BIOENGINEERING (BE)

Subject-area course lists indicate courses currently active for offering at the University of Louisville. Not all courses are scheduled in any given academic term. For class offerings in a specific semester, refer to the Schedule of Classes (https://csprd.louisville.edu/psp/ps_class/ EMPLOYEE/PSFT_CS/c/COMMUNITY_ACCESS.CLASS_SEARCH./x/? state=62dab551a0d600a5e8237359c50704e59007&duo_code=sjUx2OSTj21bWVfiuQ3ZLXRiHmfxpqoV).

500-level courses generally are included in both the undergraduate- and graduate-level course listings; however, specific course/section offerings may vary between semesters. Students are responsible for ensuring that they enroll in courses that are applicable to their particular academic programs.

Course Fees

Some courses may carry fees beyond the standard tuition costs to cover additional support or materials. Program-, subject- and course-specific fee information can be found on the Office of the Bursar website (https:// louisville.edu/bursar/tuitionfee/university-fees/).

BE 500. Special Topics in Bioengineering   **3 Units**
Term Typically Offered: Fall, Spring, Summer
Description: This course will be devoted to topics that usually are not treated in detail in the general curriculum.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/ setupSearchClassSchedule.cfm)

BE 522. Biomedical Acoustics   **3 Units**
Term Typically Offered: Spring Only
Prerequisite(s): BE 420.
Description: An introduction to the fundamental principles of physical acoustics with an emphasis on biomedical applications. Major concepts covered include acoustic wave physics, transducers, and ultrasound imaging.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/ setupSearchClassSchedule.cfm)

BE 524. LabVIEW for Bioengineers   **3 Units**
Term Typically Offered: Fall Only
Prerequisite(s): BE 340 or equivalent.
Description: This course will introduce students to an intermediate level of LabVIEW (Laboratory Virtual Instrument Engineering Workbench) available from National Instruments (Austin, TX). LabVIEW is the worldwide industry standard graphical programming environment for developing data acquisition, instrument control, and industrial automation software. Students will explore core programming fundamentals common to all programming languages by using LabVIEW software to develop independent programs and data acquisition solutions using a combination of LabVIEW, data acquisition hardware, and standard test instrumentation hardware.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/ setupSearchClassSchedule.cfm)

BE 530. Machine Learning in Python   **3 Units**
Term Typically Offered: Fall, Spring
Prerequisite(s): BE 340 or graduate/professional standing.
Description: This course covers programming concepts in Python, machine learning concepts, and application of machine learning into biomedical and other problems using Python. Students will learn about the most applicable Python libraries that deal with different machine learning tools. Students are expected to work on a team project and write technical reports.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/ setupSearchClassSchedule.cfm)

BE 540. Machine Learning in Medicine   **3 Units**
Term Typically Offered: Fall, Spring
Prerequisite(s): BE 340 or graduate/professional standing.
Description: Topics: 1) fundamentals of medical data, 2) application of machine learning models & algorithms to medicine, 3) learning from data & classification of disorders, and 4) overview of health data, collection with sensors, body area networks, brain image data and other publicly available medical applications data. Students will learn about machine learning applications to real world medical data through examples and reading papers. Students are expected to work on a team project and write technical reports.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/ setupSearchClassSchedule.cfm)

BE 542. Medical Image Computing   **3 Units**
Term Typically Offered: Fall Only
Prerequisite(s): BE 340 or graduate/professional standing.
Description: Fundamentals of 2-D and 3-D image computing, application of image computing algorithms to medical images, enhancement and restoration of 2-D and 3-D medical data, and fundamentals of machine vision and medical data visualization. Students will learn image restoration, computer vision and visualization techniques with applications to medical data through examples and reading papers. Students are expected to work on a team project and write technical reports.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/ setupSearchClassSchedule.cfm)

BE 543. Computer Tools for Medical Image Analysis   **3 Units**
Term Typically Offered: Summer Only
Prerequisite(s): BE 340 or graduate/professional standing.
Description: This course covers: 1) Essential computer software that can be used for handling all types of medical data, 2) advanced computer software that is used for medical image analysis, such as segmentation, registration, motion correction, etc., and 3) development of comprehensive computer-aided diagnosis systems based on these ready-to-go software packages.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/ setupSearchClassSchedule.cfm)

