12 Course Catalog

Subject	Credit	About the course
Scientific Research Ethics 研究者倫理論	2	Scientific development relies on trueness, trust and fairness of research practice. Scientific misconduct -violation of these norms- hampers the sound development of science. We discuss scientific misconduct and questionable research practice through case study and cultivate research ethics as practical wisdom.
Advanced Brain Sciences Ⅰ 脳科学先端セミナーⅠ	1	In this seminar, we conduct talk series of scientists who are well-known throughout the world in cutting edge in the field of neuroscience, behavioral sciences, and computational theory. Participants will not only learn the cutting edge of the latest research, but also will attempt to obtain a wider perspective on their own field by gaining a wider point of view bridging understanding across the nervous, behavioral, and social levels that form the bases of the brain sciences. This seminar is partly conducted in the Brain Science Workshop.
Advanced Brain Sciences Ⅱ 脳科学先端セミナーⅡ	1	In this seminar, we conduct talk series of scientists who are well-known throughout the world in cutting edge in the field of neuroscience, behavioral sciences, and computational theory. Participants will apply their own experiences in `Advanced Brain Sciences II' to obtain effective information as discussing with top researchers working in a variety of fields. This seminar is partly conducted in the Brain Science Workshop.
Brain-type Learning Systems 脳型学習システム	2	In the information processing of the brain, any information-integration is related to "learning and memory." Therefore, in order to understand high order functions, it is very important to study learning and memory systems. In this lecture, learning and memory systems from the synapse level of a single neuron to the network level of neurons are explained. The mechanism and dynamics of learning and memory are introduced from both the experimental side and the theoretic side. In addition, the relation between information representation and the memory function in the brain will be touched upon. Furthermore, the latest knowledge about learning and memory will be presented.
Communication Robot Engineering コミュニケーションロボット工学	2	In the case of communication between human subjects, one tries to estimate what the other party intends to do in order to establish optimal mutual interactions, because the other party is a human being with his/her own will. Lectures in Communication Robot Engineering cover theoretical models required for constructing robots that can interact with humans, for the development of cognitive functions and for algorithms for control systems. While studying the literature, graduate students introduce and discuss the latest researches, which will be provided by the professors, to learn about the backgrounds and perspectives of researches in the field of communication robot engineering, and about how to read the literature.
Pathological Neuroscience 病態神経科学	2	The aim of this course is to learn about symptoms of psychiatric disorder, such as schizophrenia, depression, autistic disorder, and neurological disorder. A further aim is to investigate appropriate methods to identify neuronal bases of psychiatric and behavioral symptoms using neuroimaging techniques.
Psychophysics 心理物理学	2	In system-neuroscience, well-controlled stimulus presentation and accurate measurement of behavior are indispensable. Experimental psychology has developed psychophysical methods to analyze the relationship between stimulus and response. In this course, we will systematically study psychophysical methods and related psychological theories, as well as discuss recent psychological studies. We will also talk on how we can apply psychophysical techniques to neuroscience research.

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Advanced Systems Neuroscience システム神経科学論	2	Higher-order brain functions such as sensory perception, behavioral actions, emotion, decision-making and thinking are mediated by nerve cells in the brain, more than 10 billion of which exist in the cerebral cortex alone, making local and global, hierarchical networks, and representing and processing neuronal information under specialized working principles. In Advanced System Neuroscience, graduate students are expected to master the coding of nerve signals, detection and perception of sensory stimuli, control of actions and motor learning, emotion and decision-making. Classes will consist of lectures, workshops and discussions in a small group of students and professors.
Systems Neuroscience Technique システム神経科学実験法	2	To understand the mechanism of the neural system, researchers need to obtain precise and reliable experimental data by an appropriate combination of several experimental techniques. In this lecture, students will learn the basics and applications of anatomical and physiological techniques widely used in neuroscience, such as tracer injections, microscopy, electroencephalograms, and extracellular and intracellular recordings. The students will learn how to select experimental techniques and how to analyze their experiment data in accordance with the purpose of their own studies.
Computational Neuroscience 計算論的神経科学	2	In this course, we review theoretical and computational neuroscience, which is an approach for understanding brain functions through mathematical formulation. Participants learn how to analyze and hypothesize through a computational point of view on their own project. The approaches of computational neuroscience try to understand brain functions by analyzing multiple levels of neuroscientific phenomena on molecular, cell, network and system levels. The goal of this course is to study mathematical and statistical concepts bridging multiple levels of neural and behavioral data, such as neural encoding and decoding, information theory, and Bayesian statistics.
Computer Simulation Technique コンピュータシミュレーション実験法	2	Computer simulation is an effective method to confirm what phenomena emerge from a hypothesized model. For instance, we can easily examine the effect of a certain cause by using a simulation of a biologically detailed model. This also allows us to understand the background mechanisms of an observed phenomenon by looking for the smallest model required in order to reproduce that phenomenon. This lecture provides concrete examples to study the required basic techniques in regards to the 2 contrary courses of action of pursuing biological fidelity on one side and of simplification in order to find mechanisms on the other.
Brain Image Analysis 脳画像解析学	2	The goals of this class are to master the theory of human non-invasive measurement of brain activity, functional magnetic resonance imaging (fMRI), and to cultivate the skills for experimental designs and analyses for fMRI. In the first half, students will learn about possible dangers, ethical issues for participants, and imaging mechanisms in MRI experiments. Also, students will gain understanding on RF pulse sequences and the meanings of the MR images. Furthermore, students will learn how to control interface devices, such as stimulus presentation systems, recording systems for biological reaction etc., which are necessary for fMRI experiments. In the latter half, students will study from basic analyses to applied ones for fMRI data. Then, in order to understand the detailed research methods of fMRI correctly, students will gain the knowledge required for task design with consideration of the characteristics of fMRI. Furthermore, students will actually try to make task designs along some given themes and have discussions in order to make up their skills for their own fMRI research.
Neuroimaging Technique ニューロイメージング実験法	2	The aim of this course is to learn about procedures for fMRI studies. The student will be shown how to perform fMRI tasks and how to calculate fMRI data. The student will also experience 3 tesla MRI operation.

