

Dossier G : 1^{ère} demande d'admission par l'État, à compter du 1er septembre 2016, des 21 programmes de formation suivants :

- *Bachelor en sciences de l'ingénieur – Bachelor of Science in de ingenieurswetenschappen (VL) - Bachelor of Science in Engineering (EN)*
- *Bachelor en sciences de l'ingénieur : architecture - Bachelor of Science in de ingenieurswetenschappen: architectuur (VL) - Bachelor of Science in Engineering: Architecture (EN)*
- *Master en sciences de l'ingénieur : architecture - Master of Science in de ingenieurswetenschappen: architectuur (VL) - Master of Science in Engineering: Architecture (EN)*
- *Master en sciences de l'ingénieur en génie biomédical - Master of Science in de ingenieurswetenschappen: biomedische technologie (VL) - Master of Science in Biomedical Engineering (EN)*
- *Master en sciences de l'ingénieur en génie civil - Master of Science in de ingenieurswetenschappen: bouwkunde (VL) - Master of Science in Civil Engineering (EN)*
- *Master en sciences de l'ingénieur en génie chimique - Master of Science in de ingenieurswetenschappen: chemische technologie (VL) - Master of Science in Chemical Engineering (EN)*
- *Master en sciences de l'ingénieur en génie informatique - Master of Science in de ingenieurswetenschappen: computerwetenschappen (VL) - Master of Science in Engineering: Computer Science (EN)*
- *Master en sciences de l'ingénieur en génie électrique - Master of Science in de ingenieurswetenschappen: elektrotechniek (VL) - Master of Science in Electrical Engineering (EN)*
- *Master en sciences de l'ingénieur en génie énergétique - Master of Science in de ingenieurswetenschappen: energie (VL) - Master of Science in Engineering: Energy (EN)*
- *Master en sciences de l'ingénieur en génie des matériaux - Master of Science in de ingenieurswetenschappen: materiaalkunde (VL) - Master of Science in Materials Engineering (EN)*
- *Master en sciences de l'ingénieur en génie mécanique - Master of Science in de ingenieurswetenschappen: werktuigkunde (VL) - Master of Science in Mechanical Engineering (EN)*
- *Master en sciences de l'ingénieur en génie mathématique - Master of Science in de ingenieurswetenschappen: wiskundige ingenieurstechnieken (VL) - Master of Science in Mathematical Engineering (EN)*
- *Master en sciences de l'ingénieur en nanoscience, nanotechnologie et en nanogénie - Master of Science in de nanowetenschappen, nanotechnologie en nano-engineering (VL) - Master of Science in Nanoscience, Nanotechnology and Nanoengineering (EN)*
- *Master en sciences de l'ingénieur : trafic, logistique et systèmes de transport intelligents - Master of Science in ingenieurswetenschappen: verkeer, logistiek en intelligente transportsystemen (VL) - Master of Science in Engineering: Traffic, Logistics and Intelligent Transportation Systems (EN)*
- *Master en sciences EIT-KIC : énergie - EIT-KIC Master of Science in Energy (EN)*

- *Master en sciences Erasmus Mundus en nanoscience et nanotechnologie - Erasmus Mundus Master of Science in Nanoscience and Nanotechnology (EN)*
- *Master avancé en sciences en urbanisme et planification stratégique - Advanced Master of Science in Urbanism and Strategic Planning (EN)*
- *Master avancé en sciences de l'ingénieur en génie nucléaire – Advanced Master of Science in Nuclear Engineering (EN)*
- *Master avancé en sciences de l'ingénieur en génie de la sûreté – Advanced Master of Science in Safety Engineering (EN)*
- *Master avancé en sciences en urbanisme et aménagement humain – Advanced Master of Science in Human Settlements (EN)*
- *Master avancé en sciences en conservation des monuments et des sites – Advanced Master of Science in Conservation of Monuments and Sites (EN)*

