UCLouvain

ELEC2M

*2017 - 2018*

# Master [120] in Electrical Engineering

**At Louvain-la-Neuve - 120 credits - 2 years - Day schedule - In english**
Dissertation/Graduation Project : **YES** - Internship : **optional**
Activities in other languages : **YES**
Activities on other sites : **optional**
Main study domain : **Sciences de l'ingénieur et technologie**
Organized by: **Ecole Polytechnique de Louvain (EPL)**
Programme acronym: **elec2m** - Francophone Certification Framework: 7

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# ELEC2M - Introduction

## Introduction

### Introduction

This Master's degree offers you:

- Diverse professional opportunities in the industrial sector and in the multiple applications of electricity and its related fields;
- Learning how to approach a project;
- Immersion in research laboratories and high technology;
- A large choice of majors;
- The possibility to complete a part of your coursework or internship abroad (in Europe and elsewhere in the world).

### Your Profile

You:

- have solid skills in the field of electrical sciences and are capable of seeing a job through to the end;
- Wish to develop the skills that will allow you to meet future technological challenges in the scientific and technical fields linked to electricity and its applications;
- Want to design, model, carry out and validate projects by way of experiments, devices, equipment and complex systems;
- Envisage a career in research or industry.

### Your Programme

This Master's degree offers you:

- Mastery of mathematical and physical methods related to electricity (circuits and measures, electromagnetics, physical electronics);
- Advanced education in electronics, electromagnetics, communication, information technology, mathematics and system design;
- Specialisations in electronic systems, telecommunication, microwaves, information and signal processing, biomedicine, cryptography, electronics, MEMS receptors, nanotechnology and photovoltaic techniques.

# ELEC2M - Teaching profile

## Learning outcomes

An essential challenge in the training of electrical engineers is the wide variety of elements that must be mastered, which range from knowledge about hardware and software to technology and mathematics to theoretical experiments in modern electricity and its different disciplines to the ability to use a wide variety of applications on a wide scale from small (such as micro-nano-technology) to big (such as spatial communication).

This programme offers diverse professional perspectives in a variety of industrial sectors: the design and achievement [of a project], installation, real time programming, security, marketing, the analysis of given signals from electronic systems, communication networks, information or receptors, electrical equipment used in industrial production, biomedical transport, aerospace, energy and sustainable development.

This Master's programme builds on students' existing knowledge of electricity acquired as part of their Bachelor's degree program including mathematical and physical approaches to electricity (circuits and measures, electromagnetism, physical electronics) as well as key related fields (electronics, telecommunications, signals, and electrotechnology). By the end of their Master's programme in electrical engineering (ELEC), students will have acquired (through their major coursework) in-depth knowledge of the following fields: electronics, electromagnetism, communication, information technologies, mathematics, and system design.

In addition, students may choose between a more general type of major and one that is more specialized (such as a major in a specific technological field).

In its entirety, the programme offers an introduction to industrialisation and research as well as to jobs in production and design or doctoral programmes in R&D.

This Master's programme in electrical engineering is a multipurpose training programme allowing students to acquire expertise in a wide and specialized variety of fields. Its objective is to create engineers who are capable of meeting future technological challenges in the scientific and technical fields linked to electricity and in the context of the rapidly changing circumstances of Europe and the world.

On successful completion of this programme, each student is able to :

1.Show the mastery of a solid body of knowledge in basic and engineering sciences, permitting him/her to understand and solve problems that are raised by electricity (Axis 1)

1.1 Identify and use concepts, laws and reasoning applicable to a given problem

During the first year of studies, in the required courses for the Master's degree in ELEC, we aim for a general education through different classes dealing with the following electrical subjects:

- Methods for mathematics and physics
- Electronics
- Communication
- Signal processing
- Electrotechnology, energy and automation (EEA)
- On board computing

In the major fields of study, the courses are specific to professional fields:

- Nanotechologies
- Electronic systems and circuits
- Electric machines and control
- Electronic security and information technology
- Communication network systems
- RF systems
- Biomedicine

1.2 Identify and use modelling and calculation tools to solve problems

- Measuring devices
- Systems of complex equations
- Calculation and simulation software (Matlab, SPICE)
- CAO software (Comsol, Synopsys, Cadence, TCAD)

1.3 Verify the plausibility and confirm the validity of results; study them closely, notably by comparing them with experimental and/or theoretical results

Verify the units of different variables and the constituent terms in model equations.

Critically compare analytical/simple/approximate solutions with those obtained by more complex numerical methods.

In the first year of studies (major/minor), classes on electrical circuits and electronics, for example, address the problem of modeling by conducting experiments or simulations and formulating simple hypotheses.

During the Master's degree programme (common core courses and coursework for the major field of study), simulation (for example: Matlab) is emphasized above all and laboratories are used to carry out projects on the justification and validation of circuit choices, technologies, programmes, protocols.

2.Organise and carry out an applied engineering process applied to the development of a product (and/or a service) corresponding to a need or a problem specific to the field of electricity (Axis 2)

2.1 Analyse a problem based on actual case studies dealt with by electrical engineers (in interdisciplinary projects) such as devices and electronic circuits and formulate corresponding specifications.

2.2 Model a problem and design one or several original technical solutions corresponding to the assignment specifications (i.e. analysis of existing case studies) and projects (based on new specifications).

2.3 Evaluate and classify solutions in light of the criteria found in the specifications, principally in the context of interdisciplinary projects and specific courses (for example MEMS design or micro-nano-manufacturing technologies).

2.4 Implement and test a solution in the form of a mock-up, a prototype or a numerical model in the context of achieving experimental interdisciplinary projects and for certain classes (for example, micro-nano-manufacturing technologies) as well as for numerical modeling (such as MEMS design).

2.5 Formulate recommendations to improve the operation of the solution under review.

3.Organize and carry out research projects in order to learn about a physical phenomenon or a new problem relating to electricity. (Axis 3)

3.1 When confronted with a new problem, explore the field in question by gathering necessary information through the various available resources (library, scientific articles, Internet, research assistants, industry).