BE 544. Artificial Intelligence Techniques in Digital Pathology   3 Units
Term Typically Offered: Spring Only
Description: This course provides both theoretical and practical information about computer vision and AI techniques required to process and analyze microscopic images as a part of the evolving transition to digital pathology. This evolution will enable the use of AI models in pathology to aid pathologists and healthcare professionals in the management and the diagnosis of different diseases.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 552. Introduction to Tissue Engineering   3 Units
Term Typically Offered: Spring Only
Prerequisite(s): CHEM 341, BE 354, BE 359, and BE 450.
Description: Design, development and clinical application of tissue engineered components, including blood vessels, bone, cartilage, pancreas, liver and skin, for use in the human body.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 553. Nanoscale Bioengineering: Application and Methodology of Nanobiomaterials in Bioengineering   3 Units
Prerequisite(s): BE 450 or BE 453 or permission of department chair.
Description: An introduction to the fundamental principles of nanoengineering with a focus on 1) synthetic methodologies of tailored nanobiomaterials (physical, chemical and electrochemical); 2) nanobiomaterial characterization using advanced analytical, microscopic and spectroscopic techniques; and 3) therapeutic and diagnostic applications.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 581. Advanced Computer-Aided Design and Manufacturing for Bioengineers   3 Units
Term Typically Offered: Fall, Spring, Summer
Prerequisite(s): BE 340 or by permission of Department Chair.
Description: An introduction to the engineering design and manufacturing processes for bioengineering applications with an emphasis on the use of modern computer-based analysis, design and presentation tools as well as manufacturing techniques such as casting, machining, forming and assembly for polymer and metal-based materials.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 593. Independent Study in Bioengineering   1-4 Units
Term Typically Offered: Fall, Spring, Summer
Prerequisite(s): Faculty consent.
Description: A theoretical or experimental investigation of a problem area related to Bioengineering.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 600. Advanced Topics in Bioengineering   1-6 Units
Prerequisite(s): Graduate/Professional Standing in Bioenginering or Consent of Instructor.
Description: An advanced course in bioengineering topics not covered by regularly scheduled courses.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 601. Bioengineering Seminar   1 Unit
Prerequisite(s): Admission to the MS Bioengineering program or the PhD in Interdisciplinary Studies with a Specialization in Translational Bioengineering (ISSTBE-PhD) program.
Description: Current research topics in the field of transnational bioengineering will be presented and discussed. Sessions will include guest speakers, student presentations on research projects with interaction and feedback from students and faculty, and critical discussion of scientific literature.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 602. Graduate Internship in Bioengineering   2 Units
Grading Basis: Pass/Fail
Term Typically Offered: Fall, Spring, Summer
Prerequisite(s): Admission to Graduate Study, Permission of Department Chair, and Permission of Director of Career Services.
Description: Supervised professional experience in industry at the graduate level. This course provides the structure and focus for the graduate intern field assignment to ensure that the assignment is appropriate and consistent with the intern's graduate course of study and professional development. Not to be counted towards meeting the requirements for a degree. May be repeated for credit.
Course Attribute(s): CBL - This course includes Community-Based Learning (CBL). Students will engage in a community experience or project with an external partner in order to enhance understanding and application of academic content.

