STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Metrology		**1010334261010320556**
Field of study: **Automatic Control and Robotics**	Profile of study (general academic, practical): **(brak)**	Year /Semester: **3 / 6**
Elective path/specialty: **-**	Subject offered in: **Polish**	Course (compulsory, elective): **obligatory**
Cycle of study: **First-cycle studies**	Form of study (full-time,part-time): **part-time**	
No. of hours: Lecture: **20** Classes: **-** Laboratory: **12** Project/seminars: **-**		No. of credits: **5**
Status of the course in the study program (Basic, major, other): **(brak)**	(university-wide, from another field): **(brak)**	
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**	Basic knowledge in the scope of mathematics including algebry, geometry, analysis Basic knowledge in the scope of physics, especially electricity, magnetism, physics of solid body including the knowledge necessary to understand physical phenomena occuring in electronic circuits Basic knowledge in the scope of the theory of electrical circuits and electrical enginnering of direct and alternating current
2	**Skills**	Ability to acquire information from the literatute, data and other sources; ability to the self-education in order to increase and update the professional competences Ability to construct, start and test a simple electronic circuit
3	**Social competencies**	Awareness of the importance of the out-of-technical aspects and effects of the engineer activity, including its influence on the environment and relating responsibility for the decisions

Assumptions and objectives of the course:

Knowledge of the measurement methodology, attributes of the modern measuring equipment, the principles of application of analog and digital devices, and the principles of the evaluation of measurement results.

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

Knowledge:

1. Well-ordered knowledge in the scope of metrology including methods of measurement of electrical and nonelectrical quantities; knowledge of computational methods needed to make analysis the experiment results - [K_W11+++]
2. Well-ordered and theoretically supported knowledge on the principles of operation of the selected electrical devices and elements - [K_W12+]
3. Understanding of the typical principles and techniques of constructing the elements and devices for measurements and control - [K_W20++]

Skills:

1. Ability to make documentation and show presentation of the results concerned with engineering task realization - [K_U03++]
2. Ability to construct an algorithm to solve a simple measurement task - [K_U11+]
3. Ability to apply corectly chosen measurement methods and devices as well as to measure the proper signals to detemine the static and dynamic characteristics of elements - [K_U15+++]
4. Ability to choose a kind and parameters of the selected application of measuring circuit - [K_U17+]
5. Ability to construct, start and test a simple electronic circuit - [K_U20+]

Social competencies:

1. Awareness of the necessity of professional approach to technical questions, meticulous knowledge of documentation and environment conditions making possible the operation of devices and their elements - [K_K04+]

2. Awareness of the socialrole of the techncal university graduate nd understanding the need to formulate information and opinions concerned with engineer activity to send them clearly to society - [K_K06+]

Assessment methods of study outcomes

Lectures:

- evaluation of the knowledge and skills shown during a written test (a test sheet includes information necessary to solve computational tasks).

Laboratory exercises:

- evaluation of the knowledge and skills connected with realization of a given task, evaluation of the report;
- tests and awarding knowledge necessary to solve questions in a given area of laboratory tasks;
- continuous evaluation (awarding activity and quality of perception).

Getting the additional points related to activity during classes such as:

- preparation and presentation of a lecture on the subject according to a module or task made by students;
- efficiency of application of the obtained knowledge during solving a given problem;
- the aesthetic qualities of the reports.

Course description

Updating 2017:

Methods of education are orientated to students to motivate them to participate actively in education process by discussion and reports.

Lectures:

Multimedia presentations expanded by examples shown on a board. Activity of students is taken into consideration in final students evaluation. Theoretical questions are presented in the exact reference to the practice.

Laboratory:

Detailed reviewing of particular exercises reports. Realization of laboratory tasks in teams, taking into account the specific computational experiments covering:

- Measurement methodology: definitiona and basic terms.
- Planning and realization of a measurement task.
- Elements of errors theory and uncertainty of measurement results.
- Measuring transducer ? processing characteristics, static and dynamic properties, inearity, supply.
- Cooperation between measuring transducers and devices ? signal transmission, interaction.
- Measurements with oscilloscopes.
- Methods of measurements.
- Measuring bridges.
- Analog and digital measurements of electrical quantities.
- Selected examples of measurements of nonelectrical quantities.
- Introduction to structure and organization of measurement systems.
- Knowledge of safety principles during measurements.
- Planning and realization of measurements of the basic electrical quantities with widely available analog and digital equipment.
- Measurements of electrical signals with analog oscilloscopes.
- Preparation of the documentation based on the obtained results of measurements.

Basic bibliography:

1. A. Chwaleba, M. Poniński, A. Siedlecki, Metrologia elektryczna, WNT, Warszawa 2000

2. A. Cysewska-Sobusiak, Podstawy metrologii i inżynierii pomiarowej, Wyd. Politechniki Poznańskiej, Poznań 2010

3. A. Cysewska-Sobusiak, Z. Krawiecki, A. Odon, P. Otomański, D. Turzeniecka, G. Wiczyński, Laboratorium z metrologii elektrycznej i elektronicznej, Wydawnictwo Politechniki Poznańskiej, Poznań 2000

4. J. Rydzewski, Pomiary oscyloskopowe, WNT, Warszawa 2007

5. P. Sydenham (red.), tłum. ang. red. J. Dudziewicz, Podręcznik metrologii, t.1: Podstawy teoretyczne t. 2: Podstawy praktyczne, WKiŁ, Warszawa, 1988-1990.

Additional bibliography:

1. S. Bolkowski, Elektrotechnika, Wydawnictwa Szkolne i Pedagogiczne, Warszawa 2009
2. W. Jakubiec, J. Malinowski, Metrologia wielkości geometrycznych, WNT, Warszawa 2007.
3. J. Grzelka, E. Mazur, M. Gruca, W. Tutak, Miernictwo i systemy pomiarowe, laboratorium, Wyd. Politechniki Częstochowskiej, 2004.
4. A. Michalski, S. Tumański, B. Żyła, Laboratorium miernictwa wielkości nieelektrycznych Oficyna Wyd. Politechniki Warszawskiej, Warszawa 1996.
5. J. Piotrowski, Podstawy miernictwa, WNT, Warszawa 2002.
6. M. Rząsa, B. Kiczma, Elektryczne i elektroniczne czujniki temperatury, WKŁ, Warszawa 2005.
7. E. Romer, Miernictwo przemysłowe, PWN, Warszawa 1970.
8. S. Tumański ? Technika pomiarowa, WNT, Warszawa 2007
9. J. Zakrzewski, Czujniki i przetworniki pomiarowe, Wyd. Politechniki Śląskiej, Gliwice 2004.
10. T. Zieliński ? Cyfrowe przetwarzanie sygnałów. Od teorii do zastosowań, WKŁ, Warszawa 2007 Międzynarodowy Słownik Podstawowych i Ogólnych Terminów Metrologii, Główny Urząd Miar, Warszawa 1996
11. www.bipm.org
12. www.electropedia.org
13. www.electropedia.org

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures	20
2. Participation in laboratory exercises	12
3. Participation in consulting withe the teachers	3
4. Preparation to laboratory exercises and preaparation of reports	35
5. Preparation to the credt	30

Student's workload

Source of workload	hours	ECTS
Total workload	130	5
Contact hours	37	1
Practical activities	27	1