- Vu le code de l'éducation et notamment les articles L642-7 et R642-9,
- Vu la demande présentée par la Vice-Ministre-Présidente du gouvernement flamand, et la Ministre flamande de l'enseignement
- Vu le rapport établi par : REMAUD Bernard, expert de la CTI et rapporteur principal
JOLLY Anne-Marie, HENRIST Gabriel, membres de la CTI et co-rapporteurs
DUVALLET Jeanne, RAY Pascal, membres de la CTI
ARDITTI Jean-Claude, BEDAT Laurent, LEMAITRE Denis, LE QUENVEN Jean,
MAILLARD Jean-Jacques, experts de la CTI
AVDELAS Aris, MULLENDER Sape J., VAN DEN BERGH Wim, experts internationaux
CURTO Hugo, ELBAZE David, experts élèves ingénieurs
et présenté en réunion plénière de la CTI les 13 et 14 septembre et le 11 octobre 2016,

*3 universités belges, établissements d'enseignement supérieur, ont demandé à être audité par la CTI en vue de faire reconnaître en France leurs diplômes par la procédure d'admission par l'État. Il s'agit d'une première demande. Ces diplômes de « **master en sciences de l'ingénieur** » sont délivrés à l'issue d'une formation en 5 ans composée d'un premier cycle scientifique et technologique généraliste de 3 ans suivi d'un cycle de spécialisation de 2 ans conduisant au Master. Le premier cycle se conclut par la délivrance d'un diplôme de bachelor dit « de transition ». 55 formations ont été examinées au regard des référentiels R&O 2012 international, ESG 2009 et EAFSG (EUR-ACE Master).*

La Commission des titres d'ingénieur a adopté le présent avis :

Présentation générale

KU Leuven est l'une des plus anciennes universités européennes fortement orientées vers la recherche. Sa création remonte à 1425 en tant que « Iovaniense Studium Generale. » En 1833, elle a été réformée et a pris le nom « Katholieke Universiteit Leuven ». Elle comprenait une importante section de langue française. Après une crise politique, la scission a été décidée en 1968 avec le départ des sections francophones de Louvain et la création de l'"Université Catholique de Louvain" dans le nouveau campus de Louvain-la-Neuve. Plus tard, "Katholieke Universiteit Leuven" prit le nom officiel de « KU Leuven ».

Durant l'année académique 2014-2015, 25 220 étudiants étaient inscrits en Bachelor (licence) et 18 770 en Master, dans les 15 Facultés de KU Leuven. Le nombre total des étudiants est de 57 284, avec 19% d'étrangers. La Faculté des sciences de l'ingénieur (FES) est l'une de celles-ci avec environ 3.400 étudiants inscrits (2013-2014, SER) ; il existe aussi

une Faculté des Sciences, une Faculté de Génie en Bioscience, une Faculté d'Architecture et une Faculté de Génie Technologique.

Seuls les programmes de FES sont concernés par la présente démarche d'accréditation :

- 2 programmes de Bachelor (180 crédits ECTS): Bachelor of Engineering (1 262 étudiants) et Bachelor of Engineering: Architecture (315 étudiants). La langue d'enseignement est le néerlandais.
- 12 programmes de Master (120 crédits ECTS) totalisant 1579 étudiants. Ces programmes doivent être enseignés d'abord en néerlandais (selon la loi en Flandres), mais peuvent être complétés par des filières en anglais.
- 6 Masters (60 crédits ECTS) totalisant 254 étudiants (en néerlandais "Master na Master"), offrant des spécialisations théoriquement aux détenteurs d'un Master en Engineering, mais en réalité pour les étudiants ayant un profil beaucoup plus large, en particulier, ils sont ouverts aux étudiants étrangers.

Ils sont tous préparés sur le campus principal de Louvain (Heverlee)

Il convient de noter que, à l'Université KU Leuven la Faculté de Génie Technologique prépare des "Masters of Industrial Engineering", types de diplômes qui étaient auparavant préparés en 4 ans par diverses institutions indépendantes réparties dans le pays.

En comparaison avec les "Masters of Engineering" de la FES, les «Masters of Industrial Engineering » ont conservé leur forte orientation professionnelle avec des études moins théoriques ; souvent des ponts sont organisés pour permettre aux étudiants en « Industrial Engineering » ou leurs diplômés de rejoindre les programmes de la FES.

Caractéristiques générales

Comme les autres facultés de KU Leuven, la FES a une grande autonomie pour la gestion de ses ressources humaines et financières. Elle est composée de sept départements, qui sont « responsables de leur recherche et aussi de la gestion de leurs propres ressources humaines et ont leur propre secrétariat » (SER page 5). La recherche constitue l'épine dorsale de la faculté ; l'éducation est une activité transversale, gérée par les comités d'éducation présidés par un directeur de programme, qui repose sur les ressources humaines et des équipements fournis par les départements.

