

**BIOMEDICAL
ENGINEERING**

BME

College of Engineering

324 Biomaterials and Biocompatibility
Spring. 3(3-0) Interdepartmental with Materials Science and Engineering. Administered by Department of Chemical Engineering and Materials Science. P:M: (PSL 250 or concurrently) and (MSE 250) R: Open only to students in the College of Engineering. SA: MSM 424

Materials science of human implants. Design requirements imposed by the human body. Need for bodily protection.

401 Quantitative Human Biology
Spring. 3(4-0) Interdepartmental with Materials Science and Engineering; Radiology; Human Anatomy. P:M: (MTH 235 and PHY 184) and (PSL 250 or concurrently or PSL 431 or concurrently) and (CEM 141 or CEM 151) and (ANTR 350 or concurrently) RB: (CSE 131 or concurrently or CSE 231 or concurrently or PSL 410)

Qualitative description and quantitative engineering analysis of selected, tractable human-biological systems. Multi-disciplinary problem-solving among medical and engineering professionals.

490 Independent Study
Fall, Spring. 3 to 12 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Approval of department.

Individualized reading and research in biomedical engineering or bioengineering.

490A Independent Study in Clinical Biomechanics
Fall. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department.

Individualized reading and research in the application of biomechanics to clinical cases.

490B Independent Study in Biomaterials
Spring. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department.

Individualized reading and research in the application of biomaterials.

491 Special Topics
Fall, Spring. 3 to 12 credits. A student may earn a maximum of 12 credits in all enrollments for this course.

Special topics in biomedical engineering or bioengineering.

495 Tissue Mechanics
Spring. 3(3-0) Interdepartmental with Mechanical Engineering. Administered by Department of Mechanical Engineering. P:M: (ME 222) SA: MSM 441

Application of solid mechanics to understanding mechanical responses of biological tissues. Microstructure and biological function for soft and hard connective tissues and muscle.

496 Biodynamics
Fall. 3(2-2) Interdepartmental with Mechanical Engineering. Administered by Department of Mechanical Engineering. P:M: (ME 361) R: Open only to students in the Engineering Mechanics major.

Fundamentals of motion analysis of human movement and its application to the study of function and dysfunction of the musculoskeletal system. Solution methods of the inverse dynamics problem.

497 Biomechanical Design
Spring. 3(3-0) Interdepartmental with Mechanical Engineering. Administered by Department of Mechanical Engineering. R: Open only to juniors or seniors in the College of Engineering. SA: BME 491A, MSM 445

Biomechanical product design with application to people or animals. Synthesis, prototyping, and analysis of designs. Project management. Market research.

**BIOSYSTEMS
ENGINEERING**

BE

**Department of Agricultural
Engineering
College of Agriculture and
Natural Resources**

130 Engineering Design Fundamentals for Biological Systems
Fall. 2(1-2) P:M: (MTH 132 or concurrently or MTH 114 or concurrently or MTH 116 or concurrently or LBS 117 or concurrently or LBS 118 or concurrently or MTH 152H)

Professional and fundamental methods of biosystems engineering. Basic engineering methods. Analysis and design. Interdisciplinary design.

230 Principles of Biosystems Engineering
Spring. 3(3-0) P:M: (MTH 132 or MTH 152H or LBS 118)

Biosystems modeling of growth and dynamic interactions. Conservation of mass, and sustainability. Steady-state and stability analysis. Ecological concepts. Life-cycle analysis. Design for environment.

232 Food Production and Processing Systems
Fall. 1(0-2)

Crop and animal production systems. Food processing systems. Field trips required.

329 Fundamentals of Food Engineering
Spring. 3(3-0) Interdepartmental with Food Science. P:M: (FSC 229) and (MTH 126 or LBS 118) and (PHY 231 or LBS 164) RB: (FSC 211) SA: FE 329

Unit operations in food industry: fluid mechanics, heat transfer, rate processes, refrigeration, freezing, and dehydration. Thermal process calculations.

331 Machinery Principles in Biosystems Engineering
Fall. 3(3-0) P:M: (MTH 235 or MTH 255H or LBS 220) and (MSM 206 or MSM 211 or concurrently) and (CE 321) RB: Upper division standing in the College of Engineering

Functional processes of machines used in biosystems engineering, including pumping, blowing, conveying, mixing, separation, atomization, size reduction and mobility. Power requirements, efficiency and failure modes

333 Biosystems Engineering Laboratory
Fall. 1(0-3) P:M: (BS 110 or BS 111 or BOT 105 or ENT 205 or MMG 205 or MMG 301 or PSL 250 or ZOL141) R: Open only to students in the Biosystems Engineering major.