3.2 Suggest a representative mathematical model of an underlying phenomenon and then by working either in a laboratory or via a software platform, create a device or programme that allows the experimental or virtual simulation of the system's behaviour (all the while taking influential parameters into account).

3.3 Write a summary report about the technical aspects of a study in a concise scientific manner; provide an overview of experimental lab results in written reports and suggest possible interpretations of the results.

4.As part of a team, carry out a multidisciplinary project keeping in mind its objectives, allocated resources and relevant constraints. (Axis 4)

4.1 Frame and explain project objectives taking into account the issues and constraints (emergencies, quality, resources, budget) that characterise the project.

4.2 Work collectively to create a project schedule and to determine team member roles in order to successfully carry out the project. This may include the organisation and planning of individual work and that of the team as well as determining the intermediate steps, division of labour, necessary documents, work schedule, and how to integrate your own investigative work into that of the group.

4.3 Work in a multidisciplinary environment in collaboration with other individuals who may hold different points of view or with experts possessing different specialisations all the while being able to put things in perspective in order to overcome any difficulties or conflicts in the team.

4.4 Make team decisions when necessary whether they be about technical solutions or about the division of labour to complete the project.

5.Communicate effectively (speaking or writing in French or a foreign language) with the goal of carrying out assigned projects. (Axis 5)

5.1 Identify the clients' needs: take up a sizable problem regarding an electronic component or system or communicate the functionalities of an algorithm or software program.

5.2 Present your arguments and convince your interlocutors (technicians, colleagues, clients, superiors) by adopting their language; from the laboratory technician to the research engineer or doctoral researcher, notably in the context of graduation projects (TFE) and experiments or APE with access to technical infrastructures or even industry internships.

5.3 Communicate through graphics and diagrams: interpret a diagram, present work results, structure information.

5.4 Read and analyse different technical documents related to the profession (standards, drawings, specifications); for example, circuit or component data sheets, communication protocols, electrical standards.

5.5 Draft a document that takes into account contextual requirements and the target audience: the specifications for an industrial project, the minutes for a project meeting, internship reports, graduation projects (TFE), etc.

5.6 Use modern communication techniques to give scientific and/or technical oral presentations in French and in English and respond to diverse questions (general or specific) generated by your presentation.

6.Demonstrate rigor, openness and critical and ethical awareness in your work: validate the socio-technical relevance of a hypothesis or a solution. (Axis 6)

6.1 Rigorously apply the field's standards (terms, units of measure, quality standards and security).

6.2 Find solutions that go beyond strictly technical issues by considering sustainable development and the socio-economic ethics of a project (for example, in the fields of photovoltaic cells or biomedical applications).

6.3 Demonstrate critical awareness of a technical solution in order to verify its robustness and minimize the risks that may occur during implementation. For example, the development of a solution that impacts work conditions or users' life in the biomedical field.

6.4 Evaluate the knowledge necessary to carry out a project and independently include knowledge that has not been addressed explicitly in the course programme.

## Programme structure

The Master's degree program is comprised of:

- a core curriculum (30 to 40 credits)
- a final specialisation (30 credits)
- one or more major or elective courses listed below

The graduation project is normally completed during the second year. However, students opt to complete the project in either the first or second year so long as they have fulfilled the necessary prerequisites. This is particularly the case for students who have completed part of their education abroad.

If during the student's previous studies, he or she has already taken a course that is part of the programme (either required or elective) or they have participated in an academic activity that is approved by the programme commission, the student may count this activity toward their graduation requirements (but only if they respect programme rules). The student will also verify that he/she has obtained the minimum number of credits required for the approval of their diploma as well as for the approval of their major (in order to include their academic distinctions in the diploma supplement).

These types of programmes will be submitted for approval by the relevant Master's degree programme commission.

*For a programme-type, and regardless of the focus, options/or elective courses selected, this master will carry a minimum of 120 credits divided over two annual units, corresponding to 60 credits each.*

> Core courses for the Master's degree in Electrical Engineering *[ en-prog-2017-elec2m-lelec220t.html ]*

> Professional focus *[ en-prog-2017-elec2m-lelec220s ]*

Options courses

- > Majors in electrical engineering *[ en-prog-2017-elec2m-lelec900r.html ]*
  - > Major in electrotechnics and electrical energy *[ en-prog-2017-elec2m-lelec221o.html ]*
  - > Major in communication systems *[ en-prog-2017-elec2m-lelec222o.html ]*
  - > Major in information and signal processing *[ en-prog-2017-elec2m-lelec224o.html ]*
  - > Major in electronic circuits and systems *[ en-prog-2017-elec2m-lelec227o.html ]*
  - > Major in cryptography and information security *[ en-prog-2017-elec2m-lelec235o.html ]*
  - > Major in advanced electronic materials and devices *[ en-prog-2017-elec2m-lelec236o.html ]*
- > Majors in business creation and management *[ en-prog-2017-elec2m-lelec950r.html ]*
  - > Major Business risks and opportunities *[ en-prog-2017-elec2m-lfsa220o.html ]*
  - > Major in small and medium sized business creation *[ en-prog-2017-elec2m-lfsa221o.html ]*
- > Elective courses *[ en-prog-2017-elec2m-lelec961r.html ]*
  - > Elective courses available to students enrolled in the Master's degree in electrical engineering *[ en-prog-2017-elec2m-lelec952o.html ]*
  - > Elective courses : Transversal skills and professional contacts *[ en-prog-2017-elec2m-lelec951o.html ]*

# ELEC2M Detailled programme

## Programme by subject

### CORE COURSES

- Mandatory
- Optional
- Courses not taught during 2017-2018
- Periodic courses not taught during 2017-2018
- Periodic courses taught during 2017-2018
- Activity with requisites

Click on the course title to see detailed informations (objectives, methods, evaluation...)

