Behavioral and Brain Sciences

**HCS 5314 (ACN 5314)** Computational Modeling Methods in Behavioral and Brain Sciences (3 semester credit hours) Computational Neuroscience, Cognitive Neural Modeling, Machine Learning, and Mathematical Psychology modeling methodologies are introduced through the use of computer-based simulation modeling experiments. Emphasizes creative applications of these research methodologies. No mathematical prerequisites and no computer programming prerequisites. Prerequisites: BBSC majors only and department consent required. (3-0) T

**HCS 6110 (ACN 6110)** Fundamentals of Functional Brain Imaging Lab (1 semester credit hour) This course covers applications of functional neuroimaging data collection and analysis methods focusing on methods of data collection, and experimental design, data analysis methods, and how they are related. Students work in the lab to develop proficiency with neuroimaging analysis software tools. Class meetings will consist of lectures, hands-on demonstrations, and work-through sessions with readily available data sets to learn the mechanics of basic fMRI data analysis. Corequisite: **ACN 6310** or **HCS 6310**. Prerequisites: BBSC majors only and department consent required. (0-3) Y

**HCS 6302** Issues in Behavioral and Brain Sciences - Part I (3 semester credit hours) Doctoral proseminar on current theory and research in cognition and neuroscience, communication sciences and disorders, and psychological sciences. Pass/Fail only. Prerequisite: BBS doctoral students only or instructor consent required. (3-0) Y

**HCS 6310 (ACN 6310)** Fundamentals of Functional Brain Imaging (3 semester credit hours) In-depth topics in brain imaging including neuroimaging detection systems (primarily MRI), experimental design, statistical techniques in image analysis, clinical applications of functional neuroimaging, and reviews of pertinent literature using functional brain imaging to illuminate various cognitive and perceptual processes, including language, memory, hearing, and vision. Corequisite: **ACN 6110** or **HCS 6110**. Prerequisites: BBSC majors only and department consent required. (3-0) Y

**HCS 6312 (ACN 6312 and PSYC 6312)** Research Methods in Behavioral and Brain Sciences - Part I (3 semester credit hours) This course focuses on applying, understanding, and interpreting various ANOVA-related statistical techniques in a behavioral science context. Students learn the frameworks for hypothesis testing and effect size estimation. The course provides students with an understanding of the interrelationships among statistical techniques, and computer skills required for data analyses. Students without the necessary background knowledge of basic statistics and experimental design will be required to take **PSY 3392** before registering for **ACN 6312**. Prerequisites: BBSC majors only and department consent required. (3-0) Y

**HCS 6313 (ACN 6313 and PSYC 6313)** Research Methods in Behavioral and Brain Sciences - Part II (3 semester credit hours) This course focuses on applying, understanding, and interpreting regression and analysis of variance -related statistical techniques in a behavioral and brain science context. The course provides students with increased conceptual understanding of topics within regression and analysis of variance (e.g., hierarchical regression analysis, multiple regression with continuous and categorical predictors, regression diagnostics, fixed, random, and mixed effect models), along with computer skills required to interpret data analyses. Prerequisites: (**ACN 6312** or **HCS 6312** or **PSYC 6312**) and department consent required. (3-0) Y
HCS 6315 Grant Writing for Researchers (3 semester credit hours) Identifying funding sources appropriate to research needs, formulating a research plan, generating specific aims and a methodological design to address those aims, presentation of preliminary results to show the feasibility of the proposed work, and use of appropriate reference citations. Prerequisites: BBSC majors only and instructor consent required. (3-0) Y

HCS 6317 (PSYC 6317) Research Methods in Psychology (3 semester credit hours) This course overviews research methods in psychological science. Students learn to design, conduct, and evaluate psychological research. Students will learn to critically evaluate the methodology and conclusions of existing and proposed research. Students will develop a formal research proposal and will learn about the process of grant submission and peer review. Students will also learn about issues related to professionalism, diversity, and ethics in the conduct and publication of research in psychology. Prerequisite: BBSC majors only and department consent required. (3-0) Y

