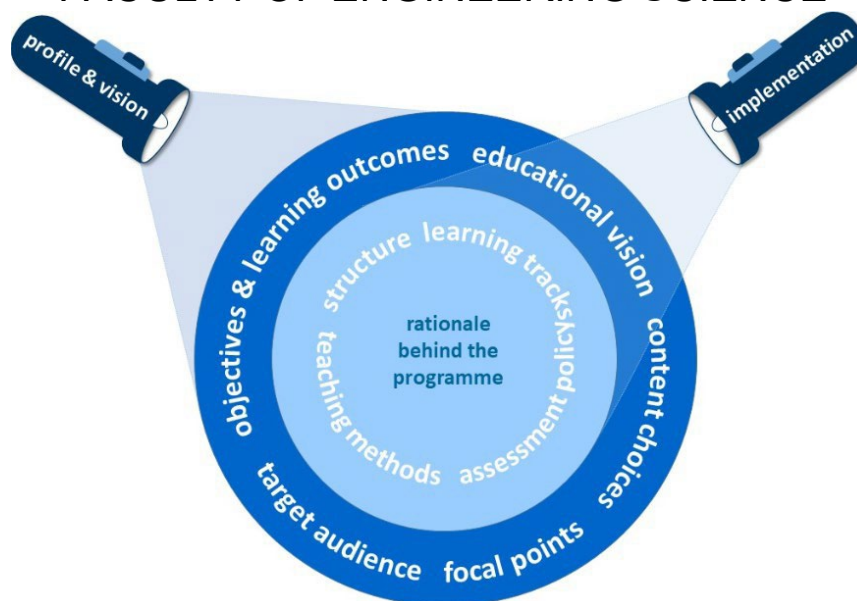


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MASTER OF ELECTRICAL ENGINEERING;
PREPARATORY PROGRAMME: MASTER OF
ELECTRICAL ENGINEERING

FACULTY OF ENGINEERING SCIENCE



DECEMBER 2022



Master of Electrical Engineering

Profile and vision

The Faculty of Engineering Science brings the intellectual and human capital of each individual student to a higher level by offering a research based education in scientific and engineering fundamentals. The Faculty stimulates students to practice in-depth learning by addressing and challenging their 'disciplinary future self', to make them aware of who they wish to become as a professional (*Beruf*) and as members of society in general (*Bildung*). In order to stimulate the development of the students' 'disciplinary future self', the Faculty provides multidisciplinary programmes that acquaint students with the engineering profession and with related disciplines. We value both breadth and depth of knowledge, expanding the reasoning, communication and problem-solving abilities, in order to prepare students for life-long learning. The research-oriented education is based on research programmes, which are defined and developed in close collaboration with recognised international peers and with industry.

The students who graduate from the Master of Electrical Engineering programme are academically schooled experts in the design of combined hardware and software systems for capturing, processing and transmitting data. The programme trains students to design and optimise concepts for new products, processes, systems or services. It focuses on both conceptual aspects and methodological approaches.

The programme is tightly coupled to the internationally renowned research of the Department of Electrical Engineering, which has resulted in many spin-offs. This is reflected in the topics of the master's thesis but it also allows the student to specialise in one or more of the following research driven aspects of electrical engineering. In the field of IC design, the student gets familiar with the next generation of integrated telecom circuits/systems and of ultra-low power integrated circuits/systems. In the field of power electronics the student learns about the design and the control of electrical energy systems and renewable energy. There are different courses available in the field of signal processing: computer vision, audio/speech processing, machine learning and biomedical applications. In the field of digital communications, courses on mobile networks for broadband communication, cryptography and embedded security systems are available.

Goals and learning outcomes

The objective of all programmes at the Faculty of Engineering Science is the education of academically skilled engineers for an active career in a technical industrial environment, the public sector or service sector. The engineer's task is the 'creative and innovative application of science for the design, development, production and exploitation of products and services that are useful to society or the management of those activities'. This

academic education is the foundation of the engineering graduate who subsequently evolves through lifelong learning.

