**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 (resitive 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**

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