La politique générale de la FES est de « porter le capital intellectuel et humain de chaque élève individuellement à un niveau supérieur en lui offrant une formation à la recherche sur la base des fondamentaux scientifiques et techniques" (SER page 3). L'orientation fondée sur la recherche de l'éducation est clairement mise en avant, avec une approche bottom-up pour la conception des programmes. Cette approche qui se fonde sur les compétences des équipes de recherche peut entraîner des difficultés pour la gestion des questions non scientifiques et transversales.

En plus de ce fort accent sur la recherche, la faculté des sciences de l'ingénieur (soutenu par KU Leuven) se distingue par une forte implication dans les sciences de l'éducation et dans l'assurance de la qualité :

- Une grande attention est accordée à la réussite des étudiants, avec de nombreuses initiatives notables : suivi des trajectoires, personnels (6 à 7 personnes) dédiés à l'accompagnement individuel des étudiants en Bachelor, formation pédagogique des enseignants nouvellement recrutés, Comités pédagogiques impliquant les enseignants et les étudiants, etc.
- La faculté, soit de sa propre initiative soit en appliquant les orientations nationales conduites par les agences VLIR / NVAO, a fixé un cadre remarquable pour la mise en œuvre de la démarche « Learning outcomes », résultats de l'apprentissage attendus des diplômés. Le cadre général ACQA définit les compétences académiques, ainsi que la méthodologie pour évaluer les programmes d'études. La description des compétences est pleinement cohérente avec les descripteurs de Dublin pour les trois cycles du

processus de Bologne, et dans une très large mesure avec les compétences incluses dans les référentiels CTI et EUR-ACE. La cartographie des compétences sur les unités d'apprentissage et sur les méthodes pédagogiques a été faite pour chaque programme. Cependant, l'articulation entre cette orientation basée sur les « outcomes » et l'approche basée sur les contenus décrite ci-dessus n'est pas finalisée ; Il reste un déséquilibre potentiel dans les arbitrages entre la part dédiée aux compétences scientifiques tirées par les besoins et les ressources en recherche et celle pour les compétences transversales (soft skills).

- Le rapport d'auto-évaluation reflète une culture claire de l'assurance qualité : on y trouve les objectifs stratégiques, une analyse SWOT de l'ensemble de l'institution et de chaque programme, les références aux enquêtes internes (KONDOR) et des plans d'action.

Analyse globale

Forces

- KU Leuven est une université axée sur la recherche, qui fournit un environnement scientifique de haut niveau (personnel et matériel) pour les études d'ingénieur.
- Avec le soutien de l'université, la faculté a une politique de formation bien définie centrée sur les compétences des élèves, avec des initiatives remarquables comme le référentiel ACQA pour les résultats de l'apprentissage ou l'approche PS&D (Problem-solving & Design).
- La conception des programmes basée sur une approche bottom-up et tirée par la recherche conduit à un haut niveau scientifique des diplômés
- La structure globale de la formation des ingénieurs paraît cohérente avec des Bachelors fournissant une base commune forte à tous les étudiants et un système Majeur/Mineur préparant aux programmes de Master à la fin du Bachelor.
- Le rapport d'auto-évaluation et la documentation fournie pour la visite démontrent une bonne culture d'assurance qualité dans l'enseignement.

Faiblesses

- La Faculté s'appuyant fortement sur départements de recherche, manque d'une vision et d'une gestion globales pour les résultats d'apprentissage non-scientifiques.
- L'autonomie notable des directions de programme conduit à une mise en pratique variable de la politique décidée par la Faculté (par exemple la mise en place des conseils consultatifs industriels qui est une action prioritaire)
- Il apparaît une certaine réticence à associer toutes les parties prenantes (la société, les anciens diplômés, les employeurs) à la supervision formelle des contenus et des résultats des programmes.
- La très forte demande d'ingénieurs en Flandre ne motive pas le personnel enseignant à investir profondément dans l'employabilité des diplômés (suivi des diplômés, politique des stages).
- La Faculté ne profite pas pleinement de sa position géographique et de sa réputation internationale pour la mobilité sortante des étudiants et l'attraction des meilleurs étudiants étrangers.

