COURSE DESCRIPTION CARD - SYLLABUS

Course name
Introduction to digital design [S1MiKC1>WdUC]

Course

Field of study
Microelectronics and digital communications

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
30

Other
0

Tutorials
15

Projects/seminars
0

Number of credit points

5,00

Coordinators

prof. dr hab. inż. Jerzy Tyszer
jerzy.tyszer@put.poznan.pl

dr hab. inż. Piotr Remlein
piotr.remlein@put.poznan.pl

Lecturers

Prerequisites

Ability to analyze and design simple electronic circuits and devices. A basic knowledge of mathematical logic.

Course objective

The course aims at providing a clear picture of fundamental concepts, effective problem-solving techniques, and the appropriate exposure to modern technologies, design techniques, and applications in the area of 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:
Students can design a combinational digital circuit using, as guiding criteria, hardware complexity, speed of the circuit, its power consumption, and heat dissipation. They understand models representing synchronous and clockless finite state machines and can run their synthesis process, including state minimization, state coding, flip-flop-based implementation, and safety analysis.

Social competences:
Students appreciate the practical significance of the systems developed in the course. They are aware of limitations of modern digital circuits. They are open for new applications of digital devices in technology, science, and social (daily) life. Can express their own opinions with respect to currently used solutions and technologies in design of contemporary digital systems.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Knowledge acquired during the lectures is verified by a written exam. It consists of 6-10 questions (tests and/or open problems) which are scored differently. The passing threshold of 50% of the possible points is used. The following grading scale is adopted: < 50% 2.0; 50%-59% 3.0; 60%-69% 3.5; 70%-79% 4.0; 80%-89% 4.5; 90%-100% 5.0.
Skills acquired during tutorials and laboratory classes are verified on the basis of both written tests and by fulfilling tasks assigned in the class or a project. The following grading scale is used: < 50% 2.0; 50%-59% 3.0; 60%-69% 3.5; 70%-79% 4.0; 80%-89% 4.5; 90%-100% 5.0.

Programme content

Current trends in the semiconductor industry. Boolean algebra, logic minimization, computer-aided design of multi-level circuits, basic combinational blocks, iterative designs, programmable logic devices. Sequential designs, latches and flip-flops, registers and counters. Analysis and design of synchronous sequential circuits, automated synthesis of finite-state machines based on Mealy and Moore models, asynchronous circuits, semiconductor memories.

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, iterative designs, programmable logic devices (FPLA, FPGA), 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 (FSMs) based on Mealy and Moore models, asynchronous (clockless) circuits, state reduction, state coding, races and hazards. Algorithmic machines. Static and dynamic semiconductor memories.
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 and simulate simple circuits.

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 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	125	5,00
Classes requiring direct contact with the teacher	75	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	50	2,00