

# NEU - Neuroscience

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## Neuroscience: NEU

### Lower-Division Courses

#### NEU 119S, 219S, 319S, 419S, 519S, 619S, 719S, 819S, 919S. Topics in Neuroscience.

This course is used to record credit the student earns while enrolled at another institution in a program administered by the University's Study Abroad Office. Credit is recorded as assigned by the study abroad adviser in the Department of Neuroscience. University credit is awarded for work in an exchange program; it may be counted as coursework taken in residence. Transfer credit is awarded for work in an affiliated studies program. May be repeated for credit when the topics vary.

### Upper-Division Courses

#### NEU 320. Introduction to Neuroscience.

Introduction to the nervous system with an emphasis on brain organization, neuron physiology, perceptual systems, and motor systems. Designed for non-neuroscience majors. Three lecture hours a week for one semester.

#### NEU 129S, 229S, 329S, 429S, 529S, 629S, 729S, 829S, 929S. Topics in Neuroscience.

This course is used to record credit the student earns while enrolled at another institution in a program administered by the University's Study Abroad Office. Credit is recorded as assigned by the study abroad adviser in the Department of Neuroscience. University credit is awarded for work in an exchange program; it may be counted as coursework taken in residence. Transfer credit is awarded for work in an affiliated studies program. May be repeated for credit when the topics vary.

#### NEU 330. Neural Systems I.

Restricted to neuroscience majors. Introduction to the nervous system with an emphasis on brain organization, neuron physiology, perceptual systems, and motor systems. Three lecture hours a week for one semester. Only one of the following may be counted: Biology 337 (Topic: Neural Systems I), 371M, Neuroscience 330, 365R, 371M.

#### NEU 335. Neural Systems II.

Introduction to the nervous system with an emphasis on neural development and on the neural mechanisms of memory, emotions, and other higher cognitive functions. Intended for neuroscience majors and those considering neuroscience as a major. Three lecture hours a week for one semester. Biology 337 (Topic: Neural Systems II) and Neuroscience 335 may not both be counted. Prerequisite: A grade of at least C- in the following: Biology 206L, and 311D or 325H, Mathematics 408C, 408L or 408S, and Neuroscience 330.

#### NEU 137, 237, 337, 437. Selected Topics in Neuroscience.

Topics include recent developments and research methods in the field of neuroscience. For each semester hour of credit earned, one lecture hour a week for one semester. Some topics may require additional hours. May be repeated for credit when the topics vary. Prerequisite: Neuroscience 335 with a grade of at least C-.

**Topic 3: Neuroscience for Plan II.** Restricted to Plan II students. Neuroscience 337 (Topic: Topics in Neuroscience: Plan II) and 137, 237, 337, 437 (Topic 3) may not both be counted.

**Topic 6: Rigor in Neuroscience.** Explore the application and integration of many different approaches, from molecules to behavior. Includes statistics, experimental design, and philosophy of science with a mixture of discussion and hands-on training. Neuroscience 337

(Topic: Rigor in Neuroscience) and 137, 237, 337, 437 (Topic 6) may not both be counted.

#### NEU 340. Neural Systems III: Quantitative Tools.

Introduction to quantitative approaches central to the study of the brain, with an emphasis on mathematical and statistical methods required for the rigorous design and interpretation of neuroscience experiments and data. Intended for neuroscience majors and those considering neuroscience as a major. Three lecture hours a week for one semester. Prerequisite: Credit or registration for Neuroscience 330 with a grade of at least C-.

#### NEU 361T. Comparative Animal Physiology.

Examine the physiology of organ systems in animal phyla, with special emphasis on the neural and behavioral adaptations of organisms to their environment. Three lecture hours and one discussion hour a week for one semester. Only one of the following may be counted: Biology 361T, Integrative Biology 361T, Neuroscience 361T, 337 (Topic: Comparative Animal Physiology). Prerequisite: Biology 325 or 325H with a grade of at least C-.