Risques et opportunités

- Le cadre légal pour l'usage des langues dans l'enseignement supérieur en Flandres, est un frein pour le développement international de la Faculté.
- L'implication du personnel pour préparer l'accréditation internationale est à noter ; des efforts doivent être faits pour qu'elle soit durable pour tirer pleinement profit de ces efforts sur le long terme.

General presentation

KU Leuven is one of the top and oldest European universities. It is strongly research-oriented. Its creation can be traced back to 1425 as the “Studium generale lovaniense. In 1833, it was reformed and took the name “Katholieke Universiteit Leuven “. It comprised an important French speaking section. After a political crisis, the scission was decided in 1968 with the departure of the French speaking sections of Leuven and the creation of the “Université Catholique de Louvain” in the new campus at Louvain-la-Neuve. Later in history, the “Katholieke Universiteit Leuven” took the official brand name KU Leuven.

In the 2014-2015 academic year, 25,220 students were attending the Bachelor’s classes and 18,770 the Master’s classes, at the 15 faculties of the KU Leuven. The overall total students’ number is 57,284, with 19% coming from abroad ¹. The Faculty of Engineering Science (FES) is one of these with about 3,400 students registered (2013-2014, SER); there exist also a Faculty of Science, a Faculty of Bioscience Engineering, a Faculty of Architecture and a Faculty of Engineering Technology.

The innovation process is very vivid and many start-ups are created by the teachers.

Only the programmes of the FES are concerned by the present accreditation audit:

- 2 Bachelor’s programmes (180 ECTS credits): Bachelor of Engineering (1262 students) and Bachelor of Engineering: Architecture (315 students). The teaching language is Dutch.
- 12 Master’s programmes (120 ECTS credits) totalizing 1579 students: These programmes must be taught in Dutch (according to the law in Flanders), but may offer tracks taught in English.
- 6 Advanced Master’s programmes (60 to 120 ECTS credits) totalizing 254 students (in Dutch “Master na Master”), offering specializations theoretically to the holders of a Master of Engineering; but in reality to students with a much wider profile, in particular as they are open to foreign students.

They are all taught on the main campus of Leuven (Heverlee)

At KU Leuven the Faculty of Engineering Technology prepares to degrees called “Master of Engineering Technology”; these degrees were formerly delivered in 4 years by several independent Higher Education Institutions spread in the country.

When compared with the “Master of Engineering Science” degrees of the FES, the “Master of Engineering Technology” degrees have kept their strong vocational orientation with less theoretical studies; often bridges are organized for the students engaged in and/or graduates of Engineering Technology studies, who want to join a Master of Engineering Science programme.

Global characteristics

As the other Faculties of KU Leuven, the FES has a large autonomy for the management of its human and financial resources. It is composed of seven departments, which are “responsible for their research and also manage their own human resources and have their own secretariat” (SER page 5). The research constitutes the backbone of the Faculty; the education is a transversal activity, managed by Educational Committees, chaired by a Programme director, who relies on the human resources and equipment provided by the departments.

The general policy of the FES is to “*bring the intellectual and human capital of each individual student to a higher level by offering him/her a research-based education in scientific and engineering fundamentals*” (SER page 3). The research-based orientation of the education is clearly put forward, with a bottom-up approach for the design of the

¹ Source : KU Leuven’s [data](#).

programmes. This approach which is based on the competences of the research teams may cause difficulties for the training in the non-scientific and transversal matters.

On top of this strong emphasis on research, the Faculty of Engineering Science (backed by KU Leuven) distinguishes itself by a strong involvement in Education Science and in Quality Assurance:

- Great attention is paid to the study efficiency, with many noticeable initiatives: follow-up of the students' trajectories, staff (6 to 7 persons) dedicated to the individual support of the Bachelor's students, PS&D approach (Problem-solving and Design) pedagogical training of the newly recruited teachers, Educational Committees involving teachers and students, etc.
- The Faculty, either on its own initiative or applying the national orientations driven by the VLIR/NVAO agencies, has set a remarkable framework for the learning outcomes expected from the graduates. The ACQA framework defines the academic competences as well as the methodology to evaluate the curricula. The competences description is fully coherent with the Dublin descriptors for the three-cycles of the Bologna process, and to a very large extent with the competences included in the CTI and EUR-ACE frameworks. The mapping of the competences on the learning units and on the pedagogical methods has been done for every programme. However, the articulation of this outcome orientation with the content-based approach described above is not achieved; the arbitration is unbalanced between the scientific competences driven by research needs and resources and the so-called "soft skills".
- The Self-evaluation Report reflects a clear Culture of Quality Assurance: it contains the strategic objectives, a SWOT analysis of the whole institution and of every programme, the references to intern surveys (KONDOR) and action plans.

