

STUDY MODULE DESCRIPTION FORM		
Name of the module/subject Metrology		Code 1010804131010830362
Field of study Electronics and Telecommunications	Profile of study (general academic, practical) general academic	Year /Semester 2 / 3
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: 30 Classes: - Laboratory: 15 Project/seminars: -		No. of credits 6
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 %) 6 100% 6 100%
Responsible for subject / lecturer: dr inż. Maciej Wawrzyniak email: mwawrz@et.put.poznan.pl tel. 665 3835 Electronics and Telecommunications Polanka 3		
Prerequisites in terms of knowledge, skills and social competencies:		
1	Knowledge	1. Has a systematic knowledge of mathematical analysis, algebra and theory of probability. (K1_W01) 2. Has a basic, systematic knowledge of physics. (K1_W02) 3. Has a detailed, systematic knowledge of the fundamentals of circuit theory, together with necessary mathematical background; this knowledge allows him/her to understand, analyze and evaluate the operation of electrical circuits. (K1_W05)
2	Skills	1. Is 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. (K1_U01) 2. Is capable of studying autonomously. (K1_U05) 3. Demonstrates the ability to solve basic problems in physics. (K1_08) 4. Demonstrates the ability to solve typical tasks and problems related to analysis of electrical circuits. (K1_09) 5. Can implement the occupational health and safety principles. (K1_U27)
3	Social competencies	1. Is aware of the limitations of his/her current knowledge and skills; is committed to further self-study. (K1_K01) 2. Is able to participate in collaborative projects. (K1_K02)
Assumptions and objectives of the course: -To present of the basic definitions and concepts of metrology, measurement methods and measurement equipment. To introduce students to the analysis and presentation of data and the determination of errors and measurement uncertainty. Practical carrying out laboratory experiments involving the preparation and execution of measurements.		
Study outcomes and reference to the educational results for a field of study		
Knowledge: 1. 1. Has a systematic knowledge, together with necessary mathematical background, of the fundamentals of metrology, which is necessary to measure the signal properties and the parameters of electronic and telecommunication systems components. Has knowledge of measurement methods, measurement equipment. - [K1_W18] 2. Has knowledge of devices and systems exploitation. - [K1_W20]		
Skills:		

<p>1. Is 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. - [K1_U01]</p> <p>2. Is able to prepare a well-documented study, in English or in Polish, on problems related to electronics and telecommunication. - [K1_U03]</p> <p>3. Is capable of studying autonomously. - [K1_U05]</p> <p>4. Is 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. - [K1_U17]</p>
<p>Social competencies:</p> <p>1. Demonstrates responsibility and professionalism in solving technical problems. - [K1_K02]</p> <p>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. - [K1_K03]</p> <p>3. Is aware of the main challenges facing electronics and telecommunication in the 21st century. - [K1_K04]</p>

Assessment methods of study outcomes		
<p>-Lectures passing based on written test from content of the lectures.</p> <p>-Tests in laboratory.</p> <p>-Reports from laboratory experiments.</p>		
Course description		
<p>- Basic definitions and terms of metrology.</p> <p>- Methods, principles and procedures of measurements. Digital measurements of frequency and period.</p> <p>= Sources of errors. Identification of systematic errors.</p> <p>- Statistics in metrology. Point and range estimation.</p> <p>- Uncertainty and error in direct and indirect measurements. Calculation of the total standard uncertainty.</p> <p>- Measurements with analog and digital oscilloscopes.</p> <p>- Analogue and digital measurements of voltage, current and resistance.</p> <p>- Metrological attributes of modern measuring instruments.</p> <p>- Selected characteristics of analog and digital measurements.</p> <p>- Conditioning circuitry and signal conditioners.</p> <p>- Digital to analog converters.</p> <p>- Analog to digital converters: the dual ramp ADC; flash , successive approximation and sub-ranging types. ADC errors.</p>		
Basic bibliography:		
<p>1. Chwaleba A., Poniński M., Siedlecki A., Metrologia elektryczna, Wydawnictwo Naukowo-Techniczne, Warszawa 2003.</p> <p>2. Dusza J., Gorat G., Leśniewski A., Podstawy miernictwa, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2002.</p> <p>3. Rydzewski J., Pomiary oscyloskopowe, Wydawnictwo Naukowo-Techniczne, Warszawa 1999.</p> <p>4. Arendarski J., Niepewność pomiarów, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2003.</p>		
Additional bibliography:		
<p>1. Turzeniecka D., Ocena niepewności wyniku pomiaru, Wydawnictwo Politechniki Poznańskiej, Poznań 1997.</p> <p>2. Maloberti F., Przetworniki danych, Wydawnictwo Komunikacji i Łączności, Warszawa, 2010.</p> <p>3. Rydzewski J., Oscyloskop elektroniczny, Wydawnictwo Komunikacji i Łączności, Warszawa 1996.</p> <p>4. Praca zbiorowa, Podręcznik metrologii tom 1 i 2, Wydawnictwo Komunikacji i Łączności, Warszawa 1988 i 1990.</p>		
Result of average student's workload		
Activity	Time (working hours)	
1. Participation in lectures and lab exercises.	48	
2. Preparation for lab exercises.	34	
3. Preparing lab reports.	33	
4. Preparation to the test.	35	
Student's workload		
Source of workload	hours	ECTS
Total workload	150	6
Contact hours	50	2

Practical activities	82	4
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