#### NEU 365D. Principles of Drug Action.

Introduction to the basic principles of pharmacology; including how drugs get into the body, exert their actions, and are metabolized and excreted. Three lecture hours a week for one semester. Prerequisite: Neuroscience 335 with a grade of at least C-.

#### NEU 365E. Epigenetics of Neuroscience.

Explore how epigenetic modifications cause long-lasting changes in gene expression. Three lecture hours a week for one semester. Neuroscience 337 (Topic: Epigenetics of Neuroscience) and 365E may not both be counted. Prerequisite: Neuroscience 335 with a grade of at least C-.

#### NEU 365L. Neurobiology Laboratory.

An introduction to physiological, morphological, and molecular techniques used for analysis of the nervous system. Experiments and computer simulations illustrate basics of information processing by the nervous system. Four laboratory hours and one discussion hour a week for one semester. Prerequisite: A grade of at least C- in Neuroscience 335 and Physics 303L, 316, or 317L.

#### NEU 365M. Advanced Experimental Neurobiology.

Examine neocortical cell and circuit function through presentation and critique of research goals and strategies. Three lecture hours a week for one semester. Neuroscience 337 (Topic 7) and 365M may not both be counted. Prerequisite: Neuroscience 335 with a grade of at least C-.

#### NEU 365N. Nerve Regeneration in Invertebrates and Vertebrates.

Explore use of nerve regeneration and degeneration in invertebrate vs vertebrate systems to synthesize concepts in neuroscience. Three lecture hours a week for one semester. Neuroscience 337 (Topic 2) and 365N may not both be counted. Prerequisite: Neuroscience 335 with a grade of at least C-.

#### NEU 365P. Programming and Data Analysis for Modern Neuroscience.

Explore the basics of programming, statistics, and machine learning, and apply these techniques to the analysis of data from neuroscience experiments. Three lecture hours a week for one semester. Neuroscience 337 (Topic 4) and 365P may not both be counted. Prerequisite: Neuroscience 335 with a grade of at least C-.

**NEU 365T. Neurobiology of Disease.**

The neurobiological basis of disorders of the brain, with the main focus on mental illness. Emphasizes the neural circuitries and neurochemical events that underlie specific mental processes and behaviors. Three lecture hours a week for one semester. Prerequisite: Neuroscience 335 with a grade of at least C-

**NEU 365W. Neurobiology of Addiction.**

Study of the neurobiology of neurotransmitters, and the influence of alcohol and drugs of abuse on neurotransmitters. Three lecture hours a week for one semester. Prerequisite: Neuroscience 335 with a grade of at least C-.

**NEU 366C. Ion Channels and the Molecular Physiology of Neuronal Signaling.**

Explores the role of molecular conformational changes in higher-level neuronal function and sensory transduction, including the generation and regulation of diverse types of neuronal signaling characteristics. Emphasizes a quantitative approach and the use of models to study function. Three lecture hours a week for one semester. Prerequisite: A grade of at least C- in Neuroscience 335 and Physics 303L, 316, or 317L.

**NEU 366D. Synaptic Physiology and Plasticity.**

Detailed study of the physiology of synaptic transmission in the mammalian central nervous system. Covers dendritic integration and various forms and mechanisms of synaptic plasticity. Three lecture hours a week for one semester. Prerequisite: A grade of at least C- in Neuroscience 335 and Physics 303L, 316, or 317L.

**NEU 466G. Functional and Synaptic Neuroanatomy.**

Neuroanatomy and function of synapses as a basis for brain function and behavior. Examine the ultrastructure and function of synapses, dendrites and axons underlying basic synaptic transmission and plasticity. Laboratory projects involve three-dimensional reconstructions from serial section electron microscopy. Three lecture hours and one-and-one-half laboratory hours a week for one semester. Only one of the following may be counted: Biology 337 (Topic: Neurobiology of Synaptic Circuits), 337 (Topic: Human Neuroanatomy), Neuroscience 466G. Prerequisite: Neuroscience 335 with a grade of at least C-.

