Goals and operational learning outcomes
‘Master of Engineering: Electrical Engineering’

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1. General objectives for the ‘Master of Engineering: Electrical Engineering’

The basis of all programs in engineering is that the student should be prepared for the function that an academically trained engineer (m/f) fulfills in the professional life, namely a career in a technical-industrial environment, the public sector or the services sector:

Applying science in a creative and innovative way to design, develop and produce useful products and/or services for society; or managing these activities.

The programs in engineering also want to provide the student with a foundation to build a career as a researcher in industrial or scientific research centers or at the university, and for a career in management. In the master’s programs, education is more oriented towards a profound specialization.

Since knowledge, skills and attitudes are intertwined, the term competence, i.e., the integration of knowledge, skills and attitudes, is used. In engineering we distinguish, by analogy with the Technical Universities in the Netherlands, 7 areas of competence. This ACQA system is a further translation of the Dublin descriptors to academic engineering programs. The objectives are:

1. Expertise in one or more scientific fields
   The program aims to offer the students opportunities to
   • acquire a more profound knowledge in the framework of electrical engineering by on the one hand educating the student further in the most important subfields of electrical engineering, on the other hand by supplying him with more specialized material through the selection of an option.
   • gain an understanding in the way knowledge comes about by confronting the student with state of the art research, and having him participate in it.

2. Scientific approach of the world
   The program wants to convey to the student a systematic approach, a critical attitude towards and an insight in science and technology in the field of electrical engineering. This consists of both a theoretical and empirical approach.

3. Research
   Relying on the research skills and attitudes taught in the bachelor program, the student will come in contact with specialized research fields of the lecturers of the program units. Furthermore he will spend a significant part of his time participating in the research.

4. Problem solving
   Building upon the skills acquired during the bachelor studies, the program wants to offer the students the opportunity to gain a broader experience in the problem solving process.

5. Design
   Compared to the bachelor student, the electrical engineering master student will be confronted with design processes that fundamentally follow the same design steps but that have an increased complexity for the individual student, having a much larger solution space, therefore requiring much more creativity. Moreover the designs require a larger scientific basis and are typically build using more complex design tools.

6. Teamwork and communication
   Modern technologies are developed and used in an environment that is much more global than it is local. Electrical engineers that work in the industry and in research and development labs are confronted with this in particular. To be prepared for this, the graduate needs to have the necessary skills in the domain of human relationships and technical and interdisciplinary communication.

7. Intellectual competence
   Engineering is an extremely fast evolving domain. In the electrical engineering domain in particular, technology generations follow each other very quickly. The graduate should be able to
handle this dynamism and will perceive fast changing environments as obvious. Furthermore he will need to be able to cope with social and economical changes, with the different aspects of the corporate culture and with the industrial environment in which he will end up. He is aware of his social, ethical and ecological responsibility and is able to handle in this way. In this context he is able to make a clear judgment based on objective arguments and to communicate his opinion in a comprehensive way.

To reach this objective, the engineering programs have chosen for a degree that is both broad and in-depth, with a stepwise specialization.

During the master program the objectives are different than those of the bachelor program, because the studies make much more use of the expertise and results from the research of the lecturers, because the student is activated even more, and because personal research by the student - especially during the master's thesis - is of great importance. For the other competences, the difference with the bachelor program is rather qualitative. Building upon the basic education of the bachelor's degree, the Master in Electrical Engineering offers a specialized education in the different aspects of electrical engineering and its applications in integrated electronics, telecommunication, multimedia and signal processing. The international dimension of the program is guaranteed by the international character of the research of the lecturers and the use of international sources and educational tools. This international character is reinforced by the possibilities for the student to participate in an exchange program like Athens and ERASMUS or a dual diploma program. Furthermore there are multiple opportunities for the Dutch speaking students to meet the international students that participate in the international ‘Master of Engineering: Electrical Engineering’.

These global objectives are a direct interpretation of the university's educational concept of Guided Independent Learning towards the engineering studies.

2. Operational learning outcomes for the ‘Master of Engineering: Electrical Engineering’

In order to limit the overlap among the different competences, these have been grouped in three domains:

1. **Academic orientation: expertise in one or more scientific disciplines, scientific approaches and research**
   The graduate ‘Master of Engineering: Electrical Engineering’
   - is able to design digital and analogue circuits, building blocks and platforms
   - understands the technological aspects of telecommunication and telecommunication systems
   - understands the several technological possibilities for the implementation of applications (in hardware or software)
   - understands the relation among the application, the way of implementation and the performance of the whole
   - is able to unify the acquired knowledge, and is able to reason and act multidisciplinary (concerning disciplines within the area of electrical engineering, as well as concerning disciplines acquainted with in the bachelor)
   - is willing to involve other disciplines in his research field
   - is capable of developing new knowledge and insights in a methodological way
   - showed a critical scientific attitude in his Master's thesis

2. **Professional orientation: problem solving thinking and designing**
   The graduate ‘Master of Engineering: Electrical Engineering’
   - has a broad experience in using software which is common in the area of Electrical Engineering
   - is able to design digital and analogue circuits, building blocks and platforms
   - is able to design building blocks and systems for telecommunication
   - is able to select, for various types of applications, the most suitable electronical platform (hardware/software), and is able to implement the application
• is able to reformulate and evaluate applications, with regard to an optimal implementation in an electronic platform (regarding power consumption, costs, etc.). Main application areas are telecommunication, cryptography, processing of audio and images and signal processing
• has a synthetic approach
• is able to think abstractly and in a structuring way
• is able to master complexity
• has expertise in all phases of the process of problem solving
• is able to independently acquire the knowledge and technological state of the art needed in the process of problem solving
• is able to balance the pros and cons of a solution in an objective way, in such a way that the most realistic, efficient and applicable solution for a specific application is selected
• is able to apply knowledge in a creative way
• is innovative

