880*. ***Plant Virology***
Fall of even-numbered years. 4(2-4)
P: BCH 462, BOT 810. R: Open only to graduate students.
Biology and molecular aspects of viruses causing plant disease.
QP: BOT 405 BCH 453 QA: BOT 880

881*. ***Molecular and Biochemical Plant Pathology***
Spring of odd-numbered years. 3(2-2)
P: BCH 462; BOT 414 or BOT 415; BOT 810; ZOL 341. R: Open only to graduate students.
Biochemical and molecular bases of host-pathogen interactions. Mechanisms of pathogenicity and the nature of disease resistance.
QP: BCH 453 ZOL 441BOT 415ORBOT 405 QA: BOT 881

884*. ***Prokaryotic Diseases of Plants***
Fall of odd-numbered years. 4(2-4)
P: BOT 810.
Description of prokaryotic genera associated with plant diseases, identification, physiology, and genetics. Laboratory techniques.
QP: BOT 405 QA: BOT 884

885*. ***Plant Diseases in the Field***
Summer. 2(1-3)
P: BOT 810. R: Open only to graduate students.
Diagnosis of plant diseases and disorders in a field setting. Field trips and independent study are required.
QP: BOT 405 QA: BOT 885

899*. ***Master's Thesis Research***
Fall, Spring, Summer. 1 to 12 credits. May reenroll for a maximum of 24 credits.
R: Open only to graduate students.
Research in anatomy, bryology, cell biology, ecology, genetics, molecular biology, morphology, mycology, paleobotany, pathology, physiology and systematics.
QA: BOT 899

999*. ***Doctoral Dissertation Research***
Fall, Spring, Summer. 1 to 24 credits. May reenroll for a maximum of 99 credits.
R: Open only to doctoral students.
Research in anatomy, bryology, cell biology, ecology, genetics, molecular biology, morphology, mycology, paleobotany, pathology, physiology and systematics.
QA: BOT 999

BUILDING CONSTRUCTION MANAGEMENT BCM

126*. ***Residential Construction Materials, Methods and Drafting***
Fall, Spring, Summer. 5(3-4)
R: Open only to Building Construction Management students. Not open to students with credit in HED 150.
Materials, methods, codes and drafting in residential construction.
QA: BCM 214 BCM 215 BCM 415

227*. ***Commercial Building Construction Methods***
Fall, Spring. 3(3-0)
P: BCM 126. R: Open only to Building Construction Management students.
Methods, codes, and plans for constructing commercial buildings. Construction system details: site preparation, foundations, floors, framing systems, and roof systems.
QP: BCM 215 BCM 214 QA: BCM 217

230*. ***Utilities***
Fall, Spring. 3(3-0)
P: BCM 227. R: Not open to freshmen. Open only to Buidling Construction Management students.
Heating, cooling, plumbing and electrical utilities in residential and light commercial construction utilizing applicable codes.
QP: BCM 216 BCM 217 QA: BCM 412

250*. ***Construction Mechanics and Equipment Management***
Fall. 3(2-3)
R: Open only to Building Construction Management and Agricultural Technology and Systems Management students.
Principles, applications, techniques, tools, materials and resources in building construction mechanics and light construction equipment management.
QA: BCM 201 BCM 327

252*. ***Current Issues in the Building and Housing Industries***
Fall. 3(3 -0)
Impacts of government policies and regulations on the building and housing industries. Land use, construction technology, energy. Economics, demographics, and lifestyle choices.
QA: BCM 200

311. ***Quantitative Methods in Technology Management***
Fall, Spring. 3(3-0)
P: MTH 116 or MTH 120; CPS 100 or CPS 130 or CPS 131. R: Not open to freshmen and sophomores.
Technology management methods including linear programming, scheduling, decision theory, queuing and simulation. Applications in building construction management, agriculture and associated industries.
QP: MTH 108 MTH 111CPS 115CPS 100 QA: ATM 311

322*. ***Structural Design***
Fall, Spring. 4(5-0)
P: BCM 227; PHY 231 or PHY 231B. R: Open only to Building Construction Management majors.
Mechanics, material strengths and section properties developed and applied to structural design using wood, steel and concrete. Beams, columns, footings, and foundation walls.
QP: BCM 215 PHY 237 QA: BCM 312 BCM 313

324*. ***Construction Estimation***
Fall, Spring. 4(3-2)
P: BCM 230, BCM 322. R: Open only to Building Construction Management majors.
Estimating construction projects: labor, material, overhead, and profit in unit and detailed formats. Job cost accounting and control. Estimation software.
QP: BCM 217 BCM 412 QA: BCM 416

325*. ***Construction and Real Estate Finance***
Fall, Spring. 4(4 -0)
P: EC 201 or EC 202; MTH 116 or MTH 120. R: Not open to freshmen and sophomores. Open only to Building Construction Management majors.
Financial methods and instruments utilized in construction, rehabilitation, development, and purchase of real estate. Terms, contracts, valuation, brokerage, taxation, risk, and interest rate analysis.
QP: MTH 109 ORMTH 110ORMTH 111 QA: BCM 417 FI 395

