Module Name
Computational Neuroscience

Type of Module	**Module Code**
o Advanced Module	Computational Neuroscience

Identification Number	**Workload**	**Credit Points**	**Term**	**Offered Every**	**Start**	**Duration**
MN-B-SM (N 6)	360 h	12 CP	2nd term of studying	Summer term	summer term only	7 weeks

1	**Course Types**	**Contact Time**	**Private Study**	**Planned Group Size***
	a) Lectures	30 h	60 h	max. 10
	b) Practical/Lab	100 h	130 h	max. 10
	c) Seminar	12 h	28 h	max. 10

2 Module Objectives and Skills to be Acquired

Students who successfully completed this module

- have acquired a general overview over the field of computational neuroscience.
- can use Python for scientific programming, data analysis, and computational modeling as well as for visualization of data and analysis of results.
- have gained an understanding of how electrical properties of neurons can be represented mathematically.
- can describe aspects of neural network connectivity using graph theoretical concepts.
- can perform basic spiking neural network simulations with NEST.
- are able to extract and condense information from the neuroscientific literature.
- have improved their overall analytical skills.
- have learned how to present research results and to critically discuss scientific publications related to the topic of the module on a professional level.
- are able to transfer skills acquired in this module to other scientific fields.

3 Module Content

- Fundamentals and selected topics of computational neuroscience
- Scientific programming with Python
- Analysis of electrophysiological data with Python
- Spike train statistics and stochastic point processes
- Neural coding and plasticity
- Mathematical descriptions of neurons and networks
- Ordinary differential equations
- Graph theory of neural networks
- Phase oscillator models of neural interactions
- Introduction to the neural network simulation tool NEST

4	**Teaching Methods** Lectures; Programming/mathematical exercises; Seminar; Guidance to independent research; training on presentation techniques in oral and written form
5	**Prerequisites (for the Module)** Enrollment in the Master´s degree course "Biological Sciences", "Experimental and Clinical Neuroscience", "Physics", or "Mathematics" **Additional academic requirements** Previous attendance of the lecture module "Neurobiology: Genes, Circuits, and Behavior (N)". Some programming experience in any language is highly recommended.
6	**Type of Examination** The final examination consists of two parts: written examination on topics of lectures, seminars and the practical/lab part (1 hour; 50% of the total module mark), oral presentation (20-30 min; 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*** Elective module in the Master´s degree course "Experimental and Clinical Neurosciences"
9	**Proportion of Final Grade** In the Master´s degree course "Biological Sciences": 15 % of the overall grade (see also appendix of the examination regulations)
10	**Module Coordinator** Prof. Dr. Martin Nawrot, phone 470-7307, e-mail: mnawrot@uni-koeln.de
11	**Further Information** **Subject module** of the Master´s degree course "Biological Sciences", **Specialization:** (N) Neurobiology: Genes, Circuits, and Behavior **Participating faculty**: Prof. Dr. S. van Albada, Prof. Dr. S. Daun, Prof. Dr. M. Nawrot, Dr. V. Rostami **Literature:** Information about textbooks and other reading material will be given on the ILIAS representation of the course (https://www.ilias.uni-koeln.de/ilias/goto_uk_cat_2815610.html) **General time schedule:** Week 1 (Mon.-Thu.): Seminar, lectures and practical sessions; Week 2-6 (Mon.-Thu.): Lectures and practical sessions; Week 1-6 (Fri.): Self-study time; Week 7 (Mon.-Thu.): Preparation for the written examination **Note:** The module contains computer-based practical sessions as a main component. **Introduction to the module:** May 17, 2022 at 15:00 p.m. online (further information/link will be sent to your Smail-Account); for preparation to the module before this introduction see ILIAS link under literature. **Oral or written examination:** July 15, 2022, second/supplementary examination August 26, 2022; the latter date may vary if students and module coordinator agree. More details will be given at the beginning of the module.

* 8 students from the Master´s degree course "Biological Sciences" and 2 students from the Master´s degree course "Experimental and Clinical Neurosciences"