For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 603. Bioengineering Research Ethics   2 Units
Term Typically Offered: Fall, Spring
Prerequisite(s): Admission to the PhD in Interdisciplinary Studies, specialization in Translational Bioengineering program or by permission of Department Chair.
Description: Complex ethical issues facing bioengineers will be addressed, including principles of beneficence, autonomy & justice and current regulations addressing research ethics. Discussion will also cover patient rights & privacy, animal experimentation, scientific misconduct, intellectual property, authorship, safety & risk, and bioethical research and technological development.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 604. Introduction to Artificial Intelligence in Bioengineering   3 Units
Term Typically Offered: Fall Only
Description: This course covers: 1) fundamentals of artificial intelligence, 2) solving problems by searching agents, 3) concepts of knowledge, logic, reasoning, and planning in AI, 4) machine learning concepts and different forms of learning and applications, and 5) data privacy and ethics in AI. Students will learn different ways to solve problems by automated searching approaches and using learning agents in machine learning with different applications in medicine. Students are expected to work on a team project and write technical reports.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 605. Tissue and Molecular Biology Techniques Laboratory   3 Units
Term Typically Offered: Summer Only
Prerequisite(s): BE 359 or equivalent.
Fee: An additional $100.00 is charged for this course.
Description: Introduces students to techniques used in tissue and molecular biology laboratories including cell and tissue culture, cell assays, cell and tissue imaging techniques and sterilization techniques.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 611. Cardiovascular Dynamics   3 Units
Prerequisite(s): Graduate or professional standing in Bioengineering.
Description: Review of basic cardiovascular physiology. Application of basic engineering principles, including electrical and mechanical analog models to describe cardiovascular function and data acquisition and analysis techniques to develop medical devices and instrumentation.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 621. Bioinstrumentation   4 Units
Term Typically Offered: Fall Only
Prerequisite(s): Graduate/Professional Standing; and BE 354 and BE 423 or equivalent(s); or consent of instructor.
Description: Analysis and design of Bioinstrumentation. Basic circuitry, electronics and laboratory techniques including sensors, transducers, biopotentials, amplifiers, measurement and safety.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 630. Biomechanical Computer Modeling and Simulation of Human Movement   3 Units
Prerequisite(s): Graduate/professional standing; BE 354 or equivalent.
Description: Development and application of musculoskeletal computer modeling and simulation techniques to analyze human movement biomechanics.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 639. Injury Biomechanics   3 Units
Prerequisite(s): ME 649 or BE 354 or equivalent, or permission of the instructor.
Description: Application of mechanics to the study of human injury. Response of the human body to injurious conditions. Injury tolerance of the human body. Applications to child abuse, transportation safety and the medico-legal environment.
Note: Cross-listed with ME 639.

For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 640. Computational Methods for Medical Image Analysis   3 Units
Term Typically Offered: Spring Only
Prerequisite(s): BE 340 or graduate/professional standing.
Description: This course covers the theory of stochastic and geometric models of medical imaging, including spatial interaction models, intensity models, and geometric shape models. The emphasis is on understanding the underlying mathematics in a practical sense. This course is restricted to Graduate Students in the Speed School of Engineering.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 645. Artificial Intelligence and Radiomics   3 Units
Term Typically Offered: Fall, Spring, Summer
Prerequisite(s): Graduate/professional standing; BE 340 or equivalent course.
Description: Artificial intelligence is comprehensively a bundle of cutting edge computational algorithms that basically learn the patterns in the provided data to make prediction on new unseen data. Radiomics is almost a new terminology in the radiology area which means the extraction of large number of features from different kinds of medical images. This course couples both artificial intelligence and radiomics together to extract meaningful hidden quantitative data to be used in real word medical applications. This course also presents the basic concepts and applications of artificial intelligence in the computer aided diagnostic systems.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 650. Advanced Biomaterials   3 Units
Prerequisite(s): BE 450 or consent of instructor.
Description: Advanced topics on the use of biomaterials,and their performance, in reconstructive surgery. Specifically skin, nerve, bone, and soft tissue regeneration utilized for burn patients, cancer patients, and trauma patients.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 654. Advanced Physiology for Engineers   3 Units
Prerequisite(s): BE 354.
Description: This course provides an in-depth view of the fundamental principles of how biochemistry and physiology are integrated. Emphasis is placed on the physiologic mechanisms for feedback control of physiologic function in humans.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 658. Rehabilitation Engineering and Assistive Technology   3 Units
Prerequisite(s): ME 649 or BE 354 or equivalent, or permission of instructor.
Description: Introduction to rehabilitation engineering and assistive technology. Medical aspects of disability, assistive technology applications and current rehabilitation research.
Note: Cross-listed with ME 658.

