CHEMICAL ENGINEERING (CH E)

Any experimental courses offered by CH E can be found at:
registrar.iastate.edu/faculty-staff/courses/explistings/ **(**http://www.registrar.iastate.edu/faculty-staff/courses/explistings/**)**

Courses primarily for undergraduates:

CH E 104: Chemical Engineering Learning Community
Cr. R. F.
Prereq: Enrollment in Chemical Engineering Learning Team
(1-0) Curriculum in career planning and academic course support for Freshmen learning team.

CH E 160: Chemical Engineering Problems with Computer Applications Laboratory
(2-2) Cr. 3. F.S.
Prereq: (MATH 143 or satisfactory scores on mathematics placement examinations); credit or concurrent enrollment in MATH 165
Formulation and solution of engineering problems. Significant figures. Use of SI units. Graphing and curve-fitting. Flowcharting. Introduction to material balances, engineering economics, and design. Use of spreadsheet programs to solve and present engineering problems. Solution of engineering problems using computer programming languages. Chemical Engineering examples. Satisfactory placement scores can be found at: https://math.iastate.edu/academics/undergraduate/aleks/placement/. Only one of ENGR 160, A B E 160, AER E 160, CH E 160, C E 160, CPR E 185, E E 185, I E 148, M E 160, and S E 185 may count towards graduation.

CH E 202: Chemical Engineering Seminar
Cr. R. F.
Professionalism in the context of the engineering/technical workplace. Introduction to chemical engineering career opportunities. Process and workplace safety. Development and demonstration of key workplace competencies: teamwork, professionalism and ethical responsibility, ability to engage in life-long learning, and knowledge of contemporary issues. Resumes; professional portfolios; preparation for internship experiences. Restricted to CHE majors. Offered on a satisfactory-fail basis only.

CH E 204: Chemical Engineering Continuing Learning Community
Cr. R.
Prereq: Enrollment in Chemical Engineering Learning Team
Curriculum and career planning, academic course support for learning community.

CH E 205: Chemical Engineering Progress Assessment
Cr. R. F.S.
Prereq: Credit or concurrent enrollment in CH E 160; CHEM 178; MATH 166
Assessment of proficiency in general chemistry, calculus (including infinite series and applications of derivatives and integrals), and material balances, and an ability to use the principles of science and mathematics to identify, formulate, and solve engineering problems. Offered on a satisfactory-fail basis only.

CH E 210: Material and Energy Balances
(3-0) Cr. 3. F.S.
Prereq: CH E 160; CHEM 178; MATH 166
Introduction to chemical processes. Physical behavior of gases, liquids, and solids. Application of material and energy balances to chemical engineering equipment and processes.

CH E 220: Introduction to Biomedical Engineering
(Cross-listed with B M E). (3-0) Cr. 3. S.
Prereq: BIOL 212; (CHEM 167 or CHEM 177); (A B E 160 or AER E 160 or C E 160 or CH E 160 or CPR E 185 or E E 185 or ENGR 160 or I E 148 or M E 160 or S E 185); MATH 166; PHYS 232; PHYS 232L
Engineering analysis of basic biology and engineering problems associated with living systems and health care delivery. The course will illustrate biomedical engineering applications in such areas as: biotechnology, biomechanics, biomaterials and tissue engineering, and biosignal and image processing, and will introduce the basic life sciences and engineering concepts associated with these topics.

CH E 290: Introduction to Undergraduate Research/Independent Study
Cr. 1. Repeatable, maximum of 2 credits. F.S.SS.
Prereq: Permission of Instructor
Introduction to independent study with emphasis on skills necessary to pursue further independent study of a topic of special interest to student and faculty. Topics may include introductions to laboratory safety, standard operating procedures, design of experiments, data analysis, computational methods, literature searches, and professional communications. Pre-enrollment contract between student and instructor required. Offered on a satisfactory-fail basis only. Not applicable to the B.S. in Chemical Engineering degree.

CH E 310: Computational Methods in Chemical Engineering
(3-0) Cr. 3. F.S.
Prereq: CH E 160; CH E 205; CH E 210; MATH 265
Numerical methods for solving systems of linear and nonlinear equations, ordinary differential equations, numerical differentiation and integration, and nonlinear regression using chemical engineering examples.

CH E 325: Chemical Engineering Laboratory I
(0-4) Cr. 2. F.S.
Prereq: CH E 357; CH E 381; (credit or concurrent enrollment in ENGL 309 or ENGL 312 or ENGL 314 or JL MC 347)
Experiments covering fundamental material and energy balances, momentum and energy transport operations, and thermodynamics. Computer applications.