**NEU 366L. Neuroimaging Laboratory.**

Basic principles of image formation and techniques of fluorescent imaging and confocal laser-scanning microscopy. Includes image processing and analysis to extract quantitative information from digital images. Survey of imaging techniques, including electron microscopy and MRI. One lecture hour and four laboratory hours a week for one semester. Prerequisite: A grade of at least C- in Neuroscience 335.

**NEU 366R. Rhythms in the Nervous System.**

Explore the study of systems of oscillators in the nervous system including mechanisms of generation and theories about functions. Three lecture hours a week for one semester. Neuroscience 337 (Topic: Rhythms in the Nervous System) and 366R may not both be counted. Prerequisite: Neuroscience 335 with a grade of at least C-.

**NEU 366S. Neuromolecular Genetics and Disease Laboratory.**

Explores techniques used to study the molecular genetic basis for nervous system function and disease with a powerful invertebrate model system. Subjects will range from studying the conserved molecular basis for our senses and male/female-specific behaviors, to exploring how mutations of conserved neural genes cause neurological disorders, such as Parkinson's disease and Alzheimer's disease. Six laboratory hours a

week for one semester Prerequisite: Neuroscience 335 with a grade of at least C-.

**NEU 466T. Modeling and Theory in Neuroscience.**

Examine the basic mathematical and computational tools central to the analysis of neural systems in a laboratory setting. Discuss linear algebra, differential equations, filtering, correlation, probability with an emphasis on quantitative methodology and applications to neuroscience. Three lecture hours and one and one-half laboratory hours a week for one semester. Neuroscience 466T and 466M may not both be counted. Prerequisite: Mathematics 408D or 408M, and Neuroscience 340 with a grade of at least C- in each.

**NEU 366W. Neural Computation.**

Examine why quantitative methods are so important in neuroscience. Learn how to apply basic mathematical concepts to neuroscience, with the goal of seeing the applications of these concepts more broadly and appreciating the interactions between neuroscience and other quantitative fields. Three lecture hours a week for one semester. Neuroscience 366W and 337 (Topic: Neural Computation) may not both be counted. Prerequisite: Neuroscience 340 with a grade of at least C-.

**NEU 367C. Cellular and Molecular Bases of Neural Development.**

Same as Molecular Biosciences 367C. Introduction to the principles by which the neural tube (brain and spinal cord) forms during embryonic development. Discuss the cellular and molecular mechanisms underlying the formation of a three-dimensional neural tube and its division into forebrain, midbrain, hindbrain, and spinal cord. Three lecture hours a week for one semester. Only one of the following may be counted: Biology 367C, Neuroscience 367C, Molecular Biosciences 367C. Prerequisite: One of the following with a grade of at least C-: Biology 325, Neuroscience 330.

**NEU 367F. Foundations of Human Neuroimaging.**

Survey of methods for neuroimaging research. Describes the physics of MRI image acquisition, the physiology of neural responses, and the design and analysis of MRI studies. Three lecture hours a week for one semester. Prerequisite: Neuroscience 335 with a grade of at least C-.

**NEU 367S. Analytical Skepticism.**

Examine basic principles that allow accurate interpretation and depiction of scientific data, with an emphasis on notions of behavioral economics, probability and statistics, and experimental design. Three lecture hours a week for one semester. Neuroscience 337 (Topic 5) and 367S may not both be counted. Prerequisite: Neuroscience 340 with a grade of at least C-

**NEU 367V. Evolutionary Neurobiology.**

Examination of the nervous system in an evolutionary context. Three lecture hours a week for one semester. Prerequisite: Biology 325 or 325H and Neuroscience 335 with a grade of at least C-.

