521. Medical Biochemistry
Fall. 5(0-0)
P: BCH 462, CEM 383.
R: Graduate professional students in colleges of Human and Osteopathic Medicine.
Basic biochemical principles and terminology; metabolism and function of biomolecules of importance in medical biology and processes pertinent to human pathophysiology.

523. Genetics for Medical Practice
Fall, Summer. 11(0) Interdepartmental with Pediatrics and Human Development. Administered by Pediatrics and Human Development.
P: Graduate professional students in colleges of Human and Osteopathic Medicine.
Basic principles of genetics for medical students.

801. Molecular Biology
Fall. 3(0-0)
P: BCH 462, CEM 383.
Organization of genes. Regulation of gene expression, replication, and recombination.

802. Metabolic Regulation and Signal Transduction
Spring. 3(0-0)
P: BCH 801.
Molecular basis for metabolic regulation. Molecular signalling mechanisms and mechanisms for allosteric and covalent protein modifications.

803. Protein Structure and Function
Fall. 2(2-0)
P: BCH 462, CEM 383.
Protein structure and relationship of function to structure. Applications of kinetic methods to elucidation of enzyme mechanisms and regulation.

821. Biochemical Mechanisms and Structure
Spring. 3(0-0)
P: BCH 462, CEM 383 or concurrently.
Structures, methods of structural analysis, synthesis, and reaction mechanisms of biological substances including proteins, carbohydrates, lipids, porphyrins, phosphopeptides, vitamins, enzymes, and coenzymes.

825. Cell Structure and Function
Spring. 3(0-0) Interdepartmental with Physiology and Microbiology.
P: BCH 461 or BCH 462.
Molecular basis of structure and function. Cell properties: reproduction, dynamic organization, integration, programmed and integrated information transfer. Original investigations in all five kingdoms.

829. Methods of Macromolecular Analysis and Synthesis
Fall. 2(2-0)
P: BCH 462.
Techniques of isolation and characterization of macromolecules. Computer use in structure-function analysis of macromolecules.

311. Physiological Biochemistry
Spring. 4(0-0)
P: BCH 401 or BCH 462.
Mammalian physiological biochemistry. Metabolic interpretive analysis of normal and altered physiological states of humans and other mammals.

165. Special Problems
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course.
P: Approval of department.
Laboratory research on special problems in biochemistry.
441. Tissue Mechanics
Spring of odd-numbered years. 3(3-0) Interdepartmental with Materials Science and Mechanics. P: MSM 211. Application of solid mechanics to understanding mechanical responses of biological tissues. Microstructure and biological function for soft and hard connective tissues and muscle.

491. Special Topics (MTC)
Fall, Spring. 3 to 12 credits. A student may earn a maximum of 12 credits in all enrollments for this course. P: BME 311. Special topics in biomedical engineering or bioengineering such as biochemical design, occupational biomechanics, biological surface science, or low-temperature biotechnology.

**BIOSYSTEMS ENGINEERING**

**BE Department of Agricultural Engineering**

**College of Agriculture and Natural Resources**

**College of Engineering**

180. Current Issues in Biosystems
Fall, Spring. 3(3-0)
P: MTH 110 or MTH 116. R: Open only to freshmen or sophomores. The relationship of biosystems engineering to current problems in food production and processing. Environment, natural resources, harvesting, handling, safety, and water quality.

230. Principles of Biosystems Engineering
Fall. 3(3-0)
P: MTH 122. R: Open only to sophomores or juniors in College of Agriculture and Natural Resources, College of Engineering, or College of Natural Science. Concepts of biosystems. Hard and soft systems. Conceptual and computer modeling of components of biosystems.

232. Food Production and Processing Systems
Fall. 1 credit. R: Open only to students in College of Agriculture and Natural Resources or College of Engineering. Crop and animal production systems. Food processing systems. Field trips required.

