**BIOMEDICAL ENGINEERING (B M E)**

**B M E 1 — COOPERATIVE EDUCATION PROGRAM**  
1 credit.  
Work experience which combines classroom theory with practical knowledge of operations to provide students with a background upon which to base a professional career in industry. Enroll Info: Sophomore standing  
Requisites: Consent of instructor  
Course Designation: Workplace - Workplace Experience Course  
Repeatable for Credit: Yes, unlimited number of completions  
Last Taught: Fall 2019

**B M E 200 — BIOMEDICAL ENGINEERING DESIGN**  
1 credit.  
Sophomores will work in a team with juniors on a client-centered biomedical engineering design project to learn concept generation, product analysis, specifications, evaluation, clinical trials, regulation, liability, and ethics. Enroll Info: None  
Requisites: Sophomore standing and declared in Biomedical Engineering  
Repeatable for Credit: No  
Last Taught: Fall 2019

**B M E 201 — BIOMEDICAL ENGINEERING FUNDAMENTALS AND DESIGN**  
2 credits.  
Fundamentals of biomedical engineering and principles of design. Hands-on skills including computer-aided design, machining, and fabrication of a physical medical device prototype. Enroll Info: Sophomore standing in biomedical engineering  
Requisites: Must have Sophomore standing or higher and have an Academic Program of BME (Biomedical Engineering) and completed BME 200.  
Repeatable for Credit: No  
Last Taught: Spring 2019

**B M E 300 — BIOMEDICAL ENGINEERING DESIGN**  
1 credit.  
Juniors will work in a team with and provide mentorship to sophomores on a client-centered biomedical engineering design project to learn concept generation, product analysis, specifications, evaluation, clinical trials, regulation, liability, and ethics. Enroll Info: None  
Requisites: B M E 201  
Repeatable for Credit: No  
Last Taught: Fall 2019

**B M E 301 — BIOMEDICAL ENGINEERING DESIGN**  
1 credit.  
Juniors will work in a team composed of all juniors on a client-centered biomedical engineering design project to learn concept generation, product analysis, specifications, evaluation, intellectual property, clinical trials, regulation, liability, and ethics. Enroll Info: None  
Requisites: B M E 201  
Repeatable for Credit: No  
Last Taught: Spring 2019

**B M E 310 — BIOINSTRUMENTATION**  
3 credits.  
A sophomore level first course in bioinstrumentation covering clinical and research measurements. Laboratory experiments complement the lectures. Enroll Info: CHEM 109 or (CHEM 103 and CHEM 104); PHYSICS 202 or PHYSICS 208; MATH 234 or concurrent registration. Open only to students in the BME program or consent of instructor  
Requisites: None  
Repeatable for Credit: No  
Last Taught: Spring 2019

**B M E 315 — BIOMECHANICS**  
3 credits.  
This course will provide an introduction to the mechanical behavior of biological tissues and systems. Specific topics include: structure and function of biological tissues, mechanical properties of biological tissues, and analysis of specific tissues (i.e. bone, muscle, and soft connective tissues). Enroll Info: MATH 234; PHYSICS 202 or PHYSICS 208; EMA 303 or ME 306. Open only to students in the BME program or consent of instructor  
Requisites: None  
Repeatable for Credit: No  
Last Taught: Fall 2019

**B M E/CBE 320 — INTRODUCTORY TRANSPORT PHENOMENA**  
4 credits.  
Mass, momentum, and energy transport; calculation of transport coefficients; solution to problems in viscous flow, heat conduction, and diffusion; dimensional analysis; mass, momentum, and heat transfer coefficients; over-all balances; elementary applications. Enroll Info: PHYSICS 201, MATH 319 or 320, CBE 250 with grade of C or better; or consent of instructor  
Requisites: None  
Repeatable for Credit: No  
Last Taught: Fall 2019

**B M E 325 — APPLIED STATISTICS FOR BIOMEDICAL ENGINEERS**  
3 credits.  
Learn and apply the fundamentals of descriptive and inferential statistics to analyze data and present the results in appropriate graphical formats. Emphasis will be on applications commonly encountered in biomedical engineering including t-tests, linear regression, analysis of variance, diagnostic tests, ROC curves, and methods for graphing and presenting data. Examples and practice problems will be drawn from biomedical research. Learn how to analyze data and interpret statistical analysis presented in research papers, and will get practical hands-on experience implementing these tools during class in a computer lab setting. Enroll Info: None  
Requisites: Declared in Biomedical Engineering and (MATH 222 or 276)  
Repeatable for Credit: No  
Last Taught: Fall 2019
B M E/CBE 330 — ENGINEERING PRINCIPLES OF MOLECULES, CELLS, AND TISSUES
4 credits.

