BCHM 4330* General Biochemistry Laboratory 1 (2) Experiments to illustrate current methods used in biochemical research. Preq or concurrent enrollment: BCHM 4310.

BCHM 4340* General Biochemistry Laboratory II 2 (4) Continuation of BCHM 4330. Preq: Concurrent enrollment in BCHM 4320.

BCHM 4360* Molecular Biology: Genes to Proteins 3 (3) Examines how nucleic acids and proteins are synthesized in prokaryotic and eukaryotic cells. Designed for students interested in biochemistry, cell biology, molecular biology, and cell physiology. Includes Honors sections. Preq: BCHM 3010 and GEN 3020, each with C or better.

BCHM (GEN) 4400* Bioinformatics 3 (3) Theory and application of computational technology to analysis of the genome, transcriptome, and proteome. Includes Honors sections. May also be offered as GEN 4400. Preq: BCHM 3010 or BCHM 3050 or GEN 3000 or GEN 3020; each with C or better.

BCHM 4430* Molecular Basis of Disease 3 (3) Topics in heritable human metabolic disorders, including clinical features and newborn screening, genetic testing, the biochemical basis, and treatment. Preq: BCHM 3010 or BCHM 3050 or GEN 3000 or GEN 3020; each with C or better.

BCHM 4900 Selected Topics in Biochemistry 1-4 (1-4) Comprehensive study of selected topics not covered in other courses. May be repeated for a maximum of eight credits, but only if different topics are covered. Preq: Consent of instructor.

BCHM 4910 Directed Research in Biochemistry 1-8 (3-24) Orientation in biochemical research (i.e., experimental planning, execution, and reporting). May be repeated for a maximum of 20 credits. Includes Honors sections. Preq: Consent of instructor.

BCHM 4920 Honors Thesis in Biochemistry 1 (1) Students complete a senior thesis and oral presentation detailing their honors research in biochemistry. Preq or concurrent enrollment: Students are expected to have completed or be concurrently enrolled in their second semester of an Honors section of BCHM 4910 for a minimum of four credits when registering for this course.

BCHM 4930 Senior Seminar 2 (2) Analysis and discussion of papers from the primary literature in the life sciences particularly in biochemistry. Students find pertinent articles in the primary literature and present and analyze the selected reading. Includes Honors sections. Preq: BCHM 3010 and GEN 3020, each with C or better; and one of BCHM 4310 or BCHM 4320 or BCHM 4360 with C or better.

BIOSYSTEMS ENGINEERING
Professor: T.H. Walker; Associate Professors: C.M. Drapcho, T.O. Owino; Assistant Professors: C. Darnault, Y. Zheng.

BE 1990 Creative Inquiry—Biosystems Engineering 1 1-3 (1-3) In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be taken twice for a maximum of six credits. To be taken Pass/No Pass only.

BE 2100 Introduction to Biosystems Engineering 2 (1) Overview of topics and engineering applications in areas that comprise the biosystems engineering profession. Significant emphasis is also given to the development of oral and written communication skills needed by the engineering professional, introduction to design methodology, and application of engineering fundamentals to biochemical systems. Preq or concurrent enrollment: ENGR 1070. Coreq: BE 2101.

BE 2101 Introduction to Biosystems Engineering Laboratory 0 (3) Non-credit laboratory to accompany BE 2100. Coreq: BE 2100.

BE 2120 Fundamentals of Biosystems Engineering 2 (1) Introduction to fundamentals in biosystems engineering, including mass, energy, and momentum balances; mass, heat, and momentum transfer; biological response to environmental variables, biological materials, biological kinetics, and techniques of measurement and analysis of engineering and biochemical data. Laboratory includes hands-on exercises, problem solving and computer sessions, and oral presentations. Preq or concurrent enrollment: MATH 1060 and ENGR 1070. Coreq: BE 2121.

BE 2121 Fundamentals of Biosystems Engineering Laboratory 0 (3) Non-credit laboratory to accompany BE 2120. Coreq: BE 2120.

BE 2990 Creative Inquiry—Biosystems Engineering II 1-3 (1-3) In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be taken twice for a maximum of six credits. To be taken Pass/No Pass only.

BE 3000 Biosystems Engineering Honors Seminar 0 (0) Introduces undergraduate students to current faculty research. Project ideas are then developed to prepare students in choosing a research topic for the senior honors thesis. Students are required to attend senior honors thesis presentations. To be taken Pass/No Pass only. Preq: Junior standing in departmental honors program.

BE 3010 Biosystems Engineering Honors Thesis Research 3 (3) Honors thesis project proposal, initial research, report, and presentation of biosystems engineering project for completion of junior requirements of the Biosystems Engineering Honors program. Preq: BE 3000.

BE 3140 Biosystems Engineering Mechanical Design 3 (3) Study of basic mechanical design of biosystems. Includes an introduction to biomechanics and biomaterial properties. Studies applications of machine components and their selection related to specific types of biosystems. Team design project is required. Preq: CE 2060 or ME 3020.


