

CS-173

Digital system design

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Cursus	Sem.	Type
Communication systems	BA2	Obl.
Computer science	BA2	Obl.

Language of teaching	English
Coefficient	6
Session	Summer
Semester	Spring
Exam	During the semester
Workload	180h
Weeks	14
Hours	6 weekly
Courses	4 weekly
TP	2 weekly
Number of positions	

Summary

The goal is to familiarize the students with the hardware components of computing systems, and to teach the modern methods of analysis and synthesis of combinational and sequential systems, with the assistance of high-level languages such as VHDL.

Content

1. Analog versus digital, logic: the principles and the operators.
2. Boolean algebra, combinational functions, and Karnaugh diagrams.
3. Sequential functions and their three representatives.
4. Coding, how do we interpret those bits.
5. Finite state machines.
6. Real gates and technology.
7. Programmable logic and their application.
8. Describing systems at a higher level by using a hardware description language (VHDL)
9. Application of the learned theory by practical problems.

Keywords

Digital system design, logic gates, Boolean algebra, gates, flip-flops, latches, FPGA, CPLD, FSM, coding, VHDL

Learning Prerequisites**Required courses**

None

Recommended courses

None

Learning Outcomes

By the end of the course, the student must be able to:

- Identify sequential and combinational logic functions
- Recognize logic functions, gates, latches, and flipflops
- Describe simple digital systems in VHDL
- Analyze digital systems either described in VHDL or implemented with gates
- Implement a digital system from a problem description

- Solve boolean equations and number system problems
- Design a complete digital system that runs on FPGA
- Detect differences between the theory and the practical application

Transversal skills

- Use a work methodology appropriate to the task.
- Continue to work through difficulties or initial failure to find optimal solutions.
- Use both general and domain specific IT resources and tools
- Access and evaluate appropriate sources of information.

Teaching methods

Course ex cathedra, exercises and practical laboratory projects

Expected student activities

The student must attend the course, prepare and solve the exercises, prepare and carry out the laboratory projects

Assessment methods

Midterm test (40%)

Final test (40 %)

Midterm practical project (10%)

Final practical project (10%)

Supervision

Office hours	No
Assistants	Yes
Forum	Yes

Resources

Virtual desktop infrastructure (VDI)

Yes

Bibliography

W. J. Dally and R. C. Harting, Digital design : A systems approach, Cambridge University Press, 2012
 J. Wakerly, Digital design (4th edition), Prentice Hall, 2005
 P. J. Ashenden, The student's guide to VHDL (2nd edition), Morgan Kaufmann, 2008
 C. Maxfield, Bebop to the boolean boogie: An unconventional guide to electronics (3rd edition), Newnes, 2008

Ressources en bibliothèque

- [C. Maxfield, Bebop to the boolean boogie: An unconventional guide to electronics \(3rd ed\)](#)
- [P. J. Ashenden, The student's guide to VHDL \(2nd ed\)](#)
- [J. Wakerly, Digital design \(4th ed\)](#)
- [W. J. Dally and R. C. Harting, Digital design : A systems approach](#)

Notes/Handbook

All material is available on moodle including:

- Slides
- Theory booklet

- Exercises
- Old exams

Moodle Link

- <https://go.epfl.ch/CS-173>

Prerequisite for

Computer Architecture (CS-208)
Systems-on-Chip Architecture (CS-209)