**NEU 170C, 270C. Topics in Neuroscience.**

Supervised study of selected topics in Neuroscience, by individual arrangement with the instructor. For each semester hour of credit earned, the equivalent of one lecture hour a week for one semester. May be repeated for credit when the topics vary. Prerequisite: Neuroscience 335 with a grade of at least C-.

**NEU 177, 277, 377, 477. Undergraduate Research.**

Laboratory or research in the various fields of neuroscience under the supervision of one or more faculty members. Supervised individual research. Up to three semester hours may be counted toward the

major requirement for the Bachelor of Science in Neuroscience. May be repeated for credit.

### **NEU 179H, 279H, 379H, 679H. Honors Tutorial Course.**

Restricted to students in the honors program in neuroscience. Original laboratory research project under the direction of a faculty mentor leading to a thesis or research presentation. For each semester hour of credit earned, one lecture hour a week for one semester. May be repeated for credit, but no more than six hours may be counted toward a degree in neuroscience. Prerequisite: Consent of student's research supervisor and the departmental honors adviser.

## **Graduate Courses**

### **NEU 380C. Computational Neuroscience.**

Introduction to computational neuroscience. Examines neural network and learning theory, coding, dynamics, memory, computation and learning in recurrent and feed forward neural circuits. Three lecture hours a week for one semester. Only one of the following may be counted: Electrical Engineering 385V (Topic: Computational Neuroscience), Neuroscience 380C, 385L (Topic: Computational Neuroscience). Prerequisite: Graduate standing, some differential equations and linear algebra, and consent of instructor.

### **NEU 380E. Vision Systems.**

Introduction to the anatomy, physiology, and psychophysics of human vision from an information-processing and computational perspective. Three lecture hours a week for one semester. Only one of the following may be counted: Neuroscience 380E, 382V, Psychology 380E, 382V. Prerequisite: Graduate standing and consent of instructor.

### **NEU 080M. Dual MD/PhD Program with UT Medical Branch.**

Preclinical medical study at the University of Texas Medical Branch at Galveston. May not be taken concurrently with another course at the University of Texas at Austin. Prerequisite: Graduate standing and admission to the MD/PhD dual degree program in neuroscience.

### **NEU 381G. Grant Writing in the Behavioral and Biological Sciences.**

Same as Psychology 381G. Introduction to grant writing in the behavioral and biological sciences and development of grant writing skills. Subjects include: finding grant opportunities, planning proposal activities, successful grant writing strategies, and how to talk to grant program officers. Write grant proposals (e.g., proposals to federal agencies such as NSF or NIH) and revise proposals based on peer and instructor feedback. Explore how grant proposals are reviewed by participating in a mock review session. Three lecture hours a week for one semester. Only one of the following may be counted: Neuroscience 381G, 394P (Topic: Grant Writing in the Behavioral and Biological Sciences), Psychology 381G, 394U (Topic: Grant Writing in the Behavioral and Biological Sciences). Prerequisite: Graduate standing and consent of instructor.

### **NEU 381N. Basic Processes of Nerve Cells.**

Same as Biology 381N. Degeneration and regeneration in nervous systems following traumatic injury; invertebrate versus vertebrate, peripheral nervous system versus central nervous system, axonal versus cell body, role of glia versus neurons. Three lecture hours a week for one semester. Only one of the following may be counted: Biology 381K (Topic 10), 381N, Neuroscience 381N, 385L (Topic 1). Prerequisite: Graduate standing.

### **NEU 381V. Mechanisms of Vision.**

Physiology of the eye, the retina, and the visual pathways. Prospects for nutritional prevention of blinding eye diseases. Functional and ecological adaptations of primate and nonprimate vision. Three lecture hours a week for one semester. Only one of the following may be

counted: Neuroscience 380G, 381V, 385L (Topic: Visual Neuroscience) Prerequisite: Graduate standing and consent of instructor.

