BIOENGINEERING (BENG)

BENG 520 Adv Molecular and Cell Biology 3 Credit Hours
This course introduces the cell and molecular biology concepts from an engineering perspective and provides the foundation for modern biotechnology and bioengineering. This course is designed for a first year engineering graduate student to develop a comprehensive understanding of relevant applications in biology, including biochemical, cellular organizational, metabolic and genetics aspects. Advanced concepts including genomics, molecular biology, recombinant DNA technology and evolution are discussed. The course provides exposure to several key techniques used in biological engineering laboratories. Students will have chance to present and discuss individual application through team project. (YR)
Restriction(s):
Can enroll if Level is Doctorate or Rackham or Graduate or
Can enroll if Major is , Bioengineering

BENG 521 Biomatls and Biochem Interface 3 Credit Hours
The course will provide graduate-level foundation on biomaterials science and principles. Specifically, the course will involve discussion on the importance of surfaces and interfaces in biomaterial function and elements controlling host responses to materials, introduction to biomimetic and rational designing approaches, and develop critical analyses of biomaterials through reading research papers and developing projects. (YR)
Restriction(s):
Cannot enroll if Level is
Can enroll if Major is , Bioengineering

BENG 526 Fundamentals of Drug Delivery 3 Credit Hours
This course is designed to provide students with an understanding on the concepts in drug delivery from an engineering perspective. The course will cover drug delivery mechanisms, quantitative understanding of drug transport, nanotechnology, drug delivery devices, toxicity and immune response, FDA regulations, clinical trials and technology transfer. The course will conclude with a design project on nanoparticles development for targeted drug delivery. (YR)
Restriction(s):
Cannot enroll if Level is
Can enroll if Major is , Bioengineering

BENG 550 Biophotonics and Optical Metrology 3 Credit Hours
The recent explosion of interest in minimally invasive medical diagnostics and contactless metrology has been fueled in part by the development of novel optics and photonics. A large number of optically-based imaging and sensing techniques have moved beyond research laboratories into medical clinics, materials engineering, and industrial applications. Topics include design principles of optical instrumentation, techniques for diagnostics and metrology, and elastic and inelastic light scattering theory. Applications include optical metrology, confocal and multiphoton microscopy, light propagation and tomographic imaging in tissues, and design of minimally invasive spectroscopic systems. Optical systems design is included as a class project. (YR).
Restriction(s):
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BENG 551 Microfluidics 3 Credit Hours
Microscaled systems and devices have enhanced reaction rates, predictable fluid mechanics, reduced reagent volumes, and a cheaper path to rapid prototyping. These advantages benefit many biomedical and processes engineering applications that require sensitive molecular detection and precise flow controls. In this course, a range of microsystem techniques will be discussed, including those based on microfluidics, MEMS, and optofluidics. The lectures will be accompanied by student-driven design projects that will be conducted in 3-hour laboratories. (YR).
Restriction(s):
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BENG 560 Nanobiosystems Engineering 3 Credit Hours
Nanobiosystems Engineering is an emerging frontier in nanotechnology. It integrates materials science, bioengineering, physics and life science with the biological and biochemical applications. This fast-developing interdisciplinary field holds the promise to solve many of the medical problems of future. The course will introduce advanced concepts related to nanomaterials and nanofabrication and their application in medicine. The course will also focus on design and development of nano-devices for the applications of pharmaceuticals and healthcare. Typcial applications including nano-biosensor, targeted drug delivery, and tissue engineering will also be discussed. Students in Bioengineering will have chance to present and discuss individual application through team project. (YR)
Restriction(s):
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Can enroll if Major is , Bioengineering

BENG 570 Advanced Biomechanics 3 Credit Hours
This course covers intermediate level subject matter on structural biomechanics, analysis and design. Topics include: soft tissues biomechanics, human motion analysis including gait, orthopedic implants. fixation and reconstruction, head impact and injury, advanced bone models. (YR) (YR).
Restriction(s):
Cannot enroll if Level is
Can enroll if Major is , Bioengineering

BENG 571 Impact Biomechanics 3 Credit Hours
This course focuses on the understanding of the behavior of human organs, bone and tissue at their point of mechanical or functional failure. Topics will include research methods in injury biomechanics, injury tolerance of the structures and materials of the head, brain, spine, thorax, abdomen and extremities and injury prevention focusing on safety equipment. Federal motor vehicle safety standards will be discussed. (YR)
Restriction(s):
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BENG 575 Regenerative Engineering 3 Credit Hours
This course will discuss principles of tissue engineering whereby the properties of stem as well as primary cells, growth factors, and extracellular matrix and their impact in the development of engineered tissue constructs will be explored. In addition, the course will also focus on supporting/enabling technologies typically utilized in engineering these constructs including nano-and micro-fabrication techniques, 3D printing, micro-patterning as well designing principles of bioreactors, and drug and gene delivery techniques. Additionally, various tissue engineering applications will be discussed including synthetic tissues and organs that are currently under development for regenerative medicine application. (YR)
Restriction(s):
Can enroll if Level is Doctorate or Rackham or Graduate or

BENG 580 Mechanotransduction 3 Credit Hours
This course will provide a basic understanding of mechanotransduction and mechanobiology from the perspective of various microenvironments and how the aspects of these microenvironments drive cellular development, homeostasis, health, and disease. Students will learn how to read, interpret, and present information found in research articles as well as design novel bioreactor systems for physiologically relevant microenvironments that recapitulate the major mechanical forces and attributes of particular tissues and diseases. Students will gain group work and presentation experience through the design and presentation of these designs to their classmates. (OC).
Restriction(s):
Can enroll if Level is Rackham or Graduate or Doctorate or
Can enroll if Major is Bioengineering

BENG 595 Digital Manufacturing and Product Innovation 3 Credit Hours
This combined lecture and hands on project course aims to train students to optimize the interplay of materials, people, machines and profitability. The course introduces methods to identify product concepts with commercial potential. Student teams will perform market analysis and explore the intellectual property space around their ideas and rapidly iterate them into a final prototype via direct digital manufacturing (e.g., 3D CAD/CAM files manifested via digital printing or machining). Advanced instruction on direct digital manufacturing tools will be given, and customer response will be used as feedback. Early stage prototypes will progress into more sophisticated designs, scaling up (cost, pricing, tooling, process flow and automation) scenario planning for mass manufacturing as well as Failure Mode Effect Analysis (FMEA) will be discussed. (W,YR)
Restriction(s):
Can enroll if Level is Rackham or Graduate or Doctorate or
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BENG 600 Study or Research in BENG 1 to 3 Credit Hours
Individual study or research in an area of bioengineering under supervision of a faculty member. The student will submit a written report at the close of the term. (YR)
Restriction(s):
Can enroll if Level is Doctorate or Rackham or Graduate or

BENG 699 Master's Thesis 1 to 6 Credit Hours
Research project in the area of bioengineering conducted under supervision of a program faculty member. While guided by a faculty member, a student electing this course is expected to carry out the work him-or herself. Successful completion of the course requires completion and public defense of a written thesis. A student must satisfactorily complete all 6 credit hours, which can be distributed over multiple semesters. (YR)
Restriction(s):
Can enroll if Level is Rackham or Graduate

*An asterisk denotes that a course may be taken concurrently.

Frequency of Offering

The following abbreviations are used to denote the frequency of offering: (F) fall term; (W) winter term; (S) summer term; (F, W) fall and winter terms; (YR) once a year; (AY) alternating years; (OC) offered occasionally