

## COURSE OUTLINE

### (1) GENERAL

SCHOOL			
ACADEMIC UNIT	Interdisciplinary Graduate Programme in the BRAIN and MIND sciences		
LEVEL OF STUDIES	7		
COURSE CODE	CS-590.75	SEMESTER	depending on availability
COURSE TITLE	Biomimetic Robotics		
INDEPENDENT TEACHING ACTIVITIES <i>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</i>		WEEKLY TEACHING HOURS	CREDITS
lectures		4	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	Special background		
PREREQUISITE COURSES:	B&M-103 Introduction to Computational Neuroscience B&M-232 Introduction to Statistics and Programming  Recommended also: B&M-236 Introduction to Signal Processing for Neural Signal Analysis		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	<a href="https://elearn.uoc.gr/course/view.php?id=4436">https://elearn.uoc.gr/course/view.php?id=4436</a>		

### (2) LEARNING OUTCOMES

<p><b>Learning outcomes</b></p> <p><i>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.</i></p> <p><i>Consult Appendix A</i></p> <ul style="list-style-type: none"> <li>• <i>Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area</i></li> <li>• <i>Descriptors for Levels 6, 7 &amp; 8 of the European Qualifications Framework for Lifelong Learning and Appendix B</i></li> <li>• <i>Guidelines for writing Learning Outcomes</i></li> </ul>
<ol style="list-style-type: none"> <li>1. <b>Knowledge:</b> Upon attending and successfully completing the course, the student will be able to describe how specific, selected problems in the broader field of biomimetic robotics are addressed in the recent relevant literature.</li> <li>2. <b>Understanding:</b> Upon attending and successfully completing the course, the student will have achieved an in-depth understanding of the mechanisms used to solve specific problems in biomimetic robotics and will be able to explain the reasons why these mechanisms are suitable for solving other problems as well.</li> <li>3. <b>Application:</b> Upon attending and successfully completing the course, the student will be</li> </ol>

able to reuse existing methodologies and tools to produce alternative solutions for special cases of specific biomimetic robotics problems or to develop related applications.

4. **Analysis:** Upon attending and successfully completing the course, the student will be able to critically examine specific problems and perceive them as a synthesis of a series of smaller subproblems.
5. **Synthesis:** Upon attending and successfully completing the course, the student will be able to combine individual tools and methodologies to achieve the solution of complex problems in biomimetic robotics.
6. **Evaluation:** Upon attending and successfully completing the course, the student will be able to measure and quantitatively assess the quality of solutions to biomimetic robotics problems and to compare these solutions with other existing ones.

#### 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
- 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

- Basic concepts of biomimetic robotics
- Biologically inspired locomotion of robotic systems (e.g., undulatory locomotion of snakes on land and in water, legged locomotion of quadrupeds and insects, fish swimming, etc.)
- Kinematics and inverse kinematics of robotic systems, especially for robotic arms and mobile robots
- Velocity kinematics of robotic systems, especially for robotic arms and mobile robots
- Dynamics of robotic systems, especially for robotic arms and mobile robots
- Control of robotic systems, with emphasis on linear and nonlinear control, especially for robotic arms and mobile robots
- Sensor- and learning-based control of robotic systems, especially for robotic arms and mobile robots
- Biologically inspired reactive behaviours of robotic systems, especially for robotic arms and mobile robots
- Biological mechanisms of motion control, such as central pattern generators, neuromuscular control, etc.

- Biologically inspired motion control of robotic systems based on linear and nonlinear oscillators, oscillator networks and related learning processes, and neuromuscular control models

## (1) TEACHING and LEARNING METHODS - EVALUATION

<b>DELIVERY</b> <i>Face-to-face, Distance learning, etc.</i>	Face-to-face	
<b>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</b> <i>Use of ICT in teaching, laboratory education, communication with students</i>	Use of slides/films Use of an online platform for posting articles Communication via the course website and email Use of publishers' databases/electronic repositories of scientific articles	
<b>TEACHING METHODS</b> <i>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</i>	<b>Activity</b>	<b>Semester workload</b>
	Lectures	52
	Tutorials	0
	Study	52
	Exercises/labs	52
	Final project	8
	Exams	4
	Course total	<b>168</b>
<b>STUDENT PERFORMANCE EVALUATION</b> <i>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.</i>	Class attendance/participation Exercises/projects Oral/written exams  Students are informed about the evaluation process during the first lecture of the course. It is also made available on the course website.	

## (2) ATTACHED BIBLIOGRAPHY

<ul style="list-style-type: none"> <li>• H. Choset, K.M. Lynch, S. Hutchinson, G.A. Kantor, W. Burgard, L. Kavraki, S. Thrun, Principles of Robot Motion, MIT Press, 2005.</li> <li>• J.J. Craig, Introduction to Robotics: Mechanics and Control, Third Edition, Pearson Prentice Hall, 2005.</li> <li>• H.K. Khalil, Nonlinear Systems, Macmillan, 1992.</li> <li>• R.M. Murray, Z. Li &amp; S.S. Sastry, A Mathematical Introduction to Robotic Manipulation, CRC Press, 1994.</li> <li>• T. Yoshikawa, Foundations of Robotics: Analysis and Control, MIT Press, 1990.</li> <li>• J.D. Murray, Mathematical Biology, Second Edition, Springer, 1993.</li> <li>• R. Pfeifer and C. Scheier, Understanding Intelligence, The MIT Press, 1999.</li> </ul>
--