FACULTY OF ELECTRICAL
ENGINEERING

SUBJECT CARD

Name in Polish:	**Podstawy automatyki 1**
Name in English:	**Fundamentals of control engineering 1**
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:	**APR012101**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30	30			
Number of hours of total student workload (CNPS):	120	60			
Form of crediting:	examination	crediting with grade			
For group of courses mark (X) final course:					
Number of ECTS points:	4	2			
including number of ECTS points for practical (P) classes :		2			
including number of ECTS points for direct teacher-student contact (BK) classes:	2.80	1.40			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student should know basics of linear algebra, math analysis and differential equations.
2. Should be familiar with complex calculus and complex functions.

SUBJECT OBJECTIVES

C1. Learning of different structures of control systems.
C2. Learning how to determine the models of dynamical system.
C3. To provide knowledge of analysis dynamical and frequency characteristics of the systems.
C4. Familiarization with methods for stability determination of continuous and discrete automatic control systems.

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 analysis of continuous linear and discrete 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 analyse and simulate and analyse of continuous and discrete linear system in time and frequency domain.

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 and their description by differential equations.	2
Lec 2	Laplace transform. Transfer function and frequency domain models. Responses for typical inputs.	2
Lec 3	Typical elements of dynamic system. Time and frequency characteristic.	2
Lec 4	Second order oscillation element. Elements with time-delay.	2
Lec 5	Complex schemes. Block diagrams. Feedback system. Equivalent transfer function.	2
Lec 6	Definition of the stability. Stability criteria. Routh-Hurwitz criterion, Nyquist criterion, Mikhaylov criterion	2
Lec 7	Nyquist criterion. Phase and magnitude margin. Bode plot. Logarithmic criterion.	2
Lec 8	Discrete linear systems. Sample and hold elements. Comparing continuous and discrete systems.	2
Lec 9	z-Transform. z-transfer function. Difference equations. s-z mapping.	2
Lec 10	Time and frequency response of discrete systems. Complex schemes.	2
Lec 11	Stability of discrete systems. s-z transformation.	2
Lec 12	Jury criterion. Bilinear transformation. z-w transformation and stability criteria.	2
Lec 13	State-variable model of the control system. Relation to the transfer function. Steps to obtaining a state model.	2
Lec 14	MIMO systems, controllability and observability. Stability of state-variable systems.	2
Lec 15	Discrete system representation in state-variable model. Application of the z-transform.	2
	Total hours:	**30**

Form of classes - class		**Number of hours:**
Cl 1	Differential equations and time-domain analysis. Solution determination for different inputs.	2
Cl 2	Impulse response and Laplace transfer function of control systems, output response of control systems under unit step input signal.	2
Cl 3	Inverse of the Laplace transform. Time and frequency relationship.	2
Cl 4	Frequency characteristics: polar plot, logarithmic of amplitude and phase of basic control elements.	2
Cl 5	Equivalent transfer function determination. Zeros and poles of the transfer function for complex systems.	2
Cl 6	Cl 6 Analysis of the linear system stability. Input – output relation for stable system. Routh-Hurwitz criterion. Mikhaylov criterion.	2
Cl 7	Stability of the closed-loop systems. Nyquist criterion. Phase and magnitude margin calculation.	2
Cl 8	Stability of the closed-loop systems. Nyquist criterion. Phase and magnitude margin calculation.	2
Cl 9	Discrete linear systems: sampling frequency determination. Laplace trans form of discrete signal. Time and frequency characteritics of typical test signals.	2
Cl 10	z-Transform calculation for different continuous signals. Reverse –transform.	2
Cl 11	z-Transform determination of discrete signls.Output calculation for different discrete systems.	2
Cl 12	Stability determination of discrete systems: with using of bilinear transformation. Jury criterion.	2
Cl 13	Stability determination of discrete systems: with using of bilinear transformation. Jury criterion.	2
Cl 14	Determination of the state variable model for transfer function. Controllability and obsevability of the system.	2
Cl 15	Qualified test	2
	Total hours:	**30**

TEACHING TOOLS USED
N1. Informative lecture. N2. 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=0,1*F1+0,9*F2	
F1(C)	PEU_U01 PEU_U02 PEU_K01	Activity in the class
F2(C)	PEU_U01 PEU_U02 PEU_K01	Qualified test
P(C)	P=0,2*F1+0,8*F2	

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 – home page for: 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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