UCLouvain

ELEC2M

2020 - 2021

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 English: **NO** - Activities in other languages : **YES**
Activities on other sites : **optional**
Main study domain : **Sciences de l'ingénieur et technologie**
Organized by: **Louvain School of Engineering (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.démontrer la maîtrise d'un solide corpus de connaissances et compétences en sciences fondamentales et sciences de l'ingénieur, lui permettant d'appréhender et de résoudre des problèmes qui relèvent de l'électricité (axe 1).

1.1 Identifier et mettre en Œuvre les concepts, lois, raisonnements applicables à une problématique donnée.

En premier cycle, et dans les cours obligatoires du master ELEC, une formation globale et large est visée dans kes différents cours abordant les disciplines de l'électricité :

- méthodes mathématiques et physiques,
- électronique,
- communication,
- traitement du signal,
- électrotechnique, énergie et automatique (EEA),
- informatique embarquée.

Dans les options du master, l'approche devient spécifique aux domaines de métiers diversifiés :

- nanotechnologies,
- circuits et systèmes électroniques,
- machines électriques et contrôle,
- sécurité électronique et informatique,
- systèmes et réseaux de communication,
- systèmes RF,
- biomédical,...

1.2 Identifier et utiliser les outils de modélisation et de calcul adéquats pour résoudre ces problématiques :

- appareils de mesure,
- systèmes d'équations complexes,
- logiciels de calcul et simulation (Matlab, SPICE,...)
- logiciels de CAO (Comsol, Synopsys, Cadence, TCAD,...)

1.3 Vérifier la vraisemblance et confirmer la validité des résultats obtenus au regard de la nature du problème posé.

étudier la précision des résultats ainsi que leur validation, notamment par comparaison avec des résultats expérimentaux et/ou théoriques,

vérifier les unités des différentes variables et des termes qui apparaissent dans les équations constitutives d'un modèle,

comparer de façon critique des solutions analytiques approximatives et simples avec celles obtenues par des méthodes numériques plus complexes.

En premier cycle (majeure/mineure) les cours de circuits électriques et d'électronique, par exemple, abordent la problématique de la modélisation en présentant des résultats d'expérience ou simulation complexe de base, la formulation d'hypothèses simplificatrices guidées par les résultats d'approches plus complètes et simplifiées.

En master (tronc commun et finalité spécialisée FS), l'accent est surtout mis sur la simulation (exemple : Matlab) et la justification, la validation de choix d'architectures de circuits, technologies, programmes, protocoles… Les laboratoires sont notamment concentrés dans les projets.

2.organiser et de mener à son terme une démarche d'ingénierie appliquée au développement d'un produit (et/ou d'un service) répondant à un besoin ou à une problématique particulière dans le domaine de l'électricité (axe 2).

2.1 Analyser le problème à résoudre basé sur l'analyse de cas d'étude réels rencontrés par des ingénieurs électriciens (dans les projets transversaux) : dispositifs et circuits électroniques, …, et formuler le cahier des charges correspondant.
2.2 Modéliser le problème et concevoir une ou plusieurs solution(s) technique(s) originales répondant à ce cahier des charges dans le cadre des exercices (analyses de cas d'étude existants) et projets (sur base d'un cahier des charges nouveau).
2.3 Evaluer et classer les solutions au regard des critères figurant dans le cahier des charges, principalement dans le cadre des projets transversaux et de certains cours (par exemple : « conception de MEMS », « technologies de micro-nano-fabrication »).
2.4 Implémenter et tester une solution sous la forme d'une maquette, d'un prototype et/ou d'un modèle numérique, dans le cadre des projets transversaux pour les réalisations expérimentales et de certains cours (par exemple « technologies de micro-nano-fabrication »), et pour les modèles numériques : conception de MEMS,..
2.5 Formuler des recommandations pour améliorer le caractère opérationnel de la solution étudiée.

3.organiser et de mener à son terme un travail de recherche pour appréhender un phénomène physique ou une problématique inédite relevant de l'électricité (axe 3).