Global analysis

Strengths

- KU Leuven is a top research-driven university, which provides a high-level scientific environment (both staff and equipment) for the engineering studies
- With the support of the university, the Faculty has a well-defined training policy centred on the students' competences, with noteworthy initiatives, such as the ACQA framework for the learning outcomes or the Problem-solving and Design approach.
- The bottom-up, research driven design of the programmes leads to high level scientific competences of the graduates
- The global structure of the engineering education seems coherent with the Bachelor's degree providing a strong common basis to all students and a Major/Minor system preparing for the Master's programmes during the end stage of the Bachelor's degree.
- The Self-evaluation Report and the documentation provided for the visitation demonstrate a good culture of Quality Assurance in Education.

Weaknesses

- The Faculty, relying strongly on the research departments, lacks a global view and a proper management of the non-scientific outcomes.
- The noticeable autonomy of the programmes' management teams leads to a variable implementation of the Faculty policy (e.g. the Industrial Advisory Boards which is a priority action)
- There seems to be some reluctance to involve all stakeholders (society, alumni, employers) in the formal supervision of the programmes contents and achievements.
- The very high demand of engineers in Flanders does not motivate the staff to invest deeply in the employability of the graduates (such as graduate follow-up, internship policy, systematic exposure of students to a non-academic work environment).

- The Faculty does not fully take advantage of its geographical position and international reputation for the outbound mobility of its students and the attraction of the best foreign students.

Risks and opportunities

- The legal framework regulating the use of languages in higher education in Flanders is a limiting factor for the international development of the Faculty.
- The staff's involvement to prepare the international accreditation deserves to be mentioned; efforts have to be made to keep it durable to take full profit of these efforts on the long term.

Evaluation synthesis per programme

Bachelors of Engineering

The Bachelor's degree has no professional orientation, but is a step towards the Master's curriculum; as such the Bachelor's programme is not eligible to the EUR-ACE label. These 2 programmes constitute de facto a 5-year integrated curriculum.

Bachelor en sciences de l'ingénieur : architecture - Bachelor of Science in de ingenieurwetenschappen: architectuur (VL) - Bachelor of Science in Engineering: Architecture (EN)

180 ECTS credits, taught in Dutch, 315 students (2013)

The aim of the programme is to deliver graduates with an engineering approach to architecture. The growing technical complexity of architecture requires an in-depth knowledge of basic sciences and the application of this knowledge in building technology, without neglecting humanities (history and theory of architecture) and creative skills in design. Students should therefore become familiar with three areas, all three rooted in up-to-date research: (1) a profound knowledge of technical aspects of architecture; (2) insight into theory and history of architecture and urbanism; (3) a design approach that combines an analytical attitude and creative steps, integrating technical aspects as well as knowledge of architecture (SER, page 51).²

To allow for the tight integration of design throughout the programme, the Bachelor of Engineering: Architecture is structured in a way that is fundamentally different from the other engineering programmes. Architectural design plays an important integrating role in each of the six semesters. Specific to our programme compared to other programmes of architecture is the focus on science and technology (SER, page 73).

