EPFL

CS-473	**Embedded systems**
	Beuchat René

Cursus	Sem.	Type
Computer engineering minor	H	Opt.
Computer science	MA1, MA3	Opt.
Electrical and Electronical Engineering	MA1, MA3	Opt.
Mineur STAS Chine	H	Opt.
SC master EPFL	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Oral
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Project	2 weekly
Number of positions	

Summary

The comprehension of a general embedded systems and the design of an embedded system on a programmable circuit (FPGA) are the main subjects of this course. The student will design a camera or a LCD controller on an FPGA associated with a softcore processor. VHDL design and C programming.

Content

- Microcontroller and associated programmable interfaces (GPIO, Timer, SPI, A/D, PWM, interrupts)
- Hardcore/softcore processors (ie. NIOS II, ARM)
- Memory organization, little/big endian
- Synchronous bus, dynamic bus sizing (ie. Avalon Bus in Memory Mapped mode)
- Processor bus, bus realized in a FPGA
- Serial bus (ie. UART, SPI, i2c, ...)
- How a LCD graphical screen and a CMOS camera work
- FPGA Embedded systems conception methodology
- Embedded systems with processor on FPGA

- Laboratories provide knowledge & practice to develop an embedded system based on FPGA module (http://fpga4u.epfl.ch).

Keywords

microprocessors, microcontroller, FPGA, embedded systems, SoC, programmable interface

Learning Prerequisites

Required courses

Introduction to computing systems, Logic systems, Computer architecture

Recommended courses

Electronic, Programming (C/C++), Project System On Chip

Important concepts to start the course

Computer architecture (processor, memory, programmable interfaces)
Processor Architecture (PC, registers, ALU, instruction decoding, instruction exécution)
C programming language knowledge,
VHDL knowledge

Learning Outcomes

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

- Design an embedded system on a FPGA
- Analyze a specific problem to solve and propose a system on FPGA to solve it
- Implement a solution to resolve the proposed problem
- Realize and simulate the design
- Test the developed solution on a FPGA
- Use complexe developping tools and hardware tools as logic analyzer and oscilloscope

Transversal skills

- Use a work methodology appropriate to the task.
- Negotiate effectively within the group.
- Set objectives and design an action plan to reach those objectives.
- Continue to work through difficulties or initial failure to find optimal solutions.
- Use both general and domain specific IT resources and tools
- Make an oral presentation.

Teaching methods

Ex cathedra and exercises, laboratories by specific sub-topics, final mini-project

Expected student activities

- Reading and deepening of course concepts
- Preparation of exercises performed in the laboratory
- Writing reports on different labs
- Realization of a final mini-project by group with oral presentation, report and demonstration

Assessment methods

With continuous control.
all labos 30%, mini-projet 20%, oral exam 50%

Supervision

Office hours	No
Assistants	Yes
Forum	Yes
Others	Course on Moodle with forum

Resources

Bibliography

Teaching notes and suggested reading material on moodle
Specialized datasheet (micro-controllers, FPGA) and norms (ie, SPI, i2c, Amba, Avalon, etc)

Notes/Handbook

Documents and slides provided on moodle

Websites

• http://fpga4u.epfl.ch

Moodle Link

• http://moodle.epfl.ch/course/view.php?id=1231

Prerequisite for

Real-time embedded systems