

Microprocessor Systems (ELB)

1	Module Number	Study Programme ELB	Semester 4	Offered in ☒WS ☒SS	Duration 1 Semester	Module Type Compulsory	Workload 120 h	ECTS Points 4
2	Courses		Teaching and Learning Forms		Contact Time		Self-Study Time	Language
					(SWS)	(h)	(h)	
	a) Microprocessor Systems		Lecture / Excercise		2	30	60	English
	b) Laboratory Microprocessor Systems		Laboratory		2	30		
3	Learning Outcomes and Competences Once the module has been successfully completed, the students can ... Knowledge and Understanding - I know the structure and the programming methods for customary microcontrollers at the example of a state-of-the-art 32-bit-microcontroller - I know programming at register level, in particular handling bit and byte manipulations and basic integer data types - I know the programming concept for GPIO pins, interrupts, analog-digital conversion units, digital analog-converters, hardware timers as well as peripheral interfaces - I be able to program a 32 Bit microcontroller embedded system in a bare-metal fashion using the programming language C - I know the basic concepts behind integrated development environments and debugging tools for microprocessors Use, Application and Generation of Knowledge <i>Use and Transfer</i> - I are capable of developing implementation concepts by means of exercise examples - I are capable of assessing suitable application fields for microcontrollers - I are effectively capable of using integrated development environments and debugging tools - I have acquired a suitable methodology to obtain knowledge from the manufacturer’s documentation in order to apply microprocessors in practice - I are capable to transfer and generalize the knowledge to work with various types of microprocessors Communication and Cooperation - I <i>communicate within a lab team in order to gather all necessary information to get a programming task solved</i> - I <i>present the results of their work in a lab review and explain the concepts behind their solutions</i> - I <i>cooperate and communicate within a lab team to derive adequate solutions for a given task</i> Scientific Self-Conception / Professionalism - I are capable of assessing their own skills in comparison to other lab groups - I are capable of assessing the quality of a programming solution in comparison to other possible implementations							
4	Contents a) Lecture Microprocessor Systems: - I Structure, mode of operation and basic programming concepts of a customary microcontroller at the example of the 32-Bit ARM Cortex M3 microcontroller <i>LPC1769</i> manufactured by NXP - I Basic bare-metal programming concepts to operate the GPIO pins of the controller - I General concept of hardware interrupts and specific interrupt programming techniques for the ARM Cortex-M3 technology - I Using and programming the Analog-Digital-Converter (ADC) and Digital-Analog-Converter (DAC) hardware in the different modes available at the <i>LPC1769</i>. - I Applying the standard timers available at the <i>LPC1769</i> for a variety of counting and timing applications - I Basics of peripheral bus interfaces b) Laboratory Microprocessor Systems: - I Simple digital input and output operations - I Using the display and other peripheral components on the µC-lab boards available for the experiments							

	- Hardware interrupts triggered by several internal and external sources - ADC-applications to read analog voltages and interface analog sensors - DAC-applications to synthesize periodic signals - Various timer and counter applications with the four standard timers available at the <i>LPC1769</i>
5	Participation Requirements Compulsory: Admission to the second stage of the degree program Recommended: Electronics and Digital Engineering (TTL and CMOS technologies, ADC and DAC principles, combinatorial and sequential logic), basic of C programming, computations in the binary and hexadecimal numeral systems.
6	Examination Forms and Prerequisites for Awarding ECTS Points a) Written exam (90 minutes) at the end of the semester b) Successful accomplishment of the lab tasks with appropriate documentation and discussion with the lab supervisors
7	Further Use of Module internship, scientific projects, final thesis
8	Module Manager and Full-Time Lecturer Prof. Schmidt
9	Literature - User-Manual <i>LPC176x/5x</i>, User manual UM10360, http://www.nxp.com (http://www.nxp.com/documents/user_manual/UM10360.pdf) - Lecture notes <i>Microprocessor Systems</i> - Lab instructions <i>Microprocessor Systems</i> - Yiu, J.: The Definitive Guide to the ARM Cortex-M3; Newnes Ltd., 2007 http://www.arm.com/products/processors/cortex-m/cortex-m3.php
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