

## Building Construction Management—BCM

- 823 Advanced Construction Project Management**  
Fall, Spring. 3(3-0) RB: (BCM 411 and BCM 415) R: Open only to graduate students in Building Construction Management.

Project management issues, services and documentation. Bidding, cost accounting, scheduling. Project planning and controlling.

- 890 Special Problems**  
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; 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.  
Master's degree 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 master's students in Building Construction Management.  
Master's thesis research.

## 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.

- 890 Independent Study**  
Fall, Spring, Summer. 1 to 8 credits. A student may earn a maximum of 8 credits in all enrollments for this course.  
Non-thesis research for Plan B master's students.

- 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.

- 899 Master's Thesis Research**  
Fall, Spring, Summer. 1 to 9 credits. A student may earn a maximum of 36 credits in all enrollments for this course.  
Master's thesis research.

- 999 Doctoral Dissertation Research**  
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 120 credits in all enrollments for this course. R: Open only to students in the Cell and Molecular Biology major.  
Doctoral dissertation research.

## CHEMICAL ENGINEERING CHE

### Department of Chemical Engineering and Materials Science College of Engineering

- 201 Material and Energy Balances**  
Fall, Spring. 3(4-0) P: (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: (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: (CHE 201 or concurrently and MTH 235 or concurrently) R: Open only to students in the College of Engineering.

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 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.

- 316 Unit Operations Laboratory**  
Spring. 3(1-6) P: (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: (CHE 201)  
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.

- 422 Transport Phenomena**  
Spring. 3(3-0) P: (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: (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: (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: (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: (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.