



Subject card

Subject name and code	Basics of Electronics and Metrology, PG_00047648						
Field of study	Informatics						
Date of commencement of studies	October 2022		Academic year of realisation of subject		2022/2023		
Education level	first-cycle studies		Subject group		Obligatory subject group in the field of study Subject group related to scientific research in the field of study		
Mode of study	Full-time studies		Mode of delivery		at the university		
Year of study	1		Language of instruction		Polish		
Semester of study	2		ECTS credits		3.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Metrology and Optoelectronics -> Faculty of Electronics, Telecommunications and Informatics						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Sylwia Babicz-Kiewlicz				
	Teachers		dr inż. Maciej Wróbel dr hab. inż. Wiesław Kordalski dr inż. Michał Ryciewicz dr inż. Sylwia Babicz-Kiewlicz dr inż. Stanisław Galla dr inż. Marcin Strąkowski				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	30.0	0.0	0.0	60
	E-learning hours included: 0.0						
	Additional information: It is obligatory to read the Health and Safety Rules and the Regulations of the Metrology Laboratory. The teachers determine the form of verification of that. Without familiarizing yourself with the Health and Safety Rules and the Laboratory Regulations, it is not possible to start classes in the metrology laboratory.						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	60		2.0		13.0	75
Subject objectives	Acquirement of basic knowledge and skills in the field of electronics and metrology						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_U05] can plan and conduct experiments related to the field of study, including computer simulations and measurements; interpret obtained results and draw conclusions	Student calibrates analog and digital electrical meters. Performs measurements of basic electrical parameters: voltage, current, resistance, power and energy. Explores measurement functions of a digital oscilloscope. Measures signal parameters: time, frequency, phase shift. Student organizes measurement system and measures parameters of selected A/D converters. Analyzes measurement results and evaluate measurement accuracy. Student defines signal types and timings. Recognizes basic properties of periodic and non-periodic signals spectrum. Classifies signal sources and RC circuits. Describes operational amplifiers and RC and relaxation oscillators. Explains digital measurement methods of time, frequency and phase shift. Describes rules of voltage to digital code conversion. Student recognizes architecture and operation modes of a digital oscilloscope. Classifies measurement systems and interfaces. Performs measurements of basic electrical parameters. Student organizes measurement system and measures parameters of selected A/D converters. Explores basic układy pracy tranzystora. Performs measurement of frequency characteristic of operational, resonant and audio frequency amplifiers.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
	[K6_U02] can perform tasks related to the field of study in an innovative way as well as solve complex and nontypical problems, applying knowledge of physics, in changing and not fully predictable conditions	Student performing experiments on a analyzes their course and effect in real time. Is able to predict the expected result of the measurement and react in case of the wrong course of the experiment. Understands the basic electrical phenomena occurring in electronic systems and can use this knowledge during the experiment.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
	[K6_W42] Knows and understands, to an advanced extent, architecture, design principles and methods of hardware and software support for local and distributed information systems, including computing systems, databases, computer networks and information applications, as well as the principles of human cooperation with computers and computer-aided teamwork	Student understands the concept of the measurement system. Performs experiments using dedicated programs and computer-assisted measurement equipment.	[SW3] Assessment of knowledge contained in written work and projects
	[K6_W06] Knows and understands the basic processes occurring in the life cycle of devices, facilities and systems specific to a given field of study.	Student knows and understands the processes that cause the uncalibration of measuring instruments. Is able to determine and qualify the reasons for the change of the boundary error value of the device. Understands the need to operate the device under certain conditions and the risk associated with working outside the rated conditions.	[SW1] Assessment of factual knowledge

