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):	**Electrical Engineering**
Specialization (if applicable):	
Level and form of studies:	**1st level, part-time**
Kind of subject:	**obligatory**
Subject code:	**ELR052162**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	20	10	20		
Number of hours of total student workload (CNPS):	60	30	60		
Form of crediting:	examination	crediting with grade	crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	2	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:	1.40	0.70	1.40		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Theoretical knowledge concerning dynamics, stability and control of continuous control systems.
2. Practical ability of mathematical modelling, analysis, synthesis, stability evaluation and compensation of linear continuous control systems.
3. Is able to think, analyse and act creatively.
4. Is able to work in a team.

SUBJECT OBJECTIVES

C1. Gaining theoretical knowledge concerning static, dynamic and quality as well as stability of discrete linear and continuous nonlinear control systems.

C2. Gaining theoretical knowledge concerning compensation allowing to get required parameters of discrete linear and continuous nonlinear control systems.

C3. Development and progress of abilities of mathematical analysis, synthesis, stability estimation and design of adequate compensation to discrete linear control systems.

C4. Gaining abilities of practical analysis and synthesis of continuous and discrete, linear and continuous nonlinear control systems.

C5. Development and progress practical analysis of control system to reach required performance of linear and nonlinear , continuous and discrete systems.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01	Has knowledge to build models , to estimate and calculate static and dynamic parameters of discrete linear and continuous nonlinear control systems.
PEU_W02	Has knowledge concerning analysis, operation and quality of discrete linear and continuous nonlinear control systems.
PEU_W03	Has knowledge concerning stability of control systems, development of compensation systems as well as improvement and optimisation of discrete linear and continuous nonlinear control systems.

relating to skills:

PEU_U01	Is able to work out mathematical analysis and synthesis, check stability and to match adequate compensation to discrete linear control systems.
PEU_U02	Is able to make practical analysis and synthesis of simple and complex continuous and discrete linear and nonlinear control systems.
PEU_U03	Is able to make practical estimation of stability of control systems and design different types of compensators allowing to reach required performance of continuous and discrete linear and nonlinear control system.

relating to social competences:

PEU_K01	Is able in a competent way either independently or in cooperation with group to work out engineering project of control system.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Introduction. Regulations to pass. Structure of discrete control systems. Samplers.	2
Lec 2	Direct and inverse Z transformation, difference equations. Discrete transfer function. Hold elements.	2
Lec 3	Block-diagram algebra of discrete systems. Steady state errors in discrete control systems.	2
Lec 4	Basic stability condition of discrete systems . Bi-linear transformation, use of stability criteria designated for linear continuous control systems. Jury stability criterion.	2
Lec 5	Nyquist stability criterion. Synthesis of discrete systems - fundamentals.	2
Lec 6	Synthesis of discrete systems. Description of continuous time systems with use of state space method.	2
Lec 7	Description of discrete systems with use of state space method. Stability, controllability and observability - fundamentals.	2
Lec 8	Stability, controllability and observability - examples. Introduction to non-linear control systems.	2
Lec 9	Typical non-linearities in non-linear control systems. Analysis of non-linear control systems using the method of describing function.	2
Lec 10	Analysis of non-linear control systems with use of phase-plane trajectories. Non-linear control systems stability analysis.	2
	Total hours:	**20**

Form of classes - class		**Number of hours:**
Cl 1	Introduction. Rules to pass. Descriptions of discrete control systems using Z transform. Direct and inverse Z transform , discrete transfer function.	2
Cl 2	Difference equations. Hold elements. Block diagram algebra. Steady state errors of discrete control systems.	2
Cl 3	Stability of discrete control systems.	2
Cl 4	Description of continuous and discrete systems using state space method.	2
Cl 5	Pass test.	2
	Total hours:	**10**

Form of classes - laboratory		**Number of hours:**
Lab 1	Safety and internal regulations of the lab. Rules to pass. Introductory presentations of laboratory stands.	2
Lab 2	Analysis methods of linear continuous control systems.	2
Lab 3	Analogue compensation of linear continuous control systems.	2
Lab 4	Investigation of industrial controllers.	2
Lab 5	Modelling of control systems with use of MATLAB package.	2
Lab 6	Analysis and synthesis of combinatorial and sequential logic circuits.	2
Lab 7	Control of electric motor with use of PLC.	2
Lab 8	Investigation of linear discrete control systems.	2
Lab 9	Analysis of non-linear control systems.	2
Lab 10	Reserve term. Summary of the laboratory excercises.	2
	Total hours:	**20**

TEACHING TOOLS USED
N1. Informative lecture.
N2. Classes.
N3. Didactic models of control systems.
N4. Simulative program.
N5. Report on the performed laboratory exercise.
N6. Student's own work.

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	Presence at the lectures
F2(W)	PEU_W01 PEU_W02 PEU_W03	Written or oral examination
P(W)	P=0,1F1+0,9F2	
F1(C)	PEU_U01 PEU_U02 PEU_U03	Activity at the classes
F2(C)	PEU_U01 PEU_U02 PEU_U03	Results of short tests
F3(C)	PEU_U01 PEU_U02 PEU_U03	Crediting test
P(C)	P=0,2F1+0,2F2+0,6F3	
F1(L)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Activity at the laboratory
F2(L)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Marks of the reports for the laboratory assignements
P(L)	P=0,3F1+0,7F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Greblicki W., „Podstawy automatyki”, Wydawnictwo Politechniki Wrocławskiej, 2006
[2] Kaczorek T., „Podstawy teorii sterowania”, WNT, Warszawa, 2009
[3] Mazurek J., Vogt H., Żydanowicz W, .„Podstawy automatyki”, Wydawnictwo Politechniki Warszawskiej, 2006
[4] Staszewski J., „Skrypt zadań z Podstaw Automatyki” *
[5] Wiszniewski A. (pod red.), „Podstawy automatyki. Ćwiczenia laboratoryjne”, skrypt Politechniki Wrocławskiej, Wrocław 2000

*position [4] available from the teacher

SECONDARY LITERATURE:

[1] Horla D., „Podstawy automatyki. Ćwiczenia rachunkowe. Cz.1”, Wydawnictwo Politechniki Poznańskiej, 2004
[2] Mazur E., Sosnowski M.; „Podstawy automatyki. Zbiór zadań”, Wydawnictwo Politechniki Częstochowskiej, 2006.

SUBJECT SUPERVISOR

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