Module Name **Computational Neuroscience**

Type of Module Advanced Module				**Module Code** AM-B-SM (N 6)		
Identification Number MN-B-SM (N 6)	**Workload** 360 Hours	**Credit Points** 12 CP	**Term** 1. – 3. Semester	**Offered Every** SuSe	**Start** Summer Term Only	**Duration** 7 weeks

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

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)** Formally: none Additional academic requirements: Basic knowledge of neurobiology is required, e.g. from the modules *Essentials in Neuroscience* or *Neural Function I: From experiments to Analysis*. Some programming experience in any language is highly recommended.
6	**Type of Examination** The final examination consists of three parts: Two hours written examination about topics of the lectures and the practical part (50 % of the total module mark), oral presentation about a scientific paper (25 % of the total module mark) and seminar paper (= written and programming exercises; 25 % of the total module mark)
7	**Credits Awarded** Regular and active participation; Each examination part at least “sufficient”
8	**Compatibility with other Curricula** None
9	**Proportion of Final Grade** 12/114
10	**Module Coordinator** Prof. Dr. Martin Nawrot, phone 470-7307, e-mail: mnawrot@uni-koeln.de
11	**Further Information** **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 **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.