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Developmental Science 発達科学	2	This course is intended for students to seek the essence of human behavioral changes with a focus on cognitive psychology, developmental psychology and linguistics, in order to deepen their understanding. In particular, students will learn about the latest research on scientific approaches to understanding a variety of findings in the developmental process of infants. The first half of the course will focus on explaining the concept of development in science (Hiroyuki Okada). We will also touch upon the modeling of learning mechanisms through a connectionist approach, which has become a hot topic in recent years. In the latter half, we will reveal various experimental aspects of its development, by concentrating on language acquisition in infants (Mutsumi Imai).
Developmental Science Technique 発達科学実験法	2	This course provides opportunities to learn and experience various research methods of developmental sciences so that students can apply suggestions from brain research to education, connecting information from linguistics, cognitive psychology, and developmental psychology. Students will experience data collection and analysis of questionnaires, surveys, behavioral observations, and behavioral experiments. Especially in behavioral observations, we will discuss the correlation between mother-child/child-child social interaction and first/second language acquisition. Students will also learn manipulations and acoustic analyses of sounds, which are used in studies of speech perception and production. By comparing these multiple research methods, we will discuss appropriate usage of these methods.
Brain Sciences Research Method Ⅰ (Research Survey) 脳科学研究法Ⅰ（研究サーベイ）	2	The goal of doctorate course research is to aim at a truly original study by seeking novel findings, innovative technique, or sophisticated theories in a specific field of brain science. To achieve this, students have to have broad knowledge of past and current researches, available and effective techniques, and most importantly, future directions of the field. In this class, students will obtain sufficient knowledge to design their own studies appropriately, by searching, reading, and understanding valuable literature in brain science.
Brain Sciences Research Method Ⅱ (Research Planning) 脳科学研究法Ⅱ（研究計画）	2	Scientific research is a methodology, which provides new experiences from which new knowledge is also deduced, by conducting well-organized experiments, analyzing their results and inspecting these results carefully. In order to clarify the differences between newly obtained knowledge and conventional knowledge, it is necessary to design a well-organized plan and to carry out experiments according to this plan for the achievement of one's own purposes. This class provides methodology that allows students to establish their own projects by themselves through discussion with instructors. It is required to complete the "Brain Sciences Method Ⅰ (Research Survey)" course to take this course.
Brain Sciences Research Method Ⅲ (Data Analysis) 脳科学研究法Ⅲ（データ解析）	2	Natural phenomena generally look stochastic unless all of the causes are controlled. There are uncontrollable internal states in the brain. Therefore, a stochastic view is inevitable to understand the brain through experimental data. Methods to infer objective conclusions from finite observations are required to understand stochastic phenomena. In this class, we discuss statistical methods to infer an objective conclusion from specific experimental data obtained by proper experiments in brain science and discuss approaches to construct testable hypotheses. It is required to complete the two courses: "Brain Sciences Research Method Ⅰ (Research Survey)" and "Brain Sciences Research Method Ⅱ (Research Planning)" to take this course.

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Brain Sciences Research Method Ⅳ (Thesis Writing) 脳科学研究法Ⅳ（論文作成）	2	The goal of scientific study is to write an original paper, in which the experimental procedures and results have to be described clearly in order for the readers to realize its originality and usefulness. Without basic techniques of scientific writing, it is hard to show the scientific validity and originality in one's paper. In this class, the supervisor provides an individual with training on how to write scientific papers. Students are required to have completed the courses "Brain Sciences Research Methods Ⅰ" (Research Survey), "Ⅱ (Research Planning)" and "Ⅲ (Data Analysis)" to take this course.
Brain Sciences Research Method Seminar 脳科学研究法セミナー	2	This is a seminar for writing a doctoral thesis as a compilation of all professional skills, knowledge, and research findings the student has gathered, after mastering research surveys, research planning, data analysis. This is a literacy to advance scientific research and develop new technology. Students will also join in discussions of other students' research, and learn how to utilize what they learned from the discussions to their own researches. Before taking Brain Sciences Research Method Seminar, Students are required to have finished Brain Sciences Research Method Ⅰ, Ⅱ, Ⅲ, and Ⅳ.