

## Descriptions — Biochemistry of Courses

- 521. Medical Biochemistry**  
Fall, 5(5-0)  
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**  
Summer, 1(1-0) Interdepartmental with Pediatrics and Human Development. Administered by Pediatrics and Human Development.  
R: Graduate-professional students in colleges of Human and Osteopathic Medicine.  
Basic principles of genetics for medical students.
- 801. Molecular Biology**  
Fall, 3(3-0)  
P: BCH 462, CEM 383.  
Organization of genes. Regulation of gene expression, replication, and recombination.
- 802. Metabolic Regulation and Signal Transduction**  
Spring, 3(3-0)  
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(3-0)  
P: BCH 462, CEM 383 or concurrently.  
Structures, methods of structural analysis, synthesis, and reaction mechanisms of biological substances including proteins, carbohydrates, lipids, porphyrins, phosphate esters, enzymes, and coenzymes.
- 825. Cell Structure and Function**  
Spring, 3(3-0) Interdepartmental with Physiology and Microbiology.  
P: BCH 401 or BCH 461.  
Molecular basis of structure and function. Cell properties: reproduction, dynamic organization, integration, programmed and integrative 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.
- 831. Physiological Biochemistry**  
Spring, 4(4-0)  
P: BCH 401 or BCH 462.  
Mammalian physiological biochemistry. Metabolic interpretation of normal and altered physiological states of humans and other mammals.
- 855. Special Problems**  
Fall, Spring, Summer, 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for his course.  
? Approval of department.  
Laboratory or library research on special problems in biochemistry.

- 856. Plant Molecular Biology**  
Spring, 3(3-0) Interdepartmental with Botany and Plant Pathology. Administered by Botany and Plant Pathology.  
P: ZOL 341.  
Recent advances in genetics and molecular biology of higher plants.

- 864. Plant Biochemistry**  
Spring, 3(3-0) Interdepartmental with Botany and Plant Pathology.  
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.

- 888. 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 graduate students in Biochemistry.  
Participation in research laboratories to learn experimental techniques and approaches, broaden research experience, and assess research interests prior to selecting a thesis or dissertation adviser.

- 899. Master's 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 master's students in Biochemistry.

- 960. Selected Topics in Biochemistry I**  
Fall, Spring, 1 to 2 credits. A student may earn a maximum of 7 credits in all enrollments for this course.  
R: Open only to graduate students in Biochemistry or approval of department.  
Contemporary biochemical research topics in such areas as biochemical genetics, biochemistry of development, biochemical evolution, complex proteins, or lipid metabolism.

- 961. Selected Topics in Biochemistry II**  
Fall, Spring, 1 to 3 credits. A student may earn a maximum of 7 credits in all enrollments for this course.  
R: Open only to graduate students in the Department of Biochemistry.  
Contemporary biochemical research topics in such areas as bioenergetics, bioinstrumentation, complex carbohydrates, mass spectrometry, biomolecular spectroscopy or computer-based modeling and analysis of DNA and protein sequences and structures.

- 978. Seminar in Biochemistry**  
Fall, Spring, 1(1-0) A student may earn a maximum of 8 credits in all enrollments for this course.  
R: Open only to graduate students in Biochemistry.  
Seminars on biochemistry research mainly with visiting scientists.

- 999. Doctoral Dissertation Research**  
Fall, Spring, Summer, 1 to 24 credits. A student may earn a maximum of 99 credits in all enrollments for this course.  
R: Open only to doctoral students in Biochemistry.

## BIOLOGICAL SCIENCE BS College of Natural Science

- 110. Organisms and Populations**  
Fall, Spring, 4(3-3)  
R: Not open to students with credit in LBS 144.  
Biological diversity and organismal biology. Principles of evolution, population biology, and community structure.

- 111. Cells and Molecules**  
Fall, Spring, Summer, 3(3-0)  
P: CEM 141 or CEM 151. R: Not open to students with credit in LBS 145.  
Cell structure and function; macromolecular synthesis; energy metabolism; molecular aspects of development; principles of genetics.

- 111L. Cell and Molecular Biology Laboratory**  
Fall, Spring, Summer, 2(1-3) Interdepartmental with Microbiology, Botany and Plant Pathology, and Zoology.  
P: BS 111 or concurrently  
Principles and applications of common techniques used in cell and molecular biology.

