Foundations of digital and microprocessor engineering - course description

General information

Course name	Foundations of digital and microprocessor engineering
Course ID	06.5-WE-AutP-FDNE-Er
Faculty	Faculty of Computer Science, Electrical Engineering and Automatics
Field of study	Automatic Control and Robotics
Education profile	academic
Level of studies	Erasmus programme
Beginning semester	winter term 2017/2018

Course information

Semester	3
ECTS credits to win	6
Course type	obligatory
Teaching language	english
Author of syllabus	• dr hab. inż. Krzysztof Sozański, 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

Aim of the course

Basic knowledge of: designing basic sequential and combinational circuits; calculating the representation of integers and real numbers as well as performing basic arithmetic operations on the representations; writing basic programs on the assembler level with the application of conditional statements, loops, operations on integers and real numbers, tables; designing and programming microprocessor systems and circuits.

Digital functional elements in MSI technique. Counters, registers, shift registers. Rules for designing synchronous and asynchronous counters. Designing combinational logic circuits with the application of : multiplexers, decoders, NAND gates. Data formats used in fixed point and floating point processors. Fixed point and floating point arithmetic. Arithmetic systems. Summation, subtraction and comparation of binary numbers. Medium-scale integration (MSI) circuits. Memory: ROM, RAM, EEPROM, FLASH. PLD, CPLD and FPGA systems. Designing digital systems with the application of PLD and CPLD systems. Microprocessors. Definitions, basic concepts and classification of microprocessors. Functional elements of microcomputer and their cooperation. Microprocessor architectures, the role of their functional elements, instruction cycle. Programming techniques, instruction set of microprocessors. Data exchange in microprocessor system. Organization and synchronization of data exchange among microprocessor system elements. Memory and I/O addressing modes. Data exchange between microprocessor system and external environment. Methods and conditions of servicing the elements of microprocessor system external environment. Data exchange among microprocessor systems. Methods for data exchange: with and without confirmation, synchronous and asynchronous, series and parallel. Advantages and drawbacks of particular methods, range of applications. Single chip-microcomputers. Characteristics of resources, application rules. Means supporting software and launch of microprocessor systems. History, trends and comparison of digital signal processors. Basic features of digital signal processors. Differences between a digital signal processor, microcontroller and microprocessor. Signal processor architectures: hardware multiplier, Harvard architecture, multibus architecture, stream conversion, delayed jumps, parallel instructions, long accumulator, shifting system, circular buffer. Memory addressing modes: direct, indirect, immediate, circular, bit reversion. Direct access systems to DMA. Multiprocessor systems.

Prerequisites

Principles of Discrete Systems, Programming with Basics of 3, Electronics Principles, Computer System Architecture.

Scope

Fundamentals of digital technology. Basic switching gates – technical specifications. Classes of integrated circuits. Integration scale. Numerical systems and codes. Boolean algebra. Logic function. Full function systems. Methods of logic function representation. Representation methods of logic function. Combinational logic circuits. Analysis and synthesis of combinational logic circuits. Minimization of logic function. Hazard in combinational logic circuits. Basic synchronous and asynchronous flip-flops. Sequential systems (Mealy and Moore machines). Analysis and synthesis of synchronous and asynchronous circuits. Characteristics of synchronous circuits and comparison with asynchronous circuits.

Teaching methods

Lecture, laboratory exercises.

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form

Outcome description	Outcome symbols	Methods of verification	The class form
Is aware of the dynamic development of microprocessors, microcontrollers and signal processors.		• an evaluation test • an ongoing monitoring during classes	• Lecture • Laboratory
Knows fundamentals of object programming and can design software, with the application of object paradigms.		• an ongoing monitoring during classes	• Laboratory
Can program in a low and high level language, carry out the analysis of a processor and is able to identify the operating status of a processor		• an ongoing monitoring during classes	• Laboratory
Knows processor construction and memory types, can analyze command lists		• an evaluation test	• Lecture
Can analyze and design simple digital systems realized with the application of discrete systems or programmable systems		• an evaluation test • an ongoing monitoring during classes	• Lecture • Laboratory

Assignment conditions

Lecture – the main condition to get a pass are sufficient marks in written or oral tests conducted at least once per semester.

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

Calculation of the final grade: lecture 60% + laboratory 40%

Recommended reading

1. Martin K., Digital Integrated Circuit Design (Oxford Series in Electrical and Computer Engineering), Oxford University Press, 1999.

2. Brown S., Vranesic Z., Fundamentals of Digital Logic with VHDL Design, Mc Graw Hill, 2009.

3. Holdsworth B., Woods C., Digital Logic Design, Newnes, 2002.

4. Stallings W., Computer Organization and Architecture, Prentice Hall Inc., 1996.

5. Baer J., Microprocessor Architecture: From Simple Pipelines to Chip Multiprocessors, Cambridge University Press, 2009.

6. McFarland G., Microprocessor Design (Professional Engineering), McGraw-Hill Professional, 2006.

7. Chassaing R., Reay D., Digital signal processing and applications with the C6713 and C6416 DSK, A John Wiley & Sons, Inc., 2008.

Further reading

1. Chassaing R., Digital Signal Processing with C and the TMS320C30, John Wiley & Sons, 1992.

Notes

Modified by dr hab. inż. Krzysztof Sozański, prof. UZ (last modification: 05-05-2017 22:39)