FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Sieci neuronowe w automatyce**
Name in English:	**Neural Networks in Control Engineering**
Main field of study (if applicable):	**Industrial Control Engineering**
Specialization (if applicable):	**Automation and Control in Electrical Power Systems**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**optional**
Subject code:	**APR013234**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	15		15		
Number of hours of total student workload (CNPS):	30		30		
Form of crediting:	crediting with grade		crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	1		1		
including number of ECTS points for practical (P) classes :			1		
including number of ECTS points for direct teacher-student contact (BK) classes:	0.70		0.70		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge in the field of control theory, informatics and modeling of dynamical systems (using Matlab/Simulink).

SUBJECT OBJECTIVES

C1. Familiarizing students with the extended knowledge on the neural modeling, topologies of neural networks, learning methods.

C2. The acquisition of practical knowledge on the design and software-based realization of different neural network structures and their applications as controllers, data classifiers in industrial systems.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01 Has a extended knowledge on different neural network architectures and learning methods.

PEU_W02 Has knowledge on basic optimization methods of neural networks.

PEU_W03 Has knowledge on fundamental applications of chosen neural network structures as controllers and predictive models in industrial systems.

relating to skills:

PEU_U01 Can design different neural network structures for specific application and train those models for problem solving.

PEU_U02 Can design the control structure with neural controller, including adaptive solution.

relating to social competences:

PEU_K01 Can think and act in a creative and independent way. Can find and improve the methods of problem solving.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Introduction. Basic problems and structures of neural networks – repetition.	2
Lec 2	Control structures with neural models.	2
Lec 3	Adaptive neural control part 1	2
Lec 4	Adaptive neural control part 2.	2
Lec 5	Application of genetic algorithms for parameters optimization of neural control structures.	2
Lec 6	Hardware implementations of neural network control structures.	2
Lec 7	Neural networks used for prediction.	2
Lec 8	Lecture assessment-written test	1
	Total hours:	**15**

Form of classes - laboratory		**Number of hours:**
Lab 1	Introduction. Organization of exercises. Familiarizing with simulation software.	2
Lab 2	Design and training of different neural networks, testing of selected learning methods.	2
Lab 3	Design and software implementation of neural predictive models for real data.	2
Lab 4	Design and training of neural controllers, including adaptive controllers.	4
Lab 5	Application of genetic algorithms for optimization of chosen parameters of neural controllers.	4
Lab 6	Crediting with grade.	1
	Total hours:	**15**

TEACHING TOOLS USED

N1. Lecture with multimedia tools combined with classical lecture (problem oriented).
N2. Own work – studying problems and preparation to the exam.
N3. Consultations.
N4. Own work – preparation to the laboratory exercises.
N5. Testing of student knowledge with short test before laboratory exercises.
N6. Laboratory exercises – discussion of the obtained experimental results in reports.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation *F – forming (during semester) P – concluding (at semester end)*	**Educational effect number**	**Way of evaluating educational effect achievement**
F1(W)	PEU_W01 PEU_W02 PEU_W03	Test.
P(W)	P=F1	
F1(L)	PEU_U01 PEU_U02	Evaluation of student preparation to laboratory exercises (short tests).
F2(L)	PEU_U01 PEU_U02	Evaluation of the laboratory reports.
F3(L)	PEU_U01 PEU_U02 PEU_K01	Activity in the laboratory practices.
P(L)	P = 0,3*F1+0,3*F2+0,4*F3	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Osowski S. Sieci neuronowe w ujęciu algorytmicznym, WNT 1996.
[2] Rutkowska D., Piliński M., Rutkowski L., Sieci neuronowe, algorytmy genetyczne i systemy rozmyte, PWN, 1997.
[3] Neural Networks Toolbox for use with MATLAB®, User's Guide.

SECONDARY LITERATURE:

[1] Korbicz J., Obuchowicz A., Uciński D., Sztuczne sieci neuronowe. Podstawy i zastosowania. Akademicka Oficyna Wydawnicza PLJ, Warszawa 1994.
[2] Żurada J., Barski M., Jędruch W., Sztuczne sieci neuronowe, PWN, 1996.

SUBJECT SUPERVISOR

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