BIOENGINEERING (BEN)

BEN 500 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

BEN 521 Stem Cell Engineering (3 Credits)
Engineering & Comp Sci
Covers wide-ranging topics related to stem cell and regenerative biology, including: introduction of cell and developmental biology, stem cell biology, tissue engineering, regenerative medicine, and the political and ethical issues surrounding the stem cell debate.
Shared Competencies: Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

BEN 522 Biomedical-Device Infections (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 522
Discussion of the complex issues related to biomedical-device infections. Investigation of the impact of biomaterials, microbiology, detection, and device regulation to reduce biomedical-device infections.
Shared Competencies: Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 541 Principles of Tissue Engineering (3 Credits)
Engineering & Comp Sci
Cellular and biomaterials principles relevant to tissue engineering, focusing on cellular and tissue organization; regulation of cell behavior; biomaterials for tissue regenerations; tissue engineering applications in cardiovascular, neurological, and musculoskeletal and other organ systems.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BEN 561 Polymer Science & Engineering (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 561
Polymer structure, physical properties, and applications of polymers. Polymer synthesis, characterization of molecular structure, and copolymerization and blending. Unique physical properties of polymeric materials. Processing and applications of polymers.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BEN 565 Biomechanics (3 Credits)
Engineering & Comp Sci
Functions and mechanical properties of cells and tissues, how those cells and tissues combine to form structures, the properties and behaviors of those structures, and biomechanical techniques to analyze the structures and individual components.
Prereq: ECS 221 and MAT 485 and BEN 364
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 568 Biomaterials & Medical Devices (3 Credits)
Engineering & Comp Sci
Materials science and biological issues associated with medical devices and biomaterials are discussed. Bulk and surface materials science, tissue engineering, degradation and biocompatibility are addressed and related to medical device design and regulatory issues.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BEN 580 International Course (1-12 Credits)
Engineering & Comp Sci
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

BEN 600 Selected Topics (1-6 Credits)
Engineering & Comp Sci
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

BEN 601 Graduate Bioengineering and Chemical Engineering Seminar (0-1 Credits)
Engineering & Comp Sci
Cross-listed with CEN 601
Selected topics in bioengineering. Presentations by internal and external speakers, discussions with students.
Repeatable

BEN 602 Ethical Issues in Engineering and Research (1-3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 602
Explores the application of professional norms to ethical decision making in engineering and scientific research. Includes examination of cases in light of the requirements of the Responsible Conduct of Research.

BEN 604 Cells, Tissues,and Systems (3 Credits)
Engineering & Comp Sci
Properties of biological systems from genes to behavior, clinical implications emphasized. Nervous and endocrine organization as control systems, cardiorespiratory system and fluid dynamics, renal system and ion transport, pH balance. Classic and contemporary literature.

BEN 612 BioMEMS, Biosensors & Biophotonics (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 412
Building blocks, fabrication techniques, sensing and actuation principles of biomedical microelectromechanical systems (bioMEMS). Case studies on biosensors, biophotonics and microsystem technologies that enhance biomedical research and healthcare. Additional work required of graduate students.
Shared Competencies: Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 613 Readings in Neuroscience (0-3 Credits)
Engineering & Comp Sci
Cross-listed with NEU 613, BIO 624, CSD 753, PSY 778
A literature-based team-taught course focusing on in depth discussions of classical or recent papers of exceptional import to neuroscience. Students will complete weekly readings assigned by faculty and participate in a 3-hr/wk group facilitated discussion

BEN 614 Interdisciplinary Methods of Neuroscience (0-3 Credits)
Engineering & Comp Sci
Cross-listed with NEU 614, BIO 625, CSD 754, PSY 779
A practical interdisciplinary survey course whereby neuroscience faculty introduce students to a wide array of methodologies, including molecular, cellular, developmental, systems, behavioral, and cognitive neuroscientific approaches to investigate basic, pre-clinical, translational, and clinical questions to unravel the relationship between brain and behavior.

