GHENT UNIVERSITY

Course Specifications

Valid in the academic year 2023-2024

Digital Electronics (E031110)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0 **Study time 180 h**

Course offerings and teaching methods in academic year 2023-2024

A (semester 1)	Dutch	Gent	lecture
			practical

Lecturers in academic year 2023-2024

Stroobandt, Dirk	TW06	lecturer-in-charge
Dambre, Joni	TW06	co-lecturer

Offered in the following programmes in 2023-2024	**crdts**	**offering**
Bachelor of Science in Engineering(main subject Computer Science Engineering)	6	A
Bachelor of Science in Engineering(main subject Electrical Engineering)	6	A

Teaching languages

Dutch

Keywords

Digital design, logic circuits, switching algebra, sequential networks

Position of the course

This course is offered in the Bachelor's Programmes in Electrical Engineering and Computer Science Engineering, and follows basic courses on electrical networks and computer architecture.
The goal of this course is to introduce the student into the design methodolgy of logic-level digital circuits. We make the connection between the physical properties of CMOS gates and their implications for circuits and systems. Starting from the necessary mathematical foundations (switching algebra) we analyse the major optimization algorithms. The use of modern, state-of-the-art computer-based design tools is addressed during the labs.
As such, this course is a preparation to systems design courses at the R/T and systems levels and advanced computer architecture, offered in the Master's Programmes on Electrical Engineering and/or Computer Science Engineering.

Contents

- Digital systems and design
- Logic-level circuit models: Boolean algebra and function, implementation properties in CMOS
- Overview of digital building blocks and technologies and their properties
- Algorithms for synthesis of networks of logic gates and synchronous finite state machines
- Synchronous behaviour and its implementation: analysis of feedback circuits, memory elements, communication between synchronous automata, decomposition and composition at the logic level
- Testing of digital systems
- Digital design in practice: behaviour description in VHDL, following the digital design trajectory, realisation of a design on FPGA

Initial competences

Basic electrical circuit theory; Electrical Networks (first-order circuits, the MOSFET transistor); Discrete Mathematics (Boole algebra), fundamentals of computer architecture (controller, datapad, register, addressing)

Final competences

1 To be able to specify Boolean functions and synchronous finite state machines and interpret such specifications.

2 To be familiar with some basic algorithms for combinational and sequential logic design and to be able to apply them to small examples.
3 To thoroughly understand the principles of synchronous design and the requirements for correct operation of synchronous digital circuits.
4 To be familiar with the available technologies for realising digital systems and to have a basic understanding of the origin of physical properties such as delay and power dissipation.
5 To be able to describe simple digital systems in VHDL and to be able to verify their operation using simulation and automated testbenches.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Lecture, Practical

Extra information on the teaching methods

Participation to the graded lab exercises is mandatory.

Learning materials and price

Video clips (in Dutch), course notes (in Dutch), lab instructions (in Dutch) and documentation available on the electronic learning platform.
Syllabus available through VTK at around 10 EUR (members) or around 15 EUD (non-members).

References

Course content-related study coaching

By the lecturer and lab assistants, during contact sessions and through chat in MsTeams.

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment

Examination methods in case of periodic assessment during the second examination period

Written assessment

Examination methods in case of permanent assessment

Skills test, Participation, Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible in modified form

Extra information on the examination methods

During examination period: written closed-book exam, on-campus if allowed.
During semester: graded lab sessions, spread over the semester, with peer-assessment and evaluation of individual contributions.

Calculation of the examination mark

50% NPE (labs), 50% PE (exam); a credit is obtained when the total score is at least 10/20 **and** each of the partial scores is at least 9/20. Students who do not fulfill the second condition but for whom the calculated score would be 9/20 or more, will receive a score of 8/20 (i.e., the largest score that is smaller than 9/20).

Resit period:

- The same ratio between practical work and exam is used
- If you didn't pass for the exam, you need to retake this during resit
- If you passed for the lab work, the score for that part is reused
- If you did not pass for lab work, you will be given a skills test (individual assignment) to evaluate the competences addressed during the lab work. This can never be a replacement for the lab work. Your final score for this part will be calculated as: 0.6*(score during the semester)+0.4*(score on resit assignment).
- **Active participation to the lab work during the semester is mandatory. If you did not sufficiently participate or contribute to the lab work, you will not be able to pass during resit!**