FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Podstawy automatyki 2**
Name in English:	**Fundamentals of control engineering 2**
Main field of study (if applicable):	**Industrial Control Engineering**
Specialization (if applicable):	
Level and form of studies:	**1st level, full-time**
Kind of subject:	**obligatory**
Subject code:	**APR012102**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30	15	30		
Number of hours of total student workload (CNPS):	90	30	60		
Form of crediting:	examination	crediting with grade	crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	3	1	2		
including number of ECTS points for practical (P) classes :		1	2		
including number of ECTS points for direct teacher-student contact (BK) classes:	2.10	0.70	1.40		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student should have the basic knowledge on analysis of dynamic and steady state characteristics of linear continuous and discrete systems
2. Student should know how to apply basic tools for analysis linear continuous and discrete systems: Laplace transformation and Z transformation.
3. Student should know how to determine the stability of basic dynamic systems.
4. Student should have ability to think and act in a creative way. Student should have ability to work in a team.

SUBJECT OBJECTIVES

C1. To provide knowledge for analysis of continuous and discrete systems including steady state error calculation.

C2. Learning how to determine the stability of nonlinear systems with using of the first and the second Liapunov’s method, describing function and the phase trajectories.

C3. To provide knowledge of analysis dynamical and frequency characteristics of the systems.

C4. Familiarization with designing methods for automatic control systems and their practical verification.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01 Student gets the knowledge on description of continuous and discrete control systems; their analysis from the point o view of statics, dynamics and stability of continuous and discrete control systems.

PEU_W02 Student gets the knowledge regarding correction of continuous linear and discrete control systems, state variables method and nonlinear control systems.

relating to skills:

PEU_U01 Student is able to solve the problems related to continuous and discrete control systems. He can apply mathematical methods for a system analysis in time and frequency domain.

PEU_U02 Student is able to design, simulate and analyse simple control system for continuous, discrete and nonlinear domain. He can analyse test results and prepare adequate report.

relating to social competences:

PEU_K01 Student can act independently and cooperate within a group working on a complex engineering project.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	General introduction – aims of the course. Establishing conditions for passing and marking the course. Task of the course. Structure of the continuous linear control system.	2
Lec 2	Methods of control systems correction.	2
Lec 3	Methods of series correction of control systems.	2
Lec 4	Application of different correction principles: parallel correctors, correctors in feedback, additive and predictive correction.	2
Lec 5	PID regulators: structure and feature analysis.	2
Lec 6	PID regulators: methods of tuning.	2
Lec 7	Steady state characteristics of discrete systems, synthesis of discrete correctors.	2
Lec 8	Digital PID regulators.	2
Lec 9	Direct design of discrete correctors. Dead-beat correctors.	2
Lec 10	Nonlinear control systems. Basic features, equilibrium states, limit cycles. Stability according to Lyapunov.	2
Lec 11	Local stability. State variables description of nonlinear systems. Stability of the linearized system: first Lyapunov method.	2
Lec 12	Direct Lyapunov method. Global stability.	2
Lec 13	Harmonic linearization: describing function.	2
Lec 14	Analysis of the nonlinear systems based on describing function, application. Extended Nyquist method.	2
Lec 15	Analysis of the nonlinear systems with using of the phase trajectories concept. Relay control systems. Correction of nonlinear control systems.	2
	Total hours:	**30**

Form of classes - class		**Number of hours:**
Cl 1	Calculation of steady state closed-loop systems. System type.	2
Cl 2	Determination of the series corrector parameters. Analysis of pre- and post- correction characteristics.	2
Cl 3	PID regulators: tuning and feature analysis.	2
Cl 4	Steady state errors of discrete systems.	2
Cl 5	Discrete PID regulators: difference equation. Direct determination of discrete correctors.	2
Cl 6	Determination of the nonlinear system stability according to the first Lyapunov method.	2
Cl 7	Determination of the nonlinear system stability according to the describing function method.	2
Cl 8	Qualified test	1
	Total hours:	**15**

Form of classes - laboratory		**Number of hours:**
Lab 1	Presentation of health and safety rules, and general regulations of the laboratory. Establishing conditions for passing and marking the project course. The lab presentation.	2
Lab 2	Analysis methods for linear continuous control systems.	2
Lab 3	Analogue correction of linear continuous control systems.	2
Lab 4	Analogue correction of linear continuous control systems.	2
Lab 5	Analysis of PID regulators (tuning, characteristics).	2
Lab 6	Synthesis and analysis of combinatorial logic circuits.	2
Lab 7	Analysis of linear discrete control systems.	2
Lab 8	Digital PID regulators: tuning and sampling time determination.	2
Lab 9	Direct computer control.	2
Lab 10	PLC controllers application to direct control system correction.	2
Lab 11	Dahlin and Vogel-Edgar method for direct correction of discrete control system.	2
Lab 12	Analysis of nonlinear continuous control system.	2
Lab 13	Correction of nonlinear continuous control system.	2
Lab 14	Microprocessor sequential controllers.	2
Lab 15	Additional term.	2
	Total hours:	**30**

TEACHING TOOLS USED

N1. Informative lecture.
N2. Calculation exercises.
N3. Lab with 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	Attendance on lectures.
F2(W)	PEU_W01 PEU_W02	Exam
P(W)	P = 0,1F1 + 0,9F2	
F1(C)	PEU_U01	Activity in the class
F2(C)	PEU_U01	Preparation of the report
P(C)	P = 0,3F1 + 0,7F2	
F1(L)	PEU_U02 PEU_K01	Activity in the lab
F2(L)	PEU_U02 PEU_K01	Preparation of the report
P(L)	P = 0,3F1 + 0,7F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] http://www.rose.pwr.wroc.pl/ - course materials.
[2] KACZOREK T., Teoria sterowania i systemów, PWN, Warszawa 1999.
[3] RUMATOWSKI K., Podstawy regulacji automatycznej. Wydawnictwo Politechniki Poznańskiej, Poznań 2008.
[4] GREBLICKI W., Podstawy automatyki. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2006.
[5] MAZUREK J., VOGT H., ŻYDANOWICZ W., Podstawy automatyki. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2006.
[6] KOWAL J., Podstawy automatyki, t. 1 i 2, AGH, Kraków, 2004.
[7] WISZNIEWSKI A. (red.), Podstawy automatyki. Ćwiczenia laboratoryjne, skrypt Politechniki Wrocławskiej, Wrocław 2000.
[8] Staszewski J., Skrypt zadań z Podstaw Automatyki *

*position [8] available at the teacher.

SECONDARY LITERATURE:

[1] http://bcs.wiley.com/he-bcs/Books?action=index&itemId=0471134767&itemTypeId=BKS&bcsId=2357 – strona do kursu: Automatic Control Systems, Benjamin C. Kuo and Farid Golnaraghi.
[2] OGATA K., Modern Control Engineering. Prentice-Hall, Inc., Upper Saddle River, New Jersey, 2002.
[3] Larminant P., Thomas Y., Automatyka - układy liniowe, WNT, Warszawa 1983.
[4] Kaczorek T., Dzieliński A., Dąbrowski W., Łopatka R.: Podstawy teorii sterowania, WNT, Warszawa 2005.

SUBJECT SUPERVISOR

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