamentals of chemical process safety and their application including professional ethics considerations. Graded on A-F basis only.</td>
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<tr>
<td>CH_ENG 4001</td>
<td>Topics in Chemical Engineering</td>
<td>Current and new technical developments in chemical engineering.</td>
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<tr>
<td>CH_ENG 4085</td>
<td>Problems in Chemical Engineering</td>
<td>Directed study of chemical engineering problems.</td>
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<tr>
<td>CH_ENG 4220</td>
<td>Hazardous Waste Management</td>
<td>Engineering principles involved in handling, collection, transportation, processing and disposal of hazardous waste, waste minimization, legislation on hazardous wastes and groundwater contamination.</td>
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<td>CH_ENG 4232</td>
<td>Ceramic Materials and Processing</td>
<td>Treatment of ceramics materials, structure, and ceramic processing with hands-on demonstration/labs.</td>
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<tr>
<td>CH_ENG 4270</td>
<td>Design of Experiments and Statistical Quality Control for Process Engineers</td>
<td>A practical statistical tool box for experimenters: process means, effects of variables, factorial experiments, and statistical quality control.</td>
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<tr>
<td>CH_ENG 4285</td>
<td>Pollution Prevention</td>
<td>Identify, analyze, and solve energy, water, and raw materials inefficiencies common to industrial processes and facilities. Graded on A-F basis only.</td>
</tr>
<tr>
<td>CH_ENG 4306</td>
<td>Advanced Engineering Math</td>
<td>Applies ordinary and partial differential equations to engineering problems; Fourier's series; determinants and matrices; Laplace transforms; analog computer techniques.</td>
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<tr>
<td>CH_ENG 4311</td>
<td>Chemodynamics</td>
<td>Environmental movement of chemicals in air, water, and soil; designed to introduce students to the basic principles and techniques useful for the prediction of the movement and fate chemicals in ecosystems.</td>
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<td>CH_ENG 4312</td>
<td>Air Pollution Control</td>
<td>Modeling of urban air pollution and control techniques. Topics treated are plume dispersion theories, photochemistry, methods of monitoring, methods of industrial abatement and legal aspects.</td>
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<tr>
<td>CH_ENG 4315</td>
<td>Principles of Biochemical Engineering</td>
<td>This course serves as an introduction to the application of biological, biochemical, and engineering fundamentals for biochemical processing. Topics include biological basics, enzyme kinetics, metabolic pathways, cell growth kinetics, analysis of intracellular flux, thermodynamics of biological reactions, and bioreactor design and modeling. Analyses proceed through the use of mass balances, energy balances, and empirical or theoretical models.</td>
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<tr>
<td>CH_ENG 4316</td>
<td>Biomass Refinery Operations</td>
<td>Design and operation of processes for conversion and/or fractionation of biomass and associated upstream and downstream unit operations. Emphasis on separations and product recovery.</td>
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**Recommended Prerequisites:**
- MATH 2300
- PHYSCS 2750; grade of C or better in CH_ENG 2225
- CH_ENG 3261, MATH 2300
- CHEM 2110 or concurrent enrollment
- BIOL_EN 3180 (for Biological Engineering students) or CH_ENG 3234 (for Chemical Engineering students) as a prerequisite or a co-requisite
Prerequisites: BIOL_EN 2180 (for Biological Engineering students) or CH_ENG 2225 (for Chemical Engineering students) or instructor's consent

CH_ENG 4317: Chemical Processing in Semiconductor Device (cross-leveled with CH_ENG 7317). This course covers the current plasma processing methods used to produce semiconductor devices with emphasis on memory devices. The physics and chemistry of how plasmas are formed, sustained and interact with the semiconductor wafers being processed. Plasma chemistry and the chemical reactions used in plasma etching are discussed.

Credit Hours: 3
Prerequisites: PHYSCS 2760, CHEM 1320, and MATH 4100 or MATH 7100

CH_ENG 4318: Energy Technology and Sustainability
An introductory course on energy technology, resources, practices, and common calculations used for energy analysis. May be repeated for credit. Recommended: at least one thermodynamics or physical chemistry course (examples: CHEM 3310, CH_ENG 3261, ENGINR 2300, MAE 2300, PHYSCS 4120) or instructor's consent.

Credit Hours: 3

CH_ENG 4319: Introduction to Polymers (cross-leveled with CH_ENG 7319). This course provides a general introduction to polymer materials and their engineering applications. The course centers on two aspects: (i) fundamental knowledge about polymer properties and synthesis; and (ii) an introduction of some emerging polymer materials, including polymer nanocomposites, conductive polymers, biodegradable polymers, self-healing polymers, and hydrogels. Examples from current literature are also introduced to expose students to the frontier research in the field.

