

CS-473

**System programming for Systems-on-chip**

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Cursus	Sem.	Type
Computer science	MA1, MA3	Opt.
Cybersecurity	MA1, MA3	Opt.
Electrical and Electronical Engineering	MA1, MA3	Opt.
Microtechnics	MA1, MA3	Opt.
Robotics, Control and Intelligent Systems		Opt.
Robotics	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language of teaching	English
Credits	6
Session	Winter
Semester	Fall
Exam	During the semester
Workload	180h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Lecture	2 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**Summary**

To efficiently program embedded systems an understanding of their architectures is required. After following this course students will be able to take an existing SoC, understand its architecture, and efficiently program it.

**Content****Hardware elements found in embedded systems:**

- Flash, tightly couples memories, SDRAM, DDR.
- IO-interfaces and protocols (RS232, I2C, I2S, SPI).
- Bus architectures.

**Architecture imposed restrictions:**

- Memory map and memory holes.
- Cached and non-cached regions.
- Interrupt latencies, bus latencies, task-switch latencies.

**Software techniques:**

- BIOS/firmware
- DMA and computation/data-transfer overlaps
- Hot-spot detection and hardware/software profiling

**Learning Prerequisites****Recommended courses**

CS-200 Computer architecture or CS-208 Computer architecture I; CS-209 Computer architecture II

**Important concepts to start the course**

- C/C++ programming skills
- Basic Verilog knowledge

**Learning Outcomes**

- Analyze and understand the architecture of embedded systems (SoC's)
- Write a firmware that initializes an embedded system and efficiently implement the required functionality
- Explain the different latencies present in an embedded system and how these latencies influence the execution time on the firmware
- Profile an embedded system and pin-point the hardware related and software induced hot-spots
- understand the different types of memories present in an embedded systems and how to use them
- Program the different types of I/O devices present in an embedded system and know how their protocol works

### Teaching methods

Ex cathedra with practical exercises (in groups of 2 students)

### Expected student activities

- Reports of practical exercises
- Written exam

### Assessment methods

- Lab reports : 50%
- Final written exam : 50%

### Supervision

Office hours	No
Assistants	Yes
Others	Electronic forum and Moodle

### Resources

#### Moodle Link

- <https://go.epfl.ch/CS-473>