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 resou rces 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 e quipment.

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 d esign. 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 optimizati on.