Module Name
Neurophysiological and genetic approaches for brain function analysis

Type of Module	**Module Code**
o Advanced Module	Neurophysiology

Identification Number	**Workload**	**Credit Points**	**Term**	**Offered Every**	**Start**	**Duration**
MN-B-SM (N 2)	360 h	12 CP	2nd term of studying	Summer term, 2nd half	Summer term only	7 weeks

1	**Course Types**	**Contact Time**	**Private Study**
	a) Lectures	30 h	70 h
	b) Practical/Lab	150 h	70 h
	c) Seminar	10 h	30 h

2 Module Objectives and Skills to be Acquired

Students who successfully completed this module

- have an understanding of how passive and active electrophysiological and biophysical properties control the functionality of neurons.
- will be able to understand how vertebrate and invertebrate monoaminergic and peptidergic circuits shape and modulate behavior.
- have an understanding of optogenetic approaches employed in vivo and in vitro in vertebrates
- have acquired a solid understanding of electrophysiological, immunohistochemical, optogenetic, and genetic approaches.
- are able to apply intracellular recording and microscopy techniques for neurobiology
- able to independently design and perform small scientific projects related to topics of the module.
- are able to analyze electrophysiological data using the Spike 2, Igor Pro,Phyton, or Clampfit.
- are able to analyze acquired images using ImageJ/Fiji.
- have learned how to present research results in oral and written form, and critically discuss scientific publications related to the module's topic on a professional level.
- are able to transfer skills acquired in this module to other fields of biology.

3	**Module Content** The module focuses on the cellular mechanisms of neuronal function and its modulation under physiological and pathophysiological conditions. The functions of nervous systems are determined by the cellular properties of their neurons and the synaptic connections between these neurons. For adaptation to changing tasks or environmental conditions, it is crucial that these cellular parameters are adaptable and can be modulated. Many brain diseases are associated with dysregulation of neuronal and synaptic properties or their modulatory control. Through a combination of lectures, seminars, practical exercises, and research projects, students learn about state-of-the art neuroscience approaches for studying the cellular mechanisms that mediate neuronal function. Participants will analyze the function of neurons and how it can be studied using single-cell electrophysiological, labeling, optogenetics, mouse genetics, and neurochemical methods. Laboratory work focuses on conducting self-designed research projects by formulating and performing rigorous experiments. • Basic properties of excitable membranes. • Intracellular recordings of neuronal activity. • Functional analysis of membrane properties and neuronal activity. • Analysis of electrophysiological data with Spike2, Igor Pro or Python. • Analysis of neuronal interaction using optogenetics. • Optogenetic manipulation of behavioral output. • Function and Properties of neuromodulatory neurocircuits in vertebrates and invertebrates. • Modulation of membrane properties by biogenic amines or neuropeptides. • Immunohistological analysis of neuromodulator and neurotransmitter networks. • Single-cell labeling techniques, and fluorescence microscopy. • Generation and characterization of transgenic mice.
4	**Teaching Methods** • Lectures; Practical/Lab (Project work); Seminars; Guidance to independent research; Training on presentation techniques in oral and written form.
5	**Prerequisites (for the Module)** Enrollment in the Master's of Science degree course "Neuroscience" or "Genetics and Biology of Aging and Regeneration", or in the Master's degree course "Experimental and Clinical Neuroscience" **Additional academic requirements** Previous attendance of the lecture module Neuroscience
6	**Type of Examination** The final examination consists of two parts: Oral presentation (20-30 min; 50 % of the total module mark), written report (50 % of the total module mark)
7	**Credits Awarded** Regular and active participation; Each examination part at least "sufficient" (see appendix of the examination regulations for details)
8	**Compatibility with other Curricula** Optional compulsory module in the Master's degree course "Experimental and Clinical Neuroscience"
9	**Proportion of Final Grade** 12.0 %

10	**Module Coordinator** Dr. Henning Fenselau, phone 4726-2170, e-mail: henning.fenselau@sf.mpg.de
11	**Further Information** **Participating faculty:** Dr. H. Fenselau, Prof. Dr. P. Kloppenburg, Dr. J. Radermacher, Prof Dr. H. Scholz, Dr. S. Valtcheva, and guests. **Literature:** • Information about textbooks and other reading material will be given on the ILIAS representation of the course. **General time schedule:** Week 1-6 (Mon.-Fri.): Lectures, practical/lab work, and preparation for the seminar talk (held at the end of week 6) as well as writing seminar paper; Week 7 (Mon.-Fri): Preparation for the written examination **Note:** The module contains hands-on laboratory work conducted individually and is taught in course rooms. The module does not contain computer-based practicals/research as a main component. **Introduction to the module:** June 8, 2026 at 9:00 a.m., Cologne Biocenter, room 1.006/1.007 (first floor); for preparation for the module before this introduction, see ILIAS link under literature **Note**: Material for mandatory preparation before the course will be made available on the ILIAS representation of the course 10 days before the start of the module. **Oral examination:** July 24, 2026, second/supplementary examination October 9, 2026; the dates may vary if students and module coordinator agree. More details will be given at the beginning of the module.