HCS 6319 Scientific Writing (3 semester credit hours) This course covers the fundamentals of effective scientific manuscript writing and de-constructs the peer-review process. Instruction, exercises and assignments will focus primarily on the process of writing and publishing scientific manuscripts. The course will be simultaneous (1) lectures / discussions / class exercises on how to write effectively, concisely, and clearly, and, (2) preparation of an actual scientific manuscript to be ready for submission to a scientific journal at the end of the semester, which will involve one-on-one editing sessions with the instructor. Students must have data available, analyzed, and prepared for a writing project (e.g., first year project) prior to enrollment in this course which is open only to BBS doctoral students. May be repeated for credit as topics vary (6 semester credit hours maximum). Prerequisite: BBS doctoral students only. (3-0) Y

HCS 6327 (PSYC 6327) Personality (3 semester credit hours) Survey of trait, biological, social-cognitive, analytic, and learning theory approaches to the study of personality. Emphasis on intensive exploration of modern theoretical and empirical work. Prerequisites: BBSC majors only and department consent required. (3-0) Y

HCS 6330 (ACN 6330 and PSYC 6330) Cognitive Science (3 semester credit hours) Cognitive, computational, and neural processing approaches to understanding perception, memory, thought, language, and emotion. Prerequisites: BBSC majors only and department consent required. (3-0) Y

HCS 6331 (ACN 6331 and PSYC 6331) Cognitive Development (3 semester credit hours) Survey of cognitive development theories and research in a variety of domains including perception, memory, language, and problem solving. Prerequisites: BBSC majors only and department consent required. (3-0) Y

HCS 6332 (ACN 6332 and PSYC 6332) Perception (3 semester credit hours) Psychophysical, neurophysiological, and computational foundations of sensation and perception. Basic senses of vision, audition, chemoreception, and tactile processing, with emphasis on understanding the processes that take us from neurons to perception and action. (3-0) R

HCS 6333 (ACN 6333 and PSYC 6333) Memory (3 semester credit hours) Research and theory on the acquisition, representation, and retrieval of information by the mind/brain. Includes information processing and neuropsychological perspectives. Prerequisites: BBSC majors only and department consent required. (3-0) R

HCS 6334 (ACN 6334) Attention (3 semester credit hours) Theory and evidence on the study of attention especially in human vision and audition. Includes consideration of automatic and controlled processes, the time course of perceptual processing, and the role of working memory. (3-0) R
**HCS 6338** (ACN 6338 and PSYC 6338) Functional Neuroanatomy (3 semester credit hours) An introduction to human neuroanatomy organized by major brain system. Function of the neuroanatomy of each major system and relation to neurological disorders associated with damage to the neuroanatomy of the system. Prerequisites: BBSC majors only and department consent required. (3-0) Y

**HCS 6340** (ACN 6340) Cellular Neuroscience (3 semester credit hours) A detailed study of neural physiology and the principles of synaptic transmission. Prerequisites: BBSC majors only and department consent required. (3-0) Y

**HCS 6341** Genes, Brain, and Behavior (3 semester credit hours) Neuroscience is a remarkable interdisciplinary field requiring analysis at multiple levels: behavioral, electrophysiological, and molecular. This course will focus on the basic cellular and molecular mechanisms that control neuronal functioning, with an emphasis on the regulation of gene expression (transcription/translation) via genetic, epigenetic and synapse to nucleus signaling mechanisms. Relevant examples will reference: regulating cellular excitability, LTP, learning and memory, psychiatric and neurological diseases. Prerequisites: BBSC majors only and department consent required. (3-0) Y

**HCS 6343** Neurobiology of Learning and Memory (3 semester credit hours) Current research and theory on modifications in the central nervous system that contribute to the processes of learning and memory. Includes an overview of different forms of learning as assessed in model systems, with extensive review of anatomical, cellular, and molecular changes underlying neuronal and behavioral plasticity. Prerequisites: (ACN 6346 or HCS 6346 or PSYC 6346) and department consent required. (3-0) Y