Credit Hours: 3
Prerequisites or Corequisites: CH_ENG 4363
Prerequisites: CHEM 2110, CH_ENG 3234, CH_ENG 3262


Credit Hours: 3
Prerequisites: CH_ENG 3234, and MATH 4100 or MATH 7100

CH_ENG 4363: Chemical Reaction Engineering and Technology
Reactor design and optimization; rate equations; thermal effects in reactor.

Credit Hours: 3
Prerequisites: CHEM 1330, CH_ENG 2226, CH_ENG 3234
Recommended: CH_ENG 3262

CH_ENG 4370: Process Control
State-space modeling, simulation, and experimental validation; stability analysis; feedback design and experimental studies; methods for disturbance rejection.

Credit Hours: 3
Prerequisites: CH_ENG 2225, CH_ENG 2226, MATH 4100

Recommended: CH_ENG 3261, MATH 4140

CH_ENG 4385: Chemical Engineering Design I
The course presents optimum design methods, cost estimation, material selection and other relevant areas for the design of chemical plants. In addition, chemical safety and risk assessment will be covered. Graded on A-F basis only.

Credit Hours: 3
Prerequisites or Corequisites: CH_ENG 4363
Prerequisites: CH_ENG 2226, CH_ENG 3234, CH_ENG 3235, CH_ENG 3262, CHEM 2110
Recommended: CH_ENG 4370 or concurrent enrollment

CH_ENG 4401: Finite Element Methods in Chemical Engineering (cross-leveled with CH_ENG 7401). The numerical solution of engineering problems in heat and mass transport, computational fluid dynamics, and chemical reactions including electromagnetic effects are treated in full detail using finite element methods and computational software to solve problems in one, two, and three dimensional spaces. Both time dependent and steady state solutions are considered. Graded on A-F basis only.

Credit Hours: 3
Prerequisites or Corequisites: MATH 4100
Prerequisites: CHEM 1330, CH_ENG 2226
Recommended: CH_ENG 4363, or concurrent enrollment

CH_ENG 4464: Electrochemical Reaction Engineering Science (cross-leveled with CH_ENG 7464). Phenomenological behavior of electrochemical processes (battery emphasis). Theoretical interpretations of diffusion and reaction processes including system modeling. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: CH_ENG 3261 or MAE 2300 or CHEM 4310 or instructor's consent
Recommended: A course in thermodynamics or physical chemistry

CH_ENG 4980: Process Synthesis and Design
Continuation of CH_ENG 4385: application of chemical analysis and modeling to a capstone design project.

Credit Hours: 3
Prerequisites: CH_ENG 3262, CH_ENG 4363, CH_ENG 4385
Recommended: CH_ENG 4370 or concurrent enrollment

CH_ENG 4980W: Process Synthesis and Design - Writing Intensive
Continuation of CH_ENG 4385: application of chemical analysis and modeling to a capstone design project.

Credit Hours: 3
Prerequisites: CH_ENG 3262, CH_ENG 4363 ,CH_ENG 4385
Recommended: CH_ENG 4370 or concurrent enrollment

CH_ENG 4990: Undergraduate Research in Chemical Engineering
Directed study of chemical engineering problems.

Recommended: CH_ENG 3261, MATH 4140

CH_ENG 4980: Process Synthesis and Design
Continuation of CH_ENG 4385: application of chemical analysis and modeling to a capstone design project.

Credit Hours: 3
Prerequisites: CH_ENG 3262, CH_ENG 4363, CH_ENG 4385
Recommended: CH_ENG 4370 or concurrent enrollment

CH_ENG 4990: Undergraduate Research in Chemical Engineering
Directed study of chemical engineering problems.
**CH_ENG 4995: Undergraduate Research in Chemical Engineering - Honors**  
Individual research for a senior thesis; research is supervised by the chemical engineering faculty. The thesis is to be defended before the departmental Honors committee.  
**Credit Hour:** 2-4  
**Prerequisites:** instructor's consent

**CH_ENG 7001: Topics in Chemical Engineering**  
Current and new technical developments in chemical engineering.  
**Credit Hours:** 3  
**Prerequisites:** instructor's consent

**CH_ENG 7220: Hazardous Waste Management**  
(same as CV_ENG 7220; cross-leveled with CH_ENG 4220, CV_ENG 4220). Engineering principles involved in handling, collection transportation, processing and disposal of hazardous waste minimization, legislation on hazardous wastes and groundwater contamination.  
**Credit Hours:** 3