BEN 621 Biochemical Engineering (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 621
Double-numbered with BEN 421, CEN 421
Introduction to microbiology, biochemical kinetics. Biochemical-reactor design, including methods for oxygen transfer and control. Introduction to separation processes in biochemical engineering. Additional work for graduate students.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BEN 622 Immunoengineering (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 422
Strategies and technologies to modulate and deconvolute the immune process for therapeutic purposes. Fundamentals of immunology, tools and methods, engineering strategies for vaccination, immunotherapy, and immunomodulation. Additional work required of graduate students.
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 630 Sports Engineering (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 430
Study of engineering principles involved in sports: body systems in human motion, analysis of gait, basic performance patterns in athletic movements, performance improvements, and design of sports equipment. Additional work required of graduate students.

BEN 631 Introduction to Global Regulatory Affairs (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 431
An introduction to Global Regulatory Affairs. Providing a foundational understanding of how regulatory and health authorities regulate products to bring safe and effective solutions to patients and consumers. Additional work required of graduate students.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/)

BEN 633 Drug Delivery (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 633
Double-numbered with BEN 433, CEN 433
Integration of biology, chemistry, and engineering to understand how pharmaceuticals are delivered to, and behave within, the body. Includes drug formulation, pharmacokinetics, pharmacodynamics, controlled release, and targeted delivery. Additional work is required of graduate students.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BEN 634 Polymer Physics (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 634
Exploration into the physical properties of polymers focusing on polymer theoretical physics, characterization of their physical properties, and the importance of their structure-property relationships in various applications.

BEN 635 Physical Cell Biology (3 Credits)
Engineering & Comp Sci
Cross-listed with PHY 635, CHE 635, BIO 635, CEN 635
This interdisciplinary class for science and engineering students provides an introduction to the quantitative description of biological systems and processes. The focus is on the biological and physical aspects of structure and function of cells and their subsystems.

BEN 638 Open Problems in Soft Interfaces (3 Credits)
Engineering & Comp Sci
Cross-listed with BIO 638, PHY 638, CHE 638, CEN 638
In this seminar course on soft and biological materials and interfaces, teams from science and engineering will identify, discuss and assess current articles from the literature. Writing skills related to publishing peer-reviewed research are introduced.

BEN 641 Mobile Health (mHealth) Device Design and Application (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 441
This course will introduce students to the rapidly growing field of Mobile Health (mHealth), including concepts of mHealth design, hardware, software, wireless integration, and mobile apps, with application of those concepts to problems faced by different patient and user populations. Additional work required of graduate students.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Information Literacy and Technological Agility (https://coursecatalog.syracuse.edu/shared-competencies/information-literacy-and-technological-agility/)

BEN 648 Biofluid Dynamics (3 Credits)
Engineering & Comp Sci
Cross-listed with MAE 648
Principles of momentum transfer in bioengineering systems. Flight and swimming in nature including flagellar propulsion. Newtonian and non-Newtonian fluid phenomena, including low-Reynolds-number flow, pulsatile and separated flows. Flow past bifurcations. Respiratory and blood circulatory flows.

BEN 650 Environmental Risk Assessment & Toxicology (3 Credits)
Engineering & Comp Sci
Cross-listed with CEE 650, CEN 650
Double-numbered with BEN 450, CEN 450, CEE 450
Students will analyze the human health impact of exposure to toxic chemicals in air, water, and soil according to USEPA Risk Assessment Guidance for Superfund. Additional work required of graduate students.
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 658 Biomedical Imaging (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 458
Basics of imaging techniques useful for biological and medical applications. Microscopy, electron microscopy, acoustic microscopy, atomic force microscopy, magnetic resonance imaging. Discussion of images and literature. MRI laboratory exercises.
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 659 Signal Processing & Analysis of Bioelectric Signals (3 Credits)
Engineering & Comp Sci
Origins and properties of bioelectric signals and noise. Digital signal processing. Theory of signal detection: applications to psychophysics. Noise reduction techniques: time averaging, spectral analysis and filtering, optimal filterings. Analysis of neural spike trains: point processes.
Advisory recommendation Prereq: ELE 251, 232, 351

BEN 662 Biofuels, Bioproducts, and Biorefining (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 662
Double-numbered with CEN 462, BEN 462
Survey of modern technologies available for the production of transportation fuels from abundant natural resources. Additional work required of graduate students.

