DESCRIPTION OF THE COURSE

Name of course: **Nonlinear systems and neural networks**	Code:	Semester: 6
Type of teaching: Lectures and Laboratory work	Lessons per week: L: 1,5 hours LW: 1 hours	Numbers of credits:

COURSE STATUS IN THE CURRICULUM: Optional for the students speciality Industrial Engineering BEng programme of the English Language Faculty of Engineering.

AIMS AND OBJECTIVES OF THE COURSE: To give knowledge about nonlinear systems, analysis of nonlinear systems, stability concepts, bifurcation and chaos, to introduce basic concepts of neural networks, perceptron, adaptive linear element and delta method, associative learning and Hebb nets, backpropagation networks, radial basis networks, neural networks based on competition, Kohonenself-organizing maps, adaptive resonance theory.

PROGRAMME OF THE COURSE:

1. Introduction to nonlinear systems. State space approach. Linearization technique. Hartman Grobman theorem.
2. Periodic orbits and limit cycles. Bendixon theorem. Poincare maps. Describing functions method.
3. Lyapunov stability concept. Lyapunov functions. Lasalle's invariance principle
4. Bifurcations and chaos.
5. Basic components of Neural Networks: architectures, learning algorithms, activation functions. Biological Neural Nets and Artificial Neural Nets.
6. Adaptive Linear Element (ADALINE) and delta method. MADALINE.
7. Perceptron and Perceptron Learning Rule. Convergence of the Perceptron Learning Rule.
8. Associative learning and Hebb Nets. Hopfield Networks.
9. Multilayer feedforward networks and basics of backpropagation algorithm. Radial Basis Function Networks
10. Competitive learning. Kohonen Self-Organizing Maps. Adaptive Resonance Theory Model.

PERSONAL WORK REQUIRED: Attendance at the course, preparation of tasks and labs.

PREREQUISITES: Mathematics I, Mathematics II, Mathematics III, Control Theory I, Electrical Engineering I.

METHOD OF ASSESSMENT: One three hours exam at the end of the semester (70%), plus laboratories (30%).

INSTRUCTION LANGUAGE: English.

BIBLIOGRAPHY:

[1] S. S. Sastry. Nonlinear Systems: Analysis, Stability, and Control, Springer-Verlag, 1999.
[2] H. K. Khalil. Nonlinear Systems, 2nd Edition. Prentice-Hall, 1996.
[3] M. Vidyasagar, Nonlinear Systems Analysis, Second Edition, Prentice Hall, 1993.
[4] Fausett L., "Fundamentals of Neural Networks", Prentice-Hall, 1994. ISBN 0130422509.
[5] Haykin S., "Neural Networks: A comprehensive foundation", 2nd Edition, Prentice Hall, 1999, ISBN 0132733501.