- 148H. Honors Organismal Biology**  
Fall, 3 credits. Interdepartmental with Lyman Briggs School. Administered by Lyman Briggs School.  
R: Honors College student or approval of department. Not open to students with credit in BS 110 or LBS 144.  
Diversity and basic properties of organisms, with emphasis on genetic principles, ecological interactions, and the evolutionary process. Historical approach to knowledge discovery.

- 149H. Honors Cell and Molecular Biology**  
Spring, 3 credits. Interdepartmental with Lyman Briggs School. Administered by Lyman Briggs School.  
P: CEM 141 or CEM 151 or CEM 181H or LBS 165 R: Honors College student or approval of department. Not open to students with credit in BS 111 or LBS 145.  
The physicochemical and molecular organization of cells as the unifying framework for genetics, evolution, and the social relevance of biology.

- 158H. Honors Organismal Biology Laboratory**  
Fall, 2 credits. Interdepartmental with Lyman Briggs School. Administered by Lyman Briggs School.  
C: LBS 148H concurrently. R: Honors College student or approval of department. Not open to students with credit in BS 110 or LBS 144.  
Basic procedures used by organismal biologists, including experimental design and statistical methods. Development and implementation of research projects to test hypotheses in genetics, ecology, and evolution.

- 159H. Honors Cell and Molecular Biology Laboratory**  
Spring, 2 credits. Interdepartmental with Lyman Briggs School. Administered by Lyman Briggs School.  
P: CEM 141 or CEM 151 or CEM 181H or LBS 165 C: LBS 149H concurrently. R: Honors College student or approval of department. Not open to students with credit in BS 111 or LBS 145.  
Basic techniques of cellular and molecular biology, including experimental design and hypothesis formulation. Development and implementation of research projects to test hypotheses in biochemistry, molecular biology, or genetics.

## BIOMEDICAL ENGINEERING BME College of Engineering

- 424. Biomaterials and Biocompatibility**  
Spring of even-numbered years, 3(3-0) Interdepartmental with Materials Science and Mechanics.  
P: MSM 250, PSL 250.  
Materials science of human implants. Design requirements imposed by the body's milieu and the need to protect the body.

**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. 2(2-0)  
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 132. 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)  
P: MTH 235.  
Processes performed by agricultural production machines. Power systems, tillage mechanics, traction, metering, distribution, conveying, fluidization, mixing, separation, and atomization. Machinery management. SA: AE 336

**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

**350. 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. Refrigeration cycles. Entropy. Thermodynamic aspects of fluid flow. Psychrometrics.

**403. Microclimate and Its Measurement**  
Fall of odd-numbered years. 4(3-3) Interdepartmental with Geography.  
P: MTH 116 R: Not open to freshmen or sophomores.  
The climate near the Earth's surface. Energy balance, thermal radiation exchange, heat fluxes, temperature sensors, wind speed and direction, humidity and evapotranspiration and their measurement. SA: ATM 836

**430. Power and Control Hydraulics**  
Spring. 3(2-2)  
P: CE 321 or CHE 311 or ME 332. R: Open only to majors in College of Engineering.  
Hydraulic fluid properties. Pump and motor performance parameters. Control valves and hydraulic circuitry components. Analysis and design of hydraulic systems. SA: AE 430

**431. Resource Optimization**  
Spring. 3(2-2)  
P: BE 230, MTH 235 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.

**438. Design of Machinery Structures**  
Fall. 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(2-2)  
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

**460. Resource and Environmental Economics**  
Spring. 3(3-0) Interdepartmental with Public Resource Management; Resource Development; and Park, Recreation and Tourism Resources. Administered by Resource Development.  
P: RD 200; EC 201 or EC 202 or PRM 201 or RD 302.  
Economics of land and related environmental resources. Production and consumption processes. Resource allocations and scarcity. Market failure and externalities. Market and institutional remedial approaches.

**481. Agricultural and Small Watershed Hydrology**  
Spring. 3(2-2)  
P: CPS 101 or CPS 131; CE 321 or CHE 311 or BE 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 soil erosion. 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. 3 credits.  
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 5 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 department; application required.  
Supervised individual student research and study in biosystems engineering. SA: AE 490

**491. Special Topics in Biosystems Engineering**  
Fall, Spring, Summer. 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**  
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