RTU Course "Microprocessors - based Automation Systems"
11103 Industriālās elektronikas un elektrotehnol.katedra

General data

Code	EEP504
Course title	Microprocessors - based Automation Systems
Course status in the programme	Compulsory/Courses of Limited Choice
Course level	Post-graduate Studies
Course type	Academic
Field of study	Computer Science
Responsible instructor	Iļja Galkins
Academic staff	Kristaps Vītols
Volume of the course: parts and credits points	1 part, 3.0 Credit Points, 4.5 ECTS credits
Language of instruction	LV, EN, RU
Possibility of distance learning	Not planned
Abstract	The course has been composed for any student who has elementary knowledge in the field of electrical engineering and programming and wish to gain basic practical skills of utilization of microcontrollers MSP430. The course briefly discusses basic design features of microcontrollers MSP430 in the context of various architectures of microprocessors, microcontrollers and peripheral devices. The most significant part of the course is devoted to the programming of MSP430 – including the programming of digital I/O, watchdog and arithmetical operations. The course is based on practical studies and assumes active individual training of the students in the laboratory or at home.
Goals and objectives of the course in terms of competences and skills	Ability to recognize the most significant elements of microprocessors and microprocessor systems (processor, memory, peripheral devices), identify their architectures, benefits and drawbacks. Ability to explain operation of CPU, memory, some peripheral devices (digital I/Os and watchdog) and other significant part of MSP430. Skills of assembler programming of MSP430 and debugging of the assembler programs utilizing its digital I/Os and watchdog with definite hardware configuration. Skills of interfacing MSP430 with definite sensors and actuators are estimated as an additional, extra, goal.
Structure and tasks of independent studies	There are a lot of practical and laboratory exercises in the course related to the corresponding theoretical material. The practical exercises are those that may be executed using only a personal computer with MSP simulation software. The laboratory exercises assume utilization of the training hardware (the training kit includes a programmer/debugger and training board equipped with LED and pushbuttons) for development and debugging of the programs for MSP430. If necessary students may be provided with the kit also for making their exercises at home.
Recommended literature	I.Galkins, MSP430 mikrokontrolleru pielietošanas pamati, Rīga: RTU izdevniecība, 2009. gads, 229 lpp., ISBN 978-9984-32-460-9.
Course prerequisites	Basic knowledge in the field of electrical engineering and programming.

Course outline

Theme	Hours
Features of microcontrollers (MCU). General data about MSP430x1xx. Introduction into programming/debugging software.	3
Central processing unit (CPU) of MSP430: structure, special function registers, clock signal.	1
Core and emulated instructions of MSP430, formats of instructions, operands of instructions and addressing modes.	2
Functional groups of MSP430 commands. Numbers, assembler directives and comments in assembler programs.	3
Generating of operation codes for MSP430 instructions: impact of formats and addressing modes.	6
Length and execution time of MSP430 instructions: impact of formats and addressing modes.	3
Features of arithmetical operations in MSP430. 8-bit, 16-bit and longer numbers. Processing arrays.Features of arithmeti	6
Numerical conditions and cycles. Short and long software delays in MSP430.	3
Digital outputs of MSP430: connection, electrical parameters and control registers. Programming of the digital outputs.	3
Digital inputs of MSP430: connection, control registers and programming. Bit conditions in assembler programs.	3
Watchdog timer (WDT) of MSP430: operation modes, parameters and registers. Measuring time intervals using WDT.	3
Definition of interrupts. Types and programming of interrupts in MSP430. Measuring time intervals using WDT interrupts.	3
Interrupts of digital inputs/outputs in MSP430. Synchronous and asynchronous interrupts. Relative utilization of CPU.	3
Clock system of MSP430: sources of clock signals, frequency regulation, programming.	3
Programming MSP430 with C: brief C description, features of MCU programming with C. Mixed programs.	3

Learning outcomes and assessment

Learning outcomes	Assessment methods
Ability to recognize the most significant elements of microprocessors and microprocessor systems (processor, memory, peripheral devices), identify their architectures, benefits and drawbacks.	Final or local quiz on this topic passed. Passed an exam

Ability to explain operation of CPU, memory, some peripheral devices (digital I/Os and watchdog) and other significant part of MSP430.	Final or local quiz on this topic passed. Passed an exam
Skills of assembler programming of MSP430 and debugging of theassembler programs utilizing its digital I/Os and watchdog with definite hardware configuration.	Correctly made practical and laboratory works. Final practical exercise passed. Passed an exam
Skills of interfacing MSP430 with definite sensors and actuators.	Correct interfacing of microcontroller with a sensor or actuator on practical kit. Passed an exam

Study subject structure

Part	CP	ECTS	Hours per Week			Tests		
			Lectures	Practical	Lab.	Test	Exam	Work
1.	3.0	4.5	1.0	1.0	1.0		*	