BE 3201 Principles and Practices of Geometrics Laboratory 0 (3) Non-credit laboratory to accompany BE 3200. Coreq: BE 3200.

BE 3220 Small Watershed Hydrology and Sedimentology 3 (3) Fundamental relationships governing rainfall disposition are used as bases for defining the hydrology of watersheds. Emphasizes application of modeling techniques appropriate for runoff and sediment control. Preq or concurrent enrollment: CE 3410.

BE 3700 Practicum 1-3 (1-3) Preplanned internship with an approved employer involved with biosystems engineering endeavors. A minimum 1300 hours of supervised responsibility is required per credit hour. Evaluation is based on activity journal, written/oral report, and an evaluation from the supervisor. May be repeated for a maximum of three credits. To be taken Pass/No Pass only. Preq: Junior standing and consent of department.

BE 3990 Creative Inquiry—Biosystems Engineering III 1-3 (1-3) In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be taken twice for a maximum of six credits. To be taken Pass/No Pass only.

BE 4000 Biosystems Engineering Honors Thesis 3 (6) Individual research projects are conducted under the supervision and guidance of a faculty member. Senior honors thesis is required. Preq or concurrent enrollment: BE 3010.

BE (PES) 4080* Land Treatment of Wastewater and Sludges 3 (3) Principles for designing environmentally acceptable land application systems using municipal and industrial wastewater and sludges are presented. Topics include land-limiting constituent analysis; soil-plant interactions; system equipment and design; system operation and management; public acceptance, social, and regulatory issues. Case studies and field trips are planned. May also be offered as PES 4080. Preq: Senior standing.

BE 4100* Biological Kinetics and Reactor Modeling 3 (2) Fundamentals of microbial and biochemical kinetics used in analysis and design of biological systems. Topics include mathematical and computer modeling of biological kinetics and systems, estimating model coefficients, and development of microbial kinetic models as basis for batch and continuous reactor design. Preq: BE 2120. Preq or concurrent enrollment: MATH 2080. Coreq: BE 4101.

BE 4101* Biological Kinetics and Reactor Modeling Laboratory 0 (3) Non-credit laboratory to accompany BE 4100. Coreq: BE 4100.

BE 4120* Heat and Mass Transport in Biosystems Engineering 3 (3) Fundamentals of heat and mass transport used in engineering design and analysis of biological systems; principles of steady state and transient energy and mass balances, including chemical and biological generation terms. Preq: BE 4100.

BE 4140 Biosystems Engineering Unit Operations Laboratory 0 (3) Non-credit laboratory to accompany BE 4140. Coreq: BE 4140.
BE 4150* Instrumentation and Control for Biosystems Engineers 4 (3) Overview of modern instrumentation techniques and digital electronic components and subsystems to integrate them into digital data acquisition and control systems for biosystems. Laboratory use of equipment is emphasized. Topics include characteristics of instruments, signal conditioning, transducer theory and applications, programmable logic controllers, and digital data acquisition and control. Prq or concurrent enrollment: ECE 2070. Coreq: BE 4151.

BE 4151* Instrumentation and Control for Biosystems Engineers Laboratory 0 (3) Non-credit laboratory to accompany BE 4150. Coreq: BE 4150.

BE 4170* Applied Instrumentation and Control for Biosystems 2 (1) Hardware and software implementation of digital data acquisition and control systems for application to agriculture, aquaculture, biotechnology, and other biosystems. Topics include digital electronic circuits and components, microcomputer architecture, interfacing, and programming. Prq: BE 4150. Coreq: BE 4171.

BE 4171* Applied Instrumentation and Control for Biosystems Laboratory 0 (3) Non-credit laboratory to accompany BE 4170. Coreq: BE 4170.

BE 4210 Engineering Systems for Soil Water Management 2 (1) Presents fundamentals of design related to drainage of lands, irrigation, and modification of the microenvironment for optimum productivity. Prq or concurrent enrollment: CE 3410 and MATH 2080. Coreq: BE 4211.

BE 4211 Engineering Systems for Soil Water Management Laboratory 0 (3) Non-credit laboratory to accompany BE 4210. Coreq: BE 4210.

BE 4220* Hydrologic Modeling of Small Watersheds 3 (3) Design of structures and development of best management practices for runoff, flood, and sediment control from rural and urban areas, including natural and disturbed watersheds. Topics include modeling of prismatic and non-prismatic channels, culverts, and detention/retention ponds. Prq: BE 3220.

BE 4240 Ecological Engineering 3 (3) Focuses on engineering solutions to environmental and socioeconomic problems using ecological design principles. Explores ecosystem processes as they pertain to sustainable development, natural resource protection, food and energy production, waste management, and environmental restoration. Engineering fundamentals and ecological modeling are integral components of this course.

BE 4280* Biochemical Engineering 3 (3) Use of microorganisms and enzymes for the production of chemical feedstocks, single-cell protein, antibiotics, and other fermentation products. Topics include kinetics and energetics of microbial metabolism, design and analysis of reactors for microbial growth and enzyme-catalyzed reactions, and considerations of scale-up, mass transfer, and sterilization during reactor design. Prq or concurrent enrollment: BE 4400 or CHE 3300.