Analysis (specific to the department):

- *The programme is broad, well rooted in basic sciences and progressively opening to all aspects of building along the curriculum, it globally corresponds roughly to equivalent programmes in other countries.*
- *The design studios which constitute an important part of the curriculum are run by practitioners who are part-time staff members. They have a limited amount of interaction with the full-time research-oriented academic staff.*
- *The department has many relations with its stakeholders, but they lack a more formal basis; in particular the Industrial Advisory Board can be activated more and the network with alumni is not systematic.*

² Here and in the following, the short descriptions of the programme are generally extracted from the Self-evaluation report

- *The issues of high workload and of low students' success, that may be connected, should be fully analysed and taken care of.*
- *The low intake of students should be addressed by the department with actions to promote the curriculum to students in the secondary education.*
- *The outgoing international mobility needs to be promoted.*
- *As well as the exposure to a non-academic work environment.*

Bachelor en sciences de l'ingénieur – Bachelor of Science in de ingenieurwetenschappen (VL) - Bachelor of Science in Engineering (EN)

180 ECTS credits, taught in Dutch, 1262 students (2013)

The Bachelor of Engineering programme aims to deliver engineers, who are well grounded in the basics of mathematics, sciences and technology, and are trained in a multidisciplinary curriculum. This three-year programme provides the students with the primary knowledge, skills and attitudes of an academic engineer. The programme contains substantial theoretical knowledge, which is positively evaluated by 91% of the students.

The multidisciplinary character is achieved through a combination of a Major and Minor in two different disciplines, after being introduced to all the options during the first three general semesters. (...). During the Bachelor's programme, students acquire basic skills that are developed further in the Master's programme, such as analytical, practical and creative skills. They also get an introduction to the principles of business and management, and a selection of topics from the humanities, as expressed by strategic objective S2.

It is the Faculty of Engineering Science's belief that the Bachelor of Engineering can only realise its full promise and potential when combined with a subsequent Master of Science in Engineering degree. A specialisation in a specific engineering discipline is obtained in the Master's studies; knowledge, skills and attitudes are deepened with emphasis on research, development and innovation. For this reason, the Bachelor's programme is designed as part of a complete curriculum of 10 semesters (SER page 59).

Analysis (specific to the programme):

- *The Bachelor's programme is intended to provide a broad and high level in the basic sciences, with a Major/Minor system which allows to prepare them to their future Master's programme*
- *Pedagogical methods are designed to enhance students and develop innovation skills*
- *The Faculty provides tutorial services and student guidance, in particular to cope with the important drop out during the first year.*
- *The share left for non-scientific courses is weak, as optional courses left to the students' choice. This part of the learning outcomes is then less managed than the scientific one.*
- *Although the programme seems too self-centred (few students and lecturers' exchanges with other programmes), there is a shared culture of continuous improvement and of student care.*

Masters of Engineering

Master en sciences de l'ingénieur : architecture - Master of Science in de ingenieurwetenschappen: architectuur (VL) - Master of Science in Engineering: Architecture (EN)

120 ECTS credits, taught in Dutch and English, 219 students (2013)

The aim of the programme is to deliver graduates with an engineering approach to architecture. The growing technical complexity of architecture requires an in-depth knowledge of basic sciences and the application of this knowledge in building technology, without neglecting humanities (history and theory of architecture) and creative skills in design. Students should therefore become familiar with three areas, all three rooted in up-to-date research:

- (1) a profound knowledge of technical aspects of architecture;
- (2) insight into theory and history of architecture and urbanism;
- (3) a design approach that combines an analytical attitude and creative steps, integrating technical aspects as well as knowledge of architecture.

Master en sciences de l'ingénieur en génie civil - Master of Science in de ingenieurwetenschappen: bouwkunde (VL) - Master of Science in Civil Engineering (EN)

120 ECTS credits, taught in Dutch and English, 110 students (2013)

The Master of Civil Engineering aims at training engineers with a broad knowledge on the many themes related to the built environment, and with specialised knowledge in either civil construction and hydraulic engineering or in building physics and services. The 'Civil Construction and Hydraulic Engineering' option focusses on larger infrastructure for transport (roads, bridges, tunnels, waterways, ...) and on infrastructure and system knowledge for water management in urban, non-urban and coastal areas. The 'Building Science and Services' option aims specifically at building physics and services with respect to the durability and sustainability of buildings and the comfort (thermal comfort, acoustics, ...) and health (air quality, fire safety, ...) of occupants (SER, page 69)

Analysis (specific to the programme):

- *The programme should be more proactive in organizing more formally its relations with its stakeholders (e.g. IAB)*
- *The panel pointed out that the two existing options have to undergo significant changes in order to offer up to date knowledge expected from the graduates in the labour market.*
- *A more varied offer of elective courses should be made available to the students.*
- *The internship should be promoted as well as the international mobility.*

Master en sciences de l'ingénieur en génie électrique - Master of Science in de ingenieurwetenschappen: elektrotechniek (VL) - Master of Science in Electrical Engineering (EN)

120 ECTS credits, taught in Dutch and English, 149 students (2013)

The programme aims at forming engineers who can design (based on fairly generally formulated needs) complex electronic circuits and systems and advanced algorithms for signal and data processing in information and telecommunication systems.