CH E 356: Transport Phenomena I
(3-0) Cr. 3. F.S.
Prereq: CH E 205; CH E 210; PHYS 231; PHYS 231L; credit or concurrent enrollment in MATH 267
Momentum and mechanical energy balances. Incompressible and compressible fluid flow. Applications to fluid drag, piping system design, filtration, packed beds and settling.

CH E 357: Transport Phenomena II
(3-0) Cr. 3. F.S.
Prereq: CH E 356
Conduction and diffusion, convective heat and mass transfer, boiling and condensation, radiation, and design of heat exchange equipment. Introduction to diffusion. Credit for only FS HN 351 or CH E 357 may be applied toward graduation for the Food Science major or Food Science minor

CH E 358: Separations
(3-0) Cr. 3. F.S.
Prereq: CH E 310; CH E 357; CH E 381
Diffusion and mass transfer in fluids. Analysis and design of continuous contacting and multistage separation processes. Binary and multicomponent distillation, absorption, extraction, evaporation, membrane processes, and simultaneous heat and mass transfer.

CH E 381: Chemical Engineering Thermodynamics
(3-0) Cr. 3. F.S.
Prereq: CH E 202; CHEM 325; MATH 267; PHYS 232; (credit or concurrent enrollment in CH E 310; PHYS 232L)
Application of thermodynamic principles to chemical engineering problems. Thermodynamic properties of fluids, phase equilibria, and chemical reaction equilibria.

CH E 382: Chemical Reaction Engineering
(3-0) Cr. 3. F.S.
Prereq: CH E 310; CH E 381; credit or concurrent enrollment in CH E 357
Kinetics of chemical reactions. Design of homogeneous and heterogeneous chemical reactors.

CH E 391: Foreign Study Orientation
(3-0) Cr. 3. S.
Prereq: CH E 357; CH E 381; (credit or concurrent enrollment in ENGL 309 or ENGL 312 or ENGL 314 or JL MC 347)
Offered on a satisfactory-fail basis only. Credit for graduation allowable only upon completion of Ch E 392.
Meets International Perspectives Requirement.

CH E 392: Foreign Study Program
Cr. 4. SS.
Prereq: CH E 358; CH E 382; CH E 391
Study of chemical engineering including laboratories and lectures at collaborating international universities. Comparative study of U.S. and international manufacturing facilities. Expenses required.
Meets International Perspectives Requirement.

CH E 406: Environmental Chemodynamics
(Dual-listed with CH E 506). (3-0) Cr. 3.
Prereq: CHE 357; CH E 381
Examines the mechanisms and rates of chemical transport across air, water, and soil interfaces. Applications of transport and thermodynamic fundamentals to movement of chemicals in the environment.

CH E 408: Surface and Colloid Chemistry
(Dual-listed with CH E 508). (3-0) Cr. 3.
Prereq: CH E 381
Examines the factors underlying interfacial phenomena, with an emphasis on the thermodynamics of surfaces, structural aspects, and electrical phenomena. Application areas include emulsification, foaming, detergency, sedimentation, fluidization, nucleation, wetting, adhesion, flotation, and electrophoresis.

CH E 410: Electrochemical Engineering
(Dual-listed with CH E 510). (3-0) Cr. 3. F.
Prereq: CH E 357; CH E 381; CH E 382
Electrochemical engineering principles in thermodynamics, electrode kinetics, charge and mass transport; modeling and simulation; electrocatalysis; electrochemical reactions; applications of electrochemical engineering in fuel cells, batteries and electrolyzers.

CH E 412: Core Concepts in Chemical Engineering
(3-0) Cr. 3. S.SS.
Prereq: CHEM 325; MATH 267; PHYS 231; PHYS 231L
Survey of the engineering science fundamentals in chemical engineering. Topics include material balances, energy balances, thermodynamics, transport phenomena, and reaction engineering. Credit for ChE 412 may not be applied to any undergraduate or graduate degree programs in chemical engineering.

CH E 415: Biochemical Engineering
(Dual-listed with CH E 515). (3-0) Cr. 3.
Prereq: (BBMB 301 or BBMB 303 or BBMB 404); CH E 357; CHEM 331
Application of basic chemical engineering principles in biochemical and biological process industries such as enzyme technology and fermentation.

CH E 420: Chemical Process Safety
(3-0) Cr. 3. F.S.
Prereq: CH E 357; CH E 381
Application of transport phenomena, thermodynamics, and chemical kinetics to the study of safety, health, and loss prevention. Government regulations, industrial hygiene, relief sizing, runaway reactions, toxic release, and dispersion models will be used. Fires, explosions, risk assessment, hazard identification, case studies, accident investigations, and design considerations will be studied.

