FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Identyfikacja obiektów sterowania**
Name in English:	**Control object identification**
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:	**obligatory**
Subject code:	**APR012511**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30		15		
Number of hours of total student workload (CNPS):	60		30		
Form of crediting:	crediting with grade		crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	2		1		
including number of ECTS points for practical (P) classes :			1		
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40		0.70		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of algebra at the basic level.
2. Knowledge of mathematical analysis at the basic level.
3. Knowledge of stochastic processes.
4. Knowledge of problems of control theory.
5. Abilities of developing computer programs and performing calculation in the Matlab environment.

SUBJECT OBJECTIVES

C1. Knowing methods of control object identification.
C2. Acquiring proficiency in solving problems of control object identification.
C3. Familiarising with software used for solving problems of control object identification.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01 The student has knowledge related to identification of parametric static models.
PEU_W02 The student has knowledge related to identification of parametric dynamic models.
PEU_W03 The student has knowledge related to identification of non-parametric stationary models.

relating to skills:

PEU_U01 The student is able to plan identification process.
PEU_U02 The student is able to solve identification problem.
PEU_U03 The student is able to perform identification calculation in the Matlab environment.

relating to social competences:

PEU_K01 The student can independently solve identification problems.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Introduction. Basic terms and definition: dynamic systems, models of dynamic systems, identification, interpretation of identified model, identification process.	2
Lec 2	Identification of static models the least squares method: a principle of the method, a recursive algorithm, a deterministic criterion for assessing model correctness.	2
Lec 3	Statistical analysis of the results of identification of static models with use of the least squares method.	2
Lec 4	The identification experiment in the case of dynamic models: general characteristics, choice of sampling time, choice of input signals.	2
Lec 5	Identification of parametric dynamic models: the essence of identification, models ARX, ARMAX, estimation of parameters of models by the least squares method, the instrumental variable method and the maximum likelihood method.	2
Lec 6	Validation of parametric dynamic models.	2
Lec 7	Identification of non-stationary parametric dynamic models.	2
Lec 8	Comparison of identification of static and dynamic parametric models. Test.	2
Lec 9	Identification of time-series models: time-series concept, properties of time-series (stationarity, stability), properties of time-series models (causality, stability, reversibility), process of identification of time-series models, stochastic time-series models (stationary and non-stationary models) and their properties.	2
Lec 10	Identification of the impulse response: recursive and non-recursive methods.	2
Lec 11	Identification of power spectral density: description of a signal in the frequency domain, classical and modern identification methods	2
Lec 12	Identification of the amplitude and phase characteristics with use of non-parametric methods: purpose of the identification, identification methods (frequency analysis, frequency analysis using correlation methods, spectral analysis), coherence function, input signals.	2
Lec 13	Identification of static and dynamic models with use of the stochastic approximation: the principle of the stochastic approximation, an algorithm of identification.	2
Lec 14	A summary of the methods for control object identification. Test.	2
Lec 15	Summary of methods for testing the quality of identified models of control objects and ways to find improved models.	2
	Total hours:	**30**

Form of classes - laboratory		**Number of hours:**
Lab 1	An introduction, the laboratory program. Mathematical models and identification process of control objects.	1
Lab 2	Identification of static models with the use of the least squares method - a deterministic approach.	2
Lab 3	Identification of static models with the use of the least squares method - a stochastic approach.	2
Lab 4	Identification of dynamic models with the use of the ARX model.	2
Lab 5	Identification of dynamic models cont. - identification of the model of a practical object.	2
Lab 6	Identification of the parameters of time series models.	2
Lab 7	Identification of the impulse response.	2
Lab 8	Identification of the amplitude and phase characteristics.	2
	Total hours:	**15**

TEACHING TOOLS USED
N1. Multimedia presentation.
N2. Information lecture.
N3. Preparation in the form of reports.
N4. he MATLAB/Simulink programming environment.

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	activity at the classes
F2(W)	PEU_W01 PEU_W02 PEU_W03	average of the grades from tests
P(W)	P=0.1F1 + 0.9F2	
F1(L)	PEU_U01 PEU_U02 PEU_U03	activity at the classes
F2(L)	PEU_U01 PEU_U02 PEU_U03	reports from the classes
P(L)	P=0,3F1+0,7F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Królikowski A., Identyfikacja obiektów sterowania, Wyd. Pol. Poznańskiej, Poznań 2005.
[2] Królikowski A., Horla D., Identyfikacja obiektów sterowania: metody dyskretne, Wyd. Pol. Poznańskiej, Poznań 2005.
[3] Mańczak K., Nahorski Z., Komputerowa identyfikacja obiektów dynamicznych, PWN, Warszawa 1983.
[4] Pr. zb., Dynamika i identyfikacja obiektów. Zbiór zadań, Wyd. Pol. Poznańskiej, Poznań 1980.
[5] Pr. zb. pod red. Kasprzyk J., Identyfikacja procesów, Wyd. Pol. Śląskiej, Gliwice 2002.
[6] Zimmer A., Englot A., Identyfikacja obiektów i sygnałów. Teoria i praktyka dla użytkowników MATLABA, Wyd. Pol. Krakowskiej, Kraków 2005.

SECONDARY LITERATURE:

[1] Mańczak K., Metody identyfikacji wielowymiarowych obiektów sterowania, WNT, Warszawa 1979.
[2] Milkiewicz F., Wstęp do metod optymalizacji i identyfikacji obiektów przemysłowych, Wyd. Pol. Gdańskiej, Gdańsk 1979.
[3] Sawicki J., Królikowski A., Florek A., Dynamika i identyfikacja obiektów sterowania. Zbiór zadań, PWN, Warszawa 1986.
[4] Zimmer A., Identyfikacja obiektów i sygnałów. Teoria i praktyka dla użytkowników MATLABA, Wyd. Pol. Krakowskiej, . Kraków 1998.

SUBJECT SUPERVISOR

Kazimierz Wilkosz, kazimierz.wilkosz@pwr.edu.pl