3.1 Confronté à un problème dont le sujet et le contexte sont nouveaux, s'organiser pour explorer le domaine considéré et pour se procurer les informations nécessaires pour faire un état des lieux via divers canaux à sa disposition (bibliothèque, articles scientifiques, web, chercheurs-assistants, industriels, ..)
3.2 Proposer une construction d'un modèle mathématique représentatif d'un phénomène sous-jacent et réaliser sur cette base, en laboratoire ou sur une plateforme logicielle, un dispositif ou programme permettant de simuler, expérimentalement ou virtuellement, le comportement du système en agissant sur les différents paramètres qui le conditionnent.
3.3 Mettre en forme un rapport de synthèse visant à rapporter une étude technique d'une manière scientifique et concise, de structurer les résultats expérimentaux obtenus lors de laboratoires, de les synthétiser dans un rapport écrit, et de proposer des pistes d'interprétation.

4.contribuer, en équipe, à la réalisation d'un projet pluridisciplinaire et de le mener à son terme en tenant compte des objectifs, des ressources, allouées et des contraintes qui le caractérisent (axe 4).

4.1 Cadrer et expliciter les objectifs d'un projet, compte tenu des enjeux et des contraintes (urgence, qualité, ressources, budget …) qui caractérisent l'environnement du projet.
4.2 S'engager collectivement sur un plan de travail, un échéancier et des rôles à tenir en assurant un fonctionnement collectif pour mener à bien le projet: organisation et planification du travail individuel et de celui de son équipe, détermination des étapes intermédiaires, répartition des tâches, documents à fournir, calendrier à respecter, inscrire son propre travail d'investigation dans celui du groupe.
4.3 Fonctionner dans un environnement pluridisciplinaire, conjointement avec d'autres acteurs porteurs de différents points de vue, ou des experts venant des domaines ou spécialités différents en prenant le recul nécessaire pour dépasser les difficultés ou les conflits rencontrés au sein de l'équipe.
4.4 Prendre des décisions en équipe lorsqu'il y a des choix à faire : que ce soit sur les solutions techniques ou sur l'organisation du travail pour faire aboutir le projet.

5.communiquer efficacement oralement et par écrit (en français et dans une ou plusieurs langues étrangères) en vue de mener à bien les projets qui lui sont confiés dans son environnement de travail (axe 5).

5.1 Identifier les besoins du client : aborder un problème de dimensionnement d'un composant ou système électronique ou de communication ou fonctionnalités d'un algorithme ou logiciel.
5.2 Argumenter et convaincre en s'adaptant au langage de ses interlocuteurs : techniciens, collègues, clients, supérieurs hiérarchiques : du technicien de laboratoire, à l'ingénieur de recherche ou au chercheur doctorant, notamment dans le cadre des projets et TFE avec réalisation expérimentale ou des APE avec accès aux infrastructures techniques, ou encore des stages en industrie.
5.3 Communiquer sous forme graphique et schématique ; interpréter un schéma, présenter les résultats d'un travail, structurer des informations.
5.4 Lire et analyser les différents documents techniques relatifs à l'exercice de son métier (normes, plans, cahier de charge…). Par exemple, des data-sheets de circuits ou composants, des protocoles de communication, des normes électriques, etc.
5.5 Rédiger un document écrit en tenant compte des exigences contextuelles et du public visé : le cahier de charges lié à un projet industriel, le compte rendu de réunions liées à ce projet, un rapport de stage, son TFE, etc.
5.6 Faire un exposé oral scientifique et/ou technique convaincant, en utilisant les techniques modernes de communication, en français et en anglais, et répondre aux diverses questions générales ou détaillées suscitées par l'exposé.

6.faire preuve de rigueur, d'ouverture, d'esprit critique et d'éthique dans son travail : valider la pertinence sociotechnique d'une hypothèse ou d'une solution (axe 6).