### **NEU 382E. Epigenetics.**

Study of how epigenetic modifications are covalent modifications of DNA or histones that cause changes in gene expression and how epigenetic modifications appear to be a method through which nurture or the environment can influence nature. Emphasis on how experience or environmental factors epigenetically modify health or behavior of animals. Three lecture hours a week for one semester. Only one of the following may be counted: Biology 381K (Topic: Epigenetics), 382E, Molecular Biology 382E, Neuroscience 382E. Offered on the letter-grade basis only. Prerequisite: Graduate standing and consent of instructor.

### **NEU 182T, 282T, 382T, 482T. Principles of Neuroscience I.**

Examines the core material on essential topics in molecular and cellular neuroscience, together with review and discussion of important early studies and contemporary literature. For each semester hour of credit earned, the equivalent of one lecture hour a week for one semester. Prerequisite: Graduate standing and consent of instructor.

### **NEU 382V. Neural and Computational Basis of Vision.**

Same as Psychology 382V. Introduction to the physiology, psychophysics and computational aspects of the visual system. Review linear systems analysis, information theory, Bayesian statistical decision theory, and other relevant mathematical areas. Three lecture hours a week for one semester. Only one of the following may be counted: Neuroscience 380E, 382V, Psychology 380E, 382V. Prerequisite: Graduate standing and consent of instructor.

### **NEU 383C. Functional Neuroanatomy.**

An examination of the anatomy of the brain and spinal cord, emphasizing connections and functions of neural systems. Three lecture hours a week for one semester. Neuroscience 383C and Psychology 383C may not both be counted. Prerequisite: Graduate standing and consent of instructor.

### **NEU 383D. Neuropharmacology.**

An advanced survey of neurotransmitters and systems in the brain. Emphasis is on pharmacological analysis at the molecular level to determine mechanisms of action of drugs that act on the brain. Three lecture hours a week for one semester. Neuroscience 383D and Pharmacy Graduate Studies 383D may not both be counted. Prerequisite: Graduate standing and consent of instructor.

### **NEU 383E. Neuropharmacology II.**

Same as Pharmacy Graduate Studies 383E. Explore neuropharmacological concepts related to brain development, organization and anatomy; neuroendocrinology, neuroimmunology and neuroinflammation; gut-brain axis; neurobiology of addiction; and others. Three lecture hours a week for one semester. Only one of the following may be counted: Neuroscience 383E, 385L (Topic: Neuropharmacology II), Pharmacy Graduate Studies 383E. Prerequisite: Graduate standing and consent of instructor.

### **NEU 383M. Data Analysis and Statistics for the Neurosciences.**

Statistical applications relevant to areas of research in neuroscience. Three lecture hours a week for one semester. Prerequisite: Graduate standing, an undergraduate statistics course, and consent of instructor.

### **NEU 183T, 283T, 383T, 483T. Principles of Neuroscience II.**

Examines the core material on essential subjects in systems and behavioral neuroscience, together with review and discussion of important early studies and contemporary literature. For every hour of



credit earned, the equivalent of one lecture hour a week for one semester. Neuroscience 383T and Psychology 383T may not both be counted. Prerequisite: Graduate standing and consent of instructor.

### **NEU 384C. Bootstrap Statistics.**

Same as Psychology 384C. An introduction to modern methods of statistical analysis based on numerical computer simulation. Covers a range of common data analysis situations drawn mainly from the fields of neuroscience and experimental psychology. Techniques include point estimation, two-group and multiple group experiments, regression and curve fitting, and Bayesian analysis. Three lecture hours a week for one semester. Only one of the following may be counted: Neuroscience 384C, 385L (Topic: Bootstrap Statistics), Psychology 384C, 394U (Topic: Bootstrap Statistics). Prerequisite: Graduate standing, an undergraduate statistics course, and consent of instructor.

### **NEU 384M. Advanced Statistics: Inferential.**

Same as Psychology 384M. Covers t-test, chi-square, analysis of variance, and nonparametric tests. Three lecture hours a week for one semester. Prerequisite: Graduate standing, an undergraduate statistics course, and consent of instructor.