*The student shall select*

| | | | | | | Year 1 | Year 2 |
|---|---|---|---|---|---|---|---|
| LELEC2990 | Graduation project/End of studies project | Claude Oestges (coord.) | | 28 Credits | | | x |

#### *Religion courses for students in natural sciences (2 credits)*

*For students who did their bachelor at UCL*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| LTECO2100 | Questions of religious sciences: Biblical readings | Hans Ausloos | 15h | 2 Credits | 1q | x | x |
| LTECO2200 | Questions of religious sciences: reflections about Christian faith | Dominique Martens | 15h | 2 Credits | 2q | x | x |
| LTECO2300 | Questions of religious sciences: questions about ethics | Marcela Lobo Bustamante | 15h | 2 Credits | 1q | x | x |

### PROFESSIONAL FOCUS [30.0]

- Mandatory
- Optional
- Courses not taught during 2017-2018
- Periodic courses not taught during 2017-2018
- Periodic courses taught during 2017-2018
- Activity with requisites

Click on the course title to see detailed informations (objectives, methods, evaluation...)

*The student has to take all the following courses:*

| | | | | | | Year 1 | Year 2 |
|---|---|---|---|---|---|---|---|
| LELEC2531 | Design and Architecture of digital electronic systems | Jean-Didier Legat | 30h+30h | 5 Credits | 1q | x | |
| LELEC2795 | Radiation and communication systems | Christophe Craeye<br>Danielle Janvier<br>Jérôme Louveaux<br>Claude Oestges<br>Luc Vandendorpe | 30h+30h | 5 Credits | 1q | x | |
| LELEC2103 | Project in Electricity 3 : Electronic systems | Jean-Didier Legat<br>Jérôme Louveaux<br>Luc Vandendorpe | 75h | 5 Credits | 1 + 2q | x | |
| LELEC2900 | Signal processing | Benoît Macq<br>Luc Vandendorpe | 30h+30h | 5 Credits | 2q | x | |
| LINGI2315 | Design of Embedded and real-time systems | Jean-Didier Legat | 30h+30h | 5 Credits | 2q | x | |

| | | | | | | Year 1 | Year 2 |
|---|---|---|---|---|---|---|---|
| LINMA1731 | Stochastic processes : Estimation and prediction | Pierre-Antoine Absil<br>Luc Vandendorpe<br>(coord.) | 30h+30h | 5 Credits | 2q | x | |

## OPTIONS

*The student has to complete his program with majors and/or elective courses. He shall select*
*De 60 à 60 CREDITS parmi*

Majors in electrical engineering

> Major in electrotechnics and electrical energy *[ en-prog-2017-elec2m-lelec221o ]*
> Major in communication systems *[ en-prog-2017-elec2m-lelec222o ]*
> Major in information and signal processing *[ en-prog-2017-elec2m-lelec224o ]*
> Major in electronic circuits and systems *[ en-prog-2017-elec2m-lelec227o ]*
> Major in cryptography and information security *[ en-prog-2017-elec2m-lelec235o ]*
> Major in advanced electronic materials and devices *[ en-prog-2017-elec2m-lelec236o ]*

Majors in business creation and management

> Major Business risks and opportunities *[ en-prog-2017-elec2m-lfsa220o ]*
> Major in small and medium sized business creation *[ en-prog-2017-elec2m-lfsa221o ]*

Elective courses

> Elective courses available to students enrolled in the Master's degree in electrical engineering *[ en-prog-2017-elec2m-lelec952o ]*
> Elective courses : Transversal skills and professional contacts *[ en-prog-2017-elec2m-lelec951o ]*

## *MAJORS IN ELECTRICAL ENGINEERING*

*The student can select one or several majors between:*

## MAJOR IN ELECTROTECHNICS AND ELECTRICAL ENERGY

The objective of the major in electronics-electro-technology-automation (EEA) is to provide students with in-depth training in electro-mechanics and automation. Students with this major will also have acquired knowledge in the fundamentals of power electronics and electric power systems. They will thus have mastered the principal aspects of electricity as a conveyor of energy.

| | |
|---|---|
| ○ Mandatory | ⊠ Optional |
| △ Courses not taught during 2017-2018 | ⊘ Periodic courses not taught during 2017-2018 |
| ⊕ Periodic courses taught during 2017-2018 | Activity with requisites |

Click on the course title to see detailed informations (objectives, methods, evaluation...)

*The student shall select:*
*De 18 à 21 CREDITS parmi*

### ○ *Compulsory courses in electrotechnics and electrical energy (13 credits)*

| | | | | | | Year 1 | Year 2 |
|---|---|---|---|---|---|---|---|
| ○ LELEC2520 | Electric Power Systems | Emmanuel De Jaeger | 30h+30h | 5 Credits | 1q | x | x |
| ○ LELEC2660 | Power electronics | Marc Bekemans | 30h+15h | 4 Credits | 1q | x | x |
| ○ LELEC2313 | Dynamic modelling and control of electromechanical converters | Emmanuel De Jaeger<br>Bruno Dehez | 30h+30h | 4 Credits | 1q | x | x |

### ○ *Elective courses in electrotechnics and electrical energy*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ⊠ LELEC2311 | Physics of Electromechanical Converters | Bruno Dehez | 30h+15h | 4 Credits | 2q | x | x |
| ⊠ LELEC2595 | Electric Power Systems Quality | Emmanuel De Jaeger | 30h+30h | 5 Credits | 2q | x | x |
| ⊠ LELEC2670 | Renewable and non conventional sources of electrical energy | Emmanuel De Jaeger<br>Pascal Jacques | 30h+15h | 4 Credits | 2q | x | x |

| | | | | | | Year 1 | Year 2 |
|---|---|---|---|---|---|---|---|
| ⊠ LELEC2753 | Electrical Power Systems: Advanced Topics | Emmanuel De Jaeger | 30h+15h | 5 Credits | 2q | x | x |
| ⊠ LELEC2811 | Instrumentation and sensors | David Bol<br>Laurent Francis | 30h+30h | 5 Credits | 1q | x | x |

## MAJOR IN COMMUNICATION SYSTEMS

The objectives of the telecommunications major are: Present the general organisation of communication networks and systems (wired or wireless) Present communications from the framework of information theory covering data compression (source-coding) and replication (channel coding) Present the different elements of modern modems, as well as systematic design methods for detection blocks and required estimates Offer a range of design tools for modems and systems Through this major, students will master important concepts about IP networks, GSM, UMTS and DSL access networks as well as new communications methods.

| | |
|---|---|
| Mandatory | Optional |
| Courses not taught during 2017-2018 | Periodic courses not taught during 2017-2018 |
| Periodic courses taught during 2017-2018 | Activity with requisites |

Click on the course title to see detailed informations (objectives, methods, evaluation...)