6.1 Appliquer les normes en vigueur dans sa discipline (terminologie, unités de mesure, normes de qualité et de sécurité …)
6.2 Trouver des solutions qui vont au-delà des enjeux strictement techniques, en intégrant les enjeux de développement durable et la dimension éthique socio-économiques d'un projet (Par exemple : domaine des cellules photovoltaïques, applications biomédicales…)
6.3 Faire preuve d'esprit critique vis-à-vis d'une solution technique pour en vérifier la robustesse et minimiser les risques qu'elle présente au regard du contexte de sa mise en Œuvre. Par exemple : dans le développement une solution qui a un impact sur les conditions de travail ou de vie de ses utilisateurs, par exemple en biomédical.
6.4 Evaluer les connaissances indispensables à la réalisation d'un projet et intégrer de manière autonome celles qui n'ont pas été abordées explicitement dans son programme de cours.

Programme structure

The Master's degree program is comprised of:

- a core curriculum (30 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-2020-elec2m-tronc_commun]*

Liste au choix de finalités ELEC2M

> Professional Focus *[en-prog-2020-elec2m-lelec220s]*

> List of electives *[en-prog-2020-elec2m-options]*

List of electives

> Major in electrotechnics and electrical energy *[en-prog-2020-elec2m-lelec221o]*
> Major in communication systems *[en-prog-2020-elec2m-lelec222o]*
> Major in information and signal processing *[en-prog-2020-elec2m-lelec224o]*
> Major in electronic circuits and systems *[en-prog-2020-elec2m-lelec227o]*
> Major in cryptography and information security *[en-prog-2020-elec2m-lelec235o]*
> Major in advanced electronic materials and devices *[en-prog-2020-elec2m-lelec236o]*

List of electives

> Major Business risks and opportunities *[en-prog-2020-elec2m-lfsa220o]*
> Major in small and medium sized business creation *[en-prog-2020-elec2m-lfsa221o]*

List of electives

> Elective courses available for Master students in electrical engineering *[en-prog-2020-elec2m-lelec952o]*
> Elective courses : Transversal skills and professional contacts *[en-prog-2020-elec2m-lelec951o]*

Preparatory Module *(only for students who qualify for the course via complementary coursework)*

> Master [120] in Electrical Engineering *[en-prog-2020-elec2m-module_complementaire]*

ELEC2M Detailled programme

Programme by subject

CORE COURSES

O Mandatory	⊠ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	Activity with requisites

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

The student shall select

						Year 1	2
LELEC2990	Graduation project/End of studies project			28 Credits			x

Religion courses for students in exact sciences (2 credits)

The students select one course between:

LTECO2100	Sociétés, cultures, religions : Biblical readings	Hans Ausloos	15h	2 Credits	q1	x	x
LTECO2300	Societies, cultures, religions : Ethical questions	Marcela Lobo Bustamante	15h	2 Credits	q1	x	x
LTECO2200	Societies-cultures-religions : Human Questions	Régis Burnet Dominique Martens	15h	2 Credits	q1 or q2	x	x

PROFESSIONAL FOCUS [30.0]

O Mandatory	⊠ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	Activity with requisites

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

The student has to take all the following courses:

Content:

						Year 1	Year 2
O LELEC2531	Design and Architecture of digital electronic systems	Jean-Didier Legat	30h+30h	5 Credits	q1	x	
O LELEC2795	Radiation and communication systems	Christophe Craeye Jérôme Louveaux Claude Oestges Luc Vandendorpe	30h+30h	5 Credits	q1	x	
O LELEC2103	Project in Electricity 3 : Electronic systems	Jean-Didier Legat Jérôme Louveaux Luc Vandendorpe	75h	5 Credits	q1+q2	x	
O LELEC2900	Signal processing	Laurent Jacques Benoît Macq Luc Vandendorpe	30h+30h	5 Credits	q2	x	
O LINGI2315	Design of Embedded and real-time systems	Jean-Didier Legat	30h+30h	5 Credits	q2	x	
O LINMA1731	Stochastic processes : Estimation and prediction	Pierre-Antoine Absil Luc Vandendorpe (coord.)	30h+30h	5 Credits	q2	x	

OPTIONS

The student has to complete his program with majors and/or elective courses. He shall select From 60 to 60 credits