The Faculty aims at educating students in the various roles engineers can take: engineers as experts in their discipline, engineers as researchers, engineers as problem solvers and designers, engineers as professionals and engineers in an international context. Furthermore, the Faculty of Engineering Science applies the ACQA criteria for the elaboration of the learning outcomes. The NVAO recognises these ACQA criteria as an operationalisation of the more global Dublin descriptors for academic engineering education. The ACQA framework distinguishes seven areas of competence with regard to method, domain and context, which will be translated into a list of concrete, operational learning outcomes.

The Master of Electrical Engineering programme aims at forming engineers who are able to design innovative electronic circuits and ICT solutions that are applied in various sectors: from smart health to self-driving cars, from cool wearables to big power plants. The engineer will know how to use signal-processing algorithms, software, hardware and ICs. The four options, that will be discussed below, emphasise different aspects of this broad spectrum.

At the end of the program the graduate will have acquired a good understanding of all fundamental aspects and methods of electronic information processing and the design of electronic systems and ICs. They will have learned how to produce structured designs as well as to acquire new insights and methodologies independently, how to process experimental results and apply them in research or industry. The specific learning outcomes are available on this webpage: https://onderwijsaanbod.kuleuven.be/opleidingen/e/CQ_50657365.htm#activetab=doelstellingen

Target group

The programme assumes basic knowledge of electrical engineering (such as basic transistor and logic design, digital signal processing, systems and control) as well as a sound knowledge of the underlying scientific disciplines (such as physics and mathematics). This corresponds to a Bachelor of Engineering with a major or a minor in Electrical Engineering.

For Dutch speaking lateral entry students (mostly students with a Master's degree in Engineering Technology), an individually tuned preparatory programme is available. Depending on the educational background of the candidate, the size of the preparatory programme ranges from 6 to 60 credits. If more than 60 credits are needed to fill in the knowledge gap, the candidate is advised to enter the Bachelor of Engineering programme instead.

For non-Dutch speaking lateral entry students, no preparatory programme is available. Dual degree students are selected by their home university based on certain criteria. For other candidates, an admission committee judges their educational level and electrical engineering background. They take into account the contents of the bachelor's programme, the grades, the reputation of the bachelor's institute, the results of the GRE test, and the motivation of the candidate. Based on this evaluation about half of the candidates are accepted. If the programme language is not the native language of the candidate, a language proficiency test is required with minimum scores defined by the Faculty. This is also a requirement for dual degree students.

Realisation

Structure

The Master of Electrical Engineering programme is organised in a Dutch-language version, targeting the Dutch-speaking students, and an English-language version. Since the two versions are each other's mirror (except for the teaching language), they have identical objectives and structure. The structure of the programme is illustrated in the table below.

The first two semesters contain the common fundamental courses extending the student's knowledge of electronics, signal processing and telecommunications, as well as several option specific courses.

The programme provides four options: 'Power Systems and Automation', 'Electronics and Chip Design', 'ICT Security and Networks', 'Information Systems and Signal Processing'. The student selects one option according to their field of interest. Each option focuses on a different domain with its own applications, typical careers and specific courses.

The third and the fourth semester are mostly taken by the master thesis, elective courses and an (optional) internship or international courses. The elective courses allow the student to choose their own path: specialise in more topics of electronics engineering or broaden their knowledge in other technical or non-technical domains. On top of this they select general interest courses and broadening education courses, for example economics, management or language courses.

The purpose of these elective courses is to allow students to personalise their programme, ranging from rather specialised over interdisciplinary to rather broad. It is also possible to include internships during summer holidays and international (summer) courses. The elective courses are divided into three categories:

- The student has to select general interest courses from a list provided by the Faculty. These are non-technical courses, often organised by other faculties, such as language courses, economics, and social science courses. For students of the English-language version, the general interest course 'Dutch Language and Cultures' is compulsory.
- Depending on the selected option, the student must take elective engineering courses, called option-specific elective courses. These can be basic courses of one of the other options or basic courses of related engineering master's programmes.
- The student completes their programme with broadening education courses: internships, ATHENS or summer courses, or even any course from the university's offer compatible with the programme.

