COURSE DESCRIPTION CARD - SYLLABUS

Course name
Fundamentals of digital systems design [S1Inf1>PTC]

Course

Field of study
Computing

Year/Semester
2/3

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
16

Other
0

Tutorials
12

Projects/seminars
0

Number of credit points

5,00

Coordinators

dr inż. Rafał Walkowiak
rafal.walkowiak@put.poznan.pl

dr inż. Krzysztof Bucholc
krzysztof.bucholc@put.poznan.pl

Lecturers

Prerequisites

Student starting this module should have knowledge of basic concepts from the field of fundamentals of electronics (transistor, CMOS, TTL technologies, logic gate, static and dynamic memory cell) and skills that are necessary to acquire information from given sources of information.

Course objective

Provide students with elementary knowledge of digital technology in the area of: construction of basic functional blocks, the principles of connecting them into structures, ways of organizing digital systems, cooperation of systems with the environment and designing control systems. Developing students" ability to analyze and design simple digital systems described at the register-transfer level and with the use of hardware description language (HDL). To acquaint students with the concept, principles and problems related to the description of digital circuits using the VHDL language. Developing students' skills of logical reasoning, presenting facts, principles of operation and descriptions in a comprehensible and concise manner, both orally and in writing.

Course-related learning outcomes

Knowledge:
The student has ordered, theoretically founded general knowledge in the field of digital technology.
Student is able to analyze and design the structure of the digital data processing system and the digital control system.
The student has detailed knowledge of the methods of designing simple combinational and sequential circuits, in particular the principles of connecting the items of digital structures and the time analysis of these circuits.
The student knows the basic techniques, methods and tools used for computer-aided design of digital circuits in FPGA programmable structures (programming environment and VHDL language).

Skills:
The student is able to design simple electronic digital circuits.
The student is able to solve design tasks in the field of digital technology using analytical, simulation and experimental methods.
The student is able to plan and carry out computer simulations of the work of designed digital circuits, interpret the obtained results and draw conclusions.

Social competences:
The student understands the need to expand the knowledge and skills resulting from technological progress in the field of digital technology affecting hardware solutions in information technology.
In the field of digital technology and using concepts related to it the student is able to express himself / herself, explain phenomena, problems and techniques in a comprehensible, logical and concise way.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Formative assessment:
- for lectures is based on answers to questions related to the material covered in previous lectures;
- for lectures is based on evaluation and discussion results of students solving problems on the blackboard;
- for laboratories is based on assessment of the current progress and the results of the ongoing and finished tasks and projects .
Total assessment:
- verification of assumed learning objectives related to laboratory classes is based by evaluation of student's knowledge necessary to prepare and carry out the lab tasks, monitoring students' activities during classes, evaluation of laboratory reports.
Assessment summarizing tutorials and lectures:
- the information presented at the lecture and the skills acquired during the tutorials are devided into three parts and tested separetelly during written tests and exam.

Programme content

The program includes theory of digital systems design, basic functional components of digital circuit, ROM, RAM, PLAs, PALs, GALs, FPGA circuits; Mealy- and Moore- mode state machines, digital data processing system design at register-transfer level, controllers design, hardware description language -VHDL.

Course topics

The purpose of this course is to provide a combination of theory and practice of the entire digital system design cycle. This includes:
- fundamentals of Boolean Algebra, logical functions, logical functions representations, minimization of logical functions in canonical forms: Karnaugh, Q-McC methods, joint minimization of many functions, fixed-point binary arithmetic, binary codes;
- basic functional elements i.e. gates, flip-flops, registers, counters, memories, multiplexers and demultiplexers, encoders and decoders, adders, comparators;
- combinational and sequential logic circuits design;
- synchronous and asynchronous systems,
- digital data processing system design at register transfer level,
- controllers design, Mealy- Moore-mode state machines - representation, optimization and implementation ;

- PLAs, PALs, GALs, FPGA;
- hardware description language -VHDL - basics and examples;
- structural and behavioral approach;
- software for CAD for digital system design, simulation and implementation in FPGA.
During lab-classes students get acquainted with a CAD system that allows for design, verification and simulation of digital systems and programming of FPGA circuits.

Teaching methods

Lectures: multimedia presentation.
Tutorials: examples presented on a black board and solving tasks.
Labs: practical exercises, design, implementation, analysis and discussion.

Bibliography

Podstawy projektowania układów logicznych i komputerów. M.M.Mano, Ch.R.Kime, WNT 2007
Komputerowe projektowanie układów cyfrowych, T.Łuba, B.Zbierzchowski, WKiŁ, 2000
Język VHDL: projektowanie programowalnych układów logicznych, Kevin Skahill, WNT 2004
Dokumentacja do ćwiczeń laboratoryjnych: zadania i narzędzia: QUARTUS, Altera DE2
Additional literature:
Podstawy projektowania układów cyfrowych, C. Zieliński, PWN 2012

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	65	2,50