Measurement of physical, chemical and biological parameters and properties that characterize engineered biosystems. Data collection and analysis. Experiment design.

337 Machinery Systems for Food Processing
Spring. 3(3-0) P:M: (BE 230) and (LBS 220 or concurrently or MTH 235 or concurrently or MTH 255H or concurrently) SA: AE 338, FE 338

Principles of design, operation, and performance of equipment for processing raw materials into finished or intermediate products.

350 Heat and Mass Transfer in Biosystems
Spring. 3(3-0) P:M: (MTH 235 or MTH 255H or LBS 220) and (CSE 131) and (CE 321 or concurrently or CHE 311 or concurrently or ME 332 or concurrently) and (CEM 143 or concurrently) R: Open only to students in the College of Engineering. Not open to students with credit in ME 410.

Steady state and transient heat conduction. Radiation and convection heat transfer. Heat exchangers. Mass transfer application problems in biosystems engineering.

351 Environmental Thermodynamics
Fall. 3(3-0) P:M: (MTH 235 or MTH 255H or LBS 220) 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.

402 Agricultural Climatology
Fall of even years. 3(3-0) Interdepartmental with Geography. Administered by Department of Geography. P:M: (MTH 104 or MTH 110 or MTH 116) R: Not open to freshmen or sophomores. SA: AE 402

Relationships between climate and agriculture in resource assessment, water budget analysis, meteorological hazards, pests, crop-yield modeling, and impacts of global climate change.

418 Comprehensive Nutrient Management Planning
Fall. 3(2-2) Interdepartmental with Animal Science. Administered by Department of Animal Science. P:M: (CSS 210)

Comprehensive nutrient management plans (CNMP) for animal feeding operations. Trends in animal production, environmental issues, and diet formulation and their impact on manure production. Development of CNMP for a specific animal feeding operation.

419 Applications of Geographic Information Systems to Natural Resources Management
Spring. 4(2-4) Interdepartmental with Fisheries and Wildlife; Forestry; Geography; Park, Recreation and Tourism Resources; Resource Development. Administered by Department of Fisheries and Wildlife. RB: (GEO 221)

The application of geographic information systems, remote sensing, and global positioning systems to integrated planning and management for fish, wildlife, and related resources.

Biosystems Engineering—BE

- 430 Power and Control Hydraulics**
Fall. 3(2-2) P:M: (CE 321 or CHE 311 or ME 332) SA: AE 430
Hydraulic fluid properties. Pump and motor performance parameters. Control valves and hydraulic circuitry components. Analysis and design of hydraulic systems.
- 431 Bio-resource Optimization**
Fall. 3(2-2) P:M: (BE 230) and (MTH 235 or MTH 255H or LBS 220) Not open to students with credit in BE 831.
Optimal engineering solutions to problems with conflicting objectives and biological constraints. Linear and goal programming, problem formulation, project management, risk and uncertainty.
- 438 Design of Machinery Structures**
Fall. 3(3-0) P:M: (BE 331 or concurrently) SA: AE 438 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.
- 443 Restoration Ecology**
Spring. 3(2-2) Interdepartmental with Fisheries and Wildlife; Zoology. Administered by Department of Fisheries and Wildlife. RB: (CSS 210 or BE 230) and (FOR 404 or FW 364 or ZOL 355)
Principles of ecological restoration of disturbed or damaged ecosystems. Design, implementation, and presentation of restoration plans. Field trips required.
- 452 Watershed Concepts**
Fall, Spring, Summer. 3(3-0) Interdepartmental with Resource Development; Crop and Soil Sciences; Forestry; Fisheries and Wildlife. Administered by Department of Resource Development. P:M: (RD 324 and ZOL 355) RB: organic chemistry
Watershed hydrology and management. The hydrologic cycle, water quality, aquatic ecosystems and social systems. Laws and institutions for managing water resources.
- 456 Electric Power and Control**
Spring. 3(2-2) P:M: (ECE 200 or ECE 345) SA: AE 356
Alternating current circuits, power distribution, electrical machines, protection, and programmable motor controllers. Design project related to food and agricultural industries.
- 460 Natural Resource Economics**
Spring. 3(3-0) Interdepartmental with Resource Development; Environmental Economics and Policy; Park, Recreation and Tourism Resources. Administered by Department of Resource Development. P:M: (EC 201) and (RD 302 or EEP 255)
Economic framework for analyzing natural resource management decisions. Spatial and inter-temporal allocation of renewable and nonrenewable resources. Special emphasis on institutions, externalities, and public interests in resource management.
- 477 Food Engineering: Fluids**
Fall. 3(2-2) Interdepartmental with Food Science. P:M: (BE 350 and BE 351) RB: (CE321 or CHE311 or ME332) SA: FE 465
Unit operations, process engineering, equipment, and industrial practices of the food industry. Manufactured dairy products: thermal processing, pipeline design, heat exchange, evaporation, dehydration, aseptic processing, membrane separation, cleaning, and sanitation.