BE 4350* Applications in Biotechnology Engineering 3 (2) Bioengineering principles applied to the expanding fields of agricultural biotechnology, ecotechnology, and biomedical technology. Specific applications include waste treatment and ecological engineering, bioreactor propagation of plant and animal cells and tissues, applied genomics and synthetic seed production, biosensors and biomonitoring, biological implants and materials biocompatibility. Prq: BE 4280 or CHE 4280. Coreq: BE 4351.

BE 4351* Applications in Biotechnology Engineering Laboratory 0 (3) Non-credit laboratory to accompany BE 4350. Coreq: BE 4350.

BE 4380* Bioprocess Engineering Design Laboratory 3 (2) Design and analysis of systems for processing biological materials. Topics include biotechnology, thermodynamics, transport processes, and biological properties related to bioprocess design and computational simulation. Unit operations include basic bioreactor operation, bioseparations, and preservation techniques. Prq or concurrent enrollment: BE 4100 or CHE 3300 or EES 4020. Coreq: BE 4381.

BE 4381 Bioprocess Engineering Design Laboratory 0 (2) Non-credit laboratory to accompany BE 4380. Coreq: BE 4380.

BE (CE) 4400* Sustainable Energy Engineering 3 (2) Investigation into merging renewable energy resources, including detailed study of solar, wind, and bioenergy alternatives. Also includes principles, technologies, and performance evaluation of components for these technologies and an introduction to tidal, hydro, geothermal, and other energy; energy conservation; cogeneration; financial, economical, and other issues related to alternative energy sources. May also be offered as CE 4400. Prq: Junior standing in an engineering major. Coreq: BE 4401.

BE (CE) 4401* Sustainable Energy Engineering Laboratory 0 (2) Non-credit laboratory to accompany BE 4400. May also be offered as CE 4401. Coreq: BE 4400.

BE (EES, FOR) 4510* Newman Seminar and Lecture Series in Natural Resources Engineering 1 (2) Topics dealing with development and protection of land, air, water, and related resources are covered by seminar with instructor and invited lecturers. Current environmental and/or resource conservation issues are addressed. Includes Honors sections. May also be offered as EES 4510 or FOR 4510. Prq: Senior standing.

BE 4640* Non-Point Source Management in Engineered Ecosystems 3 (2) Fundamentals of non-point source pollution, including quantification of environmental impact and ecosystem management related to contaminants and nutrients and to planning and design of ecological systems. Prq: MICR 3050 and Senior standing in engineering. Coreq: BE 4641.

BE 4641* Non-Point Source Management in Engineered Ecosystems Laboratory 0 (3) Non-credit laboratory to accompany BE 4640. Coreq: BE 4640.

BE 4730 Special Topics in Biosystems Engineering 1-3 (1-3) Comprehensive study of special topics not covered in other courses. Emphasizes independent pursuit of detailed investigations. May be repeated for a maximum of six credits, but only if different topics are covered. Prq: Consent of instructor.

BE 4740 Biosystems Engineering Design/Project Management 2 (1) Study of biological systems design using hydrology principles, fluid mechanics, bioprocessing, heat/mass transfer, instrumenta- tion, mechanical unit operations, and structural principles for project design, scheduling, and cost estimation. Topics also include engineering ethics, professional development, written and oral communication, and job skills. Senior portfolios are also developed. Prq: Senior standing in Biosystems Engineering. Coreq: BE 4741.

BE 4741 Biosystems Engineering Design/Project Management Laboratory 0 (3) Non-credit laboratory to accompany BE 4740. Coreq: BE 4740.

BE 4750 Biosystems Engineering Capstone Design 2 (4) Applications of hydrology, fluid mechanics, bioprocessing, heat/mass transfer, instrumentation, mechanical unit operations, and structural principles in design; project scheduling; cost estimation; ethics; environmental and social impacts; design drawings; and report documentation. Prq: Senior standing in Biosystems Engineering.

BE (EES) 4840* Municipal Solid Waste Management 3 (3) Introduction to the problems, regulations, collection, handling, recycling, and disposal of municipal solid wastes in the urban and rural sectors. Emphasizes an integrated waste-management system with resource recovery, composting, incineration, landfill disposals, and their costs. May also be offered as EES 4840. Prq: EES 3020 or EES 4010.

BE 4990 Creative Inquiry—Biosystems Engineering IV 1-3 (1-3) In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be taken twice for a maximum of six credits. To be taken Pass/No Pass only.

BIOENGINEERING

BIOE 1010 Biology for Bioengineers 1 (1) Provides basic introduction to fundamental principles of molecular and cellular biology. Prq: CH 1010.

BIOE 2000 Bioengineering Professional Development 0 (1) Provides an introduction to the professional opportunities available for bioengineering students. Students learn best practices and prepare for a bioengineering career. To be taken Pass/No Pass only. Prq: Sophomore standing in bioengineering.