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=sjUx2OSTj21bdWVEuQ3Z1YRikImfxpqoV)

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 101. Introduction to Bioengineering **1 Unit**
Term Typically Offered: Spring Only
Description: Survey of the field of bioengineering and introduction to art/practice of bioengineering. Introduction to bioengineering ethics and responsible conduct of research. Survey of potential career paths, including lab tours and interaction with faculty, alumni and industry representatives.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 288. Bioengineering Co-op Education Seminar **0 Units**
Grading Basis: Pass/Fail
Term Typically Offered: Fall, Spring, Summer
Prerequisite(s): CHEM 202, ENGL 101, ENGR 110, student must be in Good Standing with GPA of 2.25 or higher; BE 310, BE 360.
Corequisite(s): BE 310, BE 360.
Description: Discussion of rules and regulations governing cooperative internship experience and instruction in job interviewing techniques, resume preparation and in preparation of co-op report. Required prerequisite for the first cooperative internship.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 289. Bioengineering Co-op Education I **1 Unit**
Grading Basis: Pass/Fail
Term Typically Offered: Fall, Spring, Summer
Prerequisite(s): BE 288.
Fee: An additional $300.00 is charged for this course.
Description: First cooperative education work term in an area directly related to the field of specialization of their degree program. Required for Professional School of Engineering students.
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 310. Biotransport Phenomena **3 Units**
Term Typically Offered: Spring Only
Prerequisite(s): ENGR 205, ME 206, and ME 251.
Description: Introduction to fundamental concepts of momentum, heat, and mass transport with applications to biological and medical engineering science and design. Properties of biofluids. Conservation equations in integral and differential forms.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 322. Circuits and Devices for Bioengineers **3 Units**
Term Typically Offered: Summer Only
Prerequisite(s): PHYS 299 and ENGR 201; BE Students only.
Description: Concepts covered: DC/AC circuit theory. Linear network analysis. Impedance. Resonance. Solid-state devices. Integrated circuits. Op-amps. Electrical safety. RC filters. Sensors. Batteries. Data Acquisition. Software covered: LabVIEW. T-Spice. Multisim. Ultiboard.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 340. Computational Methodologies in Bioengineering **3 Units**
Term Typically Offered: Summer Only
Description: The main goal of the course is to introduce students to high-performance computing tools which are crucial to many bioengineering and scientific applications and equip students with basic knowledge of state-of -the-art computing tools available.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 354. Anatomy and Physiology **3 Units**
Term Typically Offered: Spring Only
Prerequisite(s): BIOL 240.
Description: The purpose of this course is to cover the basic structure and function of the major systems of the human body.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 359. Cell and Molecular Biology for Bioengineers **3 Units**
Term Typically Offered: Spring Only
Prerequisite(s): BIOL 240.
Description: This course examines the fundamental principles of cell and molecular biology in humans.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 360. Biomechanics Principles **3 Units**
Term Typically Offered: Spring Only
Prerequisite(s): ENGR 205 and CEE 205.
Description: Introduction to the mechanical behavior of biological tissues and systems. Methods for the analysis of rigid body and deformational mechanics applied to biological tissues including bone, muscle, and connective tissues.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 389. Bioengineering Co-op Education II **1 Unit**
Grading Basis: Pass/Fail
Term Typically Offered: Fall, Spring, Summer
Prerequisite(s): BE 289.
Fee: An additional $300.00 is charged for this course.
Description: Second cooperative education work term in an area directly related to the field of specialization of their degree program. Required for Professional School of Engineering students.
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 405. Practicum in Bioengineering Education **1 Unit**
Term Typically Offered: Spring Only
Prerequisite(s): BE 310 and BE 360 and consent of instructor.
Description: A guided learning experience in inquiry-based instructional techniques and best practices in STEM education that includes field experience as an undergraduate teaching assistant. Permission to enroll required. May be repeated for a maximum of 3 credit hours.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 420. Biosystems & Signals **3 Units**
Term Typically Offered: Spring Only
Prerequisite(s): BE 340.
Description: This course covers linear systems theory, including convolution, Fourier, Laplace, and Z-transforms. The emphasis is on understanding the underlying mathematics in a practical sense.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 423. Bioengineering Measurements Laboratory **2 Units**
Term Typically Offered: Spring Only
Prerequisite(s): BE 322.
Description: Laboratory to illustrate basic principles taught in Circuits and Devices for Bioengineers.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 430. Biosystems Controls **3 Units**
Term Typically Offered: Fall Only
Prerequisite(s): BE 322, BE 420.
Description: Classical approach to analyze and design linear and nonlinear control systems, with emphasis on nonlinearity of physiological control systems, e.g., neuromusculoskeletal, cardiovascular, thermal and mass transfer systems of the body.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 450. Biomaterials & Biocompatibility **3 Units**
Term Typically Offered: Summer Only
Prerequisite(s): CHEM 341, ME 251 and BE 360.
Description: Introduces biomaterials and the clinical relevance of biomaterial performance. The course will cover polymer synthesis, characterization, mechanical testing, surface modification and biocompatibility issues, e.g. protein adsorption, immune response, and sterilization.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 453. Introduction to Molecular Bioengineering **3 Units**
Term Typically Offered: Fall Only
Prerequisite(s): CHEM 341 and BE 359.
Description: Demonstrate how molecules are used as building blocks to engineer surfaces and materials with specific attributes/function. Introduces biomimetic design principles for biomedical materials and devices to control performance/function of materials.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 460. Biomechanics of Tissues and Organs **3 Units**
Term Typically Offered: Fall Only
Prerequisite(s): BE 360 and BE 354.
Description: Provide students with introductory materials for various interdisciplinary fields in biomechanics. The topics include orthopaedic biomechanics, musculoskeletal biomechanics and cardiovascular biomechanics.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 480. Biomedical Device Design **3 Units**
Term Typically Offered: Spring Only
Prerequisite(s): BE 423 (or concurrent) and BE 450 (or concurrent).
Description: Medical device design for surgery, patient care and patient monitoring. Emphasizes design criteria and process, human factors, patient care, bench-top testing, safety, FDA regulation, market readiness and legal liability.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 489. Bioengineering Co-op Education III **1 Unit**
Grading Basis: Pass/Fail
Term Typically Offered: Fall, Spring, Summer
Prerequisite(s): BE 389.
Fee: An additional $300.00 is charged for this course.
Description: Third cooperative education work term in an area directly related to the field of specialization of their degree program. Required for Professional School of Engineering students.
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 491. Capstone A **3 Units**
Term Typically Offered: Fall Only
Prerequisite(s): BE 423 and BE 450; Senior standing in Bio-engineering.
Corequisite(s): BE 497.
Description: Applies methods of engineering economic analysis,ethics, and FDA regulation processes. Methods to identify, articulate and resolve ethical dilemmas intrinsic to bioengineering. Practical "hands-on" experiences in the application of economic concepts and FDA regulations.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

BE 497. Capstone B - CUE **3 Units**
Term Typically Offered: Fall Only
Prerequisite(s): BE 354 and Senior standing in bio-engineering.
Corequisite(s): BE 491.
Description: Team-oriented design of a biomedical/biological mechanism, system or process satisfying a set of open-ended requirements. Written reports and oral presentations are required.
Course Attribute(s): CUE - This course fulfills the Culminating Undergraduate Experience (CUE) requirement for certain degree programs. CUE courses are advanced-level courses intended for majors with at least 90 earned credits/senior-level status., 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 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)