



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Digital systems design

### Course

Field of study

Electronics and telecommunications

Area of study (specialization)

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

2/3 and 2/4

Profile of study

general academic

Course offered in

Polish

Requirements

compulsory

### Number of hours

Lecture

45

Laboratory classes

30

Other (e.g. online)

Tutorials

30

Projects/seminars

### Number of credit points

7

### Lecturers

Responsible for the course/lecturer:

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Responsible for the course/lecturer:

### Prerequisites

A basic knowledge of Boolean algebra. An ability to analyze and design simple electrical circuits and devices.

### Course objective

The course aims at providing a clear picture of fundamental concepts, effective problem-solving techniques, and an appropriate exposure to modern technologies, design techniques, and applications in the area of VLSI digital circuits and systems, both combinational and sequential.

### Course-related learning outcomes

Knowledge

Students know basic principles and rules used to design digital circuits. They also know details regarding various digital building blocks employed in logic synthesis. They also learn how to design large and complex digital systems with the help of computer-aided design (CAD) tools.



### Skills

A student can design a combinational digital circuit using, as guiding criteria, hardware complexity, speed of the circuit, its power consumption, and heat dissipation. A student understands the concepts of simple models to represent synchronous and clockless finite state machines and run their synthesis process, including state minimization, state coding, flip-flop-based implementation, and safety analysis.

### Social competences

Appreciate the practical significance of the systems developed in the course. Is aware of limitations of modern digital circuits. Is open for new applications of digital devices in technology, science, and social (daily) life. Can express his/her own opinions with respect to currently used solutions and technologies as far as design of contemporary digital systems is concerned.

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

2,5h-long written exam comprising a few assignments that cover the content of lectures. Tutorials include two written tests. Laboratory classes are evaluated based on a few small projects.

### Programme content

Lectures, semester 3: Boolean algebra, gate-level circuits, two-level design, logic minimization, computer-aided design of multi-level circuits, basic combinational logic blocks, binary numbers and codes, arithmetic circuits, floating-point units, iterative designs, programmable logic devices, hardware description languages, sequential logic, latches and flip-flops, registers and counters, linear feedback shift registers, cellular automata.

Lectures, semester 4: analysis and design and synchronous sequential circuits, automated synthesis of finite-state machines based on Mealy and Moore models, asynchronous circuits, algorithmic state machines, RTL synthesis, algorithmic state machines, semiconductor memories, test generation for combinational circuits, design for testability, built-in self-test.

Tutorials and laboratory projects: Boolean algebra, logic minimization, synthesis of simple combinational circuits, iterative designs, synthesis of Mealy and Moore finite-state machines, use of CAD tools to design at the RTL level.

### Teaching methods

Lectures: a multimedia presentation. Tutorials: students solve various problems provided by a teacher. Laboratory classes: students design certain simple digital circuits by using CAD tools, such as Multisim.

### Bibliography

#### Basic

1. J. Kalisz, Podstawy elektroniki cyfrowej, wyd. 5, WKŁ, Warszawa 2007.
2. J. Biernat, Arytmetyka komputerów, PWN, Warszawa 1996.
3. M.M. Mano, C.R. Kime, Podstawy projektowania układów logicznych I komputerów, WNT, 2007.



4. G. De Micheli, Synteza i optymalizacja układów cyfrowych, WNT, 1998.
5. T. Łuba (red.), Synteza układów cyfrowych, Wydawnictwa Komunikacji i Łączności, 2003.

Additional

1. J. Tyszer, G. Mrugalski, A. Pogiel, D. Czysz, Technika cyfrowa – zbiór zadań z rozwiązaniami, Wydawnictwo BTC, Legionowo 2016.
2. J.P. Hayes, Digital logic design, Addison-Wesley 1994.
3. P.K. Lala, Practical digital logic design and testing, Prentice Hall 1996.

**Breakdown of average student's workload**

	Hours	ECTS
Total workload	185	7,0
Classes requiring direct contact with the teacher	125	5,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) <sup>1</sup>	60	2,0

<sup>1</sup> delete or add other activities as appropriate