| **Computational Neuroscience** | | | | | | |
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| **Identification number** | **Workload** | **Credit points** | **Term of studying** | | **Frequency of occurence** | **Duration** |
| M-Neuro-AM1 a-c | 360 h | 12 CP | 1st or 2nd term of studying | | Summer term, 2nd half | 7 weeks |

| 1 | **Type of lessons** | **Contact times** | **Self-study times** | **Intended 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 Aims of the module and acquired skills**

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 Contents of the module**

- 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/Learning methods**

- Lectures; Programming/mathematical exercises; Seminar; Guidance to independent research; Training on presentation techniques in oral and written form

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| **5** | **Requirements for participation**<br>Enrollment in the Master´s degree course "Biological Sciences" or in the Master´s degree course "Experimental and Clinical Neurosciences"<br>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 module examinations**<br>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** | **Requisites for the allocation of credits**<br>Regular and active participation;<br>Each examination part at least "sufficient" (see appendix of the examination regulations for details) |
| **8** | **Compatibility with other Curricula***<br>Elective module in the Master´s degree course "Biological Sciences" |
| **9** | **Significance of the module mark for the overall grade**<br>In the Master´s degree course "Experimental and Clinical Neurosciences": 12 % of the overall grade (see also appendix of the examination regulations) |
| **10** | **Module coordinator**<br>Prof. Dr. Martin Nawrot, phone 470-7307, e-mail: mnawrot@uni-koeln.de |
| **11** | **Additional information**<br>**Subject module** of the Master´s degree course "Biological Sciences",<br>**Specialization:** (N) Neurobiology: Genes, Circuits, and Behavior<br>**Participating faculty:** Prof. Dr. S. van Albada, Prof. Dr. S. Daun, Prof. Dr. M. Nawrot, Dr. V. Rostami<br>**Literature:**<br>• 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)<br>**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<br>**Note:** The module contains computer-based practical sessions as a main component.<br>**Introduction to the module:** June 01, 2021 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.<br>**Written examination:** July 23, 2021, second/supplementary examination August 27, 2021; 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"

**Corona note!** Depending on the Corona situation during the summer term, practical work may be skipped either totally or in part. In this case, some or all practical parts will be replaced by adequate alternatives so that (i) the workload and (ii) the principle content of the modules remained unchanged.