List of electives

> Major in electrotechnics and electrical energy *[en-prog-2020-elec2m-lelec221o]*
> Major in communication systems *[en-prog-2020-elec2m-lelec222o]*
> Major in information and signal processing *[en-prog-2020-elec2m-lelec224o]*
> Major in electronic circuits and systems *[en-prog-2020-elec2m-lelec227o]*
> Major in cryptography and information security *[en-prog-2020-elec2m-lelec235o]*
> Major in advanced electronic materials and devices *[en-prog-2020-elec2m-lelec236o]*

List of electives

> Major Business risks and opportunities *[en-prog-2020-elec2m-lfsa220o]*
> Major in small and medium sized business creation *[en-prog-2020-elec2m-lfsa221o]*

List of electives

> Elective courses available for Master students in electrical engineering *[en-prog-2020-elec2m-lelec952o]*
> Elective courses : Transversal skills and professional contacts *[en-prog-2020-elec2m-lelec951o]*

LIST OF ELECTIVES

The student can select one or several majors between:

MAJOR IN ELECTROTECHNICS AND ELECTRICAL ENERGY

The objective of this major is to provide students with knowledge in electromechanics and control. At the end of this major, the students will have acquired a basic training in power electronics and electrical energy networks. They will master the main aspects related to the use of electricity as an energy vector.

O Mandatory	⊠ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	Activity with requisites

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

The student shall select:
From 18 to 21 credits

Content:

Compulsory courses in electrotechnics and electrical energy (13 credits)

						Year 1	Year 2
O LELEC2520	Electric Power Systems	Emmanuel De Jaeger	30h+30h	5 Credits	q1	x	x
O LELEC2660	Power electronics	Marc Bekemans	30h+15h	4 Credits	q1	x	x
O LELEC2313	Dynamic modelling and control of electromechanical converters	Emmanuel De Jaeger Bruno Dehez	30h+30h	5 Credits	q1	x	x

Elective courses in electrotechnics and electrical energy

⊠ LELEC2311	Physics of Electromechanical Converters	Bruno Dehez	30h+15h	4 Credits	q2	x	x
⊠ LELEC2595	Electric Power Systems Quality	Emmanuel De Jaeger	30h+30h	5 Credits	q2	x	x
⊠ LELEC2670	Renewable and non conventional sources of electrical energy	Emmanuel De Jaeger (coord.) Pascal Jacques	30h+15h	4 Credits	q2	x	x
⊠ LELEC2753	Electrical Power Systems: Advanced Topics	Emmanuel De Jaeger	30h+15h	5 Credits	q2	x	x
⊠ LELEC2811	Instrumentation and sensors	David Bol (coord.) Laurent Francis	30h+30h	5 Credits	q1	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.

O Mandatory	⊠ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	Activity with requisites

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

From 15 to 30 credits

O Content:

O Compulsory courses in communication systems

The student shall select at least 15 credits among:

						Year 1	Year 2
⊠ LELEC2796	Wireless communications	Claude Oestges (coord.) Luc Vandendorpe	30h+30h	5 Credits	q1	x	x
⊠ LELEC2880	Modem design	Jérôme Louveaux (coord.) Luc Vandendorpe	30h+30h	5 Credits	q2	x	x
⊠ LELEC2910	Antennas and propagation	Christophe Craeye (coord.) Claude Oestges	30h+30h	5 Credits	q1	x	x
⊠ LELEC2920	Communication networks	Sébastien Lugan (compensates Benoît Macq)	30h+30h	5 Credits	q1	x	x
⊠ LINGI2348	Information theory and coding	Jérôme Louveaux Benoît Macq Olivier Pereira	30h+15h	5 Credits	q2	x	x

⊠ Elective courses in communication systems

⊠ LELEC2590	Seminars in electronics and communications	Denis Flandre Isabelle Huynen Jérôme Louveaux	30h	3 Credits	q2	x	x
⊠ LINGI2146	Mobile and Embedded Computing	Ramin Sadre	30h+15h	5 Credits	q2	x	x
⊠ LINMA1702	Optimization models and methods I	François Glineur	30h +22.5h	5 Credits	q2	x	x

MAJOR IN INFORMATION AND SIGNAL PROCESSING

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.

