SYLLABUS

Name: ***Measurement systems (MakAu>SI4MS19)***
Name in Polish:
Name in English: ***Measurement systems***

Information on course:

Course offered by department: Faculty of Automatic Control, Electronics and Computer Science
Course for department: Silesian University of Technology

Default type of course examination report:

EGZ

Language:

English

Course homepage:

https://platforma2.polsl.pl/rau1/course/view.php?id=112

Short description:

The aim of the course is to acquire knowledge, by the student, in the field of measurement systems. In particular, used in measurement systems: sensors, measuring transducers, interfaces, bench-top devices such as multimeters, generators, oscilloscopes, modular instruments as PXI and CompactRIO embedded systems (RT + FPGA), multifunctional DAQ card. The student will learn about exemplary methods and devices for measuring selected physical and electrical quantities. Become familiar with the basics of LabVIEW programming for measurement systems. As part of the laboratory, will learn about the selected measuring equipment and acquire skills in the field of measuring of selected physical and electrical quantities and programming in the LabVIEW environment, with particular emphasis on the LabVIEW + DAQ.

Description:

ECTS credits: 6
Total workload: 150 hours (75 contact hours /75 hours of individual students work)

Foem od contact hours:
Lecture: 30 hours
Laboratory: 30 hours
Other (discussion of laboratory exercises): 15 hours

Student's own work: analysis of lecture content, preparation of laboratory reports, preparation for the lecture assessment, preparation for the laboratory assessment.

Lecture:
Introduction to measurement systems in industry, research & development and science. Elements of measurement systems.
Integration of intrinsically safe field instrumentation into industrial communication networks.
Vocabulary of Basic and General Terms in Metrology: sensor, measuring instrument, measuring chain, measuring system, static characteristics - range, span, zero, zero drift, sensitivity, resolution, response, linearity, hysteresis, calibration, accuracy, dynamic characteristics.
From sensor to acquisition device. Review of sensors: conventional, thin and semiconductor technologies. Smart transducer, standarized signals and most popular industrial protocols – HART, Profibus PA (and Profibus DP), Foudation Fieldbus. Analog to digital converters for sensors and data acquisition.
Sensors properties: range, sensitivity, characteristic, intrinsic and additional errors.

Selected sensors and measurements of physical and electrical quantities: temperature, pressure, strain, acceleration, displacement, true RMS, frequency.
The IEEE 1451- a smart transducer interface standard for sensors and actuators.
Devices and interfaces in measurement systems: bench top and modular instruments (multimeters, generators, oscilloscopes..., PXI, universal DAQ boards). Serial and paraler interfaces. CompactRIO (cRIO) and Single Board RIO (sbRIO) embedded platforms with RT and FPGA. Vision acquisition systems.
Introduction to Virtual Instrumentation. LabVIEW programming: Project Explorer, VI front panel and block diagram, VI icon and connector pane. Data types. Basic loops and structures. Debuging technics. Clusters and type definition. High level and low level file I/O functions. Design patterns. Data communication between parallel loops.
Examples of Production Line Testers, End-Of-Line testers.

Laboratory:
1. Temperature sensors calibration
2. Strain gauges.
3. Digital to analog and analog to digital converters.
4. AC votage measurement.
5. Signal generation and acquisition in DAQ based systems.
6. Dual slope AD converter.
7. LabVIEW 1 – Introduction to LabVIEW programming
8. LabVIEW 2 – State Machine design pattern
9. LabVIEW 3 – Producer Consumer design pattern.
10. Multifunction DAQ device in measurement systems.

Bibliography:

Bentley J. P.: Principles of measurement systems; Longman, London and New York 1985.
Fraden J.: AIP Handbook of Modern Sensors; Physics, Design and Applications. American Institute of Physics Press, 3rd ed. p. cm., Springer-Verlag, New York, Berlin, Heidelberg, 2003.
Morris A.S.; Langari R.: Measurement and Instrumentation - Theory and Application, Elsevier, 2012
Yik Yang: LabVIEW Graphical Programming Coockbook, Packt Publishing, 2014
Travis J., Kring J.: LabVIEW for everyone : graphical programming made easy and fun - 3rd ed, Prentice Hall, 2007.

Blume P. A.: The LabVIEW style book, Prentice Hall, 2007
International Vocabulary of Basic and General Terms in Metrology. ISO 1993.Guide to the Expression of Uncertainty in Measurement. ISO 1993.

Learning outcomes:

Knowledge
The student knows and understands:
Issues related to conducting and developing measurement results, types of measurement uncertainty and methods of their determination, principles of operation of measuring transducers of electrical and non-electrical quantities K1A_W04.

Skills
The student is able to:
Carry out measurements of electrical quantities and selected non-electrical quantities K1A_U11.
Develop and present measurement results, taking into account the analysis of measurement uncertainty K1A_U11.
Apply simple algorithms for processing recorded measurement data, in the time and frequency domain K1A_U17.

Social competences
The student is ready to:
Assess the knowledge they possess and recognize the importance of knowledge in solving cognitive and practical problems K1A_K01.

Assessment methods and assessment criteria:

Lecture
Written or oral exam, graded at least 3.0.

Laboratory
Participation in all laboratory exercises. Preparation of a report and passing each exercise with a grade of at least 3.0.

Final grade: 50% of the exam grade + 50% of the laboratory grade.

The syllabus is valid from the winter semester of the 2025/26 academic year, and its content is not subject to change during the semester.

Course credits in various terms:

<without a specific program>

Type of credits	Number	First term	Last term
European Credit Transfer System (ECTS)	6	2020/2021-L	