The master's thesis finalises the learning pathway on project solving and design, started in the bachelor and complemented by an option specific design seminar in the master. Selecting a master's thesis topic starts halfway the second semester. The student selects three preferred topics out of a large list, composed of proposals by professors, industry and students themselves. The students are assigned a topic, based on these preferences. At the beginning of the second stage, the student and the promoter submit a schedule, taking into account the distribution of the remaining courses over the semesters. An intermediate presentation is used to assure that the work is still progressing as planned. After the final presentation, the jury decides on a score, normally by consensus, and the promoter provides feedback to the student.

The learning environment

The three main delivery modes (lecture, practical and assignment) are characterised by the role of the lecturer and the student, respectively. The other delivery modes are master's thesis and internship. The programmes combine the most appropriate delivery modes for each course and a proper balance over the entire curriculum is envisaged. The general objective is to activate students, stimulate them to work independently or in a group, and to have a good balance between the different delivery modes.



Options and option-specific elective courses

- | | |
|--|---|
| <ul style="list-style-type: none">• Power Systems and Automation• Electronics and Chip Design | <ul style="list-style-type: none">• Information Systems and Signal Processing• ICT Security and Networks |
|--|---|

Master's thesis

General Interest and Broadening Elective Courses

Structure of the master's programme

The Faculty and its programmes recognise the importance of a high-quality assessment. High-quality evaluation is therefore fully embedded in the learning environment: it is aligned with the objectives, uses the appropriate evaluation formats, and is adapted to fit the characteristics of the students concerned, who also receive feedback in a timely and appropriate manner. The policy document 'Tests and Assessments' describes the policy of assessment at the Faculty:

- alignment with programme and learning outcomes,
- feedback,
- quality assurance, transparency and the ombuds service,
- evaluation of master's theses and internships,
- organisation of assessments, including special provisions for students with a disability.

The implementation of the Faculty's examination regulations, the development of the programmes, the choice of assessment modes, the specific learning outcomes, etc. In short, internal quality assurance is the primary responsibility of the Educational Committee of each (cluster of) programme(s). All programme directors of the different ECs take part in the Faculty's Educational Committee.

Learning pathways

The engineer as expert in Electrical Engineering

The field of mathematics is a key element in the engineer's profile, in a direct way in the student's education and at least indirectly in the professional's reasoning patterns. Engineers develop and support their thinking in a direct way by means of mathematical models of natural and artificial processes and products. In a more transferable way, they also structure and quantify the import-export relationship or cause-effect analysis of a complex system, a mono- or multi-physical process, a technical installation, the cost structure of an organisation, product or process, and even a major investment decision.

The student has an advanced knowledge and understanding of the main disciplines of electronics (circuits, signal processing and telecommunication). Depending on the chosen option, the student has an in-depth knowledge of one of the following areas: 'Power Systems and Automation', 'Electronics and Chip Design', 'ICT Security and Networks', 'Information Systems and Signal Processing'. The student can creatively apply, expand, deepen and integrate knowledge of different domains of electrical engineering, even when faced with incomplete data.

This role mainly addresses competence areas 1 (knowledge) and 5 (intellectual skills) of the ACQA criteria.

The engineer as researcher

Research and education are closely related in the Faculty, as it is the Faculty's policy to support programmes with strong research activities. The departments of the Faculty have an excellent research record and run many research projects, both with national and international partners.

Programmes and their options have roots in research activities in well-focused topics. Master's programmes focus on one or more disciplines in depth, or combine different disciplines focusing on particular application areas that are closely linked to the scientific research of a research department, such as the Department of Electrical Engineering. Renowned experts teach the courses and this guarantees a state-of-the-art education in the field of electrical engineering.

During the final phase of the master's programme, each master's student has to complete a master's thesis of 24 credits. Each master's thesis typically contains a considerable research component. The thesis forms a major part of the programme. To support students in the process, the Educational Development Unit of the Faculty, in co-operation with the Campus Library Arenberg, organises master's thesis workshops about information literacy, intellectual integrity and plagiarism and academic writing.

The programme also prepares students well for a PhD or a career in the R&D department of a company.

This role mainly addresses competence areas 2 (research) and 4 (scientific approach) of the ACQA criteria.

The engineer as problem solver and designer

An important aspect of engineering is the role of a problem solver and designer. Many courses cover the design aspects of integrated circuits, electronic systems, and their applications. The skills for this role are further developed, based on the bachelor's and the master's PS&D curriculum. In the first stage of the master, the programme contains a design seminar on hardware/software co-design for digital platforms as well as an option specific PS&D seminar. The PS&D curriculum concludes in the second stage with a master's thesis.