O Mandatory	⊠ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	Activity with requisites

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

The student shall select:
From 15 to 30 credits

O Content:

O 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
O LINMA1510	Linear Control	Denis Dochain	30h+30h	5 Credits	q2	x	x

O Compulsory courses in information and signal processing

						Year 1	Year 2
O LELEC2870	Machine learning : regression, deep networks and dimensionality reduction	John Lee Michel Verleysen	30h+30h	5 Credits	q1	x	x
O LELEC2885	Image processing and computer vision	Christophe De Vleeschouwer (coord.) Laurent Jacques	30h+30h	5 Credits	q1	x	x
O LINGI2348	Information theory and coding	Jérôme Louveaux Benoît Macq Olivier Pereira	30h+15h	5 Credits	q2	x	x

⊠ Elective courses in information and signal processing

						Year 1	Year 2
⊠ LELEC2880	Modem design	Jérôme Louveaux (coord.) Luc Vandendorpe	30h+30h	5 Credits	q2	x	x
⊠ LGBIO2050	Medical Imaging	Greet Kerckhofs John Lee Benoît Macq Frank Peeters	30h+30h	5 Credits	q1	x	x
⊠ LINGI2262	Machine Learning :classification and evaluation	Pierre Dupont	30h+30h	5 Credits	q2	x	x
⊠ LINMA1691	Discrete mathematics - Graph theory and algorithms	Vincent Blondel Jean-Charles Delvenne	30h +22.5h	5 Credits	q1	x	x
⊠ LINMA1702	Optimization models and methods I	François Glineur	30h +22.5h	5 Credits	q2	x	x
⊠ LINMA2111	Discrete mathematics II : Algorithms and complexity	Jean-Charles Delvenne Jean-Charles Delvenne (compensates Vincent Blondel)	30h +22.5h	5 Credits	q1	x	x
⊠ LINMA2380	Matrix computations	Raphaël Jungers	30h +22.5h	5 Credits	q1	x	x
⊠ LINMA2875	System Identification	Julien Hendrickx	30h+30h	5 Credits	q2	x	x
⊠ LMAT2450	Cryptography	Olivier Pereira	30h+15h	5 Credits	q1	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.

O Mandatory	⊠ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	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:
From 15 to 30 credits

Content:

Compulsory course in electronic circuits and systems

						Year 1	Year 2
O LELEC2532	Design and Architecture of analog electronic systems	David Bol Denis Flandre	30h+30h	5 Credits	q2	x	x

Elective courses in electronic circuits and systems

						Year 1	Year 2
⊠ LELEC2541	Advanced Transistors	Denis Flandre (coord.) Benoît Hackens Jean-Pierre Raskin	30h+30h	5 Credits	q2	x	x
⊠ LELEC2570	Synthesis of digital integrated circuits	David Bol	30h+30h	5 Credits	q1	x	x
⊠ LELEC2580	Design of RF and microwave communication circuits	Christophe Craeye Dimitri Lederer	30h+30h	5 Credits	q2	x	x
⊠ LELEC2590	Seminars in electronics and communications	Denis Flandre Isabelle Huynen Jérôme Louveaux	30h	3 Credits	q2	x	x
⊠ LELEC2620	Modeling and implementation of analog and mixed analog/ digital circuits and systems on chip	David Bol	30h+30h	5 Credits	q2	x	x
⊠ LELEC2650	Synthesis of analog integrated circuits	Denis Flandre	30h+30h	5 Credits	q1	x	x
⊠ LELEC2660	Power electronics	Marc Bekemans	30h+15h	4 Credits	q1	x	x
⊠ LELEC2700	Microwaves	Dimitri Lederer	30h+30h	5 Credits	q1	x	x
⊠ LELEC2760	Secure electronic circuits and systems	François-Xavier Standaert	30h+30h	5 Credits	q2	x	x
⊠ LELEC2811	Instrumentation and sensors	David Bol (coord.) Laurent Francis	30h+30h	5 Credits	q1	x	x
⊠ LGBIO2020	Bioinstrumentation	André Mouraux Michel Verleysen	30h+30h	5 Credits	q1	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.