- 478 Food Engineering: Solids**
Spring. 3(2-2) P:M: (BE 350) and (BE 351)
Analysis and design of unit operations and complete systems for handling, processing, and manufacturing bulk, granular, and solid food products. Material variability and microbial, chemical, and physical hazards.
- 481 Land and Water Conservation Engineering**
Fall. 3(2-2) P:M: (CSE 131) and (CE 321 or CHE 311) SA: AE 481
Hydrology of small watersheds. Flood routing. Quantifying runoff, infiltration, evapotranspiration. Drainage design Global Positioning Systems. Geographic Information Systems and applications in engineering projects. Irrigation efficiency.
- 482 Non-point source pollution control**
Spring. 3(2-2) P:M: (BE 481 or CE 421)
Identification, estimation, and control of non-point source pollution from agricultural and urban sources. Geographic Information Systems (GIS) based computer models of watersheds. Engineering design of practices and structures to control non-point source pollution. Development of watershed management plans.
- 485 Biosystems Design Techniques**
Fall. 2(1-2) P:M: (BE 130 and BE 333) and (BE 331 or BE 350 or BE 351) and (BE 431 or concurrently) Not open to students with credit in BE 486.
Engineering design process. Problem identification, analysis, design, modeling, materials, cost estimation, final specifications. Safety, environmental and ethical considerations.
- 486 Biosystems Design Fundamentals**
Fall. 3(3-0) P:M: (BE 230 and BE 350) SA: AE 486
Concepts, methods, and procedures of the total design process from problem identification to final specifications.
- 487 Biosystems Design Project (W)**
Spring. 3(0-6) P:M: (BE 485) and completion of Tier I writing requirement. R: Open only to students in the College of Engineering. SA: AE 488
Individual or team design project selected in BE 486. Information expansion, development of alternatives, and evaluation, selection, and completion of a design project.
- 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:M: (BE 230 or BE 350) R: Approval of department; application required. SA: AE 490
Supervised individual student research and study in biosystems engineering.
- 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:M: (BE 230 or BE 331 or BE 350) R: Approval of department. SA: AE 491
Special topics in biosystems engineering.

BUILDING CONSTRUCTION MANAGEMENT BCM

Department of Agricultural Engineering College of Agriculture and Natural Resources

- 101 Principles of Building Construction Management**
Fall, Summer. 2(2-0) R: Not open to seniors.
Historical developments, current issues and trends in commercial and residential construction industries.
- 124 Residential Construction Materials and Methods**
Spring, Summer. 3(3-0) RB: (BCM 101) SA: BCM 126
Properties of construction materials and their application in residential construction.
- 210 Commercial Construction Methods**
Fall. 3(3-0) P:M: (BCM 101 or concurrently and BCM 124) C: BCM 211 concurrently.
Commercial construction: principles, materials, assemblies and commercial blueprints.
- 211 Building Codes**
Fall. 3(3-0) P:M: (BCM 101 or concurrently and BCM 124) SA: BCM 227 C: BCM 210 concurrently.
Construction codes: structural, mechanical, electrical and plumbing. Building safety and accessibility.
- 222 Statics and Strengths of Materials**
Spring. 3(3-0) P:M: (BCM 210 and BCM 211) and (MTH 124 or MTH 132 or LBS 118) and (PHY 183 or PHY 231 or PHY 231B or PHY 231C) Not open to students with credit in ME 221 or ME 222.
Equilibrium of forces. Free body diagrams. Force components. Bending moments. Stress and strain. Mechanical properties of materials. Beams and trusses. Computer applications. Indeterminate structures.
- 230 Utility Systems**
Spring. 4(4-0) P:M: (BCM 210 and BCM 211)
Heating, cooling, ventilating, electrical, gas, lighting, water, waste water, telecommunications, fire protection, safety security and sound control systems in residential and commercial construction. Applicable codes.
- 305 Site Construction and Measurement**
Fall. 3(2-2) P:M: (BCM 230) R: Open only to juniors or seniors in the Building Construction Management major.
Site construction methods, materials and equipment for buildings, soil, foundation, erosion and storm water. Layout, leveling, surveying and underground utilities.
- 315 Construction Quantity Surveying**
Spring. 3(2-2) P:M: (BCM 305) and (CSE 101 or CSE 131 or CSE 231 or CSS 110 or LBS 126) R: Open only to juniors and seniors in the Building Construction Management or Civil Engineering major. SA: BCM 324
Measurement of quantities for construction projects. Work breakdown structure. Industry standards.