*De 15 à 30 CREDITS parmi*

### Compulsory courses in communication systems

*The student shall select at least 15 credits among:*

| | | | | | | Year 1 | Year 2 |
|---|---|---|---|---|---|---|---|
| LELEC2796 | Wireless communications | Claude Oestges (coord.)<br>Luc Vandendorpe | 30h+30h | 5 Credits | 1q | x | x |
| LELEC2880 | Modem design | Jérôme Louveaux<br>Luc Vandendorpe | 30h+30h | 5 Credits | 2q | x | x |
| LELEC2910 | Antennas and propagation | Christophe Craeye<br>Danielle Janvier | 30h+30h | 5 Credits | 1q | x | x |
| LELEC2920 | Communication networks | Sébastien Lugan (compensates Benoît Macq)<br>Benoît Macq | 30h+30h | 5 Credits | 1q | x | x |
| LINGI2348 | Information theory and coding | Jérôme Louveaux (coord.)<br>Benoît Macq<br>Olivier Pereira | 30h+15h | 5 Credits | 2q | x | x |

### Elective courses in communication systems

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| LELEC2590 | Seminars in electronics and communications | Denis Flandre<br>Isabelle Huynen<br>Jérôme Louveaux | 30h | 3 Credits | 2q | x | x |
| LINGI2146 | Mobile and Embedded Computing | Ramin Sadre | 30h+15h | 5 Credits | 2q | x | x |
| LINMA1702 | Optimization models and methods I | François Glineur | 30h +22.5h | 5 Credits | 2q | x | x |

## MAJOR IN INFORMATION AND SIGNAL PROCESSING

As in the Master's degree programme for electrical engineering, electro-mechanical engineering, and applied mathematics, the objective of this major is to provide students with new tools used to understand graphs, discrete mathematics, matrices, and optimisation.
For example, students may use these tools when solving communication problems, analysing and recognising data and signals, cryptography and system identification.

| | |
|---|---|
| ○ Mandatory | ⊠ Optional |
| △ Courses not taught during 2017-2018 | ⊘ Periodic courses not taught during 2017-2018 |
| ⊕ Periodic courses taught during 2017-2018 | Activity with requisites |

Click on the course title to see detailed informations (objectives, methods, evaluation...)

*The student shall select:*
*De 15 à 30 CREDITS parmi*

### ○ Prerequisite courses in information and signal processing

*Students who have not previously taken LINMA1510 or its equivalent, must take it as part of their major coursework. In this case, the minimum number of required credits for this major increases to 20.*

| | | | | | | Year 1 | Year 2 |
|---|---|---|---|---|---|---|---|
| ○ LINMA1510 | Linear Control | Denis Dochain | 30h+30h | 5 Credits | 2q | x | x |

### ○ Compulsory courses in information and signal processing

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ○ LELEC2870 | Machine Learning : regression, dimensionality reduction and data visualization | John Lee (compensates Michel Verleysen)<br>Michel Verleysen | 30h+30h | 5 Credits | 1q | x | x |
| ○ LELEC2885 | Image processing and computer vision | Christophe De Vleeschouwer (coord.)<br>Laurent Jacques | 30h+30h | 5 Credits | 1q | x | x |
| ○ LINGI2348 | Information theory and coding | Jérôme Louveaux (coord.)<br>Benoît Macq<br>Olivier Pereira | 30h+15h | 5 Credits | 2q | x | x |

### ⊠ Elective courses in information and signal processing

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ⊠ LELEC2880 | Modem design | Jérôme Louveaux<br>Luc Vandendorpe | 30h+30h | 5 Credits | 2q | x | x |
| ⊠ LGBIO2050 | Medical Imaging | Anne Bol<br>John Lee<br>Benoît Macq<br>Frank Peeters | 30h+30h | 5 Credits | 1q | x | x |
| ⊠ LINGI2262 | Machine Learning :classification and evaluation | Pierre Dupont | 30h+30h | 5 Credits | 2q | x | x |
| ⊠ LINMA1691 | Discrete mathematics - Graph theory and algorithms | Vincent Blondel<br>Jean-Charles Delvenne | 30h +22.5h | 5 Credits | 1q | x | x |
| ⊠ LINMA1702 | Optimization models and methods I | François Glineur | 30h +22.5h | 5 Credits | 2q | x | x |
| ⊠ LINMA2111 | Discrete mathematics II : Algorithms and complexity | Vincent Blondel<br>Jean-Charles Delvenne (coord.) | 30h +22.5h | 5 Credits | 1q | x | x |
| ⊠ LINMA2380 | Matrix computations | Raphaël Jungers | 30h +22.5h | 5 Credits | 1q | x | x |
| ⊠ LINMA2875 | System Identification | Julien Hendrickx | 30h+30h | 5 Credits | 2q | x | x |
| ⊠ LMAT2450 | Cryptography | Olivier Pereira | 30h+15h | 5 Credits | 1q | x | x |

## MAJOR IN ELECTRONIC CIRCUITS AND SYSTEMS

The objective of the major in circuits and electronics systems (which it shares with other Master's degree programmes in electrical engineering) is to introduce students to techniques of system design, computer simulation, manufacturing and experimental classification of electronic circuit components both numerical and analogue as well as the mixed systems associated with these components. Emphasis is placed on the practical applications necessary to carry out projects.

| | |
|---|---|
| Mandatory | Optional |
| Courses not taught during 2017-2018 | Periodic courses not taught during 2017-2018 |
| Periodic courses taught during 2017-2018 | Activity with requisites |

Click on the course title to see detailed informations (objectives, methods, evaluation...)

