NEUROSCIENCES, SYSTEMS BIOLOGY, AND BIOENGINEERING (NSBB)

Courses

NSBB 500. Foundations in Neuroscience. 4 Units.
Overview of neuroscience with attention to current research and problems in the field. Includes basic neuroanatomy and neurophysiology of the human central and peripheral nervous systems. Prerequisite: Undergraduate-level biology, inorganic chemistry, organic chemistry, and general physics; previous experience with computer programming preferred but not required; a course in statistics preferred but not required.

NSBB 504. Neuroscience Methods. 4 Units.
Provides an in-depth overview of historical and current methods used to perform experiments focused on learning about neural circuits in the body, spinal cord, and brain. Emphasizes understanding of neuron labeling using dyes that can be seen in bright-field and fluorescent microscopy, recording methods for quantifying neuron activity, psychophysical experiments to assess neural function, behavioral assays, optogenetics, and the use of molecular markers. Prerequisite: NSBB 500.

NSBB 506. Fundamentals of Electrophysiology. 4 Units.
Presents fundamental theory and applications of electrophysiological methods in the context of neuroscience and biomedical research. Focuses on electrophysiological concepts and electrophysiological experiments in excitable tissues. Prerequisite: Undergraduate-level biology, inorganic chemistry, and general physics.Calculus preferred, but not required.

NSBB 507. History of Neuroscience. 3 Units.
Provides graduate and medical students with a detailed overview of the history of neuroscience from the classical Greek period through contemporary neuroscience research and clinical neurology/neurosurgery. Emphasizes experiments designed to provide current models of how the brain works. Emphasizes historical changes in treatment and clinical practice that inform current understanding of the nervous system. Prerequisite: Undergraduate-level biology and general chemistry; NSBB 500 recommended.

NSBB 510. Cortical Circuits. 3 Units.
Focuses on the development, function, and dysfunction of the cortex of the brain. Emphasizes understanding of neuronal proliferation, differentiation into circuits, and the resulting interaction of cortical circuits that generate motion and integrate touch, vision, and vestibular inputs to generate conscious perception, the network basis of learning and memory, and cortical oscillations (including cortical rhythmic networks). Prerequisite: NSBB 500.

NSBB 515. Contemporary Neuroimaging. 3 Units.
Provides an in-depth overview of historical and current imaging methods used to perform experiments focused on learning about the structure and function of neurons and the peripheral and central circuits they develop. Emphasizes understanding of neuron labeling using microscopy imaging techniques. Prerequisite: NSBB 500.

NSBB 520. Neuroinflammation: Neuron-Glia Interactions. 3 Units.
Provides graduate students with a current understanding of neuronal-glial interactions in the context of neuroinflammation and its relevance to neurological disorders. Develops competency in the fundamental concepts of cross-communication between disciplinary fields, and how they are applied to diseases of significant social, medical, and economic burden. Prerequisite: NSBB 500; Immunology (recommended).

NSBB 526. Journal Club. 1 Unit.
Provides students with the opportunity to survey current research literature in a specialized topic.

NSBB 544. Special Topics in Neuroscience, Systems Biology, and Bioengineering. 1-4 Units.
Addresses topics in neuroscience systems, biology, and bioengineering (NSBB). Specific content varies from quarter to quarter. May be repeated for additional credit.

NSBB 551. Introduction to Bioinformatics. 2 Units.
Provides a general overview of systems biology approaches that enhance understanding of molecular mechanisms underlying the different phenotypes of living cells. Emphasize the most recent developments and future directions in this new and rapidly developing field, particularly focusing on genomics, epigenomics, and transcriptomics.

NSBB 552. Data Analytics. 3 Units.
Presents contemporary data analysis and visualization methods necessary for biomedical research and presentation. Uses Python and applies scientific libraries that extend the basic Python language to incorporate image, time series, spectral, and machine- learning analyses. Addresses data cleaning, visualization, management, and security. Prerequisite: NSBB 551; previous experience with computer programming and data analysis software (recommended).

NSBB 553. Advanced Bioinformatics — Sequence and Genome Analysis. 4 Units.
Explores ways in which computational techniques can be applied to help solve problems related to biology and biochemistry. Focuses on sequence and genome analysis with genomics and bioinformatics tools. Prerequisite: NSBB 551.

NSBB 555. Genomics and Bioinformatics: Tools. 4 Units.
Teaches students to create extremely useful programs using PERL to solve biological problems. Basics of Linux and scripting with PERL. Prerequisite: NSBB 551.