3. General competences

The graduate Master of Engineering; Electrical Engineering
• has had a basic training in multiple humanities and social sciences
• has experience in interdisciplinary communication with principals, colleagues and subordinates
• has experience in communicating with specialists as well as laymen
• can handle deadlines
• got acquainted with management aspects through group assignments
• can efficiently work in a team
• is capable of independently keeping up with new evolutions in his domain
• is capable of finding, evaluating and processing professional literature and technical manuals on his own
• has an insight into the wider (economical, legal, sociological, cultural, political, technical-industrial) context
• has a working knowledge of technical English
• has a minimal knowledge of Dutch and European culture

Finally, one can expect that a graduate ‘Master of Engineering: Electrical Engineering’ shows
• a social and ethical sense of responsibility
• environmental awareness
• professional correctness
• inquisitiveness
• an open mind for new methodologies
• entrepreneurship

3. Academic and professional orientation of the objectives of the master

The academic orientation of the education at the K.U.Leuven is incorporated in its mission statement (http://www.kuleuven.be/about/mission_statement.htm ). According to its mission statement the K.U.Leuven seeks to offer a broad scientific training with, besides domain specific emphases, also attention for ethic, cultural and social aspects. It wants to be a critical think center and, rather than promote sheer knowledge of facts, it wants to improve the skills to identify, formulate and solve problems.

The K.U.Leuven has continued this philosophy in its educational concept, guided independent learning. Guided independent learning forms the guiding educational concept at the K.U.Leuven. The concept was developed in line with recent scientific insights in the areas of learning and teaching in higher education, and is the translation of what ‘good education’ means at the K.U.Leuven. Guided independent learning puts central the close bond between research and education. Education founded on research contributes to reaching the competences that are contained in the profiles of bachelor and master.

The concept guided independent learning determines which objectives are specific for academic education:
- possessing knowledge about results of scientific work situated in time and space;
- having insight in the way research results are established;
- being able to give meaning to new information;
- being able to actively contribute to knowledge development processes;
- being able to form a well-founded opinion based on a critical insight in the underlying processes, and in that way take reasoned social views.

The objectives of guided independent learning are linked with the objectives of the BaMa profiles, which are an association-specific translation of the competences described in the decree.

Guided independent learning builds on the Dublin-descriptors and does not only indicate which objectives are characterizing for academic education (with which a bachelor/master has to comply), but also indicates how they should be realized (what is the responsibility of students and lecturers, how do they evolve over consecutive educational years). The Dublin-descriptors do not mention the best way to realize this level. Guided independent learning does so. Guided independent learning has implications for the instructional formats and assessment methods to be used and requires an adapted material and organizational infrastructure. Guided independent learning emphasizes the importance of coherence and consistence in the decision-making about education, on the level of complete study programs as well as on the level of separate program units.

More information about the relation between Dublin-descriptors and guided independent learning can be found at the website [http://www.kuleuven.be/overons/strategischplan.html](http://www.kuleuven.be/overons/strategischplan.html)

For degree courses at the faculty of engineering these objectives were translated to a group of competences and concretized as intended learning outcomes, as described under section ‘General Course Objectives’.

To make the link between research and education in the degree courses in engineering more explicit, it was opted to describe research in a separate competence domain. With the definition of competence in mind, a clear line of thought in the operational attainment targets becomes apparent.

An essential precondition for scientific research is the attainment of necessary knowledge. This knowledge is built up gradually throughout the successive bachelor's and master's years. In the master's years the addressed subject matter is of an advanced level. Furthermore the students come into contact with state of the art course material for some disciplines and the research of their lecturers. However, as is apparent from the attainment targets, the attainment of insight and the application of knowledge remain emphasized.

The research skills are in line with this: the adequate application of knowledge and insight is complemented with study skills, communication skills and rather technical skills of the research field. In the master's program the emphasis lies on increasing independence and integration of skills.

The most important attitudes are a critical demeanor, multidisciplinarity and a correct stance towards plagiarism and source referrals.

On the whole, during the bachelor's programme the students receive a basic programme (both in the area of knowledge and skills as well as attitudes) which prepares them for the master's programme.

During the master's programme the master's thesis, as the ultimate component of guided independent learning and research-based education, takes on a prominent position. In addition to this, stress is laid on supplementing the basic knowledge with state of the art of the field (during which emphasis is placed on insight and skills).

The essence of the duty of an academically trained engineer is problem solving and design. This aspect was an essential element of the BaMa-reform and thus the professional orientation receives priority in the objectives and the programme (see Facet 2.2). The priority of insight above factual knowledge for these competence domains is obvious, as is the necessity of a multidisciplinary approach. This receives a lot of attention during the bachelor's programme. The skills which are addressed during the problem solving process are taught gradually during the bachelor's programme, so as to enable the student to complete the whole process independently during the master's years. It is expected of the student who enters the master's programme that he has experienced the whole problem solving process under supervision. During the master of electrical engineering he will learn to go through the whole process individually. Of course next to all this is the presence of technical skills, group work, communication skills, study skills and more.
Being innovative, being objective in judgments and creative are all essential attitudes, as are having an eye for durability and social-economic context.

The masters programme wishes to add an international dimension in the following ways. The master of electrical engineering is expected to cultivate an international open mindedness and to be able to work with English sources and literature. The programme wants to urge the master's student to acquire international experience and to make use of the available international contact facilities.