Program	Level	Second cycle			
	Name of the program	Theoretical Computer Science, Applied Mathematics			
COURSE					
Course title	**Neural Networks**				
Course code	Semester	Course status	ECTS	Contact hours (L+AE+LE)	
CS 523	III	Elective course	7	3+0+2	
Lecturer					
Course Goals	The primary goal of this elective subject is to introduce students to basic concepts from the theory of neural networks and their applications for solving practical problems.				
Learning Outcomes	By the end of this course, the students will be able to apply the fundamental knowledge from neural networks to solve very different practical problems.				

COURSE CONTENT

- Introduction to neural networks. Types of neural networks. The linear and non-linear networks.
- Elman networks and Jordan networks. Recurrent networks.Rosenblatt perceptron.
- One-layer perceptron. Multilayered neural networks with pre-propagation. Algorithms for training neural networks. A part of the rule for the return propagation of the error.
- Support Vector Machines (SVM). Bayesian Classifier (BC). Stochastic methods in statistical mechanics.
- Algorithms based on the gradient. LMS algorithms. Simulated Annealing (SA). Genetic Algorithms (GA).
- Hopfield networks and Boltzmann machines. The theory of regularization. Principal Component Analysis (PCS).
- K-Means Algorithm. Learning Methods of Radial Basis Function Neural Network.
- Advanced Neural Networks: Probabilistic neural networks, Self-organizing mappings, Competitive networks, Kohonen's rule of learning, Self-organizing folders, LVQ networks.
- Nearest Neighbors Algorithms. Dynamic Programming. Neurodynamics. Dynamically driven recurrent networks.
- PYTHON and MATLAB for simulating the work of neural networks. The applications of neural networks in pattern recognition, signal analysis, image processing, etc.

LITERATURE

[1] James A. Anderson, An Introduction to Neural Networks, 1st edition, (1995), MIT Press.

[2] Vojislav Kecman: Learning and Soft Computing: Support Vector Machines, Neural Networks, and Fuzzy Logic Models, 1st edition, (2001), MIT Press.

[3] Simon O. Haykin: Neural Networks and Learning Machines, 3rd Edition, (2008), Prentice Hall.

[4] Hertz, John, Anders Krogh, and Richard G. Palmer: Introduction to the Theory of Neural Computation, 1st edition, (1991), Addison-Wesley Pub.

[5] Christopher M. Bishop: Pattern Recognition and Machine Learning, 1st edition, (2006), Springer.

STUDENT WORKLOAD (hours in a semester)

Lectures	45	Exercises	30	Individual work	100	T o t a l	175

GRADING			**REMARKS**
Criterion	Maximum points	Minimum points	
Midterm exams	20	10	
Assignments	10	5	
Projects	30	15	
Seminar paper	0	0	
Final exam	40	25	
T o t a l	100	55	