**HCS 6346** (ACN 6346 and PSYC 6346) Systems Neuroscience (3 semester credit hours) Integrative systems level study of the nervous system. Aspects of neural mechanisms and circuitry underlying regulation of motor behaviors, sensory and perceptual processing, biological homeostasis, and higher cognitive functions. Prerequisites: BBSC majors only and department consent required. (3-0) Y

**HCS 6348** (ACN 6348) Neural Net Mathematics (3 semester credit hours) Vector calculus, Radon-Nikodym density functions, vector calculus-based probability theory, Markov chains, and Markov random fields with machine learning and artificial neural network modeling applications. Emphasizes applications of theory to unsupervised, supervised, and reinforcement learning machines and deep learning. This course is a required prerequisite for ACN 6349 and HCS 6349. Prerequisites: Linear algebra and calculus and (STAT 3341 or equivalent) and department consent required. (3-0) T

**HCS 6349** (ACN 6349) Statistical Machine Learning with Deep Learning Applications (3 semester credit hours) Mathematical tools for investigating the asymptotic behavior of both batch and adaptive machine learning algorithms including the Zoutendijk-Wolfe convergence theorem, adaptive stochastic approximation methods, and Monte Carlo Markov Chain methods. M-estimation and bootstrap asymptotic statistical theory for characterizing asymptotic behavior of parameter estimates as a function of sample size to support: model selection, specification analysis, and hypothesis testing. Emphasizes applications of theory to unsupervised, supervised, and reinforcement learning machines and deep learning. Prerequisites: (ACN 6348 or HCS 6348) and department consent required. (3-0) T

**HCS 6350** (PSYC 6350) Social Development (3 semester credit hours) Foundations of social and personality development. Includes survey of major theoretical approaches to the study of temperament, attachment, parenting, aggression, peer relationships, self and gender development, and other contemporary issues. Prerequisites: BBSC majors only and department consent required. (3-0) Y

**HCS 6357** (PSYC 6357 and HDCD 6319) The Developing Child: Infants and Toddlers (3 semester credit hours)
Theories of infant development in multiple content domains (cognitive, social, motor, language, physical) from conception to 24 months. Milestones of development and the understanding of relationship across domains and viewing the child as a "system" within the relationships. Prerequisites: BBSC majors only and department consent required. (3-0) Y

**HCS 6359** *(HDCD 6320 and PSYC 6320)* The Developing Child: Toddler and Preschool Years (Two to Five Years) (3 semester credit hours) Relevant developmental theories and processes as well as skills acquired in motor, sensory-perceptual, cognitive, and social domains. Prerequisites: BBSC majors only and department consent required. (3-0) Y

**HCS 6363** *(ACN 6363)* Text Comprehension Seminar (3 semester credit hours) Current readings in the field of text comprehension and memory. May be repeated for credit as topics vary (6 semester credit hours maximum). Prerequisites: BBSC majors only and instructor consent required. (3-0) R

**HCS 6368** *(ACN 6368 and PSYC 6368)* Language Development (3 semester credit hours) Advanced study of normal oral language development. The goals of this course are to consider the developmental trajectories of the different components of language; to consider the varied and critical roles of language in human development; to understand the impact of culture, different languages, child factors and the environment on development; and to be introduced to the theoretical perspectives driving research and thinking in this area of inquiry. Prerequisite: BBSC majors only. (3-0) Y

**HCS 6372** *(ACN 6372)* The Neuroscience of Pain (3 semester credit hours) A systems-oriented course covering the anatomical and physiologic basis of pain. The course describes the basic features of neural processing of pain signals in the spinal cord and brain, the anatomy and the function of the descending systems that can control transmission of pain signals, and peripheral and central sensitization. The physiological and molecular basis for treatment of pain is discussed. Prerequisites: BBSC majors only and department consent required. (3-0) Y

**HCS 6373** *(ACN 6373)* Intraoperative Neurophysiological Monitoring (IONM) Part I (3 semester credit hours) Part 1 of the course covers the anatomical and physiological basis for the use of electrophysiological techniques in the surgical operating room and clinically in diagnosis of disorders affecting the nervous system. Prerequisite: BBSC majors only. (3-0) Y

