851. Quantitative Methods in Ecology and Evolution
Fall. 3(3-0) Interdepartmental with Zoology. Administered by Zoology.
P: STT 465.
Interpretation and analysis of ecological and evolutionary biology data. Statistical computer software.

856. Plant Molecular Biology
Spring. 3(3-0) Interdepartmental with Biochemistry.
P: ZOL 341.
Recent advances in genetics and molecular biology of higher plants.

860. Ecology and Evolution in Terrestrial Systems
Summer. 4 credits. Given only at W.K. Kellogg Biological Station. Interdepartmental with Zoology, and Crop and Soil Sciences.
P: STT 422.
Field experimental and quantitative approaches to ecological and evolutionary mechanisms.

863. Environmental Plant Physiology
Spring of odd-numbered years. 3(3-0) Interdepartmental with Horticulture.
P: BOT 301 or BOT 414 or BOT 415.
Interaction of plant and environment. Photobiology, thermophysiology, and plant-water relations.

864. Plant Biochemistry
Spring. 3(3-0) Interdepartmental with Biochemistry. Administered by Biochemistry.
P: BCH 401 or BCH 462.
Biochemistry unique to photosynthetic organisms. Photosynthetic and respiratory electron transport, nitrogen fixation, carbon dioxide fixation, lipid metabolism, carbon partitioning, cell walls, biosynthesis of plant hormones.

865. Plant Growth and Development
Fall. 3(3-0)
P: BOT 415.
Physiology and biochemistry of growth and development as regulated by internal and external factors. Biosynthesis and action of plant hormones. Environmental factors: light and temperature.

870. Plant Nematology
Spring of odd-numbered years. 3(2-3) Interdepartmental with Entomology. Administered by Entomology.
P: BOT 405.
Biology, host parasite relationships and management of selected nematode diseases of economic plants.

880. Plant Virology
Fall of odd-numbered years. 4(2-4)
P: BCH 462, BOT 810.
Biology and molecular aspects of viruses causing plant disease.

881. Molecular and Biochemical Plant Pathology
Spring of odd-numbered years. 3(2-2)
P: BCH 462, ZOL 341, BOT 810; BOT 414 or BOT 415.
Biochemical and molecular bases of host-pathogen interactions. Mechanisms of pathogenicity and the nature of disease resistance.

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

885. Plant Diseases in the Field
Summer of odd-numbered years. 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.

891. Current Topics in Ecology and Evolution
Summer. 1 credit. Given only at W.K. Kellogg Biological Station. A student may earn a maximum of 8 credits in all enrollments for this course. Interdepartmental with Zoology, and Crop and Soil Sciences. Administered by Zoology.
Presentation and critical evaluation of theoretical and empirical developments by visiting scientists.

897. Community and Ecosystem Ecology
Spring. 4(4-0) Interdepartmental with Zoology, and Fisheries and Wildlife. Administered by Zoology.
R: Open only to students in Interdepartmental Graduate Specializations in Ecology and Evolutionary Biology.
Structure and function of natural communities and ecosystems. Community analysis along environmental gradients. Succession, food web analysis, energy flow, nutrient cycling, and effects of human activities on ecosystems.

899. Masters Thesis Research
Fall, Spring, Summer. 1 to 12 credits. A student may earn a maximum of 24 credits in all enrollments for this course.
R: Open only to graduate students.
Research in anatomy, bryology cell biology, ecology, genetics, molecular biology, morphology, mycology, paleobotany, pathology, physiology and systematics.

999. Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 12 credits. A student may earn a maximum of 99 credits in all enrollments for this course.
R: Open only to doctoral students.
Research in anatomy, bryology cell biology, ecology, genetics, molecular biology, morphology, mycology, paleobotany, pathology, physiology and systematics.

BUILDING CONSTRUCTION MANAGEMENT BCM

Department of Agricultural Engineering
College of Agriculture and Natural Resources
College of Engineering

124. Construction Materials
Fall, Spring. 3(3-0)
Properties of construction materials and their application in residential and light commercial construction.
SA: BCM 126

125. Architectural Drafting
Fall, Spring. 3(2-3)
P: BCM 124 or concurrently.
Architectural drafting including site plans, floor plans, foundation plans, elevations, sections, and details. Print reading including plan analysis of assemblies and details. Emphasizes residential construction.
SA: BCM 126

227. Commercial Building Construction Methods
Fall, Spring. 3(3-0)
P: BCM 124. 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.

