COURSE OUTLINE

(1) GENERAL

SCHOOL			
ACADEMIC UNIT	**Interdisciplinary Graduate Programme in the BRAIN and MIND sciences**		
LEVEL OF STUDIES	7		
COURSE CODE	**B&M-236**	SEMESTER	**Spring**
COURSE TITLE	Introduction to Signal Processing for Neural Signal Analysis		

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
lectures	9	6
study and analysis of bibliography	1	
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
PREREQUISITE COURSES:	B&M-105 Introduction to Molecular & Cellular Neuroscience B&M -102 Introduction to Systems Neuroscience I. Perception B&M -102A Introduction to Systems Neuroscience II. Movement & Cognitive Functions B&M -103 Introduction to Computational Neuroscience B&M -107 Introduction to Psychology & the Social Neuroscience B&M -106 Introduction to Philosophy of Mind B&M 232 Introduction to Statistics and Programming
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://elearn.uoc.gr/course/view.php?id=4431

(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 main objective of the course is to introduce students to the principles of signal processing, with special emphasis placed on techniques commonly used for the analysis of discrete signals (e.g., action potentials), and continuous neural signals (e.g., EEGs and LFPs). Students apply these concepts using Matlab or Python by analyzing electrophysiological signals and modifying template scripts to put their knowledge into practice. They also work with examples and articles from the recent literature. Through the critical review of scientific articles, students acquire specialized knowledge and gain an understanding of recent findings, which serve as a foundation for creative thinking.

By the end of the course, students master core signal analysis methods used in neuroscience, bridging theoretical understanding with practical applications in programming.

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

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Team work
- Working in an interdisciplinary environment
- Production of new research ideas
- Criticism and self-criticism
- Production of free, creative and inductive thinking

(3) SYLLABUS

1. Introduction to Signals
   - Continuous and discrete signals
   - Neural signals (e.g., action potentials, EEGs, LFPs)
2. Elementary Signals
   - Complex exponential signals
   - Unit step function
   - Impulse (delta) function
   - Triangular and rectangular pulses
3. Introduction to Systems
   - Properties of systems
   - Input-output relationships and convolution
4. Fourier Transform
   - Fourier series
   - Continuous, discrete, and fast Fourier transforms
   - Spectral analysis and Nyquist limit
   - Time-frequency analysis
   - Windowing and multi-taper techniques
5. Correlation and Coherence
6. Introduction to Filters
   - Low-pass, high-pass, and band-pass filters
7. Causality
   - Granger causality

(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>Integration of ICT in teaching
Utilizing the elearn platform for uploading teaching materials
Communication via "e-learn" and e-mail
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>Lectures</td><td>40</td></tr>
<tr><td>Practical exercises</td><td>45</td></tr>
<tr><td>Study and analysis of bibliography</td><td>20</td></tr>
<tr><td>non-directed study</td><td>120</td></tr>
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<tr><td>Course total</td><td>225</td></tr>
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<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
Assessment Methods: Multiple-choice questionnaires, short-answer questions
Written exam (oral examination available in special cases)
The written examination accounts for 70% of the final grade.

After each lecture, students are assigned exercises that combine theoretical and practical problems. They solve and submit these exercises, with their performance contributing 20% to the final grade.

Finaly, students present scientific articles from the recent neuroscience literature that implement the methods taught in the course. The presentation contributes 10% of the final grade.

Evaluation criteria are outlined in the study guide and communicated to students at the beginning of the course.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Signals and Systems by Alan V. Oppenheim, Alan Willsky, S. Nawab, 2nd edition, Publisher: Pearson
- Analyzing Neural Time Series Data: Theory and Practice (Issues in Clinical and Cognitive Neuropsychology), 1st Edition, Mike X. Cohen, The MIT Press