**HCS 6374** *(ACN 6374)* Intraoperative Neurophysiological Monitoring (IONM) Part II (3 semester credit hours) Part II covers the use of recordings of neuro-electric brain potentials and their interpretation during surgical operations and clinically for diagnostic purposes. The use of electrophysiological methods for guiding implantation of stimulating electrodes deep in the brain and for assisting the surgeon in certain operations are also described. Prerequisite: [ACN 6373](#) or [HCS 6373](#). (3-0) Y

**HCS 6376** *(PSYC 6376)* Social Psychology (3 semester credit hours) This course is a graduate-level introduction to the field of social psychology. The primary objective of this class is to acquaint students with some of the major topics and research methods in social psychology. Topics may include social cognition and self-justification, biases in judgment, attitudes and persuasion, conformity, compliance, group dynamics, prejudice and stereotyping, interpersonal attraction and relationships, aggression and altruism, cultural diversity, and applications relevant to these aspects of the human experience. Special attention to research paradigms of interest to students developing their own empirical work. Prerequisites: BBSC majors only and department consent required. (3-0) Y

**HCS 6388** *(ACN 6388)* MATLAB for Brain Sciences (3 semester credit hours) Introduction to MATLAB computer programming. Covers the use of the MATLAB programming language for the purpose of stimulus generation,
behavioral data analysis, statistical analyses, and generation of publication quality figures. Prerequisites: BBSC majors only and department consent required. (3-0) R

**HCS 6389 (ACN 6389)** Speech Perception Laboratory (3 semester credit hours) Introduction to the field of speech processing by computer, with primary application to research techniques in the study of speech perception. Prerequisites: BBSC majors only and department consent required. (0-9) T

**HCS 6395** (ACN 6395 and PSYC 6395) Cognitive Psychology (3 semester credit hours) Theory and research on perception, learning, thinking, psycholinguistics, and memory. Prerequisites: BBSC majors only and department consent required. (3-0) Y

**HCS 7121** Graduate Seminar in Systems Neuroscience (1 semester credit hour) The purpose of this course is to give PhD students in Systems Neuroscience a forum for training in oral presentation skills. Students will be expected to present their research findings in this class in a variety of formats. In addition to presentations by students, outside speakers will be invited to present their findings on current research in Neuroscience. Pass/Fail only. May be repeated for credit (10 semester credit hours maximum). Department consent required. (1-0) S

**HCS 7309 (COMD 7309)** Neural Correlates of Human Cognition: Functional Localization (3 semester credit hours) Correlation of brain lesions with cognitive deficits provides a human brain map of the essential anatomy underlying specific cognitive functions. The areas of cognition to be covered using this model include language, episodic memory, semantic memory, working memory, aspects of visuospatial functions, and higher-order motor planning. This knowledge base provides a key framework to combine with the findings of functional neuroimaging (fMRI, PET) in understanding how humans think. Cognitive deficits in patients (e.g., amnesia, aphasia, etc.) will be explained within this framework. Prerequisites: BBSC majors only and department consent required. (3-0) Y

**HCS 7310 (ACN 7310)** Advanced Research Methods (3 semester credit hours) Advanced methods of inquiry and analysis unique to cognition and neuroscience, communication sciences and disorders, or psychological sciences. May be repeated for credit as topics vary (12 semester credit hours maximum). Prerequisites: (ACN 6313 or HCS 6313 or PSYC 6313) and department consent required. (3-0) Y

**HCS 7311** Family Psychology (3 semester credit hours) Theory and research on family systems, including topics on family structure, relationships, and processes. Prerequisites: BBSC majors only and instructor consent required. (3-0) R

**HCS 7317** Longitudinal Research Methods (3 semester credit hours) Advanced methods course covering issues related to the design and analysis of multiple waves of data over time. Topics include measurement and attrition, panel models, latent growth curve modeling, and time-varying and invariant predictors. Designed for students interested in development, variability in processes over time, or experimental change. Prerequisites: HCS 6313 and department consent required. (3-0) R