This extensive project-based learning pathway allows students to develop their creative design and problem-solving abilities, and to address, research and solve real-life problems. Through this pathway, students train problem-solving abilities and design qualities in group activities. Also, the design and the practical implementation of a solution play an important role.

This learning pathway must enable the students to: formulate a problem statement, collect relevant information, independently process (analyse, evaluate and select) information, reduce the problem into a workable model, solution or solution method, work out and implement a solution, evaluate the result and report. This also exposes the students to practical planning and teamwork.

Strong emphasis is placed on transferable and transversal skills such as written and oral communication, group work, leadership, project management, responsibility and norms of engineering practice, taking initiative, and entrepreneurship. Other transferable skills like information literacy, intellectual integrity and plagiarism, and academic writing are included in the programme through other courses, workshops, etc.

This role mainly addresses competence area 3 (skilled in design), as well as competence areas 6 (ability to collaborate and communicate) and 7 (social and temporal context) of the ACQA criteria.

The engineer as professional

The professional profile of engineers implies that they can use their knowledge and skills to develop, produce, exploit and operate technical realisations in a cost-efficient and responsible way. For engineers, this means mastering all stages of the development and exploitation process under their responsibility at the appropriate level of abstraction. They must possess the necessary skills to complete this process themselves, as part of a team or to have it executed by others. In addition, they must have an overview of the organisation of these processes as supervisors, not only in their own immediate environment but also with clients and stakeholders. Finally, they are responsible for the cost and cost-effectiveness of the implementation of the technical processes.

Furthermore, the Faculty aims at enhancing the employability of its master's students. In order to reach this goal, the Faculty encourages students by incorporating both internships and entrepreneurial courses in all master's programmes as elective courses. The entrepreneurial courses are specifically created to provide an alternative way for students to get in touch with industry and/or a professional environment.

Electrical Engineering forms the backbone of the electronics industry. Examples are not only multinationals but also many smaller companies, including spin-offs of KU Leuven and Imec, which are very creative on the world market. The knowledge of both algorithms and their implementation in hardware and software is a very important plus here.

The programme provides a basis for a career in many sectors. This includes companies using or developing electronics, ICT companies (telecom operators, audio-visual industry, data security companies, telecommunication industry) and ICT departments (for computer & communication infrastructure and security) from large companies, banks and services. All sectors with a need for integrated circuits and electronic systems, with both hardware and software aspects, also offer employment.

This role mainly addresses areas of competence 7 (social and temporal context) and 6 (ability to collaborate and communicate) of the ACQA criteria.

The engineer in international context

The Faculty of Engineering aims at developing an international open policy and atmosphere. Preparing the students for the global labour market is an important focus. The Faculty is not only encouraging its students, researchers and scholars to have an international experience but is also home to a vibrant community of international students, staff and researchers.

The Faculty's and the programme's international activities are extensive and diverse:

- The Faculty has a strong international reputation and is a member of several distinguished networks of technical universities in Europe such as CLUSTER, CESAER and ATHENS.
- The Faculty offers student mobility and staff exchange on a European (Erasmus) and intercontinental level for one semester or a year. The appointment of an exchange coordinator and a well-documented website offer enough guidance. By having good contacts with a selected number of international universities, the high-level quality of the education taken abroad is assured.



The Faculty is also participating in an Erasmus Mundus programme and EIT-KIC programmes.

- Within the CLUSTER network, the Faculty collaborates with partner universities to offer students a chance to get a dual or double degree. Dual degree programmes are implemented with National Chiao Tung University (Taiwan), Tsinghua University (China), and Université Catholique de Louvain (Belgium).
- The ATHENS network organises intensive one-week courses at each member institution.
- The Master of Electrical Engineering offers its programme also completely in English, thereby improving its international visibility by facilitating access to incoming international students.
- The Dutch-language and the English-language master programme share several courses, which gives local students the opportunity to mingle with international students.
- Students and researchers get the opportunity to participate in international research projects, international internships and development cooperation projects.

This role mainly addresses competence area 7 (taking into account temporal and social context) of the ACQA criteria.

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