Introduction to the fundamental principles of kinetics and transport that are relevant for the analysis of biological systems. Topics covered include concepts of reaction rate, stoichiometry, equilibrium, momentum/mass transport, and the interaction between transport and kinetics in biological systems. Enroll Info: None

Requisites: Declared in Biomedical Engineering or Chemical Engineering and (E M A 201, PHYSICS 201, or 207) and (MATH 319, 320, or 375) and (CHEM 104 or 109)
Repeatable for Credit: No
Last Taught: Fall 2019

B M E 389 — HONORS IN RESEARCH
1-3 credits.

Undergraduate honors research projects supervised by faculty members. Not available for graduate credit. Enroll Info: Admission to BME Undergraduate Honors in Research Program

Requisites: Consent of instructor
Course Designation: Honors - Honors Only Courses (H)
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2019

B M E 399 — INDEPENDENT STUDY
1-3 credits.

Enroll Info: So st in biomedical engineering cons inst

Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2019

B M E 400 — CAPSTONE DESIGN COURSE IN BIOMEDICAL ENGINEERING
3 credits.

Applies classroom study and prior design course experiences for senior teams to solve a directed client-based biomedical engineering design project. Enroll Info: None

Requisites: (B M E 300 or B M E 301) and (B M E 310, 315, or PHM SCI/ B M E 430)
Repeatable for Credit: No
Last Taught: Fall 2019

B M E 402 — BIOMEDICAL ENGINEERING DESIGN
1 credit.

Final semester seniors will work in a team to evaluate, refine, document and orally present the client-centered biomedical engineering design completed in their prior capstone design course. Enroll Info: None

Requisites: B M E 400
Repeatable for Credit: No
Last Taught: Spring 2019

B M E/M E 414 — ORTHOPAEDIC BIOMECHANICS - DESIGN OF ORTHOPAEDIC IMPLANTS
3 credits.

Apply the design process for orthopaedic implants (total joint replacements). Topics include: library skills; joint anatomy; tissue properties; surgical approach; joint loading; implants materials; preclinical testing and analysis. Students are assumed to have knowledge of mechanics of materials. Enroll Info: None

Requisites: Senior standing and (M E 306 or E M A 303) or graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

Last Taught: Fall 2019

B M E/M E 415 — BIOMECHANICS OF HUMAN MOVEMENT
3 credits.

An overview of experimental and modeling techniques used to study human movement. Specific topics will include locomotion, motion capture systems, force plates, muscle mechanics, musculoskeletal modeling, three dimensional kinematics, inverse dynamics, forward dynamic simulation and imaging based biomechanics. Homework and laboratory activities will be conducted that emphasize applications of movement biomechanics in orthopedics and rehabilitation. The course will culminate in a class project related to each student’s research interests. Enroll Info: Senior or graduate standing, ME 240, ME 340, BME 315

Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

B M E/PHM SCI 430 — BIOLOGICAL INTERACTIONS WITH MATERIALS
3 credits.

Addresses the range of materials currently being utilized for various biomedical applications, the biological systems governing biomaterial applications, analytical techniques pertinent to biomaterial evaluation, and selected major medical applications in which biomaterials play an important role. Enroll Info: None

Requisites: (ZOOLOGY/BIOLOGY 101 and 102, ZOOLOGY/BIOLOGY/ BOTANY 151, ZOOLOGY 153, or BIOCORE 383) and (CHEM 341 or 343)
Repeatable for Credit: No
Last Taught: Spring 2019

B M E/E C E 462 — MEDICAL INSTRUMENTATION
3 credits.


Requisites: E C E 340, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2019
B M E/C E 463 — COMPUTERS IN MEDICINE
3 credits.

Study of microprocessor-based medical instrumentation. Emphasis on real-time analysis of electrocardiograms. Labs and programming project involve design of biomedical digital signal processing algorithms. Knowledge of computer programming language like C, C++ or Java, strongly encouraged. Enroll Info: None
Requisites: E C E 330 and (COMP SCI 200, 220, 300, or 301), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

B M E 489 — HONORS IN RESEARCH
1-3 credits.

