STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Sensors and Measurement Systems	**1010642211010833072**

Field of study	Profile of study (general academic, practical)	Year /Semester
Mechanical Engineering	**(brak)**	**1 / 1**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Mechatronics	**Polish**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
Second-cycle studies	**full-time**

No. of hours	No. of credits
Lecture: **1** Classes: **-** Laboratory: **1** Project/seminars: **-**	**2**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
(brak)	**(brak)**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**2 100%**
Technical sciences	**2 100%**

Responsible for subject / lecturer:

professor Waldemar Nawrocki
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Elektroniki i Telekomunikacji
Piotrowo 3A

Responsible for subject / lecturer:

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Piotrowo 3A

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	1. Students have a basic knowledge of physics. 2. Students have a knowledge of the fundamentals of circuits theory, together with necessary mathematical background; this knowledge allows them to understand, analyze and evaluate the operation of electrical circuits.
2	**Skills**	1. Students know how to use instruments like digital multimeters, signal oscillators and digital oscilloscopes. 2. Students are able to create and to run a software in C+ or C++ language. 3. Students are capable of studying autonomously. 3. Demonstrates the ability to solve basic problems in physics. 4. Demonstrates the ability to solve typical tasks and problems related to analysis of electrical circuits. 5. Can implement the occupational health and safety principles.
3	**Social competencies**	1. Students know limitations of their current knowledge and skills; they committed to further self-study. 2. They are able to participate in collaborative projects.

Assumptions and objectives of the course:

1. To learn a structure of a computer-based measurement system and its components.
2. To know the limits of a measurement accuracy and of a measurement resolutiont.
3. To learn most frequently used interface standards for measurement systems with serial or paralel data transmission.
4. To learn commonly used programming languages: LabVIEW and VEE.
5. To learn some examples of computer-based measurement systems.

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

Knowledge:

1. Students got knowledge of a structure of a measurement systems and its components. - [K1A_W14]
2. Students got knowledge of measuremnt limits (accuracy, resolution) of particular physical quantities - [K1A_W14]
3. Students know principles of analog to digital conversion and digital to analog copnversot of voltage - [K1A_W14]
4. Students know most important standards of interface for measurement systems with serial data transfer (RS232, RS485, LAN, CAN). - [K1A_W14]
5. Students know most important standards of interface for measurement systems with parallel data transfer: IEEE488 - [K1A_W14]
6. Students know important standards of wireless interface for measurement systems (GSM, Bluetooth, ZigBee) - [K1A_W14]
7. Students know the sstructure of a virtual instrument and know its performances. - [K1A_W14]
8. Students know economical limits and of activity of experts in control and measurement systems. - [K1A_W14]

Skills:

1. Students are able to extract information from Polish or English language literature, databases and other sources. Is able to synthesize gathered information, draw conclusions, and justify opinions - [K1A_U16]
2. Students are able to prepare a well-documented study, in English or in Polish, on problems related to electronics and telecommunication. - [K1A_U16]
3. Students are capable of studying autonomously. - [K1A_U16]
4. Students are able to measure typical parameters of signals, systems and devices, in particular those used in telecommunication. Is able to choose appropriate methods to measure given electrical quantities and parameters of signals and devices. Is able to plan and perform measurements and analyze the results. - [K1A_U16]

Social competencies:

1. Demonstrates responsibility and professionalism in solving technical problems. - [K1A_K04]
2. Demonstrates responsibility for designed electronic and telecommunication systems. Is aware of the hazards they pose for individuals and communities if they are improperly designed or produced. - [K1A_K04]
3. Is aware of the main challenges facing electronics and telecommunication in the 21st century. - [K1A_K04]

Assessment methods of study outcomes

-Lectures passing based on written test from content of the lectures.
-Tests in laboratory.
-Reports from laboratory experiments.

Course description

Basic definitions and terms of computer-based measurements systems.
- Methods, principles and procedures of measurements. Digital measurements of frequency and period.
= Sources of errors. Identification of systematic errors.
- Statistics in metrology. Point and range estimation.
- Uncertainty and error in direct and indirect measurements. Calculation of the total standard uncertainty.
- Measurements with analog and digital oscilloscopes.
- Analogue and digital measurements of voltage, current and resistance.
- Metrological attributes of modern measuring instruments.
- Selected characteristics of analog and digital measurements.
- Conditioning circuitry and signal conditioners.
- Digital to analog converters.
- Temperature sensors,
- Stress and pressure sensors,
- Sensors In cars.

Basic bibliography:

1. Nawrocki W., Sensory i systemy pomiarowe, Wyd. PP, 2001 i 2006;
2. Nawrocki W., Measurement Systems and Sensors, Artech House, Boston, 2005;
3. Praca zbiorowa Bosch, Czujniki w pojazdach samochodowych, Wyd. KiŁ 2009.

Additional bibliography:

1. Nawrocki W., Rozproszone systemy pomiarowe, Wyd. KiŁ 2006;
2. Praca zbiorowa Bosch, Sieci wymiany danych w pojazdach samochodowych, Wyd. KiŁ 2009.

Result of average student's workload

Activity	Time (working hours)
1. Lecture participation	15
2. Consultation on the material submitted to the lectures	2
3. Preparation to exam	10
4. Participation in the exam	2
5. Participation in laboratory exercises	15
6. Preparing for laboratories	7
7. Preparation for assessment	6
8. Assessment participation	2

Student's workload		
Source of workload	**hours**	**ECTS**
Total workload	59	2
Contact hours	36	1
Practical activities	30	1