340*. ***Residential Design Evaluation***
Fall. 3(3-0)
P: BCM 126 or HED 160. R: Not open to freshmen and sophomores. Open only to Building Construction Management and Human Environment and Design majors.
Qualitative methods for evaluating residential building designs. Design impacts on building occupants: children, families, singles, handicappers, elderly.
QP: BCM 215

349*. ***Construction Renovation***
Spring. 3(3-0)
P: BCM 227. R: Open only to Building Construction Management and Human Environment and Design majors.
Preservation, rehabilitation, remodeling and restoration of existing buildings. Analysis of building adaptability and design. Economic feasibility and codes. Historical and social considerations.
QP: BCM 217 QA: BCM 239 BCM 339

351*. ***Concepts of Fire Safe Construction***
Fall. 3(3-0)
P: BCM 126. R: Open only to Building Construction Management majors.
Safety and fire integrity of structures: principles, terminology, and techniques of construction affecting life. Applicable codes. Materials and assemblies. Suppression and detection systems.
QP: BCM 215 ORBCM 217ORBCM 412 QA: BCM 318 BCM 490

352*. ***Land Development***
Spring. 3(3-0)
P: BCM 126; BCM 325 or concurrently. R: Open only to Building Construction Management, Civil Engineering, History of Art, Landscape Architecture, and Urban Planning majors.
Methods and practices of land development for residential and commercial uses. Market research. Land use regulations. Legal documentation. Site analysis and design. Case Studies.
QP: BCM 215 BCM 417 QA: BCM 418 BCM 490

422*. ***Construction Contracts***
Fall, Spring. 3(3-0)
P: BCM 227, BCM 311, BCM 324 R: Seniors and above BCM, CE
Construction contracts for commercial and residential projects. Contract procedures, bidding, changes, substitutions, insurance, bonding, claims, disputes, and payments. Specifications. Responsibilities of owner and contractors.
QP: ATM 311 BCM 217BCM 416

423*. ***Construction Project Management***
Fall, Spring. 3(3 -0)
P: BCM 311, BCM 324. R: Open only to seniors and graduate students in Building Construction Management and Civil Engineering.
Construction management principles and practices. Site and project management.
QP: BCM 416 ATM 311 QA: BCM 420

452*. ***Commercial Utility Systems***
Spring. 3(3-0)
P: BCM 230. R: Open only to Building Construction Management, Mechanical Engineering, Civil Engineering, and Human Environment and Design majors.
Primary electrical, heating, ventilating, air conditioning, plumbing, elevator, and fire detection and suppression systems for commercial buildings.
QP: BCM 412

490*. ***Independent Study***
Fall, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 8 credits.
R: Open only to Building Construction Management majors. Approval of department; application 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.
QA: BCM 418

491*. ***Special Topics in Building Construction Management***
Fall, Spring. 1 to 4 credits. May reenroll for a maximum of 8 credits.
P: BCM 227 or BCM 311. 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.
QP: BCM 215 ORATM 311ORBCM 217 QA: BCM 490

823*. ***Advanced Construction Project Management***
Spring of even-numbered years. 3(3-0)
P: BCM 422 and BCM 423 or CE 372 and 471 R: Seniors and Graduate Students BCM, CE
Advanced construction management practices. Project management. Risk allocation. Case studies.

890*. ***Special Problems***
Fall, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 9 credits.
P: Approval of department R: Graduate students Agriculture and Natural Resources Approval of department; application required
Individual student research and study in land acquisition and development, design, construction, management, finance, marketing, and structural analysis.
QA: BCM 880

891*. ***Advanced Topics in Building Construction Management(MTC)***
Fall, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 12 credits.
P: Approval of department R: Graduate students Agriculture and Natural Resources
Advanced topics in building construction management.
QA: BCM 890

892*. ***Construction Management Research Seminar***
Fall. 1(1 -0)
R: Graduate Students
Current research topics and issues in construction management. Construction methods and materials and building design.

899*. ***Master's Thesis Research***
Fall, Spring, Summer. 1 to 8 credits. May reenroll for a maximum of 15 credits.
P: Approval of department R: Graduate students BCM

QA: BCM 899

CHEMICAL ENGINEERING CHE

201. ***Material and Energy Balances***
Fall, Spring. 3(4-0)
P: MTH 133, CEM 142 or CEM 152, CPS 131 or CPS 130 or concurrently.
Chemical engineering calculations. Synthesis of chemcial process systems. Analysis of chemical processes using material and energy balances. Enthalpy calculations for changes in temperature, phase transitions, and chemical reactions.
QP: CPS 112 MTH 214CEM 142 QA: CHE 300

311. ***Fluid Flow and Heat Transfer***
Spring. 4(5-0)
P: CHE 201 or concurrently, MTH 235 or concurrently. R: Open only to College of Engineering students. Not open to students with credit in ME 201 or MMM 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.
QP: CHE 300 MTH 310 QA: CHE 340 CHE 341