### **NEU 185D. Responsible Conduct of Science.**

Ethical considerations in the conduct of science, including issues of animal welfare, data analysis, fraud, publications, misconduct, intellectual property, grants, peer review, and mentor responsibility. One lecture hour a week for one semester. Neuroscience 185D and Pharmacy Graduate Studies 185D may not both be counted. Offered on the credit/no credit basis only. Prerequisite: Graduate standing and consent of instructor.

### **NEU 185L, 285L, 285L, 385L, 485L. Topics in Neuroscience.**

For each semester hour of credit earned, the equivalent of one lecture hour a week for one semester. Additional laboratory hours may vary with the topic. May be repeated for credit when the topics vary. Prerequisite: Graduate standing; twelve semester hours of upper-division coursework in biology; and consent of instructor.

**Topic 3: Addiction Biology.** Current research in addiction biology. Students present individual research papers and reports. Three lecture hours a week for one semester. Biology 381K (Topic 8) and Neuroscience 385L (Topic 3) may not both be counted.

**Topic 5: Behavioral Neuroendocrinology.** Current research in neuroendocrinology, including action of neuroendocrine systems on behavior, assays of substances in the blood to identify gene products, and examination of stress from neuroendocrine, behavioral, health, and immunity perspectives. Three lecture hours a week for one semester. Only one of the following may be counted: Neuroscience 385L (Topic 5), 394P (Topic: Behavioral Neuroendocrinology), Psychology 394P (Topic 17), 394P (Topic: Behavioral Neuroendocrinology).

**Topic 6: Foundations of Human Neuroimaging.** A survey of the foundations for neuroimaging research with a focus on cognitive neuroscience. Describes the physical methods of image acquisition and physiological mechanisms used for functional imaging. Emphasis on magnetic resonance methods for structural and functional imaging. Surveys other imaging modalities, including positron emission tomography (PET), optical, and EEG/MEG electrical source localization. Only one of the following may be counted: Biology 381K (Topic: Foundations of Neuroimaging), Neuroscience 385L (Topic 6), 394P (Topic: Foundations of Magnetic Resonance Imaging Research), Psychology 394P (Topic: Foundations of Magnetic Resonance Imaging Research), 394P (Topic 13).

**Topic 7: Topics in Vision and Hearing.** Current research in human vision and hearing. Three lecture hours a week for one semester.

Neuroscience 385L (Topic 7) and Psychology 394U (Topic 8) may not both be counted.

**Topic 8: Ion Channels and Neuronal Signaling.** Molecular properties of ion channels and the mechanisms of electrical signaling in neurons and other excitable cells. Three lecture hours a week for one semester.

**Topic 9: Synaptic Physiology and Plasticity in the Central Nervous System.** Detailed background in the physiology and plasticity of synaptic transmission in the mammalian central nervous system. Three lecture hours a week for one semester.

**Topic 12: Quantifying Brain Structure.** Concepts and hands-on applications for quantifying aspects of brain and cellular structure, with a focus on stereological approaches. Three lecture hours a week for one semester. Only one of the following may be counted: Neuroscience 385L (Topic 12), 394P (Topic: Quantitative Methods for Brain Structure), Psychology 394P (Topic 16: Quantifying Brain Structure), 394P (Topic: Quantitative Methods for Brain Structure).

**Topic 13: Neurobiology of Disease.** Examines the neurobiological basis of disorders of the brain, with a focus on mental illness. Emphasis on the neural circuitries and neurochemical events that underlie specific mental processes and behaviors. Neuroscience 385L (Topic: Neurobiology of Disease) and Neuroscience 385L (Topic 13) may not both be counted.

### **NEU 385P. Programming and Data Analysis for Modern Neuroscience.**

Explore the basics of programming, statistics, and machine learning, and apply these techniques to the analysis of data from neuroscience experiments. Three lecture hours a week for one semester. Neuroscience 385P and 385L (Topic: Prgm/Data Anlys Modern Neu) may not both be counted. Prerequisite: Graduate standing and consent of instructor.

