Electronic measuring instruments - course description

General information

Course name	Electronic measuring instruments
Course ID	06.5-WE-ELEKTP-ElMeasIn-S16
Faculty	Faculty of Computer Science, Electrical Engineering and Automatics
Field of study	Electrical Engineering
Education profile	academic
Level of studies	First-cycle Erasmus programme
Beginning semester	winter term 2022/2023

Course information

Semester	6
ECTS credits to win	5
Course type	optional
Teaching language	english
Author of syllabus	• prof. dr hab. inż. Ryszard Rybski

Classes forms

The class form	Hours per semester (full-time)	Hours per week (full-time)	Hours per semester (part-time)	Hours per week (part-time)	Form of assignment
Lecture	30	2	-	-	Exam
Laboratory	30	2	-	-	Credit with grade

Aim of the course

- to familiarize students with the construction, principles of operation, metrological properties of modern multimeters, digital oscilloscopes, spectrum analyzers and sources of measurement signals

- to shape the skills in the use of electronic measuring instruments and in the estimation of the accuracy of measurements

- to become aware of the role of the microprocessor technology in signal processing circuits of modern measuring instruments

Prerequisites

Fundamentals of electrical engineering, Electronics, Metrology

Scope

Trends in the development of modern measuring instruments. Microprocessor devices, microprocessor measuring blocks, cards and plug-in measurement modules, virtual instruments.

Digital multimeters. Characteristics of basic functional blocks of digital multimeters. Illustration of the possibility of using software procedures to improve the metrological properties of microprocessor measuring instruments on the example of selected digital multimeter solutions.

Electrical interference in the measurement of voltages and methods of eliminating them. Types of interferences and their sources. Attenuation of serial and parallel interferences. Principles of connections of signal sources to measuring instruments.

Measurement of high frequency voltages. Sources of errors in RF voltages measurement. Tests measuring probes. Measurement with using the voltmeter with high-impedance input circuit and measurement with impedance matching.

Instruments for narrowband AC voltage measurements. Selective voltmeter. Voltmeters with synchronous detection. Vector voltmeters.

Digital oscilloscopes. Classification of electronic oscilloscopes. Structure and principle of operation of a digital oscilloscope. Characteristics of operating modes. Comparative characteristics of selected types of modern digital oscilloscopes. Measurements using a digital oscilloscope.

Spectrum Analyzers and Nonlinear Distortion Meters. Classification, principle of operation, metrological and functional properties of spectrum analyzers. Digital spectrum analyzers: digital filter analyzers, FFT analyzers. Methods of measurement of the nonlinear distortion.

Instruments for impedance measurement. Automatic RLC meters, impedance analyzers, Q-meters, transformer bridges.

Electronic instruments for measuring electric power and energy. Specialized integrated circuits for measuring electric power and energy. Electronic energy meters.

Measurement signal sources. Sinusoidal voltage generation methods used in the field of small and high frequencies. Generators with digital frequency synthesis. Voltage and current calibrators.

Teaching methods

Lecture: conventional lecture, problem lecture, discussion

Laboratory: working with source document, group work, laboratory exercises

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
It can indicate the most important sources of interference accompanying the use of electronic measuring instruments and propose ways and means to minimize their impact on the measurement result		• an observation and evaluation of activities during the classes	• Laboratory
Student can explain the principle of operation and characterize the metrological properties of modern multimeters, digital oscilloscopes, spectrum analyzers and signal source sources		• an exam - oral, descriptive, test and other	• Lecture
It is aware of the role of the digital signal processing and microprocessor technology in the signal processing circuits of modern measuring instruments		• an exam - oral, descriptive, test and other	• Lecture
Knows the general principles of using electronic measuring instruments designed to measure basic electrical quantities, can estimate the accuracy of measurements performed with taking into account the measurement and specification conditions		• an observation and evaluation of activities during the classes	• Laboratory

Assignment conditions

Lecture – the credit is given for obtaining positive grades in written tests carried out at leastonce a semester.

Laboratory – to receive a final passing grade stude nt has to receive positive grades in all laboratory exercises provided for in the laboratory syllabus.

Calculation of the final grade: lecture 50% + laboratory 50%

Recommended reading

1. Tumanski S.: Principles of electrical measurement. Taylor & Francis, 2006
2. Bhargawa S.C: Electrical measuring instruments and measurements. CRC Press, 2012

Further reading

1. Horowitz P., Hill W.: The art of electronics. Cambridge University Press, 2017

Notes

Modified by dr hab. inż. Paweł Szcześniak, prof. UZ (last modification: 06-04-2022 22:42)