Undergraduate honors research projects supervised by faculty members. Not available for graduate credit. Enroll Info: Admission to BME Undergraduate Honors in Research Program
Requisites: Consent of instructor
Course Designation: Honors - Honors Only Courses (H)
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2019

B M E/H ONCOL/MED PHYS/PHYSICS 501 — RADIOLOGICAL PHYSICS AND DOSIMETRY
3 credits.

Interactions and energy deposition by ionizing radiation in matter; concepts, quantities and units in radiological physics; principles and methods of radiation dosimetry. Enroll Info: None
Requisites: MATH 234 and (PHYSICS 241 or 249) or graduate/professional standing
Course Designation: Level - Advanced
L&S Credit: Counts as Liberal Arts and Science credit in L&S Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2019

B M E/M E 505 — BIOFLUIDICS
3 credits.

Introduction to the physics of biological fluid flow with an emphasis on the cardiovascular system including blood rheology, pulsatile flow, wave travel, and topics relevant to blood flow measurement and biomedical device design. Enroll Info: None
Requisites: (B M E 315, M E 240 or E M A 202) or graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

B M E/CBE 510 — INTRODUCTION TO TISSUE ENGINEERING
3 credits.

Overview of tissue engineering, including discussion of cell sources, cell-material interactions, tailoring biomaterials, methods of culture and characterization of engineering tissues, ethical issues, concluding with case studies of specific types of tissue engineering. Optional laboratory exercises offered throughout semester. Enroll Info: BME 430 or equiv, or cons inst
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2019

B M E 511 — TISSUE ENGINEERING LABORATORY
1 credit.

Tissue engineering refers to the generation of biological substitutes to restore, maintain, or improve tissue function. Laboratory techniques are multi-disciplinary, from basic biological sciences, engineering, and biotechnology. Engineering approaches and analysis will be applied to theses techniques. Enroll Info: BME 510 con reg or consent of instructor
Requisites: None
Repeatable for Credit: No
Last Taught: Fall 2019

B M E 515 — THERAPEUTIC MEDICAL DEVICES
1 credit.

Design of medical devices to treat pathology. Open to majors in biomedical engineering. One lecture each week. Enroll Info: BME 310, BME 315, Physiol 335. Con reg in BME430
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2019

B M E/BSE/CBE 517 — BIOLOGY IN ENGINEERING SEMINAR
1 credit.

Current topics at the interface of biology and engineering with special emphasis on the ways in which engineers have contributed to knowledge and advances in biology. Enroll Info: Jr st in engr one college-level biol crse
Requisites: None
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2019

B M E/CBE 520 — STEM CELL BIOENGINEERING
3 credits.

Covers engineering approaches that are used to understand and manipulate stem cells. Concepts covered include: introduction to stem cell biology, quantitative modeling of stem cell signaling, methods to engineer the stem cell microenvironment, and the role of stem cells in tissue development and regeneration. Enroll Info: MATH 319 or 320, ZOOLOGY 470 or 570, CHEM 343, or cons inst
Requisites: (MATH 319 or 320), (ZOOLOGY 470 or 570), and CHEM 343
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019
B M E/MED PHYS 530 — MEDICAL IMAGING SYSTEMS
3 credits.

2D Fourier image representation, sampling, and image filtering with applications in medical imaging. Principles of operation, impulse responses, signal-to-noise, resolution and design tradeoffs in projection radiography, tomography, nuclear medicine, ultrasound, and magnetic resonance imaging. Enroll Info: None

Requisites: Graduate/professional standing or (E C E 330 or MED PHYS/B M E 573)
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

B M E/MED PHYS 535 — INTRODUCTION TO ENERGY-TISSUE INTERACTIONS
3 credits.

Explore physical interactions between thermal, electromagnetic and acoustic energies and biological tissues with emphasis on therapeutic medical applications. Enroll Info: None

Requisites: PHYSICS 202, 208, 248, or PHYSICS/MED PHYS 265, or graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

B M E 545 — ENGINEERING EXTRACELLULAR MATRICES
3 credits.

Overview of the structure, function and biophysical properties of extracellular matrix (ECM) proteins, followed by discussion of how control or manipulation of ECM protein expression and distribution impacts on cell and tissue function, concluding with impacts of engineering ECM for regenerative medicine. Enroll Info: ZOOLOGY/BIOLOGY/BOTANY 151 or equiv., BME 430 or equiv. Also recommended: ZOOLOGY 570 or equiv., BMOLCHEM 503 or equiv

Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

B M E 550 — INTRODUCTION TO BIOLOGICAL AND MEDICAL MICROSYSTEMS
3 credits.

