Cellular and Molecular Neurosciences and Mentoring 401-1 (6 ECTS)

Fundamentals of Neurochemistry
Module 401 a (M. Koch)

The lecture deals with the main cellular components of brain tissue, as well as their functions and interactions. The focus is set on the molecular determinants of brain function. The lecture also includes an overview of the neurochemistry of all transmitter systems of the brain and their roles in in normal cognitive processes and disease.

Neuropharmacology
Module 401 b (M. Koch)

This seminar consists of students talks (usually two talks per student) on general and specialised topics of neuropharmacology- and psychopharmacology.

The 401b part (Neuropharmacology) of this module will be taught together with the 404b part (Clinical Neurology) of the module Clinical Neurosciences (M. Herrmann).

Mentoring

Students select a mentor from the teaching staff with whom they meet regularly and get counselling towards the development of a personal study profile regarding professional qualification.

Systemic Neurosciences 402 (6 ECTS)

Comparative Neuroanatomy
Module 402 a (U. Dicke)

These lectures introduce into the functional organisation of the vertebrate nervous system, including comparative and evolutionary aspects. The relation between structure and function of brains will be explained on the cellular level and on the level of different functional systems. In the practical course, you will study vertebrate brains, using microscopic tissue sections and models of the brain. As a learning outcome, you will gain a sound knowledge of the cerebral architecture of the vertebrates. You will be able to use technical terms, anatomical atlases and allocate structures to the parts of the brain.

Cognitive Neurophysiology
Module 402 b (A. Kreiter)

This lecture gives an introduction into the neurophysiology of cognitive processes, exemplarily focusing on the visual system as a model system. The detailed circuitry of the visual system, the functional properties of its neurons as well as the system's functional compartmentization and integrative mechanisms will be discussed in detail. A particular emphasis will be placed on the experimental approaches and methods applied to clarify the relations between cognitive processes, the underlying neuronal mechanisms and the significance of preliminary findings.

Theoretical Neurosciences 403-1 (6 ECTS)

Computational Neuroscience I, (Computational Neuroscience II, Module 403 c - taught in second term)
Module 403 a (K. Pawelzik)

Participants will be introduced to fundamental concepts in Computational Neuroscience. In the first term, we will study basic encoding and decoding schemes, analysis of neural signals, and the dynamics of single neurons. In the second term, we will focus on synapses and neural networks, and study emergent phenomena such as computation and classification, learning and memory, pattern formation, and synchronization.

Students will develop the competency to understand and to use basic mathematical methods from Computational Neurosciences, and they will gain knowledge about paradigmatic models and theories in that field. These competencies will be trained in exercises where students will apply analytical methods to study neural dynamics and information processing in the brain. Skills acquired in this course will be essential for working in a neuroscience lab, in particular for analyzing data, testing theories, and performing simulations of brain function.

Basic knowledge in elementary calculus (functions, equation solving, differentiation, integration, probability theory) is required. An optional course for rehearsing these concepts is provided prior to the start of this lecture during the introductory week.

Statistical Methods
Module 403 b (K. Pawelzik)

The course will start with rehearsing methods from descriptive statistics, in particular on concepts important for understanding neuronal data. Subsequently, we will focus in parallel on methods useful for investigating the brain as an information-processing system, and on methods needed to analyze behavioral or neural data (e.g., EEG, fMRI, Electrophysiology).

In this course, you will acquire the necessary skills to perform analysis of neural or behavioral data in a lab situation. In particular, you will learn how to plan experiments yielding meaningful statistics, and how to select and to apply appropriate statistical tests. In parallel, you will understand how to compute with probabilities and how to perform inference and estimation on noisy data. Hereby you acquire the competency to study encoding and decoding of information of the brain.

Clinical Neurosciences 404 (6 ECTS)

Clinical neuropsychology
Module 404 a (M. Herrmann)

This module mainly focuses on the clinical aspects of the neuroscience studies. It is divided into two parts representing Clinical Neuropsychology (404a) and Clinical Neurology (404b).

You will get an insight into the basic principles of neuropsychological disorders (underlying neuroanatomy, cognitive modelling, and symptoms and diagnostics) and a basic introduction (epidemiology, pathophysiology, symptoms, diagnostics, and treatment) into selected neurological disorders affecting cognitive functions. Both parts will be the subject of a computer-based exam at the end of the module.

Students have to present a basic knowledge in human neuroanatomy, neurophysiology and neurochemistry/neuropharmacology.

Clinical neurology
Module 404 b (M. Herrmann)

The 404b part of this module is being taught together with the 401b part (Neuropharmacology) of the module Cellular and Molecular Neurosciences (M. Koch).

Programming 414 (3 ECTS)
(K. Pawelzik)

This module will provide you with the knowledge needed for writing your own computer programs to analyze data and simulate neuronal systems. We will use Matlab as an easy-to-use, popular programming language with a convenient interface for plotting functions and displaying data. In the first half of the lectures and practical exercises, you will achieve the basic skills to write computer programs, which perform simple calculations, and we will advise you how to break down a more complex problem into simple tasks a computer can perform. In the second half of the course, you will apply your acquired skills to analyze neural signals (mean and variance, estimation of firing rates, reverse correlation, ROC analysis, etc.), and simulate single neurons or synapses (integrate-and-fire neuron, Hodgkin-Huxley neuron).

Laboratory Animal Science 415 (3ECTS)
(M. Koch, A. Kreiter, S. Mandon and collaborators)

In this course, students learn legal aspects of animal experiments and euthanasia; anatomy, biology and housing of laboratory animals; substance administration to rats and mice; methods of anesthesia and analgesia; application of substances to rats and mice; performing a surgery on rats; euthanasia according to the standards of the FELASA (Federation of Laboratory Animal Science Associations) Category B.