**Module Description**

# Advanced Electronic Design

## General Information

### Number of ECTS Credits

3

### Module code

TSM_AdvElDes

### Responsible of module

Christophe Bianchi, HES-SO

### Language

**Explanations regarding the language definitions for each location:**

- Instruction is given in the language defined below for each location/each time the module is held.
- Documentation is available in the languages defined below. Where documents are in several languages, the percentage distribution is shown (100% = all the documentation).
- The examination is available 100% in the languages shown for each location/each time it is held.

| | Berne | Lausanne | | | Lugano | Zurich | | |
|---|---|---|---|---|---|---|---|---|
| Instruction | ☐ E 100% | ☐ E 100% | | ☒ F 100% | ☐ E 100% | ☒ E 100% | | ☐ D 100% |
| Documentation | ☐ E 100% | ☐ E 100% | ☒ E 100% | ☐ F % | ☐ E 100% | ☒ E 100% | ☐ E % | ☐ D % |
| Examination | ☐ E 100% | ☐ E 100% | ☐ E 100% | ☒ F 100% | ☐ E 100% | ☒ E 100% | ☐ E 100% | ☐ D 100% |

### Module category

☐ FTP Fundamental theoretical principles

☒ TSM Technical/scientific specialization module

☐ CM Context module

### Lessons

2 lecture periods and 1 tutorial period per week

## Entry-level competencies

### Prerequisites, previous knowledge

The student must have knowledge and experience in the following areas:

- Circuit analysis
- Electrical and magnetic fields
- Active and passive electronic components, operational amplifiers
- AD and DA conversion principle
- Digital circuits

## Brief course description of module objectives and content

This Advanced Electronic Design module gives to the students the key elements for the development of high performance electronic systems. These systems are characterized by:

- a mixed-signal PCB (Printed Circuit Board)
- the presence of sensitive analogue circuits and signals
- the presence of complex and high-speed digital ICs (Integrated Circuits)

## Aims, content, methods

### Learning objectives and acquired competencies

- The student masters the technologies used in the development of high-performance printed circuit boards.
- The student is able to design a high-performance electronic board composed of sensitive analogue, mixed signal and high speed digital circuits.
- The student is able to implement high-speed and high-resolution signal processing chains based on A/D and D/A converters, analogue functions blocs and complex digital ICs

### Contents of module with emphasis on teaching content

The topics of this module can be grouped into three different subject areas. Therefore three courses are proposed. Each course is taught by a different person.

| Course | Title | Weeks | Emphasis |
|---|---|---|---|
| 1 | High-performance PCB development :<br>• PCB technologies: materials, multi-layers, micro vias<br>• PCB design: EMC, signal integrity, grounding and power supply routing, decoupling, transmission lines and effects, simulation tools<br>• Board assembly: IC package, chip-on-board, soldering, heat transfer, testability | 1 – 4 | ~30% |
| 2 | High-speed digital electronic design :<br>• high-speed signaling and timing, clock distribution, skew, jitter, latch-based design, low-power | 5 – 8 | ~30% |
| 3 | Advanced analogue electronic design :<br>• Advanced operational amplifier applications: low level and sensor signal conditioning, electronic noise, high-speed and low-power amplifiers, simulation tools, frequency response analysis<br>• Advanced ADC and DAC implementations: high-speed, high-resolution, sigma-delta converter, low-power, anti-aliasing and post-filter | 9 – 14 | ~40% |

**Teaching and learning methods**

- Lecture
- Exercises
- Presentation and discussion of case studies
- Self-study of the presented cases and exercises

**Literature**

*The Data Conversion Handbook*, Walt Kester, Analog devices, March 2004.
*High Speed Signal Propagation: Advanced Black Magic,* Howard Johnson – Martin Graham, Prentice Hall, 2003.
*Op Amps for everyone*, Ron Mancini, Texas Instruments, 2002.

## Assessment

**Certification requirements for final examinations (conditions for attestation)**

None

**Basic principle for exams:**
**All the standard final exams for modules are written exams.**
**The repetition exams can be either written or oral.**

**Standard final exam for a module and written repetition exam**

| | |
|---|---|
| Kind of Exam | written |
| Duration of exam | 120 minutes |
| Permissible aids | ☐ no aids |
| | ☒ permissible aids: |
| | ☒ Electronical aids: pocket calculator |
| | ☒ Hardcopy form: Course material |
| | ☐ |

**Special case: Repetition exam as an oral exam**

If an oral exam is set (only possible for ≤ 4 students), the following applies:

| | |
|---|---|
| Kind of Exam | oral |
| Duration of exam | 30 minutes |
| Permissible aids | no aids |