CH E 421: Process Control
(3-0) Cr. 3. F.S.
Prereq: CH E 358; CH E 382; MATH 267
Control of industrial chemical processes. Device applications and limitations. Dynamics of chemical process components and process control systems.

CH E 426: Chemical Engineering Laboratory II
(0-4) Cr. 2. F.S.
Prereq: CH E 325; CH E 358; CH E 382
Experiments in heat and mass transfer, staged operations, chemical reactor performance, unit processes. Computer applications. Only one of Ch E 426 or 427 may count toward graduation.

CH E 427: Biological Engineering Laboratory
(0-4) Cr. 2. S.
Prereq: (BBMB 301 or BBMB 303 or BBMB 404); CH E 325; CH E 358; CH E 382
Experiments on biological applications in chemical engineering. Only one of CH E 426 or CH E 427 may count toward graduation.

CH E 429: Chemical Engineering Product Design
(3-0) Cr. 3. F.S.
Prereq: CH E 358 and CH E 382
Application of core chemical engineering concepts to product design. Market and economic analysis, and technical feasibility. Literature and intellectual property search. Environmental, regulatory, and safety considerations.

CH E 430: Process and Plant Design
(2-4) Cr. 4. F.S.
Prereq: CH E 358; CH E 382
Synthesis of chemical engineering processes, equipment and plants. Cost estimation and feasibility analysis.

CH E 440: Biomedical Applications of Chemical Engineering
(Dual-listed with CH E 540). (Cross-listed with B M E). (3-0) Cr. 3.
Prereq: (CH E 210 or CH E 220); (MATH 266 or MATH 267); PHYS 232
Applications of material and energy balances, transport phenomena, chemical reaction engineering, and thermodynamics to problems in biomedical engineering and applied physiology; survey of biomedical engineering; biomaterials; biomedical imaging.

CH E 447: Polymers and Polymer Engineering
(Dual-listed with CH E 547). (3-0) Cr. 3.
Prereq: CHEM 331; (CH E 382 or MAT E 351)
Chemistry of polymers, addition and condensation polymerization. Physical and mechanical properties, polymer rheology, production methods. Applications of polymers in the chemical industry.

CH E 490: Undergraduate Research/Independent Study
(0-18) Cr. 1-6. Repeatable, maximum of 6 credits.
Prereq: Permission of Department
Investigation of topics of special interest to student and faculty with a final written report or presentation. Election of course and topic must be approved in advance by Department with completion of Study Proposal. No more than 6 credits of ChE 490 may be counted towards technical electives.

CH E 490H: Undergraduate Research/Independent Study, Honors
(0-18) Cr. 1-6. Repeatable, maximum of 6 credits.
Prereq: Permission of Department
Investigation of topics of special interest to student and faculty with a final written report or presentation. Election of course and topic must be approved in advance by Department with completion of Study Proposal. No more than 6 credits of ChE 490 may be counted towards technical electives.

CH E 499: Applied Industrial Research
Cr. 3. Repeatable, maximum of 6 credits. F.S.
Prereq: CH E 205; CH E 210; Permission Instructor
Application of core chemical engineering concepts to solve industrially-sponsored process design problems in teams. Introduction to literature review and analysis, intellectual property, and project management.

Courses primarily for graduate students, open to qualified undergraduates:

CH E 506: Environmental Chemodynamics
(Dual-listed with CH E 406). (3-0) Cr. 3.
Prereq: CHE 357; CH E 381
Examines the mechanisms and rates of chemical transport across air, water, and soil interfaces. Applications of transport and thermodynamic fundamentals to movement of chemicals in the environment.

CH E 508: Surface and Colloid Chemistry
(Dual-listed with CH E 408). (3-0) Cr. 3.
Prereq: CH E 381
Examines the factors underlying interfacial phenomena, with an emphasis on the thermodynamics of surfaces, structural aspects, and electrical phenomena. Application areas include emulsification, foaming, detergency, sedimentation, fluidization, nucleation, wetting, adhesion, flotation, and electrophoresis.

CH E 510: Electrochemical Engineering
(Dual-listed with CH E 410). (3-0) Cr. 3. F.
Prereq: CH E 357; CH E 381; CH E 382
Electrochemical engineering principles in thermodynamics, electrode kinetics, charge and mass transport; modeling and simulation; electrocatalysis; electrochemical reactions; applications of electrochemical engineering in fuel cells, batteries and electrolyzers.

CH E 515: Biochemical Engineering
(Dual-listed with CH E 415). (3-0) Cr. 3.
Prereq: (BBMB 301 or BBMB 303 or BBMB 404); CH E 357; CHEM 331
Application of basic chemical engineering principles in biochemical and biological process industries such as enzyme technology and fermentation.