**CH_ENG 7232: Ceramic Materials and Processing**  
(same as MAE 7232; cross-leveled with CH_ENG 4232, MAE 4232). Treatment of ceramics materials, structure, and ceramic processing with hands-on demonstration/labs. Graded on A-F basis only.  
**Credit Hours:** 3  
**Prerequisites:** MAE 2200 or equivalent course

**CH_ENG 7270: Design of Experiments and Statistical Quality Control for Process Engineers**  
(same as BIOL_EN 7270; cross-leveled with CH_ENG 4270, BIOL_EN 4270). A practical statistical tool box for experimenters: process means, effects of variables, factorial experiments, and statistical quality control.  
**Credit Hours:** 3  
**Prerequisites:** experience with Excel or instructor's consent

**CH_ENG 7311: Chemodynamics**  
(cross-leveled with CH_ENG 4311). Environmental movement of chemicals in air, water, and soil; designed to introduce students to the basic principles and techniques useful for the prediction of the movement and fate chemicals in ecosystems.  
**Credit Hours:** 3  
**Prerequisites:** CH_ENG 3234 or instructor's consent

**CH_ENG 7312: Air Pollution Control**  
(cross-leveled with CH_ENG 4312). Modeling of urban air pollution and control techniques. Topics treated are plume dispersion theories, photochemistry, methods of monitoring, methods of industrial abatement and legal aspects.  
**Credit Hours:** 3  
**Prerequisites:** CH_ENG 3234 or instructor's consent

**CH_ENG 7315: Principles of Biochemical Engineering**  
(same as BIOL_EN 7315; cross-leveled with CH_ENG 4315, BIOL_EN 4315). This course serves as an introduction to the application of biological, biochemical, and engineering fundamentals for biochemical processing. Topics include biological basics, enzyme kinetics, metabolic pathways, cell growth kinetics, analysis of intracellular flux, thermodynamics of biological reactions, and bioreactor design and modeling. Analyses proceed through the use of mass balances, energy balances, and empirical or theoretical models.  
**Credit Hours:** 3  
**Prerequisites:** BIOL_EN 2180 (for biological engineering students) or CH_ENG 2225 (for chemical engineering students) or Instructor's consent  
**Recommended:** BIOL_EN 3180 (for Biological Engineering students) or CH_ENG 3234 (for Chemical Engineering students) as a prerequisite or a co-requisite

**CH_ENG 7316: Biomass Refinery Operation**  
(same as BIOL_EN 7316; cross-leveled with CH_ENG 4316, BIOL_EN 4316). Design and operation of processes for conversion and/or fractionation of biomass and associated upstream and downstream unit operations. Emphasis on separations and product recovery.  
**Credit Hours:** 3  
**Prerequisites:** BIOL_EN 2180 or CH_ENG 2225 or instructor's consent

**CH_ENG 7317: Chemical Processing in Semiconductor Device**  
(cross-leveled with CH_ENG 4317). This course covers the current plasma processing methods used to produce semiconductor devices with emphasis on memory devices. The physics and chemistry of how plasmas are formed, sustained and interact with the semiconductor wafers being processed. Plasma chemistry and the chemical reactions used in plasma etching are discussed.  
**Credit Hours:** 3  
**Prerequisites:** PHYSCS 2760, CHEM 1320, and MATH 4100 or MATH 7100

**CH_ENG 7319: Introduction to Polymers**  
(cross-leveled with CH_ENG 7319). This course provides a general introduction to polymer materials and their engineering applications. The course centers on two aspects: (i) fundamental knowledge about polymer properties and synthesis; and (ii) an introduction of some emerging polymer materials, including polymer nanocomposites, conductive polymers, biodegradable polymers, self-healing polymers, and hydrogels. Examples from current literature are also introduced to expose students to the frontier research in the field.  
**Credit Hours:** 3  
**Prerequisites or Corequisites:** CH_ENG 4363

**CH_ENG 7335: Intermediate Transport Phenomena**  
(cross-leveled with CH_ENG 4335). Integrated study of momentum, heat and mass transport.  
**Credit Hours:** 3  
**Prerequisites:** CH_ENG 3234, and MATH 4100 or MATH 7100
CH_ENG 7401: Finite Element Methods in Chemical Engineering
(cross-leveled with CH_ENG 4401). The numerical solution of engineering problems in heat and mass transport, computational fluid dynamics, and chemical reactions including electromagnetic effects are treated in full detail using finite element methods and computational software to solve problems in one, two, and three dimensional spaces. Both time dependent and steady state solutions are considered. Graded on A-F basis only.

