COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	Informatics and Computer Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	ICE-8110	**SEMESTER**	8th
COURSE TITLE	Neural Networks		
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	3	
	Computer Laboratory	1	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		**4**	**5**
COURSE TYPE general background, special background, specialised general knowledge, skills development	Specialised general knowledge, skills development		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/CS200/		

(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

Upon successful completion of the course, the student must:

- understand the difference between the algorithmic way of solving the problems of classical artificial intelligence and the inductive learning process of artificial neural networks
- understand the difference between supervised and unsupervised learning
- explain the operation of various neural network models
- design and implement single-layer and multi-layer neural networks
- analyze the performance of neural networks
- choose an appropriate neural network model depending on the problem to be solved
- explain the technical possibilities, advantages and limitations of learning and self-organizing systems
- analyze, design and implement deep learning neural networks
- appliy deep learning neural networks, such as convolutional neural networks, to various applications from the fields of pattern recognition, computer vision and artificial intelligence.

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 Project planning and management

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	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
- Decision-making
- Team work
- Production of new research ideas
- Production of free, creative and inductive thinking

(3) SYLLABUS

Introduction - Historical review - Artificial neuron model - Training of neural networks. Supervised training. Linear associative memories: Correlation Matrix Memory - Generalized Inverse Memory. Single-layer Perceptron. Multi-layer Perceptron. BackPropagation, Resilient Propagation (RProp), No propagation (No-Prop), Extreme Learning Machines (ELM). ADALINE – the LMS algorithm. Hamming network/MAXNET. Hopfield Network. Radial Basis Function Networks. The LVQ algorithm and its variants. Convolutional Neural Networks. Deep learning neural networks. Unsupervised training. Kohonen network (self-organizing maps). Neurocomputers – Parallel neural network implementations. Applications.

Computer Lab: Training in the MATLAB environment and the Neural Networks toolbox. Implementation of a simple Perceptron and its application to linearly and non-linearly separable problems. Implementation of multilayer neural network with back-propagation and Levenberg-Marquardt training algorithms for solving non-linear problems. Implementation of associative correlation matrix and generalized inverse memories for solving pattern recognition problems. Implementation of LVQ and self-organizing map (SOM) network in synthetic problems. Implementation of deep learning convolutional network in a real problem (e.g. recognition of handwritten numeric characters, image classification, etc.)

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY Face-to-face, Distance learning, etc.	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY Use of ICT in teaching, laboratory education, communication with students	Use of web-based asynchronous elearning systems to support the educational material (notes, powerpoint presentations, self assignments, past exams etc.) and examinations. Use of email and announcements in elearning system to communicate and inform students.
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.	

Activity	Semester workload
Lectures	39
Computer Laboratory	13
Written assignments	30
Self study	43
Course total	**125**

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	
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.	I. Final written exam (70%) which contains : - Short-answer questions - Multiple choice questionnaires - Problem solving II. Computer laboratory assignments (30%) The exam material and the assessment process are made known to students in the lecture hall, the laboratory and the e-learning platform of the course.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Haykin S., Νευρωνικά Δίκτυα και Μηχανική Μάθηση, Εκδόσεις Παπασωτηρίου, 2010.
2. Διαμαντάρας Κ., Τεχνητά Νευρωνικά Δίκτυα, Εκδόσεις Κλειδάριθμος, 2007.
3. Ρίζος Γ., Τεχνητά Νευρωνικά Δίκτυα: Θεωρία και Εφαρμογές, Εκδόσεις Νέων Τεχνολογιών, 1996.
4. Bishop M., Neural Networks for Pattern Recognition, Clarendon Press, 1997.
5. Lin C-T., Lee C.S.G., Neural Fuzzy Systems: A Neuro-Fuzzy Synergism to Intelligent Systems, Prentice Hall, 1996.
6. Kohonen T., Self-Organizing Maps, Springer Verlag, 1995.
7. Haykin S., Neural Networks: A Comprehensive Foundation, McMillan, 2nd ed., 1999.
8. Hertz J., Krogh A., Palmer R., Introduction to the Theory of Neural Computation, Addison Wesley, 1991.
9. Goodfellow I., Bengio Y., Courville A., Deep Learning, MIT Press, 2016.
10. Nielsen M., Neural Networks and Deep Learning, free online book, http://neuralnetworksanddeeplearning.com/, 2017.