*Students may select 15 to 30 credits from the following courses:*
*De 15 à 30 CREDITS parmi*

### Compulsory course in electronic circuits and systems

| | | | | | | Year 1 | Year 2 |
|---|---|---|---|---|---|---|---|
| LELEC2532 | Design and Architecture of analog electronic systems | David Bol<br>Denis Flandre | 30h+30h | 5 Credits | 2q | x | x |

### Elective courses in electronic circuits and systems

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| LELEC2541 | Advanced Transistors | Vincent Bayot (coord.)<br>Denis Flandre<br>Jean-Pierre Raskin | 30h+30h | 5 Credits | 2q | x | x |
| LELEC2570 | Synthesis of digital integrated circuits | David Bol | 30h+30h | 5 Credits | 1q | x | x |
| LELEC2580 | Design of RF and microwave communication circuits | Christophe Craeye<br>Danielle Janvier | 30h+30h | 5 Credits | 2q | x | x |
| LELEC2590 | Seminars in electronics and communications | Denis Flandre<br>Isabelle Huynen<br>Jérôme Louveaux | 30h | 3 Credits | 2q | x | x |
| LELEC2620 | Modeling and implementation of analog and mixed analog/ digital circuits and systems on chip | David Bol | 30h+30h | 5 Credits | 2q | x | x |
| LELEC2650 | Synthesis of analog integrated circuits | Denis Flandre | 30h+30h | 5 Credits | 1q | x | x |
| LELEC2660 | Power electronics | Marc Bekemans | 30h+15h | 4 Credits | 1q | x | x |
| LELEC2700 | Microwaves | Isabelle Huynen<br>Danielle Janvier<br>Danielle Janvier (compensates Isabelle Huynen) | 30h+30h | 5 Credits | 1q | x | x |
| LELEC2760 | Secure electronic circuits and systems | François-Xavier Standaert | 30h+30h | 5 Credits | 2q | x | x |
| LELEC2811 | Instrumentation and sensors | David Bol<br>Laurent Francis | 30h+30h | 5 Credits | 1q | x | x |
| LGBIO2020 | Bioinstrumentation | André Mouraux<br>Michel Verleysen | 30h+30h | 5 Credits | 1q | x | x |

## MAJOR IN CRYPTOGRAPHY AND INFORMATION SECURITY

As with most of the other Master's degree programmes in electrical engineering, computer science and applied mathematics, this major provides students with the knowledge to answer questions about information security with algorithms and mathematics as well as design and solve problems in the context of electronic circuits and information systems.

| | |
|---|---|
| Mandatory | Optional |
| Courses not taught during 2017-2018 | Periodic courses not taught during 2017-2018 |
| Periodic courses taught during 2017-2018 | Activity with requisites |

Click on the course title to see detailed informations (objectives, methods, evaluation...)

*Students may choose 15-30 credits from the following courses:*
*De 15 à 30 CREDITS parmi*

### Elective courses

*In order to validate this option INFO and MAP students have to take at least 20 credits and the ELEC students have to take at least 15 credits among:*

| | | | | | Year | | |
|---|---|---|---|---|---|---|---|
| | | | | | | 1 | 2 |
| LELEC2760 | Secure electronic circuits and systems | François-Xavier Standaert | 30h+30h | 5 Credits | 2q | x | x |
| LINGI2144 | Secured systems engineering | Gildas Avoine | 30h+15h | 5 Credits | 1q | x | x |
| LINGI2347 | Computer system security | Ramin Sadre | 30h+15h | 5 Credits | 2q | x | x |
| LINGI2348 | Information theory and coding | Jérôme Louveaux (coord.)<br>Benoît Macq<br>Olivier Pereira | 30h+15h | 5 Credits | 2q | x | x |
| LMAT2440 | Number theory | Olivier Pereira<br>Jean-Pierre Tignol | 30h+15h | 5 Credits | 1q | x | x |
| LMAT2450 | Cryptography | Olivier Pereira | 30h+15h | 5 Credits | 1q | x | x |

## MAJOR IN ADVANCED ELECTRONIC MATERIALS AND DEVICES

| | |
|---|---|
| ○ Mandatory | ⊠ Optional |
| △ Courses not taught during 2017-2018 | ⊘ Periodic courses not taught during 2017-2018 |
| ⊕ Periodic courses taught during 2017-2018 | Activity with requisites |

Click on the course title to see detailed informations (objectives, methods, evaluation...)

*The student shall select between:*
*De 15 à 30 CREDITS parmi*

### ○ Compulsory courses in advanced electronic materials and devices

*Student choose at least 5 credits among:*

| | | | | | | Year 1 | Year 2 |
|---|---|---|---|---|---|---|---|
| ⊠ LELEC2541 | Advanced Transistors | Vincent Bayot (coord.)<br>Denis Flandre<br>Jean-Pierre Raskin | 30h+30h | 5 Credits | 2q | x | x |
| ⊠ LELEC2550 | Special electronic devices | Vincent Bayot (coord.)<br>Denis Flandre<br>Laurent Francis<br>Jean-Pierre Raskin | 30h+30h | 5 Credits | 1q | x | x |
| ⊠ LELEC2700 | Microwaves | Isabelle Huynen<br>Danielle Janvier<br>Danielle Janvier (compensates Isabelle Huynen) | 30h+30h | 5 Credits | 1q | x | x |
| ⊠ LELEC2895 | Design of micro and nanosystems | Denis Flandre<br>Laurent Francis (coord.)<br>Thomas Pardoen<br>Jean-Pierre Raskin | 30h+30h | 5 Credits | 1q | x | x |