Credit Hours: 3
Prerequisites or Corequisites: MATH 4100
Prerequisites: CHEM 1330, CH_ENG 2226
Recommended: CH_ENG 3234 and CH_ENG 4363, or concurrent enrollment

CH_ENG 7464: Electrochemical Reaction Engineering Science
(cross-leveled with CH_ENG 4464). Phenomenological behavior of electrochemical processes (battery emphasis). Theoretical interpretations of diffusion and reaction processes including system modeling. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: CH_ENG 3261 or MAE 2300 or CHEM 4310 or instructor's consent
Recommended: A course in thermodynamics or physical chemistry

CH_ENG 7980: Synthesis and Design of Chemical Process
(cross-leveled with CH_ENG 4980). This is a heuristics-based design course intended to assist students in bringing together capabilities from previous course. An emphasis is placed on the creation process of design. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: CH_ENG 3262, CH_ENG 4363, CH_ENG 4385
Recommended: CH_ENG 4370 or concurrent enrollment

CH_ENG 8001: Advanced Topics in Chemical Engineering
Credit Hours: 3
Prerequisites: instructor's consent

CH_ENG 8029: Advanced Plasma Processing
Concepts and techniques in novel plasma processing: plasma characteristics, plasma sputtering, plasma enhanced chemical vapor deposition (PECVD), plasma etching, plasma treatment, plasma fabrication of nano-structured materials and diamondlike films, biomedical applications.

Credit Hours: 3

CH_ENG 8085: Problems in Chemical Engineering
Supervised investigation in chemical engineering to be presented in the form of a report.

Credit Hour: 1-5
Prerequisites: instructor's consent

CH_ENG 8087: Seminar in Chemical Engineering
Reviews investigations and projects of importance in chemical engineering.

Credit Hour: 1

CH_ENG 8230: Advanced Ceramic Materials
(same as BIOL_EN 8230 and MAE 8230). To provide an advanced level understanding between processing, properties, and microstructure of ceramic materials. Topics include crystallography, defect chemistry, transport properties, microstructure, and forming methods. Graded on A-F basis only.

Credit Hours: 3

CH_ENG 8336: Advanced Heat and Momentum Transfer
Advanced study of these transport phenomena.

Credit Hours: 3
Prerequisites: CH_ENG 3235 or instructor's consent

CH_ENG 8337: Advanced Mass Transfer
Advanced study of mass transfer.

Credit Hours: 3
Prerequisites: CH_ENG 4336 or instructor's consent

CH_ENG 8338: Analysis of Equilibrium Stage Processes
Advanced study of stage processes.

Credit Hours: 3
Prerequisites: CH_ENG 2226, CH_ENG 3235 and CH_ENG 3262

CH_ENG 8451: Advanced Chemical Engineering Thermodynamics I
Advanced thermodynamics; particular reference to its application to chemical engineering.

Credit Hours: 3
Prerequisites: CH_ENG 8451 or instructor's consent

CH_ENG 8452: Advanced Chemical Engineering Thermodynamics II
Introduction to the methods of statistical thermodynamics and statistical mechanics. The method of ensembles, Maxwell-Boltzmann statistics, the kinetic theory of gases, and theories of liquids. Applications of statistical mechanics to the prediction of physical and chemical properties such as rate coefficients, diffusion coefficients, and conductivities. Graded A-F only.

Credit Hours: 3
Prerequisites: CH_ENG 8451 or instructor's consent

CH_ENG 8463: Chemical Reaction Engineering Science
Phenomenological behavior of catalysts. Theoretical interpretations for heterogeneous and homogeneous catalysts.

Credit Hours: 3
Prerequisites: CH_ENG 4363

CH_ENG 8470: Mathematical Studies of Chemical Engineering Operation
Analytical methods applied to solution of chemical engineering problems.

Credit Hours: 3
Prerequisites: MATH 4100
CH_ENG 8990: Research-Masters Thesis in Chemical Engineering
Independent investigation in chemical engineering, to be presented as a thesis. Graded on a S/U basis only.

Credit Hour: 1-99
Prerequisites: Masters candidate

CH_ENG 9990: Research-Doctoral Dissertation in Chemical Engineering
Independent investigation in chemical engineering, to be presented as a thesis. Graded on a S/U basis only. candidate

Credit Hour: 1-99
Prerequisites: Ph.D