

- 322 Structural Systems**
Fall. 3(3-0) P:M: (BCM 222) or (ME 221 or ME 222) R: Open only to juniors or seniors in the Building Construction Management and Civil Engineering majors. Not open to students with credit in CE 406.
Structural design using wood, steel and concrete. Beams, columns, footings, and foundation walls. Loading, soils.
- 324 Construction Estimation**
Fall, Spring. 4(3-2) P:M: (BCM 230 or concurrently and BCM 322) R: Open only to juniors or seniors in the Building Construction Management or Civil Engineering major. C: BCM 311 concurrently.
Estimating construction projects: labor, material, overhead, and profit in unit and detailed formats. Job cost accounting and control. Estimation software.
- 325 Real Estate Principles and Construction Finance**
Fall. 4(4-0) P:M: (EC 201 or EC 202 or EC 251H or EC 252H) and (MTH 124 or MTH 132 or LBS 118) R: Open only to juniors or seniors in the Building Construction Management major or approval of department.
Financial methods and instruments utilized in construction, rehabilitation, development, and purchase of real estate. Terms, contracts, valuation, brokerage, taxation, risk, and interest rate analysis.
- 328 Construction Presentation Graphics**
Fall, Spring. 2(1-2) P:M: (BCM 230) and (CSE 101 or CSE 131 or CSE 231 or CSS 110 or LBS 126) R: Open only to juniors or seniors in the Building Construction Management major.
Graphic communication methods used in construction organizations.
- 353 Land Development**
Spring. 3(3-0) P:M: (BCM 211 and BCM 305) and (BCM 325 or UP 458) R: Open only to juniors or seniors in the Building Construction Management or Civil Engineering or Landscape Architecture or Urban and Regional Planning major. SA: BCM 352, BCM 403
Methods and practices of land development. Market research. Financial feasibility. Land use regulations. Legal documentation. Site analysis and design. Case studies.
- 385 Construction Documents and Contracts (W)**
Spring. 3(3-0) P:M: (BCM 305) Completion of Tier I writing requirement. R: Open only to juniors and seniors in Building Construction Management, Civil Engineering and Landscape Architecture. SA: BCM 422
Construction contracts for commercial and residential projects. Contract procedures, bidding, changes, substitutions. Specifications. Insurance, bonding, claims, disputes, and payments. Responsibilities of owners and contractors.
- 401 Construction Safety Management**
Spring. 3(3-0) P:M: (BCM 305) RB: (BCM 385 or BCM 423 or concurrently) R: Open only to juniors or seniors in the Building Construction Management or Civil Engineering major.
Construction safety with Occupational Safety and Health Administration (OSHA) emphasis. General safety and health provisions, records, and safety management programs. Personnel protection and life saving equipment. Economic impact of safety program.
- 411 Construction Project Scheduling**
Fall. 3(2-2) P:M: (STT 200 or STT 201 or STT 315 or STT 421) and (BCM 315 and BCM 322) R: Open only to juniors or seniors in the Building Construction Management or Civil Engineering major. SA: BCM 311
Basic construction project scheduling procedures. Work breakdown structure, critical path method and scheduling logic. Activity durations, status reports, resource allocation and control.
- 415 Cost Estimating and Analysis**
Fall. 3(2-2) P:M: (BCM 315 and BCM 385) SA: BCM 324
Estimation of construction project costs: direct and indirect, labor, material, and equipment. Overhead and profit. Bidding. Computer-based estimating.
- 423 Construction Project Management**
Fall, Spring. 3(3-0) P:M: (BCM 385 and BCM 411 or concurrently and BCM 415 or concurrently) R: Open only to seniors in the Building Construction Management or Civil Engineering major.
Construction management principles and practices. Project planning and controls.
- 435 Residential Building Projects (W)**
Spring. 3(1-4) P:M: (ACC 201 and ACC 202) or (ACC 230) and (BCM 328 and BCM 353 and BCM 423 or concurrently) and completion of Tier I writing requirement. R: Open only to seniors in the Building Construction Management major.
Development of a residential project and business plan.
- 436 Commercial Building Projects (W)**
Spring. 3(1-4) P:M: (ACC 201 and ACC 202) or (ACC 230) and (BCM 328 and BCM 353 and BCM 423 or concurrently) and completion of Tier I writing requirement. R: Open only to seniors in the Building Construction Management major.
Evaluation, procurement and management of commercial building projects.
- 490 Independent Study**
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Open only to Building Construction Management majors. Approval of department required.
Special problems in acquisition and development of residential land, design, construction technology, building materials, finance, marketing, construction management, or land use codes and regulations.
- 491 Special Topics in Building Construction Management**
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. P:M: (BCM 210) R: Open only to Building Construction Management majors. Approval of department.
Topics such as computer methods in building construction management, construction technology, solar energy, special land use codes or new technology management.
- 493 Professional Internship in Building Construction Management.**
Fall, Spring, Summer. 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to juniors or seniors in Building Construction Management. Approval of department; application required. A student may earn a maximum of 6 credits in all enrollments for any or all of these courses: ABM 493, AEE 493, ANR 493, ANS 493, BCM 493, CSS 493, EEP 493, FIM 493, FSC 493, FW 493, HRT 493, PKG 493, PLP 493, PRR 493, and RD 493.
Supervised professional experiences in agencies and businesses related to a student's major field of study.

