DESCRIPTION OF THE COURSES

- Course code: ELR2169
- Course title: ARTIFICIAL INTELLIGENCE METHODS IN POWER SYSTEM PROTECTION AND CONTROL
- Language of the lecturer: Polish

Course form	***Lecture***	***Classes***	***Laboratory***	***Project***	***Seminar***
*Number of hours/week**	*2*				
*Number of hours/semester**	*22*				
Form of the course completion	*pass*				
ECTS credits	*2*				
Total Student's Workload	*30*				

- Level of the course (basic/advanced): advanced
- Prerequisites:
  completed courses: Fundamentals of Control Engineering.
- Name, first name and degree of the lecturer/supervisor:
  Waldemar Rebizant, Ph. D., D. Sc.
- Names, first names and degrees of the team's members:
  Mirosław Łukowicz, Ph. D.
- Year:..... Semester:.....
- Type of the course (obligatory/optional): optional
- Aims of the course (effects of the course):
  The students should obtain the knowledge on theory and application possibilities of artificial intelligence methods for power system protection and control tasks. They should be able to decide which of the method to apply for given power system problem.
- Form of the teaching (traditional/e-learning): traditional
- Course description:
  Artificial intelligence techniques in power system control; Expert systems – main features, structure, inference methods, strategies for conflict resolving, application fields; Systems based on fuzzy logic – fuzzy signals, membership functions, fuzzy settings, fuzzification and defuzzification methods, multicriterial algorithms; Artificial neural networks – main features, neurone types, activation functions, neural network architectures, learning methods, application fields; Genetic algorithms – evolutionary strategies, genetic modifications, application examples; Hybrid intelligent schemes; Application examples of intelligent techniques described for power system protection and control purposes.
- Lecture:

Particular lectures contents	*Number of hours*
1. Introduction – definition of artificial intelligence (AI), AI as a branch of science, AI techniques in power systems, statistics of AI application	*1*

	in power system protection and control.	
2.	*AI approach to protection and control tasks – problems of contemporary digital protection systems, protection relay as a classifying unit, protection tasks as pattern recognition tasks.*	*1*
3.	*Expert Systems (ES) – definitions, knowledge base, data base, inference mechanisms.*	*2*
4.	*ES – semantic rules and structures, acquisition of rules, inference methods, conflict resolving strategies.*	*2*
5.	*Expert Systems – application fields, examples.*	*1*
6.	*Fuzzy Logic (FL) – basics of fuzzy sets theory, operations on fuzzy sets, fuzzy arithmetic, linguistic variables, operators of aggregation, fuzzy reasoning.*	*2*
7.	*Elements of FL in power system protection – fuzzy criteria signals, fuzzy settings, fuzzy comparison, amount of information, multicriterial decision making.*	*2*
8.	*Examples of FL technique application in power system protection.*	*2*
9.	*Artificial Neural Networks (ANN) – neurone models, activation functions, ANN architectures: multilayer perceptron, feed-forward networks, ANNs with feedback connections, Hopfield networks, Kohonen networks.*	*2*
10.	*ANN design problems – network structure selection, generation of training patterns, training algorithms with and without the teacher, learning process acceleration techniques, knowledge generalisation vs. overfitting.*	*2*
11.	*Examples of ANN application in power system control.*	*1*
12.	*Genetic algorithms – evolutionary strategies, genetic modification of individuals, genetic optimisation, application examples.*	*2*
13.	*Comparison of described AI techniques, hybrid structures, examples.*	*2*

- Classes – the contents:
- Seminars – the contents:
- Laboratory – the contents:
- Project – the contents:
- Basic literature:

[1] Pao Y.A.: "Adaptive Pattern Recognition and Neural Networks", Addison-Wesley, Reading, MA, 1989.

[2] Yager R.R. and Filev D.P.: "Essentials of Fuzzy Modelling and Control", J. Wiley & Sons, Inc., New York, USA, 1994.

[3] Ringland G.A. and Duce D.A. (ed. By): "Approaches to Knowledge Representation: An Introduction", Research Studies Press Ltd., Wiley & Sons, Chichester, England, 1988.

[4] Dillon T.S. and Niebur D. (edited by): "Neural Network Applications in Power Systems", CRL Publishing Ltd., London, 1996.

[5] Cichocki A., Unbehauen R., "Neural Networks for Optimization and Signal Processing". John Wiley & Sons, 1993.

[6] Gottlob G. And Nejdl W. (ed. by): “Expert Systems in Engineering: Principles and Applications”, Proceedings of the International Workshop, Vienna, Austria, Sept. 1990.

- Additional literature:
  Selection of papers from scientific journals and conference proceedings.
- Conditions of the course acceptance/credition:
  pass

***** - depending on a system of studies