312. ***Mass Transfer and Separations***
Fall. 4(5-0)
P: CHE 201 or concurrently, MTH 235 or concurrently. R: Open only to College of Engineering students.
Diffusion. Mass transfer coefficients. Design of countercurrent separation systems, both stagewise and continuous. Distillation, absorption, extraction. Multicomponent separations. Batch processes. Computer-aided design methods.
QP: CHE 300 MTH 310 QA: CHE 342 CHE 343

316*. ***Unit Operations Laboratory***
Spring. 3(01-06)
P: CHE 311, CHE 312; CHE 321 or concurrently. R: Open only to Chemical Engineering majors.
Momentum, heat, and mass transfer. Separation processes: distillation, filtration, and drying. Reactor kinetics. Automatic process control. Laboratory problems requiring team effort.
QP: CHE 451 CHE 428 QA: CHE 423

321*. ***Thermodynamics for Chemical Engineering***
Spring. 4(05-00)
P: CHE 201, CEM 361. R: Open only to College of Engineering students.
First and second laws. Thermodynamics of flow and energy conversion processes. Properties of single and multi-component systems. Phase equilibria. Chemical equilibria in reacting systems.
QP: CHE 300 CEM 361 QA: CHE 311 CHE 411

371*. ***Chemical Engineering Materials***
Fall. 3(03-00)
P: CEM 352; CEM 361 or concurrently. R: Open only to Chemical Engineering majors.
Structure, properties, and performance of classes of materials emphasizing polymeric materials.
QP: CEM 353 QA: CHE 443 CHE 442

422*. ***Transport Phenomena***
Spring. 3(03-00)
P: CHE 311, CHE 312. R: Open only to Chemical Engineering majors.
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.
QP: MTH 310 CHE 343 QA: CHE 381 CHE 481

431. ***Chemical Reaction Engineering***
Spring. 3(3-0)
P: CHE 311, CHE 312, CHE 321 or concurrently. R: Open only to Chemical Engineering majors.
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.
QP: CHE 343 CHE 411 QA: CHE 428

432*. ***Process Dynamics and Control***
Fall. 3(03-00)
P: CHE 431. R: Open only to Chemical Engineering majors.
Mathematical modeling of process dynamics. Control theory. Design of control systems and specification of control hardware. Integration of control theory with modern practice.
QP: CHE 428 QA: CHE 451

433. ***Process Design and Optimization I***
Fall. 3(4-0)
P: CHE 431, CHE 432 or concurrently. R: Open only to Chemical Engineering majors.
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.
QP: CHE 428 CHE 451 QA: CHE 461

434*. ***Process Design and Optimization II***
Spring. 3(04-00)
P: CHE 433. R: Open only to Chemical Engineering majors.
Integrated design of chemical engineering processes. Process and project engineering. Instrumentation and control systems. Flowsheet layout and optimization. Process simulation.
QP: CHE 461 QA: CHE 462

472. ***Composite Materials Processing***
Fall. 3(2-3)
P: CHE 311 or ME 332 or CE 321. R: Open only to College of Engineering majors.
Manufacturing processes for thermoset and thermoplastic matrix composites. Mechanical and thermal evaluation of composites. Rheology and molding of fiber-filled materials.
QP: CHE 341 QA: CHE 444

481. ***Biochemical Engineering***
Fall. 3(2-3)
P: CHE 431. R: Open only to College of Engineering majors.
Applications of microbiology and biochemistry to biochemical engineering. Kinetics and thermodynamics of biochemical reactors. Transport phenomena in biological systems. Bioreactor design and scale-up.
QP: CHE 428

490*. ***Independent Study***
Fall, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 6 credits.
R: Open only to Chemical Engineering majors. Approval of department.
Theoretical or experimental studies of current research topics in chemical engineering. Individual interaction with faculty adviser.
QA: CHE 460

491*. ***Selected Topics in Chemical Engineering***
Fall, Spring. 1 to 4 credits. May reenroll for a maximum of 6 credits.
R: Open only to Chemical Engineering majors.
Study of newly-developing or non-traditional chemical engineering topics in a classroom environment.
QA: CHE 460

801*. ***Advanced Chemical Engineering Calculations***
Fall. 3(3-00)
P: CHE 431 R: Senior or Graduate Student
Formulation of differential equations modelling physical phenomena in chemical engineering. Application of analytical and numerical solution methods including spectral, finite difference and finite element methods.
QA: CHE 801 CHE 802

804*. ***Thermodynamics and Kinetics in Chemical Engineering***
Summer. 3(02-02)
R: Approval of department.
Mass and energy balances in batch, continuous and open systems. Process thermodynamics. Cryogenics. Properties of substances and mixtures. Phase equilibria. Chemical reaction equilibria. Chemical reactor kinetics. Process design orientation.
QA: CHE 806