### **NEU 386D. Multivariate Pattern Analysis.**

Same as Psychology 386D. Explores cutting-edge techniques for finding meaningful patterns in large, noisy brain data sets, and how to use these techniques to address a variety of questions in cognitive neuroscience. Three lecture hours a week for one semester. Only one of the following may be counted: Neuroscience 386D, 394P (Topic: fMRI Brain Decoding), Psychology 386D, 387D. Prerequisite: Graduate standing and consent of instructor.

### **NEU 386G, 486G. Functional and Synaptic Neuroanatomy.**

Neuroanatomy and functional connectivity as a basis for brain function and behavior examined from gross structure, cytology and nanoscale synaptic connectivity. Subjects includes somatosensory, motor, visual, auditory, olfactory, taste, limbic, vestibular, hypothalamus, and other systems in addition to the synaptic basis of learning and memory, fear, sleep, stress, and synaptic changes during development, aging, mental retardation, and neurological diseases. Laboratory projects include three-dimensional reconstructions from serial section electron microscopy. For Neuroscience 386G, two lecture hours and one and one half laboratory hours a week for one semester; for Neuroscience 486G, three lecture hours and one and one half laboratory hours a week for one semester. Only one of the following may be counted: Neuroscience 385L (Topic 10), 386G, 486G. Prerequisite: Graduate standing and principles of neuroscience, vertebrate physiology, or other introductory neuroscience course; or consent of instructor.

### **NEU 387S. Analytical Skepticism.**

Examine basic principles that allow accurate interpretation and depiction of scientific data, with an emphasis on notions of behavioral economics, probability and statistics, and experimental design. Three lecture hours a week for one semester. Neuroscience 387S and 385L (Topic: Analytical

Skepticism) may not both be counted. Prerequisite: Graduate standing and consent of instructor.

### **NEU 288M. Fundamentals of Fluorescence Microscopy.**

Same as Pharmacy Graduate Studies 288M. Explores optics, image formation, functioning of epifluorescent and confocal microscopes, detector technology (cameras and photomultiplier tubes), immunofluorescence techniques, image analyses, and image presentation for publication. Study of the technology and science behind widely-used high-end microscope systems. One lecture hours and two lab hours a week for one semester Only one of the following may be counted: Neuroscience 285L (Topic: Fndmntls of Fluorscnc Micsrcpy), 288M, Pharmacy Graduate Studies 288K (Topic: Fndmntls of Fluorscnc Micsrcpy), 288M. Offered on the letter-grade basis only. Prerequisite: Graduate standing and consent of instructor.

### **NEU 088V. Career Development for Neuroscientists.**

Explore a range of careers in neuroscience and career development. Discuss professional development and careers with scientists from industry, academia, and government agencies. Hours to be arranged May be repeated for credit. Offered on the credit/no credit basis only. Prerequisite: Graduate standing.

### **NEU 190, 290, 390. Research.**

The equivalent of one, two, or three lecture hours a week for one semester. May be repeated for credit. Prerequisite: Graduate standing and fifteen semester hours of coursework in neuroscience; students must contact the Neuroscience Graduate Studies Office before registering.

### **NEU 191. Graduate Seminar in Neuroscience.**

Presentations and discussions of research topics in neuroscience. One lecture hour a week for one semester. May be repeated for credit. Offered on the credit/no credit basis only. Prerequisite: Graduate standing and consent of instructor.

### **NEU 391N. Learning and Memory.**

Same as Psychology 391N. Presentation of contemporary approaches to the study of conditioning and learning at the behavioral level. Focuses on empirical data and theoretical analysis of acquisition and performance in Pavlovian and instrumental conditioning. Includes discussion of habituation, sensitization, stimulus control, and other paradigms for studying cognitive processes in nonverbal organisms. Three lecture hours a week for one semester. Prerequisite: Graduate standing.

