

DOMAINE SCIENCES, TECHNOLOGIES, SANTE  
PROGRAMME PEDAGOGIQUE MASTER 2

## MASTER AUTOMATIC CONTROL AND ELECTRICAL SYSTEMS

Parcours Electrical Energy for Sustainable Development (E2SD)



### Contact

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### Objectives

Ways to contribute to Sustainable Development are to produce electrical energy from renewable sources and design more efficient electrical systems to transport, manage and consume it. Proposed Units aim to educate future R & D engineers, managers in the field of innovation and future researchers on new electrical systems for sustainable development and are addressed for the second MSc year (semester 3 and 4).

Students will master the knowledge on the design, development, implementation and management of innovative electrical systems for the production, transmission and conversion of electricity with various industrial and domestic applications. Units are taught in english

### Knowledge requirement

Meet the following minimum requirements before submitting an application:

- State equations, Laplace transform, transfer function and block diagram representation, design of correctors (P, PI, ...)
- Models in steady and transient states, fundamentals about power (mean, instantaneous, real, reactive, ... power)
- Fundamentals about signal analysis (continuous, periodic, sampled... signals), Fourier transform, Spectral analysis,
- The DC machine, characteristics and properties of operation equations,
- Principle and equivalent electrical models of machines (DC machines, synchronous machines, induction machine),
- Control and torque adjustment of these machines,
- Fundamentals about reversible electrical sources, energy balance, efficiency, losses
- Power electronic converter (PEC) concept (ideal switch, diode, transistor and their associations), structures with ideal switches, drives (model of the machine and PEC association),
- Modeling of electrical machines in transient state (Conversion of electromagnetic energy, classification of machine technologies, Generalized Theory of machines, calculation of inductance matrices, synchronous and asynchronous machines)
- Control model of AC machines (Park transform, Application to synchronous and induction machines, Principle of vector control)

- Electrical conversion with PEC (switching circuits with ideal switches and with semiconductors, DC/AC converters, AC/DC converters, DC/DC converters)
- Three phase electrical system (in balanced and unbalanced conditions, three phase transformer).

Since the number of places is limited, candidates are individually selected. The selection committee is aware about the past followed education program, the level of knowledge, internship report, project report, motivations, English and French levels of each candidate.

Candidates are invited to send any additional documents that could be appreciated by the committee in pdf format in their application and by email to the coordinator.

## Semester 3 & Semester 4

### Semester 3

#### Unit 1 in Communication and foreign language

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| Speaking practice in French language for English spoken students or in English language for others.<br>Groups are organized regardless various levels. | 50h, 5 ECTS |
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#### Unit 2 in Energy Conversion (EC)

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| Design of advanced power electronic systems<br><br>Analyze complex energy conversion system for control purpose | 50h, 5 ECTS |
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#### Unit 3 in Electromagnetic Conversion and Eco-Design (ECED)

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| Design of advanced power electronic systems<br><br>Analyze complex energy conversion system for control purpose | 50h, 5 ECTS |
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#### Unit 4 Optional Unit

Two units are proposed to students, they have to choose one :

**Unit in Electrical Production with Renewable Energy Systems (PRE), 50h, 5 ECTS**

- \* Integration of renewable energies in the power system
- \* Operating and energy management of electrical networks
- \* Design components for renewable energy systems

**Unit in Electrical devices for Transportation Systems (FTS), 50h, 5 ECTS**

- \* Study and analyze of new electrical drives applied to transport with high energy efficiency and fault tolerance

### Unit 5 in Bibliographic research Project (BRP)

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| Perform a bibliographic research on various topics<br>Write a scientific literature review | 50h, 5 ECTS |
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### Unit 6 in Sustainable Development Applications (SDA)

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| Advanced applications of sustainable development<br>Write a synthetic report in English on a seminar and<br>present a poster about a scientific topic | 50h, 5 ECTS |
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Semester 4

### Unit in Scientific Project (SP)

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| Scientific project | 100h, 10 ECTS |
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### Internship

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| Internship in a research and development laboratory | 4 months, 20 ECTS |
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