For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 668. Translational Bioengineering teaching Practicum **2 Units**
Prerequisite(s): Admission to Translational Bioengineering PhD program and permission of course instructor.
Description: A guided learning experience in inquiry-based instructional techniques and best practices in engineering education that includes field experience as a graduate instructor.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 670. Cellular Mechanobiology in Cancer **3 Units**
Term Typically Offered: Fall Only
Prerequisite(s): BE 359, BE 450.
Description: This course will focus on biophysical and bioengineering aspects of mechanotransduction, the process through which living cells sense and respond to their mechanical environment. Specifically, this class will discuss the role of these mechanisms in the context of cancer tumorigenicity and spread. Students will learn how mechanical inputs to cells influence both subcellular biochemistry and whole-cell behavior. They will also study newly engineered technologies for force manipulation and measurement in living cells, and synthetic strategies to control the mechanics and chemistry of the extracellular matrix.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 683. Artificial Organs **3 Units**
Term Typically Offered: Spring Only
Prerequisite(s): Graduate/professional standing in bioengineering.
Description: Bioengineering design of artificial organ replacement systems and their clinical usage. Commercially available systems analyzed for mass transfer efficiency; biomechanics and henodynamics; and size and efficiency of the device.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 685. Modeling of Biological Phenomena **3 Units**
Term Typically Offered: Summer Only
Prerequisite(s): Graduate/professional standing in Bioengineering, BE 359 and BE 354 or equivalent(s).
Description: Introduces basic concepts of the development, analysis, and evaluation of mathematical models of biological systems. Demonstrates how modeling related to genetic, biochemical, physiological, and/or ecological systems is performed by combining both biological and mathematical information, with the goal to apply these techniques in the field of translational bioengineering. Sessions will include critical discussion of scientific literature and student presentations on a research project with interaction and feedback from students and faculty.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 691. Bioengineering Non-thesis Design/Research Project **3 Units**
Term Typically Offered: Fall, Spring, Summer
Prerequisite(s): Graduate/Professional standing in bioengineering.
Description: Design or research project involving a literature search, project planning, design objectives, fabrication and/or experimentation, analysis, technical report writing, and oral presentation under a faculty member's guidance. Final technical report is required to be presented orally to course instructor and faculty mentor for graded evaluation.
Course Attribute(s): CBL - This course includes Community-Based Learning (CBL). Students will engage in a community experience or project with an external partner in order to enhance understanding and application of academic content.

For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 692. Bioengineering Clinical Rotation **2 Units**
Prerequisite(s): Successful completion of Translational Bioengineering qualifying exam, permission of advisor and program director, and HIPAA certified.
Description: Students will observe day to day clinical activities associated with patient care by participating in clinical rounds and/or scheduled specialty clinics led by residents, fellow and/or clinical faculty. Exposure to the clinical setting will allow students to gain an understanding of concepts such as patient history, disorder/disease presentation, diagnostics, clinical decision making, treatment modalities, disease management, procedures and clinical outcomes. Students must work with their PhD advisor and the ISSTBE-PhD Program Director to identify clinical rotation opportunities in specialty areas of interests within the Schools of Medicine or Dentistry.
Course Attribute(s): CBL - This course includes Community-Based Learning (CBL). Students will engage in a community experience or project with an external partner in order to enhance understanding and application of academic content.

For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 693. Independent Study in Bioengineering **1-6 Units**
Prerequisite(s): Faculty consent.
Description: An advanced theoretical or experimental investigation of a problem area related to Bioengineering.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 695. Bioengineering Research Design & Methods **3 Units**
Term Typically Offered: Spring Only
Prerequisite(s): Graduate/Professional standing.
Description: Focus on study designs & methodologies and their appropriate application. Emphasis placed on development of specific aims, testable hypotheses, and interpretation and communication of research findings. Data analysis concerns and strategies for parametric and non-parametric applications will be addressed using SPSS. Students will learn to communicate scientific methodologies and findings, and to interpret their
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 697. Master of Engineering Thesis in Bioengineering   **1-6 Units**
Term Typically Offered: Fall, Spring, Summer
Prerequisite(s): Graduate/Professional standing in bioengineering.
Description: Original design or research activity in a bioengineering discipline, under the direction of a faculty member. A written thesis must be presented to a faculty committee and defended.
Course Attribute(s): CBL - This course includes Community-Based Learning (CBL). Students will engage in a community experience or project with an external partner in order to enhance understanding and application of academic content.

For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 698. Master of Science Thesis in Bioengineering   **1-6 Units**
Term Typically Offered: Fall, Spring, Summer
Prerequisite(s): Graduate or Professional school standing and permission of Department Chair.
Description: Experimental or design-based thesis research performed as part of Master of Science degree requirements. A written thesis is required to be presented and defended orally and submitted to the faculty for approval.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 699. Dissertation Research   **3-15 Units**
Prerequisite(s): Successful completion of the Translational Bioengineering PhD qualifying exam.
Description: Original research activity in an appropriate translational bioengineering discipline, under the direction of a graduate faculty member affiliated with PhD in Interdisciplinary Studies with a Specialization in Translational Bioengineering (ISSTBE PHD).
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)