230. Utilities
Fall, Spring. 3(3-0)
P: BCM 227. R: Not open to freshmen. Open only to Building Construction Management students and Civil Engineering majors.
Heating, cooling, plumbing and electrical utilities in residential and light commercial construction utilizing applicable codes.

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

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.

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.

322. Structural Design
Fall, Spring. 4(5-0)
P: BCM 227; PHY 231 or PHY 231B. R: Open only to Building Construction Management or Agricultural Technology and Systems 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.

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

325. Construction and Real Estate Finance
Fall, Spring. 4(4-0)
P: EC 201 or EC 202; MTH 116 or MTH 120. R: Open only to Building Construction Management, Civil Engineering, and College of Business 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.

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.

349. Construction Renovation
Spring. 3(3-0)
P: BCM 227. R: Open only to Building Construction Management or Human Environment and Design majors or to juniors and seniors in Historic Preservation Specialization.
Preservation, rehabilitation, remodeling and restoration of existing buildings. Analysis of building adaptability and design. Economic feasibility and codes. Historical and social considerations.

422. Construction Contracts
Fall, Spring. 3(3-0)
P: BCM 227, BCM 311, BCM 324. R: Open only to seniors and graduate students in Building Construction Management and Civil Engineering.
Construction contracts for commercial and residential projects. Contract procedures, bidding, changes, substitutions. Insurance, bonding, claims, disputes, and payments. Specifications. Responsibilities of owner and contractors.

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.

451. Concepts of Fire Safe Construction
Fall. 3(3-0)
P: BCM 230 or HED 350. 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.

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.

453. Land Development
Spring. 3(3-0)
P: BCM 227, BCM 325. 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.

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; 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.

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: 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.

811. Advanced Project Scheduling
Fall of odd-numbered years. 3(2-2)
Critical path analysis for effective and logical scheduling of construction projects. Identification of project activities and their relationships. Schedule development, analysis, and updating. Relationship of project costs and resources to the schedule. Effective communication of schedule information.

823. Advanced Construction Project Management
Spring of even-numbered years. 3(3-0)
P: BCM 422, BCM 423; or CE 373, CE 471. R: Open only to graduate students in Building Construction Management or Civil Engineering.
Project management issues, services, documentation, risk assessment. Bidding, cost accounting, scheduling. Dispute resolution and liability case studies.

890. Special Problems
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 4 credits in all enrollments for this course.
R: Open only to graduate students in College of Agriculture and Natural Resources. Approval of department; application required.
Individual study in land acquisition and development, design, construction, management, finance, marketing, and structural analysis.

891. Advanced Topics in Building Construction Management
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 graduate students in College of Agriculture and Natural Resources. Approval of department.
Advanced topics in building construction management.

892. Construction Management Seminar
Fall. 1(1-0)
R: Open only to graduate students in College of Agriculture and Natural Resources or College of Engineering.
Current topics and issues in construction management. Construction methods and materials and building design.

899. Master's Thesis Research
Fall, Spring, Summer. 1 to 10 credits. A student may earn a maximum of 99 credits in all enrollments for this course.
R: Open only to graduate students in Building Construction Management.

CHEMICAL ENGINEERING CHE

Department of Chemical Engineering
College of Engineering

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. R: Open only to students in the College of Engineering.
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.

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 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
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.

316. Unit Operations Laboratory
Spring. 3(1-6)
P: CHE 311 or concurrently; CHE 312; CHE 321 or concurrently. R: Open only to Chemical Engineering and Food Engineering majors. Completion of Tier I writing requirement.
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: CHE 201. 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.

371. Chemical Engineering Materials
Fall. 3(3-0)
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.

422. Transport Phenomena
Spring. 3(3-0)
P: CHE 311, CHE 312; or FE 485. R: Open only to Chemical Engineering and Food 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.