COURSE DESCRIPTION CARD - SYLLABUS

Course name
Digital systems design [S1Teleinf1>TCYFR]

Course

Field of study
Teleinformatics

Year/Semester
2/4

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
15

Other (e.g. online)
0

Tutorials
15

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

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

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
A student appreciates 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

Current trends in a semiconductor industry. Boolean algebra, gate-level circuits, two-level design, logic minimisation, 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 designs, latches and flip-flops, registers and counters, linear feedback shift registers. Analysis and design of 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, design for test.

Course topics

Lectures: Moore's law, 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, Booth algorithm, floating-point units, iterative designs, programmable logic devices, hardware description languages, sequential logic, latches and flip-flops, registers and counters, Fibonacci and Galois linear feedback shift registers, ring generators, phase shifters. Analysis and design of synchronous sequential circuits, automated synthesis of finite-state machines based on Mealy and Moore models, asynchronous circuits, state reduction, state coding, races and hazards. algorithmic state machines, RTL synthesis, algorithmic state machines. Static and dynamic semiconductor memories. VLSI test and design for testability.

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

1. J. Kalisz, Podstawy elektroniki cyfrowej, wyd. 5, WKŁ, Warszawa 2007.
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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.
6. J. Tyszer, G. Mrugalski, A. Pogiel, D. Czysz, Technika cyfrowa – zbiór zadań z rozwiązaniami, Wydawnictwo BTC, Legionowo 2016.
7. J.P. Hayes, Digital logic design, Addison-Wesley 1994.
8. P.K. Lala, Practical digital logic design and testing, Prentice Hall 1996.

Breakdown of average student's workload

	Hours	ECTS
Total workload	120	5,00
Classes requiring direct contact with the teacher	64	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	56	2,00