FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Zaawansowane metody przetwarzania sygnałów**
Name in English:	**Advanced Signal Processing Methods**
Main field of study (if applicable):	**Electrical Engineering**
Specialization (if applicable):	**Renewable Energy Systems**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**optional**
Subject code:	**ELR051335**
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):	90	30			
Form of crediting:	examination	crediting with grade			
For group of courses mark (X) final course:					
Number of ECTS points:	3	1			
including number of ECTS points for practical (P) classes :		1			
including number of ECTS points for direct teacher-student contact (BK) classes:	2.10	0.70			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in the fields of calculus and linear algebra
2. Basic knowledge of the C language
3. Ability of systematic work and individual problem solving

SUBJECT OBJECTIVES

C1. Understanding and proper application of digital signal processing methods
C2. Presentation of tools for description and analysis of digital systems in time and frequency domain
C3. Ability to design and implement simple digital systems

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01 knows mathematical methods for description and analysis of digital systems in time and frequency domain
PEU_W02 knows algorithms for digital filter design

relating to skills:

PEU_U01 is able to provide a spectral analysis of a signal
PEU_U02 is able to design a simple digital filter

relating to social competences:

PEU_K01 creativity in searching for the solution of a given problem

PROGRAMME CONTENT

Form of classes - lecture		Number of hours:
Lec 1	Discrete signal and systems – examples, mathematical notation, sampling, aliasing. Part I.	2
Lec 2	Discrete signal and systems – examples, mathematical notation, sampling, aliasing. Part II.	2
Lec 3	Description and analysis of digital systems in time domain: difference equation, convolution, impulse response, block schemes, state space variables, system classification. Part I.	2
Lec 4	Description and analysis of digital systems in time domain: difference equation, convolution, impulse response, block schemes, state space variables, system classification. Part II.	2
Lec 5	Z transform: definition of Z transform, the correlation of Z transform to Laplace transform, basic properties of Z transform , inverse Z transform (methods and computational examples), the area of convergence and its meaning, computations. Part I.	2
Lec 6	Z transform: definition of Z transform, the correlation of Z transform to Laplace transform, basic properties of Z transform , inverse Z transform (methods and computational examples), the area of convergence and its meaning, computations. Part II.	2
Lec 7	Applications of the Z transform: solving of difference equations, the transfer function, casuality and stability of systems. Part I.	2
Lec 8	Applications of the Z transform: solving of difference equations, the transfer function, casuality and stability of systems. Part II.	2
Lec 9	Discrete Fourier transform: Definition of DFT (introduction, examples, properties), correlation of DFT to Z transform, inverse DFT, elimination of leakage with the window method, resolution of FFT. Part I.	2
Lec 10	Discrete Fourier transform: Definition of DFT (introduction, examples, properties), correlation of DFT to Z transform, inverse DFT, elimination of leakage with the window method, resolution of FFT. Part II.	2
Lec 11	Digital filters: introduction, methods of description, examples, classification. Finite impulse response filters -FIR. Design of FIR, window method. Part I.	2
Lec 12	Digital filters: introduction, methods of description, examples, classification. Finite impulse response filters -FIR. Design of FIR, window method. Part II.	2
Lec 13	Fast Fourier transform FFT. Correlation between FFT and DFT. Part I.	2
Lec 14	Fast Fourier transform FFT. Correlation between FFT and DFT. PartII.	2
Lec 15	Algorithm for FFT: computational scheme, implementation example, butterfly structures for FFT	2
	Total hours:	**30**

Form of classes - class		Number of hours:
Cl 1	Mathematical description, generation and sampling for discrete signals. Part I.	2
Cl 2	Mathematical description, generation and sampling for discrete signals. Part II.	2
Cl 3	Z transform, Inverse Z transform. Part I.	2
Cl 4	Z transform, Inverse Z transform. Część II.	2
Cl 5	Transfer function, impulse response, difference equation, block scheme. Part I.	2
Cl 6	Transfer function, impulse response, difference equation, block scheme. Part II.	2
Cl 7	Fourier Transform - implementation. Part I.	2
Cl 8	Fourier Transform - implementation. Part II.	1
	Total hours:	**15**

TEACHING TOOLS USED

N1. Lecture with multimedia presentations
N2. Classes with problems for individual solving

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	exam
P(W)	P=F1	
F1(C)	PEU_U01 PEU_U02 PEU_K01	written final test
P(C)	P=F1	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] S. Haykin, B. Van Veen – Signals and Systems, John Wiley & Sons, Inc., 1999
[2] D. F. Elliot – Handbook of Digital Signal Processing, Academic Press, Inc., 1987
[3] S. M. Kay – Modern Spectral Estimation, Prentice Hall, Signal Processing Series, Englewood Cliffs, 1988

SECONDARY LITERATURE:

[1] M. Vetterli, J. Kovacevic - Wavelets and Subband Coding, Englewood Cliffs, Prentice Hall, 1994

SUBJECT SUPERVISOR

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