

DESCRIPTION OF THE COURSES

- Course code: ARR2108
- Course title: BASICS OF SYSTEMS MODELLING
- Language of the lecturer: Polish

<i>Course form</i>	<i>Lecture</i>	<i>Classes</i>	<i>Laboratory</i>	<i>Project</i>	<i>Seminar</i>
<i>Number of hours/week*</i>	2		1		
<i>Number of hours/semester*</i>	30		15		
<i>Form of the course completion</i>	pass		pass		
<i>ECTS credits</i>	2		1		
<i>Total Student's Workload</i>	60		30		

- Level of the course (basic/advanced): basic
- Prerequisites:
completed course: Numerical Methods, Control Theory, AI Methods.
- Name, first name and degree of the lecturer/supervisor:
Eugeniusz Rosołowski, Prof., Ph. D., D. Sc.
- Names, first names and degrees of the team's members:
Jan Iżykowski, Ph. D., D. Sc.
Waldemar Rebizant, Ph. D., D. Sc.
Marek Michalik, Ph. D.
Mirosław Łukowicz, Ph. D.
- Year: 4 Semester: 8
- Type of the course (obligatory/optional): obligatory
- Aims of the course (effects of the course):
The course provides descriptions of contemporary methods used for mathematical representation of basic physical processes. The formulated models are represented in the form suitable for computer simulation.
- Form of the teaching (traditional/e-learning): traditional
- Course description:
The course consists of the lecture and laboratory classes. Both of these forms deal with the following problems: General introduction to the modelling, Modelling of physical systems with special consideration of electrical systems - basic principles. Linear and non-linear models with lumped and distributed parameters. Continuous and discrete-time models. State-variables model with state-observer application. Stochastic, neural and fuzzy models. Representation of suddenly changing structures: bifurcation, chaos theory and fractals application.
- Lecture:

<i>Particular lectures contents</i>	<i>Number of hours</i>
1. <i>Introduction: basic definitions, physical – mathematical models, identification, parameters estimation.</i>	2
2. <i>Process modelling. Linear and non-linear models.</i>	2

3. Continuous-time models. Numerical simulation of continuous-time models.	2
4. Discrete-time models. Examples of discrete-time models. Simulation problems.	2
5. Distributed-parameter models: waves phenomena.	2
6. Distributed-parameter models: heat transportation phenomena.	2
7. Input-output models. State-variable models – canonical forms.	2
8. Stochastic models. Random signals: specification and characteristics.	2
9. Generation of random and pseudo-random signals. Generation of pseudo-random binary sequences.	2
10. Generation of random signals with a given distribution. Statistical tests for generators of random signals.	2
11. Neural models. Feed-forward and feedback neural networks.	2
12. Modelling of elements and processes with unknown mathematical models.	2
13. Fuzzy logic application to modelling of dynamical systems.	2
14. Modelling of suddenly changing structures: bifurcation, chaos and fractals.	2
15. Application aspects. Model verification.	2

- Classes – the contents:
- Seminars – the contents:
- Laboratory – the contents:
 1. Modelling of wave phenomena in transmission lines.
 2. Simulation investigation of electrostatic fields.
 3. Modelling of heat transportation.
 4. Simulation of windmill power station.
 5. Modelling of electrical energy load forecasting.
 6. Fuzzy model of multi-criteria decision making device.
- Project – the contents:
- Basic literature:
 - [1] Pidd M. (ed.), Systems Modelling: Theory and Practice. Wiley, 2004.
 - [2] Peebles P. Z. Jr. Probability, random variables and random signal principles. McGraw-Hill, Inc., 1993
 - [3] Materials available: <http://www.rose.pwr.wroc.pl/>
- Additional literature:
 - [1] Sharon Allen, Modelowanie danych. Wydawnictwo Helion, Gliwice, 2004.
 - [2] Elektroniczny poradnik statystyczny: www.statsoft.pl/textbook/stsepath.html
 - [3] Mariusz Ziółko, Modelowanie zjawisk falowych. AGH Uczelniane Wydaw. Naukowo-Dydaktyczne, Kraków 2000. Dostępne: <http://winntbg.bg.agh.edu.pl/skrypty2/0066/>
 - [4] Modelling of reality. Materials available: <http://www.neuroinf.pl/Members/danek/swps/>
 - [5] World of bifurcation. Available: <http://www.bifurcation.de/>

[6] Iwo Białynicki-Birula, Iwona Białynicka-Birula, Modelowanie rzeczywistości. Pruszyński i S-ka, Warszawa, 2002.

- Conditions of the course acceptance/creditation: test pass, lab pass.

* - depending on a system of studies