O Mandatory	⊠ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	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:
From 15 to 30 credits

O Content:

⊠ Elective courses

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

						Year 1	Year 2
⊠ LELEC2760	Secure electronic circuits and systems	François-Xavier Standaert	30h+30h	5 Credits	q2	x	x
⊠ LINGI2144	Secured systems engineering	Axel Legay	30h+15h	5 Credits	q2	x	x
⊠ LINGI2347	Computer system security	Ramin Sadre	30h+15h	5 Credits	q2	x	x
⊠ LINGI2348	Information theory and coding	Jérôme Louveaux Benoît Macq Olivier Pereira	30h+15h	5 Credits	q2	x	x
⊠ LMAT2440	Number theory	Olivier Pereira Jean-Pierre Tignol	30h+15h	5 Credits	q1	x	x
⊠ LMAT2450	Cryptography	Olivier Pereira	30h+15h	5 Credits	q1	x	x
⊠ LELEC2770	Privacy Enhancing technology	Olivier Pereira (coord.) François-Xavier Standaert	30h+30h	5 Credits	q1	x	x

MAJOR IN ADVANCED ELECTRONIC MATERIALS AND DEVICES

O Mandatory	⊠ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	Activity with requisites

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

From 15 to 30 credits

O Content:

O Compulsory courses in advanced electronic materials and devices

Student choose at least 5 credits among:

						Year 1	Year 2
⊠ LELEC2541	Advanced Transistors	Denis Flandre (coord.) Benoît Hackens Jean-Pierre Raskin	30h+30h	5 Credits	q2	x	x
⊠ LELEC2550	Special electronic devices	Vincent Bayot	30h+30h	5 Credits	q1	x	x
⊠ LELEC2700	Microwaves	Dimitri Lederer	30h+30h	5 Credits	q1	x	x
⊠ LELEC2895	Design of micro and nanosystems	Laurent Francis	30h+30h	5 Credits	q1	x	x

⊠ Elective courses in advanced electronic materials and devices

⊠ LELEC2560	Micro and Nanofabrication Techniques	Laurent Francis (coord.) Benoît Hackens Jean-Pierre Raskin	30h+30h	5 Credits	q2	x	x
⊠ LELEC2580	Design of RF and microwave communication circuits	Christophe Craeye Dimitri Lederer	30h+30h	5 Credits	q2	x	x
⊠ LELEC2710	Nanoelectronics	Vincent Bayot (coord.) Benoît Hackens	30h+30h	5 Credits	q1	x	x
⊠ LELEC2811	Instrumentation and sensors	David Bol (coord.) Laurent Francis	30h+30h	5 Credits	q1	x	x
⊠ LMAPR2015	Physics of Nanostructures	Jean-Christophe Charlier (coord.) Xavier Gonze Luc Piraux	37.5h +22.5h	5 Credits	q1	x	x
⊠ LMAPR2020	Materials Selection	Pierre Bollen (compensates Bernard Nysten) Thomas Pardoen	30h +22.5h	5 Credits	q2	x	x
⊠ LMECA2300	Advanced Numerical Methods	Philippe Chatelain Christophe Craeye (coord.) Vincent Legat Jean-François Remacle	30h+30h	5 Credits	q2	x	x
⊠ LPHYS2143	Optics and lasers	Clément Lauzin	22.5h +22.5h	5 Credits	q1	x	x
⊠ LPHYS2303	Cryophysics and vacuum physics	Vincent Bayot Benoît Hackens Sorin Melinte	30h+15h	5 Credits	q1	x	x

LIST OF ELECTIVES

MAJOR BUSINESS RISKS AND OPPORTUNITIES

O Mandatory	⊠ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	Activity with requisites

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

This Major is not available in English and cannot be taken simultaneously with the Major "Major in small and medium sized business creation".
From 17 to 20 credits