In this problem-solving process, the graduate takes into account technological constraints and constraints inherent to the industrial environment, both in terms of hardware and software.

Depending on the chosen option, the graduate has an in-depth knowledge of one of the following areas: electronics and integrated circuits (with emphasis on designing electronic components and systems) or embedded systems and multimedia (with emphasis on designing applications of electronic systems). In the option 'Electronics and Integrated Circuits' (EIC), the graduate has learned to design integrated analogue, digital and high frequency circuits as well as building blocks and platforms for different applications and with

the necessary knowledge of sensors, antennas and the underlying semiconductor technology. In the option 'Embedded Systems and Multimedia' (ESM), the graduate has learned to develop and evaluate applications in telecommunications, cryptography, and in audio, image and signal processing in the light of an optimal implementation (hardware / software) (SER, page 85).

Analysis (specific to the programme):

- *The scientific programme with mandatory courses ensure the acquisition of scientific and technical skills*
- *The core courses, option courses and option specific courses are greatly connected to high level research works from the six teams of the KU Leuven electrical department*
- *The English-speaking programme supports the internationalisation policy and improves the attractiveness, the rate of international student must be positively noted.*
- *Efforts are still needed to open the programme to its stakeholders and to society; the Industrial Advisor Board is almost composed of alumni.*
- *The context and soft skills are not fully considered; they are mainly offered as option or elective courses.*

Master en sciences de l'ingénieur en nanoscience, nanotechnologie et en nanogénie - Master of Science in de nanowetenschappen, nanotechnologie en nano-engineering (VL) - Master of Science in Nanoscience, Nanotechnology and Nanoengineering (EN)

120 ECTS credits, taught in Dutch and English, 160 students including the Erasmus Mundus Master (2013)

The general objective of this science, technology and engineering oriented educational programme is to provide students with the fundamental knowledge and necessary practical skills and attitudes necessary for their role as academically formed professionals in nanoscience, nanotechnology and nano-engineering, and this in a strong international context. The graduates will also be part of the important and challenging task of transforming today's nanoscience into tomorrow's nanotechnology. They will have to combine ground breaking findings within physics, chemistry, biology, biotechnology, electronics, and material science and to put them into practice in useful well-engineered products (SER, page 89).

Analysis (specific to the programme):

- *This multidisciplinary programme is well established, offers a good balance between deep fundamental knowledge and broad vision of the topic.*
- *The programme offers various and attractive specializations.*
- *As pointed out by the alumni, there is a lack of opportunities to acquire a real working experience during the studies. The industrial experience and the exposure to industrial issues should be developed.*
- *The low rate of graduates employed in the Nano technological industry should be analysed.*
- *The international programme is quite attractive thanks to the Erasmus Mundus label (at least until 2018), but the local programme should develop outgoing mobility and intercultural activities.*
- *The IAB would help to define the place given to the international and industrial student mobility.*

Master en sciences Erasmus Mundus en nanoscience et nanotechnologie - Erasmus Mundus Master of Science in Nanoscience and Nanotechnology (EN)

120 ECTS credits, taught in English, 160 students including the Master of Nanoscience (2013)

The Erasmus Mundus programme: Nanoscience and nano-technology is a European integrated programme based on a curriculum jointly developed by four leading European universities in the field of nanoscience and nanotechnology. The programme fills the need for an education in this discipline at European level, with a broad multidisciplinary scope which can compete with the highest excellence programmes organised outside Europe, and which attracts both students from outside Europe as well as European students with international scope. The partner universities offering the programme are: KU Leuven (Belgium), which acts as the coordinator, Chalmers Tekniska Högskola, Göteborg (Sweden), Technische Universität Dresden (Germany) and Joseph Fourier Université Grenoble (France).

