STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Advanced Signal Processing Algorithm**			Code **1010802121010832878**
Field of study **Electronics and Telecommunications**	Profile of study (general academic, practical) **general academic**		Year /Semester **1 / 2**
Elective path/specialty **Information and Communication**	Subject offered in: **Polish / English**		Course (compulsory, elective) **obligatory**
Cycle of study: **Second-cycle studies**	Form of study (full-time,part-time) **full-time**		
No. of hours Lecture: **2** Classes: **2** Laboratory: **-** Project/seminars: **-**			No. of credits **5**
Status of the course in the study program (Basic, major, other) **major**	(university-wide, from another field) **from field**		
Education areas and fields of science and art **technical sciences** **Technical sciences**			ECTS distribution (number and %) **5 100%** **5 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Has extended, in-depth knowledge of those branches of mathematics which are used in formulating and solving problems in electronic and telecommunications - K2_W00 Is conversant with numerical methods used in electronics and telecommunication - K2_W07
2	**Skills**	Is able to select adequate numerical methods and simulation methods to solve typical tasks related to analysis, design and optimization of systems and computational tasks in telecommunication - K2_U09
3	**Social competencies**	Is aware of the limitations of his/her current knowledge and skills; is committed to lifelong learning - K2_K04

Assumptions and objectives of the course:

Learning of theoretical and practical knowledge linked with advanced digital signal processing techniques, e.g. design and analysis of time-variant systems (adaptive), multirate systems, and advanced methods of spectral analysis.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Has a systematic, detailed knowledge, together with necessary mathematical background, of advanced methods of digital signal processing - [K2_W09]

Skills:

1. Is able to make typical calculations and use appropriate software to design and analyze the operation of advanced digital signal processing circuits - [K2_U12]
2. Is able to design, construct, program and test complex, technologically advanced electronic circuits and systems, especially for telecommunication devices and systems and networks - [K2_U15]

Social competencies:

1. Is aware of the limitations of his/her current knowledge and skills; is committed to lifelong learning - [K2_K04]
2. Is aware of the necessity to approach solving technical problems with responsibility and professionalism - [K2_K05]

Assessment methods of study outcomes

Final exam following lectures - written answers to 10 questions covering lecture material
Colloquia during exercise classes, two - solution of few exercises
Knowledge verification on the fly during classes

Course description

Prediction: Wold model, ARMA, AR and MA models, linear predictor, lattice structure, normal equations, Levinson-Durbin and Schur algorithms, Wiener FIR and IIR filters. Identification and modeling: least-squares (LS) solutions for AR, MA and ARMA models. Adaptive filters: applications, gradient filters - LMS and its analysis, recursive LS filters (RLS) - Kalman filter, its improvements, various versions of fast RLS algorithms. Multirate systems: idea, interpolator and decimator, poliphase structures, exact and approximate solutions to sampling rate conversion, multiplierless modulation and demodulation, filter banks - uniform, critically sampled, perfectly and nearly-perfectly reconstructing, QMF filters, time-frequency analysis - spectrogram, Gabor transformation, wavelet transforms. Advanced methods of spectrum estimation: non-parametric methods (extension), parametric methods - Yule-Walker, Burg and unconstrained AR methods, methods based on eigenvector analysis - Pisarenko approach, MUSIC and ESPRIT.

Basic bibliography:

1. J.G. Proakis, D.G. Manolakis, "Digital Signal Processing, Principles, Algorithms, and Applications", 4 ed., Prentice Hall, 2007.

Additional bibliography:

1. T. Zieliński, "Cyfrowe Przetwarzanie Sygnałów, od teorii do zastosowań", WKŁ, 2005.

Result of average student's workload

Activity	Time (working hours)
1. Lectures	30
2. Preparation to exam	40
3. Exam	2
4. Classes	30
5. Preparation to classes	20
6. Preparation to colloquia	15
7. Consultations	3

Student's workload

Source of workload	hours	ECTS
Total workload	125	5
Contact hours	65	3
Practical activities	65	3