BEN 664 Quantitative Physiology (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 364
Introduction to mammalian physiology from an engineering perspective. Each of the major systems of the body will be addressed, with an emphasis on electrical, mechanical, and thermodynamic principles Lecture and laboratory. Additional work required of graduate students.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 666 Advanced Biomechanics (3-4 Credits)
Engineering & Comp Sci
Double-numbered with BEN 466
Introduction to kinesiology and kinematics; finite element method; joint force analysis and the properties of bone cartilage and tendon as related to functional analysis of bone-joint systems.
Advisory recommendation Prereq: BEN 665

BEN 670 Experience Credit (1-6 Credits)
Engineering & Comp Sci
Participation in a discipline or subject related experience. Student must be evaluated by written or oral reports or an examination. Permission in advance with the consent of the department chairperson, instructor, and dean. Limited to those in good academic standing.
Repeatable

BEN 673 Biomanufacturing (3 Credits)
Engineering & Comp Sci
Cross-listed with CEN 673
Double-numbered with BEN 473, CEN 473
Students learn the governing principles of conventional and advanced manufacturing techniques, which are adapted/modified to engineer living tissues/organs, biomedical products and test-platforms for investigating fundamental cell biology. Additional work required for grad students.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BEN 674 Medical Image Processing & Analysis (3 Credits)
Engineering & Comp Sci
Double-numbered with BEN 474
Introductory medical image processing and analysis. An open source software that has been developed for this purpose will be used. Additional work required of graduate students.

BEN 687 Advanced Bioengineering Design (3 Credits)
Engineering & Comp Sci
Bioengineering solution development experience. Team development of a bioengineering innovation. Brainstorm, design, iterate and test hypotheses. Lecture and experiential learning. Hands on concept development and evaluation, bioengineering industry exposure, visual management, oral, and poster presentations.

BEN 690 Independent Study (1-6 Credits)
Engineering & Comp Sci
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

BEN 706 Nonlinear Dynamics and Electrophysiology of the Heart (3 Credits)
Engineering & Comp Sci
The electrical activity of the heart, nonlinear dynamics theory and computer modeling of mechanisms of complex cardiac rhythms. Specific topics include electrical excitation and propagation in the heart, cell-to-cell communication, and cardiac arrhythmias.

BEN 741 Biopolymers (3 Credits)
Engineering & Comp Sci
Polymer structure, physical properties, and clinical applications of natural and synthetic biomedical polymers. Polymer synthesis, structural and molecular characterization, material properties, polymer processing, biocompatibility, and polymer degradation will be discussed.
Advisory recommendation Prereq: BEN 668

BEN 765 Orofacial Biomechanics (3 Credits)
Engineering & Comp Sci
Methods (instrumentation, data collection and reduction, modeling) for the analysis of structure and function of the orofacial complex and its constituent elements (jaws, teeth, muscles, tongue, pharynx) and their CNS control in feeding and speech.
Advisory recommendation Prereq: BEN 465 or 665

BEN 768 Surfaces of Biomaterials (3 Credits)
Engineering & Comp Sci
Metallic, ceramic, and polymeric surfaces used in biomaterials. Surface forces, structure, chemistry, electrochemical behavior of surfaces, and corrosion reactions related to material-body interactions will be discussed and surface-analytical techniques present.

BEN 991 Introduction to MS Research (3 Credits)
Engineering & Comp Sci
Preliminary research and investigation on a topic of interest under supervision of a member of the faculty.

BEN 996 Masters Project (0 Credits)
Engineering & Comp Sci
Investigation of a bioengineering problem. An oral defense is required in accordance with current departmental guidelines. Required of all students electing the non-thesis option for a master¿s degree.

BEN 997 Masters Thesis (3 Credits)
Engineering & Comp Sci
Independent investigation on a topic of interest under supervision of a member of the faculty.
Advisory recommendation Prereq: BEN 991

BEN 999 Dissertation (1-15 Credits)
Engineering & Comp Sci
Research work on a doctoral dissertation under the supervision of a member of the faculty.
Repeatable 15 times for 30 credits maximum