**HCS 7319** Molecular Target Discovery for Neuroscience and Neurological Disorders (3 semester credit hours) Neurological disorders are prominent in the population but poorly treated by existing therapeutics. The purpose of this course is to familiarize students working in research environments with the process of identifying and vetting targets for the potential treatment of neurological disorders. Research manuscripts from the recent literature will be assigned, and students will be expected to present data in these papers to their peers and critically discuss findings in the papers. Discussions will focus on future directions for target discovery based on the presented work. Prerequisites: (HCS 6340 or HCS 6346) and departmental consent required. (3-0) R
**HCS 7320 (ACN 7320)** Topics in Multivariate Data Analysis using R (3 semester credit hours) R programming language (including writing functions and using special packages). Using the R programming language to analyze standard designs used in Behavioral and Brain Science. Includes designing publication ready graphics and analysis of experimental data and surveys. May be repeated for credit as topics vary (9 semester credit hours maximum). Prerequisite: [ACN 6313](#) or [HCS 6313](#) or [PSYC 6313](#) or instructor consent required. Corequisite: **HCS 7321**. (3-0) Y

**HCS 7321 (ACN 7321)** Topics in Multivariate Data Analysis Theory (3 semester credit hours) Principal component analysis, correspondence analysis, multidimensional scaling, discriminant analysis, partial least square methods, multi-table analysis, cluster analysis, and various other statistical techniques. Includes discussion of computationally intensive cross-validation inference methods such as jackknife and bootstrap. May be repeated for credit as topics vary (9 semester credit hours maximum). Prerequisite: [ACN 6313](#) or [HCS 6313](#) or [PSYC 6313](#) or instructor consent required. Corequisite: **HCS 7320**. (3-0) Y

**HCS 7338 (ACN 7338)** Brain Connectivity (3 semester credit hours) Systems and cognitive neuroscience based approach towards measuring and understanding patterns of brain connectivity in humans and non-human animals. Prerequisites: [HCS 6346](#) or [HCS 6338](#) and instructor consent required. (3-0) R

**HCS 7343 (ACN 7343)** Neuropharmacology (3 semester credit hours) Biology of neurotransmission in the central nervous system. Includes ionotropic and metabotropic coupling of all known classes of receptors to both their cellular and systemic effects. Clinical efficacy, side effects, and other issues related to drug use and abuse are covered. Prerequisites: [ACN 6340](#) or [HCS 6340](#) or [ACN 6346](#) or [HCS 6346](#) or [PSYC 6346](#) and department consent required. (3-0) T

**HCS 7351** Aging and the Nervous System (3 semester credit hours) Critical evaluation of research and theory concerning the impact of aging on neuronal function. Cognitive dysfunctions, dementias, and underlying neuropathologies, as well as neurophysiological and neurochemical changes that accompany normal aging. Prerequisites: BBSC majors only and department consent required. (3-0) R

**HCS 7355** Seminar in Psychological Sciences (3 semester credit hours) Selected topics of current research in social or cognitive development. May be repeated for credit as topics vary. Prerequisites: BBSC majors only and department consent required. (3-0) Y

**HCS 7364** Cognitive Neuroscience of Human Memory (3 semester credit hours) Seminar-based class that covers the cognitive neuroscience of human long term memory. It combines a historical perspective with discussion of current controversies and advances. Prerequisites: BBSC majors only and department consent required. (3-0) Y

**HCS 7365** Fear and Anxiety: Biology and Causes (3 semester credit hours) The purpose of this course is to discuss and develop a general understanding of the neuroscience of fear and anxiety. The neuroanatomy and function of neural systems that are the basis for fear and other emotions are described. The benefit and harm from fear and anxiety is discussed. Prerequisites: BBSC majors only and department consent required. (3-0) R

**HCS 7371** Neuroplasticity and Disorders of the Nervous System (3 semester credit hours) Understanding the anatomical and functional bases for human neuroplasticity. This is a systems-oriented course that covers aspects of the pathophysiology of the nervous system that are related disorders where expression of neuroplasticity plays an important role. The course covers the neuroscience bases for expression of neuroplasticity and how reorganization of the nervous system may cause pain, tinnitus, paresthesia, and other symptoms of neural disorders. The role of the little known non-classical sensory pathways is
discussed. The organization of motor systems, pain circuits, and sensory systems are also included in the course. Prerequisites: BBSC majors only and department consent required. (3-0) Y

