

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): **Control Engineering and Robotics**  
 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: **ARR043234**  
 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 EDUCATIONAL EFFECTS***relating to knowledge:*

- PEK\_W01 Has a extended knowledge on different neural network architectures and learning methods.  
 PEK\_W02 Has knowledge on basic optimization methods of neural networks.  
 PEK\_W03 Has knowledge on fundamental applications of chosen neural network structures as controllers and predictive models in industrial systems.

*relating to skills:*

- PEK\_U01 Can design different neural network structures for specific application and train those models for problem solving.  
 PEK\_U02 Can design the control structure with neural controller, including adaptive solution.

*relating to social competences:*

- PEK\_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 EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation <i>F - forming (during semester) P - concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(W)	PEK_W01 PEK_W02 PEK_W03	Test.
P(W)	P=F1	
F1(L)	PEK_U01 PEK_U02	Evaluation of student preparation to laboratory exercises (short tests).
F2(L)	PEK_U01 PEK_U02	Evaluation of the laboratory reports.
F3(L)	PEK_U01 PEK_U02 PEK_K01	Activity in the laboratory practices.
P(L)	$P = 0,3 \cdot F1 + 0,3 \cdot F2 + 0,4 \cdot F3$	

## 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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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT  
**ARR043234 - Neural Networks in Control Engineering**  
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Control Engineering and Robotics**  
AND SPECIALIZATION **Automation and Control in Electrical Power Systems**

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	S2ASE_W13	C.1	Lec1 Lec2	N.1 N.2 N.3
PEK_W02	S2ASE_W13	C.1	Lec1 Lec2 Lec5	N.1 N.2 N.3
PEK_W03	S2ASE_W13	C.1 C.2	Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N.1 N.2 N.3
PEK_U01	S2ASE_U12	C.1	Lab1 Lab2 Lab3	N.4 N.5 N.6
PEK_U02	S2ASE_U12	C.2	Lab4 Lab5	N.4 N.5 N.6
PEK_K01	K2AiR_K06	C.1 C.2	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6	N.3 N.6