336. Machinery Systems for Food Production
Fall. 3(3-0)

337. Machinery Systems for Food Processing
Spring. 3(3-0)
P: MTH 235. Principles of design, operation, and performance of equipment for processing raw materials into finished or intermediate products. SA: AE 338, FE 338

359. Heat Transfer in Biosystems
Spring. 2(2-0)
P: MTH 235; CPS 101 or CPS 131. R: Not open to students with credit in CHE 311 or ME 410. Steady state and transient heat conduction, radiation and convection heat transfer. Heat exchangers. Application problems in biosystems engineering.

351. Environmental Thermodynamics
Spring. 3(3-0)
P: MTH 235. R: Not open to students with credit in CHE 321 or ME 201. First and Second Laws of Thermodynamics with applications in food, biosystems, and environmental engineering. Engineering principles involved with the storage and handling of grains and horticultural crops between harvest and processing. SA: FE 460

431. Resource Optimization
Spring. 3(3-2)
P: BE 230, MTH 230. R: Not open to students with credit in BE 831. Optimal solutions to problems with multiple and conflicting objectives and constraints. Applications to natural and manufactured biological systems. SA: AE 450

438. Design of Machinery Structures
Fall, Spring. 3(3-0)
P: MSM 211. R: Open only to majors in College of Engineering. Not open to students with credit in ME 471. Design of structural components and systems in machines. Tension, compression, torsion, bending and combined loadings. Joint connections. SA: AE 438

453. Engineering Principles of the Plant Environment
Fall. 3(3-0)
P: BOT 105 or BS 110 or BS 111; CEM 141, BE 350, BE 351. R: Open only to majors in College of Engineering. Analysis of the soil-plant-atmosphere continuum. Thermodynamics effects on plant environment: water, soil heat flow, radiation, and soil water movement. SA: AE 353

456. Electric Power and Control
Spring. 3(3-2)
P: EE 200 or EE 345. R: Open only to majors in College of Engineering. Alternating current circuits, power distribution, electrical machines, protection, and programmable motor controllers. Design project related to food and agricultural industries. SA: AE 356

457. Postharvest Engineering
Fall. 3(3-0)
P: BE 350 or CHE 311 or ME 410. R: Open only to majors in College of Agriculture and Natural Resources or College of Engineering. Engineering principles involved with the storage and handling of grains and horticultural crops between harvest and processing. SA: FE 460

490. Resource and Environmental Economics

481. Agricultural and Small Watershed Hydrology
Spring. 3(3-2)
P: CPS 101 or CPS 131. R: Not open to students with credit in CHE 311 or ME 350; BE 453 or CE 312. R: Open only to seniors in College of Engineering or graduate students. Runoff, infiltration, surface and subsurface drainage and saturation. SA: AE 481

486. Biosystems Design Fundamentals
Fall. 3(3-0)
P: BE 350 or BE 336 or BE 453. R: Open only to seniors in College of Engineering or graduate students. Concepts, methods, and procedures of the total design process from problem identification to final specifications. SA: AE 486

487. Biosystems Design Project (W)
Spring. 1 credit. P: BE 486. R: Open only to seniors in College of Engineering. Completion of Tier I writing requirement. Individual or team design project selected in BE 486. Information expansion, development of alternatives, and evaluation, selection, and completion of a design project. SA: AE 488

490. Independent Study
Fall, Spring, Summer. 1 to 5 credits. A student may earn a maximum of 12 credits in all enrollments for this course. P: BE 230 or BE 336 or BE 350 or BE 453. R: Open only to majors in College of Engineering. Approval of departmental application required. Supervised individual student research and study in biosystems engineering. SA: AE 490

491. Special Topics in Biosystems Engineering
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. P: BE 230, BE 336 or BE 350 or BE 453. R: Open only to majors in College of Engineering. Approval of department. Special topics in biosystems engineering. SA: AE 491

802. Computational Methods in Biosystems Engineering
Fall. 3(3-0)
P: Summer of odd-numbered years. 3(3-0) R: Open only to graduate students in the College of Agriculture and Natural Resources or College of Engineering. Formulation and solution of mathematical equations in biosystems engineering. Constitutive equations. Linear and nonlinear problems. Steady state and transient problems. Computer solutions. SA: AE 802