CHEMICAL ENGINEERING CHE

Department of Chemical Engineering and Materials Science College of Engineering

- 201 Material and Energy Balances**
Fall, Spring. 3(4-0) P:M: (MTH 133) and (CEM 142 or CEM 143 or CEM 152) and (CSE 101 or concurrently or CSE 131 or concurrently)
Chemical engineering calculations. Synthesis of chemical process systems. Analysis of chemical processes using material and energy balances. Enthalpy calculations for changes in temperature, phase transitions, and chemical reactions.
- 301 Chemical Engineering as a Profession**
Fall. 1(2-0) P:M: (CHE 201 or concurrently) RB: Junior standing in chemical engineering R: Open only to students in the Chemical Engineering major.
Professional aspects of chemical engineering. Communication skills, professionalism and ethics, teamwork skills, contemporary engineering issues, career planning, project management, industrial processes.
- 311 Fluid Flow and Heat Transfer**
Fall. 4(5-0) P:M: (CHE 201 or concurrently and MTH 235 or concurrently) R: Open only to students in the College of Engineering. Not open to students with credit in ME 201 or MSM 351.
Thermodynamics of fluid flow. Laminar and turbulent flow. Design of flow systems. Heat transfer in solids and flowing fluids. Interphase heat transfer. Radiant heat transfer. Multiple effect evaporation. Design of heat exchange equipment.
- 312 Mass Transfer and Separations**
Spring. 4(5-0) P:M: (CHE 201 and MTH 235 or concurrently) R: Open only to students in the College of Engineering.
Diffusion. Mass transfer coefficients. Design of countercurrent separation systems, both stagewise and continuous. Distillation, absorption, extraction. Multicomponent separations. Batch processes. Computer-aided design methods.

Chemical Engineering—CHE

- 316 Unit Operations Laboratory**
Spring. 3(1-6) P:M: (CHE 311 and CHE 312 or concurrently and CHE 321 or concurrently and CHE 431 or concurrently) and completion of Tier I writing requirement. R: Open only to students in the Department of Chemical Engineering.

Momentum, heat, and mass transfer. Separation processes: distillation, filtration, and drying. Reactor kinetics. Automatic process control. Laboratory problems requiring team effort.

321 Thermodynamics for Chemical Engineering

Spring. 4(5-0) P:M: (CHE 201)

First and second laws. Thermodynamics of flow and batch conversion processes. Properties of single and multi-component systems. Phase equilibria. Chemical equilibria in reacting systems.

422 Transport Phenomena

Spring. 3(3-0) P:M: (CHE 311 and CHE 312)

Mathematical and physical analogies among mass, energy and momentum transfer processes. Dimensional analysis and solutions to multivariable boundary value problems. Numerical solutions to nonlinear problems.

431 Chemical Reaction Engineering

Spring. 3(3-0) P:M: (CHE 311 and CHE 312 or concurrently and CHE 321 or concurrently) R: Open only to juniors or seniors in the Chemical Engineering major.

Design and analysis of homogeneous flow and batch reactors. Chemical kinetics and equilibria. Reaction rate expressions from mechanisms and experimental data. Mass and heat transfer in heterogeneous reactors. Heterogeneous reactor design. Catalysis.

432 Process Dynamics and Control

Fall. 3(3-0) P:M: (CHE 431)

Mathematical modeling of process dynamics. Control theory. Design of control systems and specification of control hardware. Integration of control theory with modern practice.

433 Process Design and Optimization I

Fall. 4(5-0) P:M: (CHE 432 or concurrently) and completion of Tier I writing requirement. R: Open only to students in the Department of Chemical Engineering.

Applications of chemical engineering principles in design calculations. Selection of optimum design. Influence of design on capital investment, operating cost, product loss and quality. Mathematical programming methods for optimization.

434 Process Design and Optimization II

Spring. 2(0-4) P:M: (CHE 433)

Design project requiring an integrated design of chemical engineering processes. Process and project engineering. Instrumentation and control systems. Flowsheet layout and optimization. Process simulation.

472 Composite Materials Processing

Fall. 3(2-3) P:M: (CHE 311 or ME 332 or CE 321)

Manufacturing processes for thermoset and thermoplastic matrix composites. Mechanical and thermal evaluation of composites. Rheology and molding of fiber-filled materials.