### ⊠ Elective courses in advanced electronic materials and devices

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ⊠ LELEC2560 | Micro and Nanofabrication Techniques | Laurent Francis<br>Benoît Hackens<br>Jean-Pierre Raskin | 30h+30h | 5 Credits | 2q | x | x |
| ⊠ LELEC2580 | Design of RF and microwave communication circuits | Christophe Craeye<br>Danielle Janvier | 30h+30h | 5 Credits | 2q | x | x |
| ⊠ LELEC2710 | Nanoelectronics | Vincent Bayot (coord.)<br>Denis Flandre<br>Laurent Francis<br>Jean-Pierre Raskin | 30h+30h | 5 Credits | 1q | x | x |
| ⊠ LELEC2811 | Instrumentation and sensors | David Bol<br>Laurent Francis | 30h+30h | 5 Credits | 1q | x | x |
| ⊠ LMAPR2015 | Physics of Nanostructures | Jean-Christophe Charlier<br>Xavier Gonze<br>Aurélien Lherbier (compensates Xavier Gonze)<br>Aurélien Lherbier (compensates Jean-Christophe Charlier)<br>Luc Piraux | 37.5h +22.5h | 5 Credits | 1q | x | x |
| ⊠ LMAPR2020 | Materials Selection | Christian Bailly<br>Thomas Pardoen | 30h +22.5h | 5 Credits | 2q | x | x |
| ⊠ LMECA2300 | Advanced Numerical Methods | Philippe Chatelain<br>Christophe Craeye<br>Vincent Legat<br>Jean-François Remacle | 30h+30h | 5 Credits | 2q | x | x |
| ⊠ LPHY2141 | Optics and lasers | Alain Cornet<br>Clément Lauzin | 30h+10h | 5 Credits | 1q | x | x |
| ⊠ LPHY2246 | Vacuum physics and techniques | Benoît Hackens<br>Sorin Melinte | 30h | 5 Credits | 1q | x | x |

*MAJORS IN BUSINESS CREATION AND MANAGEMENT*

## *MAJOR BUSINESS RISKS AND OPPORTUNITIES*

- Mandatory
- Courses not taught during 2017-2018
- Periodic courses taught during 2017-2018
- Optional
- Periodic courses not taught during 2017-2018
- Activity with requisites

Click on the course title to see detailed informations (objectives, methods, evaluation...)

| | | | | | | Year 1 | Year 2 |
|---|---|---|---|---|---|---|---|
| LFSA1290 | Introduction to financial and accounting management | André Nsabimana (compensates Gerrit Sarens) Gerrit Sarens | 30h+15h | 4 Credits | 2q | x | x |
| LFSA2140 | Elements of law for industry and research | Werner Derijcke Bénédicte Inghels Christophe Lazaro | 30h | 3 Credits | 1q | x | x |
| LFSA2210 | Organisation and human resources | John Cultiaux | 30h | 3 Credits | 2q | x | x |
| LFSA2230 | Introduction to management and to business economics | Benoît Gailly | 30h+15h | 4 Credits | 2q | x | x |
| LFSA2245 | Environment and business | Thierry Bréchet Jean-Pierre Tack | 30h | 3 Credits | 2q | x | x |

### *One course between*

*De 3 à 5 CREDITS parmi*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| LFSA2202 | Ethics and ICT | Axel Gosseries Olivier Pereira | 30h | 3 Credits | 2q | x | x |
| LLSMS2280 | Business Ethics and Compliance Management | Carlos Desmet | 30h | 5 Credits | 1q | x | x |

### *Alternative to the major in business risks and opportunities for computer science students*

*Computer science students who have already taken courses in this field while pursuing their Bachelor's degree may choose between 16-20 credits from the courses offered in the management minor for computer sciences.*

## MAJOR IN SMALL AND MEDIUM SIZED BUSINESS CREATION

| | |
|---|---|
| Mandatory | Optional |
| Courses not taught during 2017-2018 | Periodic courses not taught during 2017-2018 |
| Periodic courses taught during 2017-2018 | Activity with requisites |

Click on the course title to see detailed informations (objectives, methods, evaluation...)

### Required courses for the major in small and medium sized businesses

| | | | | | Year 1 | Year 2 |
|---|---|---|---|---|---|---|
| LCPME2001 | Entrepreneurship Theory (in French) | Frank Janssen | 30h+20h | 5 Credits | 1q | x | |
| LCPME2002 | Managerial, legal and economic aspects of the creation of a company (in French) | Yves De Cordt<br>Marine Falize | 30h+15h | 5 Credits | 1q | x | x |
| LCPME2003 | Business plan of the creation of a company (in French) | Frank Janssen | 30h+15h | 5 Credits | 2q | | x |
| LCPME2004 | Advanced seminar on Enterpreneurship (in French) | Roxane De Hoe (compensates Frank Janssen)<br>Frank Janssen | 30h+15h | 5 Credits | 2q | x | x |

### Prerequisite CPME courses

*Student who have not taken management courses during their previous studies must enroll in LCPME2000.*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| LCPME2000 | Venture creation financement and management I | Yves De Rongé<br>Olivier Giacomin | 30h+15h | 5 Credits | 1q | x | |

## *ELECTIVE COURSES*

## ELECTIVE COURSES AVAILABLE TO STUDENTS ENROLLED IN THE MASTER'S DEGREE IN ELECTRICAL ENGINEERING

*Students can also include in their curriculum any course included in other EPL masters, subject to the approval of the jury.*

## ELECTIVE COURSES : TRANSVERSAL SKILLS AND PROFESSIONAL CONTACTS

| | |
|---|---|
| Mandatory | Optional |
| Courses not taught during 2017-2018 | Periodic courses not taught during 2017-2018 |
| Periodic courses taught during 2017-2018 | Activity with requisites |

Click on the course title to see detailed informations (objectives, methods, evaluation...)

