Embedded measurement systems - course description

General information

Course name	Embedded measurement systems
Course ID	06.0-WE-ELEKTD-EmbMeasSys-Ee
Faculty	Faculty of Computer Science, Electrical Engineering and Automatics
Field of study	Electrical Engineering
Education profile	academic
Level of studies	Second-cycle Erasmus programme
Beginning semester	winter term 2017/2018

Course information

Semester	2
ECTS credits to win	6
Course type	optional
Teaching language	english
Author of syllabus	• dr hab. inż. Janusz Kaczmarek, prof. UZ

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	-	-	Credit with grade
Laboratory	30	2	-	-	Credit with grade
Project	15	1	-	-	Credit with grade

Aim of the course

Skills and competences in the field of designing the hardware and the software of embedded systems with emphasis on measurement equipment.

Prerequisites

- Electrical metrology
- Principles of electronics
- Fundamentals of microprocessor technology
- Programming languages

Scope

Fundamentals terms and definition. Architecture microprocessor measurement devices. Methodology of designing embedded systems: division of project tasks on software and hardware, creating technical documentation. Some elements of microprocessor technique. Microprocessors and microcontrollers. Microcontroller architecture.

Overview of some microcontroller families. Architecture of DSP floating-point processors. Problems of power-saving in embedded systems. Microprocessor power-saving modes. Interfacing of analog- to-digital and digital- to-analog converters.

Introduction to programming for embedded systems. Integrated programming environments. Low-level and high-level programming languages. Hybrid programming technique. Methods of code optimization.

Applying real-time operating system (RTOS) to design the software for embedded systems with low resources. Basic terms. Principles and aims of applying RTOS systems. Mechanisms of RTOS kernel. Services of peripheral devices. Scalability of RTOS. Examples of commercial and non-commercial RTOS. Advantages of applying RTOS in measurement equipment.

Processing of measurement data in digital systems. Arithmetic and numerical representations for measurement data. Effective fixed-point arithmetic on fractional numbers. Transformations of numbers and conversions of codes. Scaling and calibrating. Display of measurement results.

Implementation of some measurement and control algorithms. Software control procedures for analog-to-digital and digital-to-analog converters. Acquisition and generation signals using interrupts. Sampling methods of RMS and frequency measurement. Real-time signals processing with DSP processors.

Teaching methods

Lecture: conventional lecture
Laboratory: laboratory exercises, group work
Project: project method, discussions and presentations

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
Student knows specifics of embedded systems including microprocessor architecture of measurement devices		• a multiple choice and open questions test	• Lecture

Outcome description	Outcome symbols	Methods of verification	The class form
Student can design microprocessor measuring devices		• a project	• Project
Student can program microprocessor measuring devices in low- and high- level languages and carry out the startup process.		• a multiple choice and open questions test • an ongoing monitoring during classes • carrying out laboratory reports	• Lecture • Laboratory
Student can realize in a team the tasks related to microprocessor programming of measurement devices		• an ongoing monitoring during classes • carrying out laboratory reports	• Laboratory

Assignment conditions

Lecture – the passing condition is to obtain a positive mark from the final test.

Laboratory – the passing condition is to obtain positive marks from all laboratory exercises to be planned during the semester.

Project - the project documentation and oral presentation

Calculation of the final grade: lecture 35% + laboratory 35% + project 30%

Recommended reading

1. Barney G.C.: Intelligent Instrumentation. Microprocessor Applications in Measurement and Control , Prentice Hall, 1988
2. Tumański S.: Measuring Technique, WNT, Warszawa, 2007 (n Polish)
3. Labrosse J.J.: Embedded System Building Blocks, CMP Books, 2000
4. Dąbrowski A.: Processing of signals with DSP processors, Wydawnictwo Politechniki Poznańskiej, Poznań, 1998 (in Polish)

Further reading

Notes

Modified by dr hab. inż. Radosław Kłosiński, prof. UZ (last modification: 02-05-2017 14:31)