Introduces students to the field of MEMS (Micro-Electro-Mechanical-Systems), as it applies to biology and medicine. Topics will cover methodology of traditional MEMS devices, how they can be incorporated with biological systems, and methods for micro-structuring biological materials. Enroll Info: Zoöl 152, BME 310, or cons inst

Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2019

B M E 556 — SYSTEMS BIOLOGY: MAMMALIAN SIGNALING NETWORKS
3 credits.

Introduction to the experimental and mathematical modeling techniques used in systems biology through lectures and critical analyses of relevant publications with a primary focus on gene/protein networks and mammalian systems. Enroll Info: ZOOLOGY 570 or BME 510, and MATH 319 or MATH 320 or MATH 340; or consent of instructor

Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

B M E/CBE 560 — BIOCHEMICAL ENGINEERING
3 credits.

Properties of biological molecules; enzyme kinetics, enzyme reactors, and enzyme engineering; metabolic engineering; microbial growth kinetics; bioreactor design; bioseparations. Enroll Info: CBE 310; CBE/B M E 320; Zoo 151 or 153; or consent of instructor

Requisites: None
Repeatable for Credit: No
Last Taught: Fall 2019

B M E/I SY E 564 — OCCUPATIONAL ERGONOMICS AND BIOMECHANICS
3 credits.

Introduces engineers how to design manufacturing and industrial operations in which people play a significant role, so that human capabilities are maximized, physical stress is minimized, and workload is optimized. Examples and topics emphasize industrial applications. Enroll Info: None

Requisites: PSYCH/I SY E 349 or B M E 315, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

B M E/MED PHYS 566 — PHYSICS OF RADIOTHERAPY
4 credits.

Ionizing radiation use in radiation therapy to cause controlled biological effects in cancer patients. Physics of the interaction of the various radiation modalities with body-equivalent materials, and physical aspects of clinical applications; lecture and lab. Enroll Info: None

Requisites: PHYSICS/B M E/H ONCOL/MED PHYS 501
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019
B M E/MED PHYS 567 — THE PHYSICS OF DIAGNOSTIC RADIOLOGY
4 credits.
Physics of x-ray diagnostic procedures and equipment, radiation safety, general imaging considerations; lecture and lab. Enroll Info: None
Requisites: MATH 234 and (PHYSICS 241 or 249) or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018

B M E/MED PHYS 568 — MAGNETIC RESONANCE IMAGING (MRI)
2 credits.
Core course covering the physics associated with magnetic resonance imaging emphasizing techniques employed in medical diagnostic imaging. Major MRI topics include: physics of MR, pulse sequences, hardware, imaging techniques, artifacts, and clinical applications. At the completion of this course, students should have an understanding of the technical and scientific details of modern magnetic resonance imaging and its use in diagnosing disease. Graduate students who have not taken MATH 222 and PHYSICS 202 at UW-Madison must have the equivalent coursework in order to be successful in this course. Enroll Info: None
Requisites: Graduate/professional standing or (MATH 222 and PHYSICS 202, 208, 241, 244, 248 or 249)
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

B M E/MED PHYS 573 — MEDICAL IMAGE SCIENCE: MATHEMATICAL AND CONCEPTUAL FOUNDATIONS
3 credits.
The conceptual and mathematical foundations of medical imaging, including both deterministic and stochastic aspects. Enroll Info: None
Requisites: MATH 234, 319 and (PHYSICS 202 or 208) or graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2019

B M E/MED PHYS 574 — IMAGING IN MEDICINE: APPLICATIONS
3 credits.
Builds on the fundamental conceptual and mathematical foundations addressed in MED PHYS/B M E 573, with application of concepts to practical medical imaging problems and emerging quantitative imaging techniques. Enroll Info: None
Requisites: MED PHYS/B M E 573
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

B M E/MED PHYS 575 — DIAGNOSTIC ULTRASOUND IMAGING
2 credits.
Propagation of ultrasonic waves in biological tissues; principles of ultrasonic measuring and imaging instrumentation; design and use of currently available tools for performance evaluation of diagnostic instrumentation; biological effects of ultrasound. Enroll Info: None
Requisites: Graduate/professional standing or (MATH 234, 319, or 320 and PHYSICS 202 or 208)
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