O *Content:*

						Year 1	Year 2
O LFSA1290	Introduction to financial and accounting management	Philippe Grégoire	30h+15h	4 Credits	q2	x	x
O LFSA2140	Elements of law for industry and research	Vincent Cassiers Werner Derijcke Bénédicte Inghels	30h	3 Credits	q1	x	x
O LFSA2210	Organisation and human resources	John Cultiaux Eline Jammaers	30h	3 Credits	q2	x	x
O LFSA2230	Introduction to management and to business economics	Benoît Gailly	30h+15h	4 Credits	q2	x	x
O LFSA2245	Environment and business	Jean-Pierre Tack	30h	3 Credits	q1	x	x

O One course between

From 3 to 5 credits

⊠ LFSA2202	Ethics and ICT	Axel Gosseries Olivier Pereira	30h	3 Credits	q2	x	x
⊠ LLSMS2280	Business Ethics and Compliance Management	Carlos Desmet	30h	5 Credits	q1	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

In keeping with most of the EPL Masters' degrees, the goal of this major is to familiarize the student with the specifics of entrepreneurship and business development in order to develop the necessary abilities, knowledge and tools to create a business. It is a truly interdisciplinary initiative where students from different faculties are brought together in cross-disciplinary teams to create an entrepreneurial project.

The Interdisciplinary program in entrepreneurship (CPME) is spread over two years and is integrated into more than 30 Masters (9 faculties). The program includes a collective and interdisciplinary master thesis focused on an entrepreneurial project (start-up or spin-off) and realized in teams of 3 to 4 students from 3 to 4 different faculties. The access is reserved for a small number of students by a selection procedure. Additional information may be found at www.uclouvain.be/cpme.

This major is not available in English and may not be taken at the same time as the major "Business risks and opportunities".

O Mandatory	⊠ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	Activity with requisites

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

From 20 to 25 credits

O Content:

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

O LCPME2001	Entrepreneurship Theory (in French)	Frank Janssen	30h+20h	5 Credits	q1	x	
O LCPME2002	Managerial, legal and economic aspects of the creation of a company (in French)	Yves De Cordt Marine Falize	30h+15h	5 Credits	q1	x	x
O LCPME2003	Business plan of the creation of a company (in French) *Les séances du cours LCPME2003 sont réparties sur les deux blocs annuels du master. L'étudiant doit les suivre dès le bloc annuel 1, mais ne pourra inscrire le cours que dans son programme de bloc annuel 2.*	Frank Janssen	30h+15h	5 Credits	q2		x
O LCPME2004	Advanced seminar on Entrepreneurship (in French)	Frank Janssen	30h+15h	5 Credits	q2	x	x

⊠ Prerequisite CPME courses

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

O LCPME2000	Venture creation financement and management I	Yves De Rongé Olivier Giacomin	30h+15h	5 Credits	q1	x	

LIST OF ELECTIVES

ELECTIVE COURSES AVAILABLE FOR MASTER STUDENTS 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

O Mandatory	⊠ Optional
△ Courses not taught during 2020-2021	⊘ Periodic courses not taught during 2020-2021
⊕ Periodic courses taught during 2020-2021	Activity with requisites

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

The student selectss between 3 and 22 credits (max 27 if the student selectss the intership) in this list below or in the courses of the major "business risks and opportunities". An alternative is to select the Major in small and medium sized business creation.

	Year	
	1	2

O *Content:*

O Transversal skills and contacts with industry

The student selects min 3 credits among the courses of the Majors "business risks and opportunities", "small and medium sized business creation" and courses of professional integration activity specific to the program.

⊠ Internship

⊠ LFSA2995	Company Internship	Jean-Pierre Raskin	30h	10 Credits	q1+q2	x	x

⊠ Professional integration activity specific to the program

⊠ LELEC2590	Seminars in electronics and communications	Denis Flandre Isabelle Huynen Jérôme Louveaux	30h	3 Credits	q2	x	x
⊠ LFSA2212	Innovation classes	Benoît Macq Jean-Pierre Raskin Benoît Raucent	30h+15h	5 Credits	q1	x	x

⊠ Communication

Students may select max. 8 credits of languages courses or group dynamics :
Maximum 8 credits