*De 3 à 21 CREDITS parmi*

### Compétences transversales et contact avec l'entreprise

*L'étudiant choisit minimum 3 crédits parmi un stage, un ou plusieurs cours de l'option "Enjeux de l'entreprise", l'option "CPME", une UE d'activité professionnelle liée à sa discipline*
*Min=3 credits parmi*

#### Internship

| | | | | | Year 1 | Year 2 |
|---|---|---|---|---|---|---|
| LFSA2995 | Company Internship | Jean-Pierre Raskin | 30h | 10 Credits | 1 + 2q | x | x |
| LFSA2996 | Company Internship | | | 5 Credits | 1 + 2q | x | x |

| | | | | | | Year 1 | Year 2 |
|---|---|---|---|---|---|---|---|

## Professional integration activity specific to the program

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| LELEC2590 | Seminars in electronics and communications | Denis Flandre<br>Isabelle Huynen<br>Jérôme Louveaux | 30h | 3 Credits | 2q | x | x |
| LFSA2212 | Innovation classes | Pierre Latteur<br>Benoît Macq<br>Benoît Raucent | 30h+15h | 5 Credits | 1q | x | x |

## *Communication*

*L'étudiant choisit maximum 8 crédits visant le développement de ses compétences de communication*
*Max=8 CREDITS parmi*

### Languages

*Students may select from any language course offered at the ILV. Special attention is placed on the following seminars in professional development:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| LALLE2500 | Professional development seminar German | Caroline Klein<br>Ann Rinder (coord.) | 30h | 3 Credits | 1 + 2q | x | x |
| LALLE2501 | Professional development seminar-German | Caroline Klein<br>Ann Rinder (coord.) | 30h | 5 Credits | 1 + 2q | x | x |
| LESPA2600 | Vocational Induction Seminar - Spanish (B2.2/C1) | Paula Lorente Fernandez (coord.) | 30h | 3 Credits | 1q | x | x |
| LESPA2601 | Vocational Induction Seminar - Spanish (B2.2/C1) | Paula Lorente Fernandez (coord.) | 30h | 5 Credits | 1q | x | x |
| LNEER2500 | Seminar of Entry to professional life in Dutch - Intermediate level | Isabelle Demeulenaere (coord.)<br>Mariken Smit | 30h | 3 Credits | 1 ou 2q | x | x |
| LNEER2600 | Seminar of entry to professional life in Dutch - Upper-Intermediate level | Isabelle Demeulenaere (coord.) | 30h | 3 Credits | 1 ou 2q | x | x |

### Group dynamics

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| LFSA2351A | Group dynamics | Piotr Sobieski (coord.)<br>Vincent Wertz (coord.) | 15h+30h | 3 Credits | 1q | x | x |
| LFSA2351B | Group dynamics | Piotr Sobieski (coord.)<br>Vincent Wertz (coord.) | 15h+30h | 3 Credits | 2q | x | x |

## *Autre UE non disciplinaires*

*L'étudiant peut proposer maximum 8 crédits d'ouverture vers d'autres disciplines (maximum un cours BEST ou des UE hors EPL).*
*Max=8 CREDITS parmi*

## Course prerequisites

A document entitled (nb: not available for this programme elec2m) specifies the activities (course units - CU) with one or more pre-requisite(s) within the study programme, that is the CU whose learning outcomes must have been certified and for which the credits must have been granted by the jury before the student is authorised to sign up for that activity.

These activities are identified in the study programme: their title is followed by a yellow square.

As the prerequisites are a requirement of enrolment, there are none within a year of a course.

The prerequisites are defined for the CUs for different years and therefore influence the order in which the student can enrol in the programme's CUs.
In addition, when the panel validates a student's individual programme at the beginning of the year, it ensures the consistency of the individual programme:

- It can change a prerequisite into a corequisite within a single year (to allow studies to be continued with an adequate annual load);
- It can require the student to combine enrolment in two separate CUs it considers necessary for educational purposes.

For more information, please consult regulation of studies and exams.

## The programme's courses and learning outcomes

For each UCL training programme, a reference framework of learning outcomes specifies the competences expected of every graduate on completion of the programme. You can see the contribution of each teaching unit to the programme's reference framework of learning outcomes in the document "In which teaching units are the competences and learning outcomes in the programme's reference framework developed and mastered by the student?"

# ELEC2M - Information

## Admission

*General and specific admission requirements for this program must be satisfied at the time of enrolling at the university..*

SUMMARY



### Specific Admission Requirements

Ce programme étant enseigné en anglais, aucune preuve préalable de maitrise de la langue française n'est requise. L'étudiant est supposé avoir minimum le niveau B2 en anglais dans le cadre européen commun de référence pour les langues.

### University Bachelors

| Diploma | Special Requirements | Access | Remarks |
|---|---|---|---|
| **UCLouvain Bachelors** | | | |
| Bachelor in engineering [180.0] | | Direct Access | Students who have neither major nor minor in the field of their civil engineering Master's degree may have an adapted master programme. |
| | | Direct Access | |
| **Others Bachelors of the French speaking Community of Belgium** | | | |
| Bachelor in engineering | With specific options in former institution related to electricity. | Direct Access | |
| **Bachelors of the Dutch speaking Community of Belgium** | | | |
| Bachelor in engineering | | Access with additional training | Students who have no specialisation in the field of their civil enginering master degree may have an adapted master programme with up to 60 additional credits. |
| **Foreign Bachelors** | | | |
| Bachelor in engineering | Other institutions | Based on application: accepted, conditional on further training, or refusal | See personalized access |
| | | Direct Access | |

### Non university Bachelors

### Holders of a 2nd cycle University degree

| Diploma | Special Requirements | Access | Remarks |
|---|---|---|---|

| "Licenciés" |
|---|

| Masters | |
|---|---|
| Master s in engineering | Direct Access |

## Holders of a non-University 2nd cycle degree

## Adults taking up their university training

> See the website Valorisation des acquis de l'expérience (https://uclouvain.be/fr/etudier/vae)

It is possible to gain admission to all masters courses via the validation of professional experience procedure.

## Access on the file

Reminder : all Masters (apart from Advanced Masters) are also accessible on file.

Students may submit an application for admission to the Louvain School of Engineering in which they list their detailed course curriculum (list of course work and marks year by year). The School in collaboration with the relevant programme commission will determine whether the student may be admitted and their decision will respect the programme rules. When necessary, they may suggest an individualised programme consisting of a part of the elective courses in the relevant Master's degree programme in civil engineering with the possible addition of a maximum of 15 supplemental credits.

The School in collaboration with the relevant programme commission will determine whether the student may be admitted and their decision will respect the programme rules. When necessary, the jury may suggest a programme in keeping with the student's previous course of study with the possible addition of a maximum of 15 supplemental credits.