### **NEU 394I. Neuroinflammation in Health and Pathology.**

Same as Psychology 394I. Assess cutting-edge pre-clinical and clinical neuroimmune research, and interact with professors from across campus in special seminars. Three lecture hours a week for one semester. Only one of the following may be counted: Neuroscience 394I, 394P(Topic: Neuroinflammation in Hlth/Path), Psychology 394I, 394P (Topic: Neuroinflammation in Hlth/Path). Prerequisite: Graduate standing and consent of instructor.

### **NEU 394N. Neural Networks.**

Same as Computer Science 394N. Biological information processing; architectures and algorithms for supervised learning, self-organization, reinforcement learning, and neuro-evolution; theoretical analysis; hardware implementations and simulators; applications in engineering, artificial intelligence, and cognitive science. Three lecture hours a week for one semester. Only one of the following may be counted: Computer Science 394N, Neuroscience 394N, 394P (Topic: Neural Networks). Prerequisite: Graduate standing.

### **NEU 394P. Topics in Neuroscience: Seminar.**

Three lecture hours a week for one semester. May be repeated for credit when the topics vary. Prerequisite: Graduate standing and consent of instructor.

**Topic 1: Current Topics in Behavioral Neuroscience.** Brain-behavior relationships, particularly recent research in behavioral neuroscience, including the anatomical and neurochemical mechanisms of behavioral events, and behavioral influences on the brain. Neuroscience 394P (Topic 1) and Psychology 394P (Topic 1) may not both be counted.

**Topic 3: Neurobiology of Learning and Memory.** Neuroanatomical systems that are functionally related to basic forms of learning and memory in mammals. Neuroscience 394P (Topic 3) and Psychology 394P (Topic 3) may not both be counted.

**Topic 4: Advanced Topics in Neuroanatomy.** Neuroanatomical systems and function across species. Basic forms of neuroanatomy in mammals. Neuroscience 394P (Topic 4) and Psychology 394P (Topic 7) may not both be counted.

**Topic 7: Analysis of Functional Magnetic Resonance Imaging Data.** Functional magnetic resonance imaging experimental design and analysis. Additional prerequisite: Basic knowledge of functional neuroanatomy.

**Topic 8: Topics in Systems Neuroscience.** Focuses on one or two topics and examines them in depth through group discussions of key scientific manuscripts. Discusses both classical studies and contemporary research. Only one of the following may be counted: Neuroscience 394P (Topic 8), Psychology 394U (Topic 14), 394U (Topic: Advanced Topics in Systems Neuroscience).

**Topic 9: Perception and Action.** Current topics in visually guided behavior, including eye movements, attention, and motor control, from behavioral, computational, and neurophysiological approaches. Neuroscience 394P (Topic 9) and Psychology 394U (Topic 16) may not both be counted.

**Topic 10: Statistical Methods in Computational Neuroscience.** Same as Psychology 394U (Topic 19: Statistical Methods in Computational Neuroscience). Introduction to statistical and computational methods for understanding information processing in the nervous system, with emphasis on neural coding and statistical modeling of neural responses. Three class hours a week for one semester. Prerequisite: Graduate standing and consent of instructor.

### **NEU 396D. Clinical Psychopharmacology.**

Same as Psychology 396D. Recent findings concerning the mechanisms of action and the behavioral effects of psychoactive drugs, particularly those used in psychiatry. Three lecture hours a week for one semester. Prerequisite: Graduate standing and consent of instructor.

### **NEU 698. Thesis.**

The equivalent of three lecture hours a week for one semester. Offered on the credit/no credit basis only. Prerequisite: For 698A, graduate standing in neuroscience and consent of the graduate adviser; for 698B, Neuroscience 698A.

### **NEU 399W, 699W, 999W. Dissertation.**

May be repeated for credit. Offered on the credit/no credit basis only. Prerequisite: Admission to candidacy for the doctoral degree.

## **Professional Courses**