CH E 540: Biomedical Applications of Chemical Engineering
(Dual-listed with CH E 440). (3-0) Cr. 3.
Prereq: (CH E 210 or CH E 220); (MATH 266 or MATH 267); PHYS 232
Applications of material and energy balances, transport phenomena, chemical reaction engineering, and thermodynamics to problems in biomedical engineering and applied physiology; survey of biomedical engineering; biomaterials; biomedical imaging.

CH E 542: Polymeric Biomaterials
(3-0) Cr. 3.
Prereq: CHEM 331 or a polymers class
Polymeric biomaterials, overview of biomaterial requirements, different classes of polymers used as biomaterials, specific bioapplications of polymers.

CH E 545: Analytical and Numerical Methods
(3-0) Cr. 3. F.
Prereq: CH E 358, MATH 267
Analysis of equipment and processes by analytic and/or numerical solution of descriptive differential equations. Operational and series techniques, boundary value problems, numerical interpolation and approximation, integration techniques.

CH E 547: Polymers and Polymer Engineering
(Dual-listed with CH E 447). (3-0) Cr. 3.
Prereq: CHEM 331; (CH E 382 or MAT E 351)
Chemistry of polymers, addition and condensation polymerization. Physical and mechanical properties, polymer rheology, production methods. Applications of polymers in the chemical industry.

CH E 554: Integrated Transport Phenomena
(4-0) Cr. 4. F.
Prereq: CH E 357, CH E 381, Math 267, credit or enrollment in CH E 545
Conservation equations governing diffusive and convective transport of momentum, thermal energy and chemical species. Transport during laminar flow in conduits, boundary layer flow, creeping flow. Heat and mass transport coupled with chemical reactions and phase change. Scaling and approximation methods for mathematical solution of transport models. Diffusive fluxes; conservation equations for heat and mass transfer; scaling and approximation techniques; fundamentals of fluid mechanics; unidirectional flow; creeping flow; laminar flow at high Reynolds number; forced-convection heat and mass transfer in confined and unconfined laminar flows.

CH E 562: Bioseparations
(3-0) Cr. 3.
Prereq: CH E 357 or advanced standing in a science major
Principles and techniques for separation and recovery of biologically-produced molecules, especially proteins. Relationship between the chemistry of biological molecules and efficient separation and preservation of biological activity. Includes centrifugation and filtration, membrane processing, extraction, precipitation and crystallization, chromatography, and electrophoresis.

CH E 572: Turbulence
(Cross-listed with AER E). (3-0) Cr. 3.
Prereq: AER E 541 or M E 538
Qualitative features of turbulence. Statistical representation of turbulent velocity fields: averages, moments, correlations, length and time scales and the energy cascade. Averaged equations of motion, closure requirements, Reynolds averaged models. Homogeneous shear flows, free shear flows, boundary layers. Numerical simulation of turbulence: DNS, LES, DES.

CH E 583: Advanced Thermodynamics
(3-0) Cr. 3. F.
Prereq: CH E 381
Application of thermodynamic principles to chemical engineering problems. Thermodynamic properties of non-ideal fluids and solutions; phase and chemical-reaction equilibria/stability.

CH E 587: Advanced Chemical Reactor Design
(3-0) Cr. 3. S.
Prereq: CH E 382
Analysis of complex reactions and kinetics. Fixed bed, fluidized bed, and other industrial reactors. Analysis and design of non-ideal flow mixing, and residence times. Heterogeneous reactors.

CH E 590: Independent Study
Cr. 2-6. Repeatable.
Investigation of an approved topic on an individual basis.

CH E 595: Special Topics
Cr. 2-3. Repeatable.

CH E 595A: Special Topics: Separations
Cr. 2-3. Repeatable.

CH E 595B: Special Topics: Advanced Control Theory
Cr. 2-3. Repeatable.

CH E 595C: Special Topics: Crystallization
Cr. 2-3. Repeatable.

CH E 595D: Special Topics: Thermodynamics
Cr. 2-3. Repeatable.

CH E 595E: Special Topics: Protein Engineering/Bioseparations
Cr. 2-3. Repeatable.

CH E 595F: Special Topics: Biological Engineering
Cr. 2-3. Repeatable.

CH E 595G: Special Topics: Materials and Biomaterials
Cr. 2-3. Repeatable.

CH E 595H: Special Topics: Surfaces
Cr. 2-3. Repeatable.

CH E 595I: Special Topics: Combinatorial Design
Cr. 2-3. Repeatable.