## Admission and Enrolment Procedures for general registration

## Teaching method

**Methods that promote multidisciplinary studies**

The Master's degree programme in electrical engineering provides students with considerable technical and professional knowledge. It offers in-depth knowledge of the different subjects covered in the Bachelor's degree programme on electricity and expected of electrical engineers (electronics, electromagnetics, communication, system design). It is open to other fields such as

- Computer science, applied mathematics and automation (the latter having been studied in the Bachelor's degree programme for students enrolled in the electricity major); achieved through 15 credits of required common courses
- Electrotechnology, photovoltaic technologies, nanotechnologies, MEMS and NEMS, computer science and communication, biomedical engineering, cryptography and information security via specialised majors.

Regarding elective courses, the programme commission encourages students to broaden their training by choosing classes organised by other programme commissions. Thus the majority of suggested majors are MAPR, INGI, INMA or MATH.

Also of note are the dozen ELEC classes that are open to students enrolled in other Master's degree programmes on the condition that they have taken introductory classes on electric circuits and electronics or complementary classes in electricity.

To encourage interdisciplinary coursework, there are interdisciplinary projects regrouping a series of subjects from the common core curriculum.

**Diverse learning situations**

The diverse learning situations include lectures, practical work and projects based on the following approach: modelling-simulation-realisation -experimental validation. Depending on the case, students are encouraged to work either in groups or individually. Of note is the interdisciplinary project that requires students to design, model, carry out and test a system. This project draws upon the entirety of their knowledge in the field of their final specialisation as well completes the work begun during their undergraduate studies (ELEC Bachelor's degree programme).

Furthermore, in certain subjects, e-Learning permits students to educate themselves at their own pace and carry out virtual experiments.

This variety of learning situations help students to learn in an iterative and progressive manner, all the while developing their autonomy, organisational abilities, as well as time management and communication skills. Modern information technologies (materials, software, networks) are made available to students.

For example, the major in business creation is based on an interactive approach that emphasizes problem-based learning. Throughout the programme, students enrolled in this major must carry out group work as part of multidisciplinary teams. Their interdisciplinary thesis or graduation project permits groups of three students, ideally from different academic departments, to collaborate on a business creation proposal.

The graduation project aims for the most part to integrate students into research teams at the Institute.

Thus, teaching activities are supplemented by research activities and serve as a starting point for the recruitment of researchers (often a graduation project is the starting point for a doctorate, publication or paper presentation).

Depending on the situation, students are encouraged to work either individually or in groups.

**Concrete learning: infrastructure**

In ELEC courses, "concrete" learning is characterised by student access to high quality technical infrastructures:

The Marconi and Faraday pedagogical laboratories are equipped with the latest in work stations (oscilloscopes, sources, computers) and are accessible to students as part of their laboratory classes and Bachelor's and Master's degree projects. In the case of projects including the creation of a prototype by groups of students, access to prototypes of electronic cards (PCB, components, welding) is available.

R&D platforms in the areas of electronic components and communication systems (Welcome) and micro and nano-technologies (Winfab) are accessible to Master's degree students as part of certain classes and graduation projects.

Computers and work stations equipped with the most recent professional CAO software are accessible to students in the Maxwell building but also remotely from the Engineering School's computer labs. This software is largely used in classes, APE and projects: design sequences for electronic circuits and microwaves, simulation of manufacturing processes, electronic devices, etc.

## Evaluation

***The evaluation methods comply with the regulations concerning studies and exams (https://uclouvain.be/fr/decouvrir/rgee.html). More detailed explanation of the modalities specific to each learning unit are available on their description sheets under the heading "Learning outcomes evaluation method".***

Teaching activities are evaluated according to University rules (see the rules for evaluating coursework and exams) namely written and oral exams, laboratory exams, individual or group work, public presentations of projects and theses defences.

In most Master's degree classes, students are primarily evaluated on the basis of their written work, which assesses their mastery of theoretical concepts as well as their ability to solve exercises (of the same level of difficulty as in class).

Group projects are primarily used to evaluate students' ability to solve complex equations and master software. These projects generally result in a report (in the form of a scientific article or a conference paper) or an oral presentation before a jury or lecture hall about the project's results and/or progress. In either case, particular attention is paid to the project's technical qualities as well as the quality of the report's structure, the use of supporting materials, and the students' presentation skills.

For more information on evaluation methods, students may consult the relevant evaluation descriptions.

To obtain a passing grade, the marks received for the teaching units are offset by their respective credits.

## Mobility and/or Internationalisation outlook

Since its creation, the Louvain School of Engineering (EPL) has participated in diverse exchange programs that were put into place at the European level and beyond.

## Possible trainings at the end of the programme

- Accessible complementary Masterâ€™s degrees:

Masterâ€™s in nuclear engineering

Master in nanotechnologies

- Accessible Ph. D. curricula

The department of electrical engineering is one of those with the largest number of doctoral students. Members of the department are involved in many thematic Ph. D. schools, some of these having been active for many years, others currently being set up. A list of these thematic Ph. D. schools can be obtained from the chairperson of the Ph. D. committee relating to "Engineering sciences and the Art of building and town planning " of the Académie Universitaire Louvain or on the FNRS Website http://www1.FNRS.BE

## Contacts

***Attention, you are currently reading an archived page: below contact informations were for program study 2017-2018 only. To get current contact informations please got to current program study site.***

### Curriculum Management

Entity

| | |
|---|---|
| Structure entity | SST/EPL/ELEC |
| Denomination | (ELEC) (https://uclouvain.be/repertoires/entites/elec) |
| Faculty | Louvain School of Engineering (EPL) (https://uclouvain.be/repertoires/entites/epl) |
| Sector | Sciences and Technology (SST) (https://uclouvain.be/repertoires/entites/sst) |
| Acronym | ELEC |
| Postal address | Place du Levant 3 - bte L5.03.02<br>1348 Louvain-la-Neuve<br>Tel: +32 (0) 10 47 25 86 - Fax: +32 (0) 10 47 86 67 |

Academic supervisor: Claude Oestges

Jury

- Jean-Didier Legat
- Claude Oestges

Useful Contact(s)

- Isabelle Dargent

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