473 Chemical Engineering Principles in Polymers and Materials Systems

Spring. 3(3-0) P:M: (CHE 311 and CHE 321 and CHE 431 and CEM 352) SA: CHE 371

Application of chemical engineering principles to polymer and materials systems. Structures and properties of metals, ceramics and polymers. Thermodynamics, synthesis, rubber elasticity, viscoelasticity, kinetics, rheology, and processing of polymers systems. Application of statistics and problem-solving skills to materials systems.

481 Biochemical Engineering

Fall. 3(2-3) P:M: (CHE 431)

Applications of microbiology and biochemistry to biochemical engineering. Kinetics and thermodynamics of biochemical reactors. Transport phenomena in biological systems. Bioreactor design and scale-up.

490 Independent Study

Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to juniors or seniors or graduate students in the Department of Chemical Engineering. Approval of department.

Theoretical or experimental studies of current research topics in chemical engineering. Individual interaction with faculty adviser.

491 Selected Topics in Chemical Engineering

Fall, Spring. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to juniors or seniors or graduate students in the Department of Chemical Engineering.

Study of newly developing or non-traditional chemical engineering topics in a classroom environment.

143 Survey of Organic Chemistry

Fall, Spring. 4(3-3) P:M: (CEM 141 or CEM 151) Not open to students with credit in CEM 251 or CEM 351.

Chemistry of carbon compounds. Chemistry of the main organic functional groups with applications to everyday life, industry, and biology.

151 General and Descriptive Chemistry

Fall. 4(4-0) P:M: (MTH 116 or concurrently or MTH 124 or concurrently or MTH 132 or concurrently or MTH 152H or concurrently or LBS 117 or concurrently or LBS 118 or concurrently) or designated score on Mathematics placement test. Not open to students with credit in CEM 141 or CEM 181H or LBS 171.

Atomic structure, chemical bonding and molecular structure; solid state; main group chemistry; acids and bases; transition metal chemistry; coordination chemistry and theories of bonding.

152 Principles of Chemistry

Spring. 3(4-0) P:M: (CEM 151 or CEM 181H or LBS 171) Not open to students with credit in CEM 142 or CEM 182H or LBS 172.

The mole concept and stoichiometry; solution stoichiometry; thermochemistry; gases, liquids, and solids; kinetics; chemical equilibria; acid-based equilibria; aqueous equilibria; thermodynamics; redox and electrochemistry.

161 Chemistry Laboratory I

Fall, Spring. 1(0-3) P:M: (CEM 141 or concurrently or CEM 151 or concurrently) Not open to students with credit in LBS 171L or CEM 185H.

Experiments in general chemistry; stoichiometry, calorimetry, electrochemistry, molecular geometry, gas laws, kinetics, acids and bases, and inorganic chemistry.

162 Chemistry Laboratory II

Fall, Spring. 1(0-3) RB: (CEM 161 or LBS 171L or CEM 185H) and (CEM 142 or concurrently and CEM 152 or concurrently)) Not open to students with credit in LBS 172L or CEM 186H.

Analytical and inorganic chemistry; redox and acid base titrations; spectrophotometric and gravimetric analysis; preparation and analysis of coordination complexes of nickel, iron, and cobalt.

181H Honors Chemistry I

Fall. 4(4-0) P:M: (MTH 124 or concurrently or MTH 132 or concurrently or MTH 152H or concurrently or LBS 118 or concurrently) R: Approval of department.

Elements and compounds; stoichiometry; reactions; atomic structure and quantum mechanics, chemical bonding and molecular structure; spectroscopy; coordination chemistry and theories of bonding; structure of biochemical molecules.

182H Honors Chemistry II

Spring. 4(4-0) P:M: (CEM 151 or CEM 181H or LBS 171) and (MTH 126 or concurrently or MTH 133 or concurrently or MTH 153H or concurrently) R: Approval of department.

Thermodynamics and chemical equilibria; acids and bases; redox chemistry; main group elements; solid state; group theory and symmetry; molecular orbital theory; transition metal chemistry and spectroscopy.

CHEMISTRY

CEM

Department of Chemistry College of Natural Science

141 General Chemistry

Fall, Spring. 4(4-0) P:M: (MTH 103 or concurrently or MTH 110 or concurrently or MTH 116 or concurrently or MTH 124 or concurrently or MTH 132 or concurrently or MTH 152H or concurrently or LBS 117 or concurrently or LBS 118 or concurrently) or designated score on Mathematics placement test. Not open to students with credit in CEM 151 or CEM 181H or LBS 171.

Elements and compounds; reactions; stoichiometry; thermochemistry; atomic structure; chemical bonding; states of matter; solutions; acids and bases; aqueous equilibria.

142 General and Inorganic Chemistry

Fall, Spring. 3(4-0) P:M: (CEM 141 or CEM 151 or CEM 181H or LBS 171) Not open to students with credit in CEM 152 or CEM 182H or LBS 172.

Kinetics; gaseous equilibria; acids and bases; pH; buffers; hydrolysis; titrations; heterogeneous equilibria; thermodynamics; redox and electrochemistry; transition metal chemistry; nuclear chemistry; main group chemistry.