**Nazwa przedmiotu:**

Digital Circuits

**Koordynator przedmiotu:**

Cezary Zieliński, Przemysław Miazga

**Status przedmiotu:**

Obowiązkowy

**Poziom kształcenia:**

Studia I stopnia

**Program:**

Computer Science

**Grupa przedmiotów:**

Technical Courses

**Kod przedmiotu:**

EDC1

**Semestr nominalny:**

3 / rok ak. 2015/2016

**Liczba punktów ECTS:**

6

**Liczba godzin pracy studenta związanych z osiągnięciem efektów uczenia się:**

Total work-load imposed on an avarage student:
- participation in lectures: 15 x 2 h = 30 h,
- participation in laboratory classes: 6 x 5 h + 2 godz = 32 h,
- preparation for the consecutive lectures and laboratory classes (Reading the lecture notes and additional literature, solution of miniproblems contained in the books): 1 x 15 h (preparation for lectures) + 6 x 4 h (preparation for laboratory classes) = 39 h
- participation in consultatations: 2 h (we assume taht the student participates in 2-h of consultations in a semester to resolve his/her doubts regarding the design of digital circuits),
- preparation for the exam (solution of the pre-exam problems) and the presence during the exam: 20 h + 3 h = 23 h
Thus the total workload amounts to: 30 + 32 + 39 + 2 + 23 = 130 h, what is equivalent to about 6 ECTS points.

**Liczba punktów ECTS na zajęciach wymagających bezpośredniego udziału nauczycieli akademickich:**

work requiring the presence of an academic teacher is equal to 30 + 32 + 2 + 3 = 67 h, what is equivalent to about 2 ECTS points (if fractional points are not credited).

**Język prowadzenia zajęć:**

angielski

**Liczba punktów ECTS, którą student uzyskuje w ramach zajęć o charakterze praktycznym:**

work associated with practical assignments takes 32 h, , what is equivalent to about 1 ECTS point (if fractional points are not credited).

**Formy zajęć i ich wymiar w semestrze:**

|  |  |
| --- | --- |
| Wykład: | 30h |
| Ćwiczenia: | 0h |
| Laboratorium: | 30h |
| Projekt: | 0h |
| Lekcje komputerowe: | 0h |

**Wymagania wstępne:**

None

**Limit liczby studentów:**

30

**Cel przedmiotu:**

- to develop the ability to design digital circuits and systems
- to provide the necessary knowledge about fundamental techniques of designing digital circuits and systems
- to convince the students that the development of digital systems and design techniques is a continuous and evolutionary process starting with a single transistor, passing through gates, combinational logic, sequential circuits, functional blocks and ending with digital subsystems being the components of computers.

**Treści kształcenia:**

The course deals with:
1. Algebraic notation and Boolean algebra, simple problem solved intuitively showing the necessity of minimization
2. Combinational circuits , Natural Binary Code (NBC), Grey's code, adjacency, partial adjacency, Karnaugh maps, implicants and implicents, minimization using Karnaugh maps, sum of products (SOP) form, product of sums (POS) form; AND, OR, NOT, NAND and NOR gates; Functionally complete systems; prohibition, factorization
3. Minimization using Quine's and McCluskey's algorithms; Iterative circuits; Hazard
4. Design of combinational circuits using: multiplexers,demultiplexers, encoders, decoders, programable logic arrays (PAL, GAL, PLA), read only memories (ROM),
5. Sequential circuits; Concept of internal state in an automaton with memory; Moore and Mealy automatons; natural language description, timing plots, graphs
6. Synchronous automatons; equivalence of automatons; minimisation of the number of internal states; Graph of a synchronous automaton
7. Complete and incomplete synchronous automatons; transfer and output tables; minimisation for complete and incomplete automatons; coding of internal states; realisation using D flip-flops and JK flip-flops
8. Asynchronous automatons; transfer and output tables; timing plot of an asynchronous automaton; stable states and transition states; minimization of a primary automaton graph of an asynchronous automaton; coding of states (hypercubes); races
9. Realisation using gates and R-S flip-flops;
10. Functional blocks; Design of a selected functional block using flip-flops and gates; Types of inputs to functional blocks (static, dynamic, enabling); types of functional blocks; registers; counters; MUX, DEMUX, 3-state gates; comparators; adders; ALU
11. Representation of numbers. Codes: positional number systems, signed-magnitude, complement number systems, radix-complement representation, two’s complement, diminished radix complement, ones’ complement
12. Digital systems. Decomposition of a digital system into operational and control subsystems; design of the operational subsystem using functional blocks;
13. Control subsystem; flow chart of the control subsystem; conversion of a flow chart into a Moore/Mealy automaton graph; minimal synchronous automaton realisation; sequencer realisation
14. Conversion into a microprogrammed controller; timing problems (clocks); power up initialisation of the system; Interfacing to external systems (e.g. handshaking)
15. Concurrent digital circuits; Petri nets (places, transitions, marking, firing sequences); Transition from a Petri net to a control circuit

**Metody oceny:**

exam, laboratory class test and laboratory report

**Egzamin:**

tak

**Literatura:**

1. Wakerly J. F.: Digital Design. Pronciples and Practices. Prentice Hall, Upper Saddle River, 2000.
2. Zieliński C.: Podstawy projektowania układów cyfrowych. PWN, Warszawa, 2003

**Witryna www przedmiotu:**

http://studia.elka.pw.edu.pl/

**Uwagi:**

## Efekty przedmiotowe

### Profil ogólnoakademicki - wiedza

**Efekt EDC1\_W01:**

The student, who successfully completed the course, will have the knowledge of: combinational circuits, synchronous automatons, asynchronous automatons, functional block, digital system composed of operational subsystem and control subsystem (data acquisition and processing systems); and methods of designing those circuits and systems

Weryfikacja:

exam, laboratory class test and laboratory report

**Powiązane efekty kierunkowe:** K\_W03

**Powiązane efekty obszarowe:** T1A\_W02

### Profil ogólnoakademicki - umiejętności

**Efekt EDC1\_U01:**

The student will be able to design: combinational circuits, synchronous automatons, asynchronous automatons, functional block, digital system composed of operational subsystem and control subsystem (data acquisition and processing systems); select an appropriate design method to the formulated task; implement and debug the created circuit; acquire the necessary information from the literature and the Internet

Weryfikacja:

exam, laboratory class test and laboratory report

**Powiązane efekty kierunkowe:** K\_U01, K\_U05, K\_U09

**Powiązane efekty obszarowe:** T1A\_U01, T1A\_U05, T1A\_U08, T1A\_U09

### Profil ogólnoakademicki - kompetencje społeczne

**Efekt EDC1\_K01:**

work individually and in a team

Weryfikacja:

demonstration to the laboratory assistant a correctly functioning circuit ; laboratory report

**Powiązane efekty kierunkowe:** K\_K04

**Powiązane efekty obszarowe:** T1A\_K03, T1A\_K04