CH E 599: Creative Component
Cr. arr. Repeatable.

Courses for graduate students:

CH E 601: Seminar
Cr. R. Repeatable. F.S.
Offered on a satisfactory-fail basis only.

CH E 625: Metabolic Engineering
(3-0) Cr. 3.
Prereq: CH E 382, CHEM 331
Principles of metabolic engineering. Emphasis on emerging examples in biorenewables and plant metabolic engineering. Overview of biochemical pathways, determination of flux distributions by stoichiometric and labeling techniques; kinetics and thermodynamics of metabolic networks; metabolic control analysis; genetic engineering for overexpression, deregulation, or inhibition of enzymes; directed evolution; application of bioinformatics, genomics, and proteomics.

CH E 632: Multiphase Flow
(Cross-listed with M E). (3-0) Cr. 3. Alt. S., offered even-numbered years.
Prereq: M E 538
Single particle, mutliparticle and two-phase fluid flow phenomena (gas-solid, liquid-solid and gas-liquid mixtures); particle interactions, transport phenomena, wall effects; bubbles, equations of multiphase flow. Dense phase (fluidized and packed beds) and ducted flows; momentum, heat and mass transfer. Computer solutions.

CH E 642: Principles and Applications of Molecular Simulation
(3-0) Cr. 3.
Prereq: CH E 545
Principles of statistical physics. General features of molecular simulations including Monte Carlo (MC) methods, molecular mechanics (MM), and molecular dynamics (MD). Overview of intermolecular and interatomic potentials. Evaluation of phase equilibria, free energies, and surface/interfacial properties. Coarse-grained methods.

CH E 688: Catalysis and Catalytic Processes
(3-0) Cr. 3.
Prereq: CH E 382
Principles and applications of heterogeneous and homogeneous catalysis. Adsorption. Reaction kinetics and mass transfer effects. Catalyst characterization. Industrial catalytic processes.

CH E 692: Independent Study
Cr. 2-6. Repeatable.
Investigation of an approved topic on an individual basis. Election of course and topic must be approved in advance by Program of Study Committee.

CH E 695: Advanced Topics
Cr. arr. Repeatable.

CH E 695A: Advanced Topics: Separations
Cr. arr. Repeatable.

CH E 695B: Advanced Topics: Advanced Statistical Modeling and Control
Cr. arr. Repeatable.

CH E 695C: Advanced Topics: Crystallization
Cr. arr. Repeatable.

CH E 695D: Advanced Topics: Thermodynamics
Cr. arr. Repeatable.

CH E 695E: Advanced Topics: Protein Engineering/Bioseparations
Cr. arr. Repeatable.

CH E 695F: Advanced Topics: Biological Engineering
Cr. arr. Repeatable.

CH E 695G: Advanced Topics: Materials and Biomaterials
Cr. arr. Repeatable.

CH E 695H: Advanced Topics: Surfaces
Cr. arr. Repeatable.

CH E 695I: Advanced Topics: Combinatorial Design
Cr. arr. Repeatable.

CH E 695J: Advanced Topics: Polymeric and Nanostructured Materials
Cr. arr. Repeatable.

CH E 695K: Advanced Topics: Biomaterials and Tissue Engineering
Cr. arr. Repeatable.

CH E 695L: Advanced Topics: Catalysis, Reaction Engineering, and Renewable Energy
Cr. arr. Repeatable.

CH E 697: Engineering Internship
Cr. R. Repeatable. F.S.SS.
Prereq: Permission of major professor, graduate classification
One semester and one summer maximum per academic year professional work period.

CH E 698: Chemical Engineering Teaching Practicum
(1-0) Cr. 1. F.S.SS.
Prereq: Graduate student classification and permission of instructor
Offered on a satisfactory-fail basis only.

CH E 698A: Chemical Engineering Teaching Practicum: Teaching Practicum
(1-0) Cr. 1. F.
Prereq: Graduate student classification and permission of instructor
Discussions intended to foster the development of graduate students as teaching assistants and future chemical engineering instructors. Topics include classroom and laboratory instruction, grading, and developing a teaching philosophy. Offered on a satisfactory-fail basis only.

CH E 698B: Chemical Engineering Teaching Practicum: Teaching Experience
(1-0) Cr. 1. Repeatable. F.S.SS.
Prereq: CH E 698A
Participation in the instruction of a CH E course under the mentorship of a CBE faculty member. Typical activities may include lecture preparation and delivery, laboratory instruction, design of assessments, problem-solving sessions, office hours, and grading. Offered on a satisfactory-fail basis only.

CH E 699: Research
Cr. arr. Repeatable.
Advanced topic for thesis/dissertation.