

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, full-time**
 Kind of subject: **obligatory**
 Subject code: **ELR042103**
 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):	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 estimation 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. Gaining 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 nonlinear control systems.
- C5. Gaining abilities of practical analysis of control system to reach required performance of linear and nonlinear, continuous and discrete systems.

SUBJECT EDUCATIONAL EFFECTS*relating to knowledge:*

- PEK_W01 Has knowledge to build models , to estimate and calculate static and dynamic parameters of discrete linear and continuous nonlinear control systems.
- PEK_W02 Possesses knowledge concerning analysis, operation and quality of discrete linear and continuous nonlinear control systems.
- PEK_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:

- PEK_U01 Is able to work out mathematical analysis and synthesis, check stability and to match adequate compensation to discrete linear control systems.
- PEK_U02 Is able to make practical analysis and synthesis of simple and complex continuous and discrete linear and nonlinear control systems.
- PEK_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 systems.

relating to social competences:

- PEK_K01 Is able in a competent way either independently or in cooperation with group to work out an 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.	2
Lec 2	Sampler and hold elements.	2
Lec 3	Direct and inverse Z transformation, difference equations.	2
Lec 4	Discrete transfer function.	2
Lec 5	Block-diagram algebra of discrete systems.	2
Lec 6	Steady state errors in discrete control systems.	2
Lec 7	Basic stability condition of discrete systems.	2
Lec 8	Bi-linear transformation, use of stability criteria designated for linear continuous control systems.	2
Lec 9	Jury and Nyquist stability criteria.	2
Lec 10	Synthesis of discrete control systems.	2
Lec 11	Description of continuous and discrete control systems with use of state space methods.	2
Lec 12	Stability, controllability and observability.	2
Lec 13	Introduction to non-linear control systems. Typical non-linearities in non-linear control systems.	2
Lec 14	Analysis of non-linear control systems: methods of describing function and phase-plane trajectories.	2
Lec 15	Non-linear control systems stability analysis with use of Liapunow methods.	2
Total hours:		30

Form of classes - class		Number of hours:
Cl 1	Introductions. Rules to pass. Descriptions of discrete control systems using Z transform.	2
Cl 2	Response of a control system to standard input signals.	2
Cl 3	Difference equations, Hold elements.	2
Cl 4	Block diagram algebra. Steady state errors of discrete control systems.	2
Cl 5	Stability of discrete control systems.	2
Cl 6	Description of continuous and discrete systems using state variables.	2
Cl 7	Crediting test.	2
Cl 8	Analysis of the pass test results and clarification of the most difficult problems.	1
Total hours:		15

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 - part 1.	2
Lab 4	Analogue compensation of linear continuous control systems - part 2.	2
Lab 5	Investigation of industrial controllers.	2
Lab 6	Modelling of control systems with use of MATLAB package.	2
Lab 7	Direct digital control.	2
Lab 8	Analysis and synthesis of combinatorial and sequential logic circuits.	2
Lab 9	Control of electric motor with use of PLC.	2
Lab 10	Investigation of linear discrete control systems.	2
Lab 11	Digital compensation.	2
Lab 12	Analysis of non-linear control systems.	2
Lab 13	Compensation of nonlinear control systems.	2
Lab 14	Microprocessor sequential controllers.	2
Lab 15	Reserve term. Summary of laboratory excersices.	2
Total hours:		30

TEACHING TOOLS USED

N1.	Informative lecture.
N2.	Classes.
N3.	Didactic models of control systems.
N4.	Simulative program.
N5.	Report on conducted experiment.
N6.	Student's own work.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation <i>F – forming (during semester) P – concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(W)	PEK_W01 PEK_W02 PEK_W03	Presence at the lectures
F2(W)	PEK_W01 PEK_W02 PEK_W03	Written or oral examination
P(W)	$P=0,1F1+0,9F2$	
F1(C)	PEK_U01 PEK_U02 PEK_U03	Activity at the classes
F2(C)	PEK_U01 PEK_U02 PEK_U03	Results of short tests
F3(C)	PEK_U01 PEK_U02 PEK_U03	Crediting test
P(C)	$P=0,2F1+0,2F2+0,6F3$	
F1(L)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Activity at the laboratory
F2(L)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Marks of the reports for the laboratory assignments
P(L)	$P=0,3F1+0,7F2$	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Greblicki W., Podstawy automatyki, Wydawnictwo Politechniki Wrocławskiej, Wrocław 2006
- [2] Kaczorek T., Podstawy teorii sterowania, WNT, Warszawa 2009
- [3] Mazurek J., Vogt H., Żydanowicz W., Podstawy automatyki, Wydawnictwo Politechniki Warszawskiej, Warszawa 2006
- [4] Staszewski J., Skrypt zadań z Podstaw Automatyki *

* position available from lecturer

SECONDARY LITERATURE:

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

SUBJECT SUPERVISOR

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**MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ELR042103 - Fundamentals of control engineering 2
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering****

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1ETK_W27	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec11 Lec13 Lec14	N.1 N.6
PEK_W02	K1ETK_W27	C.1 C.2	Lec5 Lec6 Lec10 Lec14	N.1 N.6
PEK_W03	K1ETK_W27	C.1 C.2	Lec7 Lec8 Lec9 Lec12 Lec15	N.1 N.6
PEK_U01	K1ETK_U24	C.3	CI2 CI3 CI4 CI5 CI6 CI7 CI8	N.2 N.6
PEK_U02	K1ETK_U14 K1ETK_U24	C.4	Lab1 Lab2 Lab6 Lab8 Lab10 Lab12	N.3 N.4 N.5 N.6
PEK_U03	K1ETK_U14 K1ETK_U24	C.5	Lab1 Lab3 Lab4 Lab5 Lab7 Lab9 Lab11 Lab13 Lab14	N.3 N.4 N.5 N.6
PEK_K01	K1ETK_K05	C.3 C.4 C.5	CI1 CI2 CI3 CI4 CI5 CI6 CI7 CI8 Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N.2 N.5 N.6