B M E/MED PHYS 578 — NON-IONIZING DIAGNOSTIC IMAGING
3 credits.
Covers the physics associated with magnetic resonance imaging and diagnostic ultrasound emphasizing techniques employed in medical diagnostic imaging. Major MRI topics include: physics of MR, pulse sequences, hardware, imaging techniques, artifacts, and spectroscopic localization. Ultrasound based topics covered include: propagation of ultrasonic waves in biological tissues, principles of ultrasonic measuring and imaging instrumentation, design and use of currently available tools for performance evaluation of diagnostic instrumentation, and biological effects of ultrasound. At the completion of this course, students should have an understanding of the technical and scientific details of modern non-ionizing medical magnetic resonance and ultrasound devices and their use in diagnosing disease. Enroll Info: None
Requisites: MATH 234, 319, (PHYSICS 202 or 208) and (PHYSICS 241 or 248) or graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

B M E 601 — SPECIAL TOPICS IN BIOMEDICAL ENGINEERING
1-3 credits.
Enroll Info: Requisite varies by topic
Requisites: None
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2019

B M E/M E 603 — TOPICS IN BIO-MEDICAL ENGINEERING
1-3 credits.
Various aspects of living systems of interest to the mechanical engineer, such as the mechanics of hearing and vision, cardiac and central nervous systems, artificial organs, blood flow behavior, and energy-transfer processes. Enroll Info: None
Requisites: None
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2019
**Biomedical Engineering (B M E)**

**B M E/M E 615 — TISSUE MECHANICS**

3 credits.

Focus on solid mechanics of prominent musculoskeletal and cardiovascular tissues. Their normal and pathological behaviors (stiffness, strength, relaxation, creep, adaptive remodeling, etc.) in response to physiologic loading will be examined and quantified. Enroll Info: None

**Requisites:** M E 306 or E M A 303 or graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2018

**B M E/MED PHYS/PHMCOL-M/PHYSICS/RADIOI 619 — MICROSCOPY OF LIFE**

3 credits.

Survey of state of the art microscopic, cellular and molecular imaging techniques, beginning with subcellular microscopy and finishing with whole animal imaging. Enroll Info: None

**Requisites:** PHYSICS 104, 202, 208, or 248 or PHYSICS/MED PHYS 265

**Course Designation:** Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2019

**B M E/CHEM/MED PHYS 650 — BIOLOGICAL OPTICAL MICROSCOPY**

3 credits.

This course for graduate students will cover several aspects of state of the art biological and biophysical imaging. We will begin with an overview of geometrical optics and optical and fluorescence microscopy, with an emphasis on instrumentation. The bulk of the course will focus on advanced imaging techniques including nonlinear optical processes (multi-photon excitation, second harmonic generation, and stimulated Raman processes) and emerging super-resolution methods. Special emphasis will be given to current imaging literature and experimental design. Enroll Info: None

**Requisites:** Senior or Graduate standing, and CHEM 104 or 109 or 116 and, PHYSICS 104 or 202 or 208

**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2018

**B M E/I SY E 662 — DESIGN AND HUMAN DISABILITY AND AGING**

3 credits.

Design of products for persons with physical, sensory or cognitive impairments is covered as well as the design of standard mass market products. Interdisciplinary teams explore specific disabilities, then design a standard mass market product in competition with each other. Enroll Info: None

**Requisites:** Junior standing or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2019

**B M E 701 — SEMINAR IN BIOMEDICAL ENGINEERING**

0 credits.

Speakers present current research, reviews of previous research, or topics of interest to biomedical engineering graduate students and faculty. Enroll Info: Grad st in biomedical engineering

**Requisites:** Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** Yes, unlimited number of completions

**Last Taught:** Fall 2019

**B M E 702 — GRADUATE COOPERATIVE EDUCATION PROGRAM**

1-2 credits.

Work experience that combines classroom theory with practical knowledge of operations to provide students with a background on which to develop and enhance a professional career. The work experience is tailored for MS students from within the U.S. as well as eligible international students. Enroll Info: None

**Requisites:** Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** Yes, unlimited number of completions

**Last Taught:** Fall 2019

**B M E/MED PHYS 710 — ADVANCES IN MEDICAL MAGNETIC RESONANCE**

3 credits.

