COURSE OUTLINE

(1) GENERAL

SCHOOL			
ACADEMIC UNIT	**Interdisciplinary Graduate Programme in the BRAIN and MIND sciences**		
LEVEL OF STUDIES	7		
COURSE CODE	**B&M-R-118**	SEMESTER	**depending on availability**
COURSE TITLE	Computational Neuroscience		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
laboratory exercises	6	9-27
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background, skills development
PREREQUISITE COURSES:	B&M -103 Introduction to Computational Neuroscience B&M -238 Principles of Computational Modeling in Neural Circuits Also recommended: B&M -232 Introduction to Statistics and Programming in Matlab B&M-236 Introduction to signal processing with applications in the analysis of discrete and continuous neuronal signals
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The goal of the research at the PoiraziLab of the Institute of Molecular Biology and Biotechnology (IMBB) at the Foundation for Research and Technology-Hellas (FORTH) is to implement computational models at various levels (neuronal, microcircuit, and neural network) and regions of the brain (hippocampus, amygdala, prefrontal cortex, visual cortex) and to use them for studying specific functions (learning and memory, interneuron function, spatial navigation, decision-making, sensory perception), with an emphasis on the role of dendrites. Our models are often used in conjunction with experiments from our experimental and collaborating laboratories. We also apply our models on various machine learning and

AI problems.

Upon completion of the laboratory exercise, the student will be able to:

- *Integrate and apply knowledge gained from mandatory and elective courses in the research context of their exercise topic.*
- *Develop skills in programming and usage of modern software.*
- *Use knowledge as a basis for original ideas and research.*
- *Think conceptually, develop, and deepen arguments.*
- *Analyze and carry out complex scientific work.*
- *Collaborate with colleagues and supervisor(s).*
- *Take responsibility for the results of their work.*
- *Communicate conclusions and knowledge clearly and accurately to specialized and non-specialized audiences, which may result from original research, self-study, or experience.*

If the laboratory exercise evolves into a master thesis, further engagement with the research topic will enable the student to:

- *Independently complete fundamental research based on methodological knowledge.*
- *Contribute original ideas to the research field.*
- *Recognize the limitations of existing knowledge in their scientific field and at the interface between adjacent scientific fields, and adjust their actions accordingly.*
- *Identify and analyze complex problems and solve them with strategy and creativity.*
- *Take responsibility for managing complex processes.*
- *Communicate in a targeted manner with colleagues, both experts and non-experts, as well as supervisors.*

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
Others…
…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Working independently
- Team work
- Working in an international environment
- Working in an interdisciplinary environment
- Production of new research ideas
- Project planning and management
- Showing social, professional and ethical responsibility and sensitivity to gender issues
- Criticism and self-criticism
- Production of free, creative and inductive thinking

(3) SYLLABUS

Students will be trained in the development of brain modeling techniques with an emphasis on the following:

Detailed Models: Development and/or use of detailed biophysical models of neurons that incorporate a wide variety of molecular mechanisms (using the NEURON simulation environment). Simulations of the electrical behavior of cell models to investigate their capacity for information processing under normal and pathological conditions (aging, chronic stress, Alzheimer's disease, schizophrenia, etc.).

Simplified Neuron Models: Less detailed mathematical and computational models of a single neuron or a group of neurons (e.g., artificial neural networks) for studying topics related to information processing in the brain, as well as neuro-inspired AI models.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of shared analysis codes.
Use of publisher databases/electronic repositories of scientific articles</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Study and analysis of bibliography</td><td>50-150</td></tr>
<tr><td>project</td><td>100-300</td></tr>
<tr><td>essay writing</td><td>25-75</td></tr>
<tr><td>non-directed study</td><td>50-150</td></tr>
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<tr><td>Course total</td><td>225-675</td></tr>
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</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Evaluation Language: English

Evaluation Criteria: The student's dedication to conducting the study, autonomy and independence, critical review and analysis of the literature, progress over time, and the quality of the report are evaluated.

Evaluation criteria are outlined in the study guide and communicated to students at the beginning of the course.</td></tr>
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(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
Scientific articles published in reputable scientific journals related to the research interests of the Poirazi Lab at the Institute of Molecular Biology and Biotechnology of the Foundation for Research and Technology-Hellas.

Useful link: https://dendrites.gr/