

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.
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 125 R: Open only to students in the Building Construction Management major.
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; MTH 116 or MTH 120 R: Not open to freshmen. Open only to students in the Building Construction Management major or to juniors or seniors in the Civil Engineering major.
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. Construction Project Scheduling
Fall, Spring. 3(2-2)
P: BCM 230 or concurrently; BCM 322 C: BCM 324 concurrently. R: Open only to juniors or seniors in the Building Construction Management or Civil Engineering major.
Basic construction project scheduling procedures. Work breakdown structure, critical path method and scheduling logic. Activity durations, status reports, resource allocation and control.

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 or concurrently; BCM 322 C: BCM 311 concurrently. R: Open only to juniors or seniors in the Building Construction Management or Civil Engineering major.
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 and 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.

Descriptions — Building Construction Management of Courses

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.

817. Computer-Integrated Construction Management

Spring. 3(2-2)

R: Approval of department; application required. Information generation and utilization for the management of construction projects. Integration of construction management software, conceptual modeling and knowledge-based models.

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 Research Seminar

Fall. 2(2-0)

R: Open only to graduate students in the College of Agriculture and Natural Resources or College of Engineering, or College of Human Ecology.

Current areas and topics of research in construction management. Resources of research results. Analysis of existing research and development of preliminary proposal.

898. Master's Research

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 master's students in the Building Construction Management major. Masters degree Plan B research paper.

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.

CELL AND MOLECULAR BIOLOGY

CMB

College of Natural Science

800. Cell and Molecular Biology Seminar

Fall, Spring. 1(1-0) A student may earn a maximum of 5 credits in all enrollments for this course. R: Open only to students in the Cell and Molecular Biology major.

Current literature in such areas of cell and molecular biology as gene expression, intracellular transport, cell signalling, regulation of cell growth and cell structure.

880. Laboratory Rotation

Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course.

R: Open only to students in the Cell and Molecular Biology major.

Participation in research projects in laboratories of Cell and Molecular Biology faculty.

892. Research Forum

Fall. 1(1-0) A student may earn a maximum of 4 credits in all enrollments for this course. R: Open only to students in the Cell and Molecular Biology major.

Advanced graduate students present their laboratory research.

999. Doctoral Dissertation Research

Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 60 credits in all enrollments for this course.

R: Open only to students in the Cell and Molecular Biology major.

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 101 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

Fall. 4(5-0)

P: CHE 201 or concurrently, MTH 235 or concurrently. R: Open only to College of Engineering students.

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: 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.

431. Chemical Reaction Engineering

Spring. 3(3-0)

P: CHE 311 or concurrently; 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.

432. Process Dynamics and Control

Fall. 3(3-0)

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.

433. Process Design and Optimization I

Fall. 4(5-0)

P: CHE 431, CHE 432 or concurrently. R: Open only to Chemical Engineering majors. Completion of Tier I writing requirement.

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.