

EE-588

**Advanced lab in electrical energy systems**

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Cursus	Sem.	Type
Electrical and Electronical Engineering	MA2, MA4	Opt.
Energy Science and Technology	MA2, MA4	Opt.

Language of teaching	English
Credits	4
Withdrawal	Unauthorized
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	<b>4 weekly</b>
TP	4 weekly
Number of positions	
<b>It is not allowed to withdraw from this subject after the registration deadline.</b>	

**Remark**

Pre-requisites required. Please register only after having obtained the teacher's agreement.

**Summary**

The purpose of this teaching lab is to put together all the concepts learned during the course into electrical energy by the implementation of an islanded production unit. The number of places is limited, therefore the student must contact the teacher before the beginning of the course.

**Content**

The goal of this teaching lab is to follow all the steps for setting-up of an islanded production unit.

The group consists of a direct current machine and of a synchronous machine.

The DC machine is used to model an hydraulic turbine. To do this, a speed control will be implemented. First a Matlab-Simscape model is developed and the speed control is tested in simulation, then the speed control is exported in a real time controller and tested in practice. The whole design will be made such as, the choice of controller type, the type of control, the type of criteria ( symmetric or meplat ), measurement of small time constants, the controller implementation (C code) , and tests under steady state as well as in transient.

The synchronous machine is used as a generator and commissioning of industrial voltage regulator (Unitrol of ABB) will be made. Will also follow a customization of the coefficients of the control as well as tests in transient and steady state. The group will then be tested on different loads (resistive and capacitive loads and induction machine).

In parallel to that the voltage control will also be implemented in the simulation model to be able to compare the real world with simulations.

Finally, the different production units will be connected together to create an interconnected islanded network and inherent interconnection/synchronization problems will be addressed. Here as well, this will be done in simulations and then in practice.

The following will be studied, all include simulation, practical implementation and real tests :

- Modeling of a hydraulic turbine by a DC machine
- Speed control
- Voltage regulator
- Islanded production unit
- Interconnection of islanded units

During this teaching lab the student is left very free and independent and learn how to sum up all the knowledge

learned in different domains (control, electrical machines, grid, measurements, simulation).

### Keywords

- Production unit
- Simulation
- DC machine
- Synchronous machine
- Speed control (DSP)
- Voltage regulator (Unitrol)
- Islanded network
- Interconnection of islanded production units

### Learning Prerequisites

#### Recommended courses

EE-360 Conversion d'énergie  
EE-361 Machines électriques (pour EL)  
EE-382 Machines électriques (pour GM)  
EE-365 Power Electronics  
EE-370 Réseaux électriques

### Learning Outcomes

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

- Perform an interconnection with other production units
- Analyze problems
- Create a production unit
- Use an industrial voltage regulator
- Perform tests on electrical machine
- Design a speed control
- Test an islanded production unit
- Apply all the knowledge learned as a student in electrical energy

### Transversal skills

- Use a work methodology appropriate to the task.
- Set objectives and design an action plan to reach those objectives.
- Demonstrate the capacity for critical thinking

### Teaching methods

Practical work in groups

### Expected student activities

Attend every session and participate actively

### Assessment methods

Obligatory continuous. Lab books or reports are given back for correction during the whole semester.

### Resources

**Moodle Link**

- <https://go.epfl.ch/EE-588>