# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Fundamentals of digital systems design

## Course

Field of study
Computing
Area of study (specialization)

Year/Semester
2/3
Profile of study

Level of study
First-cycle studies
Form of study
full-time

Course offered in
polish
Requirements
compulsory

## Number of hours

Lecture
30
Laboratory classes
16
Other (e.g. online)

Tutorials
12
Projects/seminars

## Number of credit points

5

## Lecturers

Responsible for the course/lecturer:
dr inż. Rafał Walkowiak

Responsible for the course/lecturer:
dr inż. Krzysztof Bucholc

## Prerequisites

Student starting this module should have basic knowledge regarding Boolean Algebra and binary arithmetic. He/she should also 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:

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. The final grade is a weighted average of the grades obtained during the tests.

**Programme content**

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;

- 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 elements.

## Teaching methods

Lectures: multimedia presentation.

Tutorials: examples presented on a black board and solving tasks.

Labs: practical exercises, design, implementation, analysis and discussion.

## Bibliography

Basic

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

Układy scalone TTL w systemach cyfrowych, J.Pienkos, J.Turczyński, WKiŁ, 1994

Podstawy projektowania układów cyfrowych, C. Zieliński, PWN 2012

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 150 | 5,0 |
| Classes requiring direct contact with the teacher | 58 | 2,0 |
| Student's own work (literature studies, preparation for laboratory classes and tutorials, preparation for tests) [1] | 92 | 3,0 |

[1] delete or add other activities as appropriate