Addresses the theory and applications of magnetic resonance (MR) in medicine, by providing the necessary theoretical background to understand advanced MR techniques including magnetic resonance imaging (MRI). Enroll Info: None

**Requisites:** MED PHYS/B M E 568

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2019

**B M E/MED PHYS 751 — BIOMEDICAL OPTICS AND BIOPHOTONICS**

3 credits.

The study and use of light in the life sciences. Interactions of light with cells and tissue can be used for imaging, measurement, diagnosis, and therapy. Applications include optical imaging, endoscopy, microscopy, resolution enhancement, adaptive optics, Optical Coherence Tomography (OCT), quantitative phase microscopy, spectroscopy (fluorescence, elastic scattering), diffuse optical tomography, and computational modeling of light transport in tissue. Fundamental skills, concepts, and theory used for these applications include geometric optics, lens design, Fourier transforms, polarization, interference, coherence, and scattering theory. Particular emphasis will be placed on current literature and cutting edge instruments and methods. Enroll Info: Students should have prior knowledge of introductory physics or optics and introductory calculus.

**Requisites:** Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2019
B M E/C E 762 — BIOMEDICAL INSTRUMENTATION
3 credits.

Design and application of specialized biomedical instrumentation. Information retrieval techniques. Lab. Enroll Info: ECE 462 or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2011

B M E/MED PHYS/PHYSICS 775 — ADVANCED ULTRASOUND PHYSICS
3 credits.

Foundations of acoustic wave equations, diffraction phenomena and acoustic beam formation, models for acoustic scattering from discrete structures and inhomogeneous continua, speckle statistics including speckle correlation, applications of these topics in medical imaging. Enroll Info: None
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2013

B M E 780 — METHODS IN QUANTITATIVE BIOLOGY
1 credit.

Focuses on understanding the key methods and principles of quantitative biology through a close reading of the primary literature. Topics covered will include deterministic and stochastic methods for modeling cellular systems, techniques in systems and synthetic biology, image processing tools and image analysis for biology, data-driven network models, genomic approaches, single-molecule approaches, and key computational biology tools. This course is intended for graduate students from a variety of backgrounds who are interested in pursuing quantitative biology during their graduate studies. Students who have a background in differential equations and linear algebra and cell biology will find themselves well prepared for this course. Enroll Info: None
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2019

B M E/CBE 782 — MODELING BIOLOGICAL SYSTEMS
3 credits.

Literature survey of mathematical models in biology at the molecular and cellular levels; application of chemical kinetics and thermodynamics to biological systems; comparison of deterministic and stochastic strategies. Enroll Info: MATH 319 or 320 or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2015

B M E/CBE 783 — DESIGN OF BIOLOGICAL MOLECULES
3 credits.

Introduction to the methodologies for engineering the structure and function of biological molecules, especially proteins. Students will develop an understanding for the integration of computation and experiment to address biological molecular engineering problems. Enroll Info: Biocore 303 or BIOCHEM 501 or ZOOLOGY 570; or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

B M E 790 — MASTER'S RESEARCH AND THESIS
1-9 credits.

Under faculty supervision. Enroll Info: None
Requisites: Graduate Students Only
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2019

B M E 799 — ADVANCED INDEPENDENT STUDY
1-5 credits.

Under faculty supervision. Enroll Info: None
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2019

B M E/PHM SCI 801 — SEMINAR ON DEVELOPMENT OF MEDICAL DEVICES AND DRUGS
1 credit.

An overview of three major sectors of medical product and technology development including pharmaceuticals, medical devices and combination products. Regulatory framework, disclosure and patenting, technical design and development strategy, academia-specific development challenges will be among the major lecture topics. Enroll Info: None
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

B M E 890 — PRE-DISSERTATION RESEARCH
1-9 credits.

Enroll Info: Under faculty supervision; for pre-dissertators only
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2019
B M E/B M I/BIOCHEM/CBE/COMP SCI/GENETICS 915 — COMPUTATION AND INFORMATICS IN BIOLOGY AND MEDICINE
1 credit.

Participants and outside speakers will discuss current research in computation and informatics in biology and medicine. This seminar is required of all CIBM program trainees. Enroll Info: None
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2019

B M E 990 — RESEARCH AND THESIS
1-9 credits.

Under faculty supervision. Enroll Info: For students with Dissertator status only
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2019

B M E 999 — ADVANCED INDEPENDENT STUDY
1-9 credits.

Under faculty supervision. Enroll Info: None
Requisites: Declared in Biomedical Engineering PhD or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2019