	Course outcome	Subject outcome	Method of verification
	[K6_W05] Knows and understands, to an advanced extent, methods of supporting processes and functions, specific to the field of study	Student understands the concept of the measurement system. Knows the simplified construction and tasks of the measuring system. Recognizes the need to properly build the system in the context of performed tasks. Knows alternative programming environments used in building a measurement system.	[SW1] Assessment of factual knowledge
Subject contents	<p>1. Introduction to basic of electronics. 2. Electronic signals: kind and their course time, into it: detailed description of harmonical signal, AM, FM, PM signals. 3. Spectrum of periodic signals: Fourier sequence, examples of signals about different spectra, into it spectrum of rectangular wave and AM signal. 4. Distortions of periodic signals: nonlinear distortions (intermodulation) and linear distortions, influence of frequency characteristic of load on form of signal, typical distortions of rectangular wave. 5. Spectrum of periodic signal: Fourier integral, spectrum of rectangular pulse, spectrum of acoustic and video signals. 6. Noises, digital signals and principles of conversion of analog signals to digital signals, into it Nyquist condition. 7. Sources of signals, electric sources and measures of signals, into it: a statement about supplementary source, electronic circuits as sources of signals, absolute and relative signals. 8. RC circuits and their influence on electronic signals: switching of circuit, integral and compensate circuits, elementary low-pass and high-pass filters. 9. Voltage and current resonance, resonance LC circuits, quartz resonator. 10. Detection, demodulation and decoding of signals. 11. Amplification of signals transistors. 12. Amplifier with negative feedback, differential amplifier, push-pull and operational amplifier. 13. Harmonic generators. 14. Relaxation oscillators. 15. Signal synchronisation. 16. Introduction. Basic metrological terms: measurement, converter, measuring instrument and system, measurement errors, standard and extended uncertainty. 17. Oscilloscope: Block diagram, principles of operation. 18. Time base generator, triggering methods. 19. Oscilloscope measurement methods: phase, pulse parameters, observation of device characteristics. 20. Digital method of time-interval measurement, +/-1 count error. 21. Digital methods of low and high frequency measurements. 22. Phase measurements. 23. Classification and characterization of digital voltage measurements methods. 24. Dual-slope integration ADC. 25. Voltage to frequency integration ADC. 26. DACs with binary weighted resistors and R-2R ladder. 27. Compensation ADC with successive-approximation. 28. Flash ADC. 29. Measurements of AC voltage, AC/DC converters of true RMS value. 30. Digital multimeters: 2 & 4-wire resistance to voltage converters. 31. Digital storage oscilloscope, architecture, sampling techniques, modes of operations, applications. 32. Digital measurement methods of impedance parameters R, L, C, Z . 33. Classification and characterization of measuring systems. 34. Measuring systems based on general purpose interface bus (GPIB), signals and lines, three wire handshake process. 35. Creating of virtual instruments.</p>		
Prerequisites and co-requisites	It is obligatory to read the Health and Safety Rules and the Regulations of the Metrology Laboratory. The teachers determine the form of verification of that. Without familiarizing yourself with the Health and Safety Rules and the Laboratory Regulations, it is not possible to start classes in the metrology laboratory.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Practical exercises	50.0%	50.0%
	Colloquiums	50.0%	50.0%
Recommended reading	Basic literature	<ol style="list-style-type: none"> 1. Taylor J. R., Wstęp do analizy błędów pomiarowych, PWN, 2. Tumański S., Technika pomiarowa, WNT, 3. Chwaleba A., Poniński M., Siedlecki A., Metrologia elektryczna, WNT, 4. Stabrowski M., Cyfrowe przyrządy pomiarowe. PWN, 5. Nawrocki W., Komputerowe systemy pomiarowe, WKiŁ, 6. Dusza J. i inni, Podstawy miernictwa. Wyd. Politechniki Warszawskiej 7. Guide to the Expression of Uncertainty in Measurement. Wydanie polskie: Wyrażenie niepewności pomiaru, Przewodnik, Główny Urząd Miar 8. Sedra A., Microelectronic circuits, HRW, New York, 10. Osowski J., Szabat J., Podstawy teorii obwodów, t.2, WNT, 11. Stabrowski M., Cyfrowe przyrządy pomiarowe, PWN, 12. Instrukcje i materiały pomocnicze do laboratorium 	
	Supplementary literature	A. Filipkowski: Układy elektroniczne analogowe i cyfrowe, WNT	
	eResources addresses	<p>Podstawowe</p> <p>https://enauczanie.pg.edu.pl/moodle/course/view.php?id=23442 - eCourse on eNauczanie platform</p> <p>Adresy na platformie eNauczanie:</p> <p>Podstawy Elektroniki i Metrologii INF st. 2022/2023 - Moodle ID: 25500</p> <p>https://enauczanie.pg.edu.pl/moodle/course/view.php?id=25500</p>	

Example issues/ example questions/ tasks being completed	Principle of operation of an integrating voltage to time converter. Use of an oscilloscope to observe and measure the parameters of analogue and digital signals.
Work placement	Not applicable