**HCS 7372 (ACN 7372)** Seminar in Neuroscience (3 semester credit hours) Selected topics and current research in neuroscience. May be repeated for credit as topics vary (12 semester credit hours maximum). Prerequisite: BBSC majors only. (3-0) Y

**HCS 7376 (HDCD 6385 and PSYC 6335)** Child Psychopathology (3 semester credit hours) Major classes of childhood psychopathology manifested during infancy through adolescence. Normal personality development as a basis for identifying psychopathology. Issues of etiology, diagnosis, prognosis and social policy. Prerequisites: BBSC majors only and department consent required. (3-0) R

**HCS 7382 (PSYC 7382 and HDCD 7382)** Health Psychology (3 semester credit hours) This course is a graduate-level introduction to the field of health psychology. The course will utilize a biopsychosocial perspective to understand the biological, social, and psychological factors associated with health and well-being. Topics may include stress and coping, developmental origins of health, chronic disease, and psychoneuroimmunology. Prerequisites: BBSC majors only and department consent required. (3-0) Y

**HCS 7V71** Topics in Communication Sciences and Disorders (1-6 semester credit hours) Selected topics and current research in communication sciences and disorders. May be repeated for credit as topics vary. Prerequisites: BBSC majors only and department consent required. (1-6-0) R

**HCS 7V97** Directed Individual Study in Psychological Sciences (1-9 semester credit hours) Individualized program of study which may include reading, research, or other designated activities. May be repeated for credit as topics vary. Prerequisites: BBSC majors only and instructor consent required. (1-9-0) Y

**HCS 7V98** Directed Individual Study in Communication Sciences and Disorders (1-9 semester credit hours) Individualized program of study which may include reading, research, implementation of clinical strategies, and/or other designated activities. May be repeated for credit as topics vary. Prerequisites: BBSC majors only and instructor consent required. (1-9-0) S

**HCS 7V99** Directed Individual Study in Neuroscience (1-9 semester credit hours) Individualized program of study which may include reading, research, or other designated activities. May be repeated for credit as topics vary. Prerequisites: BBSC majors only and instructor consent required. (1-9-0) S

**HCS 8V50** Doctoral Readings and Research Seminar (1-6 semester credit hours) Seminar for advanced doctoral students on current issues and research in Behavioral and Brain Sciences. Pass/Fail only. May be repeated for credit as topics vary. Prerequisites: BBSC majors only and instructor consent required. (1-6-0) R

**HCS 8V80** Research in Behavioral and Brain Sciences (1-9 semester credit hours) Supervised research experience. Pass/Fail only. May be repeated for credit. Prerequisites: BBSC majors only and instructor consent required. (1-9-0) S

**HCS 8V87** Research in Psychological Sciences (1-9 semester credit hours) Supervised research experience. Pass/Fail only. May be repeated for credit. Prerequisites: BBSC majors only and instructor consent required. (1-9-0) S

**HCS 8V88** Research in Communication Sciences and Disorders (1-9 semester credit hours) Supervised research experience. Pass/Fail only. May be repeated for credit. Prerequisites: BBSC majors only and instructor consent required. (1-9-0) S
HCS 8V89 Research in Neuroscience (1-9 semester credit hours) Supervised research experience. Pass/Fail only. May be repeated for credit. Prerequisites: BBSC majors only and instructor consent required. ([1-9]-0) S

HCS 8V97 Dissertation in Psychological Sciences (1-9 semester credit hours) Pass/Fail only. May be repeated for credit. Prerequisites: BBSC majors only and instructor consent required. ([1-9]-0) S

HCS 8V98 Dissertation in Communication Sciences and Disorders (1-9 semester credit hours) Pass/Fail only. May be repeated for credit. Prerequisites: BBSC majors only and instructor consent required. ([1-9]-0) S

HCS 8V99 Dissertation in Neuroscience (1-9 semester credit hours) Pass/Fail only. May be repeated for credit. Prerequisites: BBSC majors only and instructor consent required. ([1-9]-0) S