**EPFL**

EE-490(c)     **Lab in electrical energy systems**

Dujic Drazen

| Cursus | Sem. | Type |
|---|---|---|
| Electrical and Electronical Engineering | MA1, MA3 | Opt. |

| | |
|---|---|
| Language of teaching | English |
| Credits | 4 |
| Withdrawal | Unauthorized |
| Session | Winter |
| Semester | Fall |
| Exam | During the semester |
| Workload | 120h |
| Weeks | 14 |
| **Hours** | **4 weekly** |
| Practical work | 4 weekly |
| **Number of positions** | |

**It is not allowed to withdraw from this subject after the registration deadline.**

**Summary**

This teaching lab provides the practical experiences related to the operation of power electronics converters and digital control in power electronics, through experimental activities on the Power Electronic Teaching Setups. Work is organised by means of mini projects.

**Content**

Topics covered in the lab are related to various concepts in power electronics:

- Semiconductor devices and losses in operation
- Pulse Width Modulation methods
- Converter operating principles, e.g. DC-DC, DC-AC,...
- Current control using different regulators (e.g. PID, PR)
- Voltage control
- Control system development
- Power Quality
- Grid monitoring and synchronization
- Photovoltaic energy generation
- Control of various electrical machines (e.g. DC machines, Induction machine)

The work will typically have three parts:

1. Theory, Modelling and Simulations
Following mini project assignement and understanding of theoretical foundation and concepts, modelling and offline simulations using PLECS software will be carried out. In the next step, control concepts will be deployed on the Texas Instruments Digital Signal Processor (DSP) and verified in the Real-Time Hardware-in-the-Loop (RT_HIL) environment, with relevent power hardware part being modeled on the RT-HIL platform. This part of the work is direct preparation for the experimental verification that will follow.

2. Experimental investigations
All the experimental works will be carried out on the Power Electronic Teaching Setups. These are composed from industrial converters with modified control boards that are based on Texas Instruments Digital Signal Processor (DSP). For that reason, this part of the lab will involves software deployment of the concepts developed in the part 1 and systematic testing and commisioning on the real hardware. Experimental results will be collected and compared against offline and real-time simulations.

3. Transversal skill
The student will learn how to plan a mini project, collect and analyse results, write technical report and present results.

**Keywords**

- power electronics
- digital control
- renewable applications

**Learning Prerequisites**

**Required courses**

Basic electrical enegineering knowledge and some programming skills.

**Recommended courses**

EE-365 Power Electronics
EE-465 Industrial Electronics 1

**Important concepts to start the course**

- basic knowledge on electronics
- some programming skills

**Learning Outcomes**

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

- Analyze
- Characterize
- Perform
- Exploit
- Manipulate
- Verify

**Transversal skills**

- Communicate effectively with professionals from other disciplines.
- Make an oral presentation.
- Write a scientific or technical report.

**Teaching methods**

Theoretical concepts relevant forever project assignement will be presented during lectures in the lab. Power Electronic Teaching Setups will be introduced and relevant supporting material will be provided.

**Expected student activities**

Students will be doing mini project, with goals of converting theoretical concept into working experimental demonstration.

**Assessment methods**

Mini project report and final presentation of the results.

**Supervision**

Office hours          Yes
Assistants            Yes
Forum                 No

**Resources**

**Moodle Link**

- https://go.epfl.ch/EE-490_c

**Prerequisite for**

This course is useful for the courses:
EE-465 Industrial Electronics 1
EE-565 Industrial Electronics 2