SYLLABUS OF A MODULE

Polish name of a module	**Analiza sygnałów i przetwarzanie danych**
English name of a module	**Signal analysis and data processing**
ISCED classification - Code	0710
ISCED classification - Field of study	*Engineering and engineering trades*
Languages of instruction	*English*
Level of qualification:	*1*
Number of ECTS credit points	*4*
Examination:	*A*
Available in semester:	*A*

Number of hours per semester:

Lecture	Exercises	Laboratory	Seminar	E-learning	Project
15	0	30	0	0	0

MODULE DESCRIPTION

MODULE OBJECTIVES

O1. To make students familiar with statistical methods and numerical tools used in signal analysis.

O2. To provide the general knowledge of measuring techniques applied for diagnostics of dynamic processes

PRELIMINARY REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of mathematics, physics and fluid mechanics, statistics and error estimation.
2. Ability to work individually and collaborate in a group.
3. Data analysis and presentation of results.

LEARNING OUTCOMES

LO 1 – Knowledge of statistical methods in analysis of dynamic processes

LO 2 – Ability to use software tools for signal analysis

MODULE CONTENT

Type of classes – lecture	**Number of hours**
Lec 1 - Introduction to metrology of dynamic processes, basic definitions. Dynamic process as a stochastic process. Time history (signal) as a realisation of stochastic process. Stationary and ergodic processes.	**1**
Lec 2-3 - Signal classification. Statistical moments, stationarity tests. Averaging rules, estimation and estimator. Probability density function.	**2**
Lec 4-5 - Correlation analysis, auto- and cross-correlation functions. Properties of correlation functions and their relations with signals' statistical measures	**2**
Lec 6-7 - Fourier series, spectrum. Fourier integral. Power spectral density.	**2**
Lec 8-9 - Analogue to digital conversion, sampling, Shannon theorem, sampling ambiguity, Nyquist condition. Digitization. Pre-processing and post-processing.	**2**
Lec 10-11 - Discrete (DFT) and fast (FFT) Fourier transforms.	**2**
Lec 12-13 - Aliasing. Spectral leakage, smoothing (window) functions.	**2**
Lec 14-15 - Wavelet analysis. Basic definitions. Properties and limitations. Application to analysis of non-stationary and unsteady signals. Diagnostic value of wavelet analysis.	**2**
Sum	**15**
Type of classes– laboratory	**Number of hours**
Lab 1-2 - Analogue to digital processing.	**2**
Lab 3-4 - Statistical moments. Stationarity tests.	**2**
Lab 5-6 - Probability density function, its relations to statistical measures of the signal.	**2**
Lab 7-8 - Autocorrelation function.	**2**
Lab 9-10 - Cross-correlation function.	**2**
Lab 11-12 - Application of DFT (Discrete Fourier Transform) to frequency analysis of dynamic processes.	**2**
Lab 13-16 - Spectral leakage and window functions.	**4**
Lab 17-20 - Signal filtering. Influence of filtering on signal properties and its statistical measures.	**4**
Lab 21 - 24 - Application of wavelet analysis for diagnostics of dynamic and unsteady processes.	**4**
Lab 25 - 28 - Analysis of unsteady signals.	**4**
Lab 29 - 30 - Analysis of irregularly sampled time traces.	**2**
Sum	**30**

TEACHING TOOLS

1. Lecture with the use of multimedia presentations and online tools
2. Computer laboratory
3. Licenced software tools
4. Instructions to laboratory exercises

WAYS OF ASSESSMENT (F – FORMATIVE, S – SUMMATIVE)

F1 - assessment of preparation for laboratory exercises
F2 - assessment of the ability to apply the acquired knowledge while doing the exercises
F3 - evaluation of reports on the implementation of exercises covered by the curriculum

F4 - assessment of activity during classes
S1 - assessment of the ability to solve the problems posed and the manner of presentation obtained results - pass mark *
S2 - assessment of mastery of the teaching material being the subject of the lecture - exam

*) in order to receive a credit for the module, the student is obliged to attain a passing grade in all laboratory classes as well as in achievement tests.

STUDENT'S WORKLOAD

L.p.	Forms of activity	Average number of hours required for realization of activity
1.	**Contact hours with teacher**	
1.1	Lectures	15
1.2	Tutorials	0
1.3	Laboratory	30
1.4	Seminar	0
1.5	Project	0
1.6	Examination	0
	Total number of contact hours with teacher:	45
2.	**Student's individual work**	
2.1	Preparation for tutorials and tests	15
2.2	Preparation for laboratory exercises, writing reports on laboratories	30
2.3	Preparation of project	0
2.4	Preparation for final lecture assessment	5
2.5	Preparation for examination	0
2.6	Individual study of literature	5
	Total number of hours of student's individual work:	55
	Overall student's workload:	100
Overall number of ECTS credits for the module		4 ECTS
Number of ECTS points that student receives in classes requiring teacher's supervision:		1.8 ECTS
Number of **ECTS** credits acquired during practical classes including laboratory exercises and projects:		2.4 ECTS

BASIC AND SUPPLEMENTARY RESOURCE MATERIALS

1. Newland D.: An Introduction to Random Vibrations, Spectral & Wavelet Analysis, Dover Publications, 2005
2. Hlawatsch F., Auger F.: Time-Frequency analysis. John Wiley & Sons, 2013
3. Cariolaro G.: Unified Signal Theory, Springer, 2011
4. Shiavi R.: Introduction to Applied Statistical Signal Analysis. Elsevier, 2007
5. Agilent Technologies:The Fundamentals of Signal Analysis, Application Note 243, 2000

MODULE COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

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