# UE Power Systems Modeling and Analysis II

ECTS
3 credits

Component
UFR PhITEM (physique, ingénierie, terre, environnement, mécanique)

Semester
Automne

- **Teaching language(s):** English
- **Open to exchange students:** Yes

# Presentation

## Description

Provide students with basic knowledge of the general principles of operation of electrical networks and the control of its elements. Future experts in electrical networks or engineers working on energy systems, this course will provide a system vision to students, with the notions of interactions and coupling of components.

**LECTURE PART (10h)**

**General introduction (4hCM)**

- General structure of electrical networks
- Costs and means of production
- New operating contexts (GED, deregulation, etc.)
- What are the key themes in this area?
- Links with the control part

**Structure and modeling of alternators and typical grid components (2hCM)**

- Modeling of alternators, presentation of simplified models
- Presentation of the different notions of settings (primary, secondary, tertiary)
- Adjustment means available (AVR, GOVER)

- Some basic regulators (PID, phase advance-delay, pole placement) - examples of AVR, GOVER
- Coupling of regulators

**Structure and operation of electrical networks (1hCM)**

- Power balance, notion of static balance, approach in the sense of the first harmonic
- Basic equations lines, concept of voltage drop and maximum power
- Planning elements

**Load distribution calculation (1hCM)**

- Presentation of the problem
- Load flow resolution method (backward, forward – Gauss-Seidel – Newton-Raphson)
- Illustration on a simple case

**Concept of stability (2hCM)**

- Rotor stability, equation
- Area criterion, application to a case of fugitive defect
- Metric frequency load shedding

**PROJECT PART (40h)**

The goal of this project is to apply the elements presented in the electrical network construction course as well as the notions of control and state representation.

The project begins with an introduction to a scientific tool for engineers (MATLAB). It continues with an application of the calculation of load distribution and the concepts of energy markets. A third axis corresponds to the synthesis of corrector applied to a single and composite corrector (Tubrine Gouvernor TG and Automatic Voltage Regulation AVR).

The final application system is an isolated network with several generators (equipped with their TG and AVR regulations). The alternators will be set for a given state of charge. Then several events will be applied in this network:

- Increase in load
- Loss of a work (line)
- Loss of an installation (primary and secondary)
- Application of a transient fault and effect on generator stability

Students will have to apply their knowledge to successfully stabilize the electrical network by adjusting the parameters of the correctors and setting up a suitable frequency-metric load shedding system.

**Assessment:** The grading policy comprises lab assessments plus a final examination. The grade of the module is the weighted average of the marks of each assessment.

## Course parts

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| CM | Lectures (CM) | 10h |
| TP | Practical work (TP) | 40h |

## Recommended prerequisites

Kirschoff Laws, Basics of system controls, state space representation

## Bibliography


- Power System Stability and Control, Wiley-ISTE, from Prabha S. Kundur, Om Malik, 1994-2022.
- Power System Dynamics: Stability and Control, Wiley-ISTE, from Jan Machowski, Zbigniew Lubosny, Janusz W. Bialek, James R. Bumby, 2020.


# Useful info

## Campus

Grenoble - Scientific Polygon