NSBB 557. Integration of Computational and Experimental Biology. 4 Units.
A multidisciplinary introduction to computational methods used to analyze experimental biological data. Introduces mathematical concepts needed to understand protein structure and dynamics, protein-protein interactions (structures and networks), gene regulatory networks, signal transduction networks, metabolic networks, and kinetic modeling of cellular processes. Also covers techniques used to derive experimental data. Prerequisite: MICR 515; NSBB 552; and programming experience.

NSBB 571. Engineering Analysis of Physiological Systems. 3 Units.
Provides basic engineering analytical tools for quantifying physiological systems behavior. Addresses several key systems, using engineering methodology to evaluate the system of interest for solving particular problems. Prerequisite: A first course in ordinary differential equations is essential; working knowledge of computer manipulation and programming (recommended).

NSBB 572. Cellular and Molecular Engineering. 3 Units.
Emphasizes engineering and biochemical/biophysical concepts intrinsic to specific topics at the cellular and molecular level. Includes receptor-ligand dynamics in cell signaling and function; DNA replication and RNA processing; cellular energetics and control of gene expression; membrane structure; transport and traffic; biological process; and mechanics of cell division and protein and cellular engineering approaches. Prerequisite: NSBB 570.

NSBB 575. Orthopaedic Regenerative Engineering and Mechanobiology. 4 Units.
Introduces advanced biomechanics and mechanobiology of skeletal tissues—including bone and cartilage— through an understanding of structure-function relationship in biological tissues. Focuses on bone and cartilage regenerative engineering approaches based on scaffolds, stem cells, and mechanotransduction. Prerequisite: PTGR 591, PTGR 592 (recommended); NSBB 579 (recommended); general biology.

NSBB 579. Bioengineering Fabrication. 3 Units.
Provides a foundational skill set for using 3D software; for computer numerical control (CNC) machining, 2D laser cutting, additive 3D printing, and data collection with Raspberry Pi and Arduino devices; and for understanding intellectual property. Students use campus resources and local maker-spaces to complete a project focused on a bioengineering application.

NSBB 580. Medical Imaging Physics. 3 Units.
Includes medical imaging science and the radiological modalities, basic radiation physics and the interaction of radiation with matter, the physics of X-ray production, computed tomography, magnetic resonance imaging, ultrasound and nuclear medicine, quality control, and safety; as well as clinical applications in each modality. Prerequisite: Undergraduate level physics course and biology course.

NSBB 584. Medical Image Analysis. 2 Units.
Introduces theory, processing, analysis, and high-level applications of commonly used digital image techniques. Presents common computer programs and tools for image analysis. Prerequisite: Undergraduate-level class in calculus and one of the following; introduction to programming, numerical analysis, computational statistics, or related topics; previous experience with computer programming highly recommended; course in statistics helpful but not required.

NSBB 585. Radiation Detectors for Medical Applications. 4 Units.
Provides students with a broad overview of radiation detectors for medical applications in general, with emphasis on scintillation detectors and their applications in positron emission tomography. Prerequisite: Undergraduate B.S. degree or equivalent in one of the following areas: physics or biophysics, chemistry or biochemistry, engineering or bioengineering.

NSBB 587. Radiation Therapy Physics. 4 Units.
Provides graduate and medical students with a broad understanding of the processing and analysis of basic physics in regards to applications within the context of radiation therapy. Designed to provide students with a basic understanding of basic physical sciences, with the necessary specialist knowledge required to develop a career in radiation therapy. Prerequisite: Undergraduate B.S. degree in the field of physics, chemistry, computer science, or engineering.

NSBB 588. Radiation Biology. 4 Units.
Provides a broad understanding of the effects of ionizing radiation at the molecular, cellular, tissue, and system levels.

NSBB 697. Research. 1-8 Units.
The final and central requirement for research-related degrees within the neurosciences, systems biology, or bioengineering programs. Successful completion of this original, independent research project demonstrated through production of a written summary of the research project and approval by the student's mentor and/or research committee. NSBB 697 research units applicable to both the master's and Ph.D. degrees. Prerequisite: Successful completion of coursework leading to research.

NSBB 699. Dissertation. 1-8 Units.
Serves as final and central requirement for research-related doctoral degrees within the neurosciences, systems biology, or bioengineering programs. Successful completion of this original, independent research project is demonstrated through production of a written summary of the research project, and approval by the student's mentor and/or research committee. Prerequisite: Successful completion of coursework leading to research.