⊠ 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 (coord.)	30h	3 Credits	q1+q2	x	x
⊠ LALLE2501	Professional development seminar-German	Caroline Klein (coord.)	30h	5 Credits	q1+q2	x	x
⊠ LESPA2600	Vocational Induction Seminar - Spanish (B2.2/C1)	Paula Lorente Fernandez (coord.)	30h	3 Credits	q1	x	x
⊠ LESPA2601	Vocational Induction Seminar - Spanish (B2.2/C1)	Paula Lorente Fernandez (coord.)	30h	5 Credits	q1	x	x
⊠ LNEER2500	Seminar of Entry to professional life in Dutch - Intermediate level	Isabelle Demeulenaere (coord.) Marie-Laurence Lambrecht	30h	3 Credits	q1 or q2	x	x
⊠ LNEER2600	Seminar of entry to professional life in Dutch - Upper-Intermediate level	Isabelle Demeulenaere (coord.) Dag Houdmont	30h	3 Credits	q1 or q2	x	x

⊠ Group dynamics

⊠ LEPL2351	Dynamique des groupes - Q1	Christine Jacqmot Claude Oestges Benoît Raucent Vincent Wertz	15h+30h	3 Credits	q1	x	x

						Year 1	2
⊠ LEPL2352	Dynamique des groupes - Q2	Christine Jacqmot Claude Oestges Benoît Raucent Vincent Wertz	15h+30h	3 Credits	q2	x	x

⊠ Other non-disciplinary courses

The student may further select maximum 8 credits in other disciplines.

Course prerequisites

A document entitled #nom_fichier_pdf# 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.

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 # Prerequisities list

LELEC2570 "Synthesis of digital integrated circuits" has prerequisite(s) LELEC2531

- LELEC2531 - Design and Architecture of digital electronic systems

LELEC2650 "Synthesis of analog integrated circuits" has prerequisite(s) LELEC2532

- LELEC2532 - Design and Architecture of analog electronic systems

The programme's courses and learning outcomes

For each UCLouvain 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?"*

The document is available by clicking this link after being authenticated with your UCLouvain account.

ELEC2M - Information

Admission

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

In the event of the divergence between the different linguistic versions of the present conditions, the French version shall prevail.

SUMMARY

Specific Admission Requirements

This programme is taught in English with no prerequisite in French. The student is supposed to have at least a B2 level in the European Framework of Reference. A certificat is required for the holders of a non-Belgian degree, see selection criteria of the Accès on the file.

University Bachelors

Diploma	Special Requirements	Access	Remarks
UCLouvain Bachelors			
Bachelor in Engineering		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.
Others Bachelors of the French speaking Community of Belgium			
Bachelor in engineering		direct_access	Students with a Bachelor's degree in engineering sciences who have not taken the equivalent of a minor in the field of their civil engineering master degree may have an adapted master programme.
Bachelors of the Dutch speaking Community of Belgium			
Bachelor in engineering		access_with_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	Bachelors degree of Cluster Institution	direct_access	Students with a Bachelor's degree in engineering sciences who have not taken the equivalent of a minor in the field of their civil enginering master degree may have an adapted master programme.
Bachelor in Engineering	For others institutions	on_the_file	See personalized access

Non university Bachelors

> Find out more about links to the university

Holders of a 2nd cycle University degree

Diploma	Special Requirements	Access	Remarks
"Licenciés"			
Masters			
Master in Engineering		direct_access	

Holders of a non-University 2nd cycle degree

> Find out more about links to the university

Adults taking up their university training

> See the website Valorisation des acquis de l'expérience

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.

The first step of the admission procedure requires to submit an application online: https://uclouvain.be/en/study/inscriptions/futurs-etudiants.html

Selection criteria are summarized here (contact : epl-admission@uclouvain.be).

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. 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

Curriculum Management

Entity

Structure entity	SST/EPL/ELEC
Denomination	(ELEC)
Faculty	Louvain School of Engineering (EPL)
Sector	Sciences and Technology (SST)
Acronym	ELEC
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Jury

- Président: Jean-Didier Legat
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