FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Cyfrowe Techniki Sterowania**
Name in English:	**Digital Control Techniques**
Main field of study (if applicable):	**Electrical Engineering**
Specialization (if applicable):	**Control in Electrical Power Engineering**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**obligatory**
Subject code:	**ELR052132**
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 basics of continuous control systems.
2. Knowledge of basics synthesis and analysis of digital systems.
3. Basic knowledge of MATLAB / Simulink software.
4. Practical skills of using MATLAB: writing programs.
5. Is capable of implementing digital algorithms based on difference equations.

SUBJECT OBJECTIVES

C1. Acquaintance of knowledge related to: function of analogue filtering in the context of proper operation of digital systems, digital signal processing, representation methods of discrete-time systems, appropriate sampling time selection, effect of pole location on system response.

C2. Practical skills to analyze and design of both finite and infinite impulse response filters.

C3. Practical skills to: PID digital controller tuning, design of digital controller dedicated to particular object, design of state variable feedback controller and state observer.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01	Possesses knowledge related to processing of continuous signals, their discretization and processing of digital signals.
PEU_W02	Has a basic knowledge of structure of digital control systems and their design methods.
PEU_W03	Possesses knowledge related to design of digital filters and various types of digital regulators.

relating to skills:

PEU_U01	Is able to select appropriate sampling time, represent continuous control system with use of transfer function and state space model, retrieve difference equation of digital model of continuous plant and implement this equation.
PEU_U02	Is able to design and perform analysis of digital filters.
PEU_U03	Is able to tune as well as design digital controller of a given output transient performance indices.

relating to social competences:

PEU_K01	Is able to carry out a complex engineering project in a competent way, unaided as well as to cooperate with a team if required

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Introduction. Setting rules of course crediting. Tasks, structures and interface circuits of digital control system.	2
Lec 2	Classification of plants in digital control, basic notions used in analysis and design of real time control systems.	2
Lec 3	Classification of plants in digital control, basic notions used in analysis and design of real time control systems.	2
Lec 4	Digital models of continuous plants.	2
Lec 5	Processing of the plant output signals by interface circuits.	2
Lec 6	Processing of input digital signals – digital filtration, design of recursive digital filters based on analog lowpass filters transformation.	2
Lec 7	Processing of input digital signals – digital filtration, design of recursive digital filters based on analog lowpass filters transformation.	2
Lec 8	Processing of input digital signals – digital filtration, design of nonrecursive digital filters.	2
Lec 9	Design of nonrecursive digital filters using the Fourier transformation.	2
Lec 10	Digital PID regulators.	2
Lec 11	Design of the dedicated digital regulator for the determined plant and for predetermined transfer function of the closed-loop system K(z).	2
Lec 12	Robust digital regulators.	2
Lec 13	Design methods of state variable feedback controller.	2
Lec 14	Digital controller with a state observer.	2
Lec 15	Pass test.	2
	Total hours:	**30**

Form of classes - laboratory		**Number of hours:**
Lab 1	Introduction. Setting rules of course crediting. Acquaintance with lab stands, safety rules and available software.	2
Lab 2	Design and analysis of recursive digital filters based on analog lowpass filters transformation.	2
Lab 3	Design and analysis of recursive digital filters based on analog lowpass filters transformation.	1
Lab 4	Design of nonrecursive digital filters using the inverse DFT.	2
Lab 5	Tuning of the digital PID regulator.	2
Lab 6	Design of dedicated and robust digital regulators.	2
Lab 7	Design of state variable feedback controller.	2
Lab 8	State variable feedback controller with a state observer.	2
	Total hours:	**15**

TEACHING TOOLS USED
N1. Project presentation.
N2. Informative lecture.
N3. Presentation of the reports.
N4. Matlab program.

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	Participation in the course
F2(W)	PEU_W01 PEU_W02 PEU_W03	Pass test
P(W)	P = 0,1F1+ 0,9F2	
F1(L)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Activity during the classes
F2(L)	PEU_U01 PEU_U02 PEU_U03	Presentation of the reports done
P(L)	P = 0.7F1+ 0.3F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Digital Control Systems – the lecture outline, provided by subject supervisor.

SECONDARY LITERATURE:

[1] Kuo B.C.: Digital Control Systems, Hold. Reinhard and Winston Inc. 1981.
[2] Bozic S. M.: Digital and Kalman Filtering, Edward Arnold Publishers, London 1984.
[3] Astrom K.J., Wittenmark B.: Computer Controlled Systems, Printice Hall, London 1989.
[4] Iserman R.: Digital Control Systems, Springers-Verlag, Berlin 1988.
[5] Vaccaro R.J.:Digital Control, A State Space Approach, McGrew-Hill, New York 1995.

SUBJECT SUPERVISOR

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