The Master's programme is awarding a common (joint) degree to graduate students of the programme. The consortium has developed a common set of standards and mechanisms for the application, admission, student selection, individual study programme selection, scoring and score registration, thesis guidelines, examination of the students, etc. These mechanisms, criteria and procedures are transparent to the students and are available at the consortium's website (see <http://www.emm-nano.org>) (SER, page 93).

Analysis (specific to the programme):

- *This multidisciplinary programme is well established, offers a good balance between deep fundamental knowledge and broad vision of the topic.*
- *The programme offers various and attractive specializations, all at a high scientific level thanks to the quality of the partners.*
- *The programme is quite attractive for international students and the consortium has developed strong links.*
- *This Erasmus Mundus Master's degree is recognised until 2018. What will decide the consortium at this time? The tuitions fees for Master's programmes will be more expensive for non-European students and the impact is difficult to anticipate.*
- *As for all Erasmus Mundus programmes, it is difficult to ascertain that all learning objectives are equally shared by all the partners.*
- *The industrial experience during the studies should be developed.*

Master en sciences de l'ingénieur en génie biomédical - Master of Science in de ingenieurwetenschappen: biomedische technologie (VL) - Master of Science in Biomedical Engineering (EN)

120 ECTS credits, taught in Dutch and English, 91 students (2013)

The Master of Science in Biomedical Engineering (BME) was created to respond to the increased technological needs in healthcare. These needs result, among others, from the ageing population, the challenge to provide more and better care with less people and to obtain cost-effectiveness in our healthcare system. Industry, government, hospitals and social insurance companies need of engineers with a specific training in the multidisciplinary domain of biomedical engineering. These engineers are biomedical engineers that can integrate technological knowledge (e.g. in mechanical engineering, electrical engineering and material sciences) with medical knowledge.

The Master's degree BME aims to deliver interdisciplinary-trained biomedical engineers that can act as integrator between medical specialists and technological specialists by understanding the medical needs and by translating them into engineering requirements. Conversely, these biomedical engineers are able to design and produce medical devices and procedures that can effectively solve problems through their integration in clinical practice. Biomedical engineering is not to be understood as a 'light' version of engineering, rather it is state-of-the-art technology used in a medical context (SER, page 97).

This Master's degree has been designed in a cooperative way between Medicine and Engineering, which makes it very relevant.

There is no Major and Minor at the Bachelor's level at KU Leuven leading to this programme, which makes it difficult to attract KU Leuven's students, and could be an opportunity.

The process to recruit international students should be improved with interviews to ensure the level of the students recruited

Grants should be allocated by companies or institutions because this programme is clearly fitting tomorrow's engineers and because some other European countries also have this kind of programme and could defeat this one.

The Faculty should keep the information about the alumni.

Analysis (specific to the programme):

- *The programme offers a good balance between engineering skills and medical knowledge; which is attractive for students.*
- *The programme provides skills strongly needed in developing countries; although some waivers for tuition fees and grants from a special fund are available for the students from these countries, the cost of the studies and of life remains a limiting factor.*
- *In the same time, the quality control for the international recruitment must be improved (possibly by a pooling with the other departments).*
- *The link with the KU Leuven Bachelor of Engineering should be improved (no Minor/Major leading to this Master).*
- *The follow up of the graduate's employment should be organized (for example, there is no tracks of the alumni getting to industry after obtaining the Master's degree).*

Master en sciences de l'ingénieur en génie énergétique - Master of Science in de ingenieurwetenschappen: energie (VL) - Master of Science in Engineering: Energy (EN)

120 ECTS credits, taught in Dutch and English, 117 students including the EIT-KIC Master (2013)

The Master of Engineering: Energy (and its Dutch variant) is organised by the Faculty of Engineering Science of KU Leuven, with the collaboration of the departments of Mechanical and Electrical Engineering. The programme aims at educating engineering students in the field of energy technology, covering a broad range of topics in electrical, mechanical, and other engineering disciplines. The programme combines an in-depth approach to the different fields with an integrative systems approach to energy engineering. It also takes into account environmental consequences, and economic and regulatory aspects. The Master in Energy programme is therefore highly multidisciplinary, with outflow possibilities to research & development, policy & management and various branches of industry (SER, page 105).

Analysis (specific to the programme):

- *Broad multidisciplinary programme based on the Mechanical and Electrical departments.*
- *Environmental issues are taken into account.*
- *There exists a preparatory programme for the Bachelor's students coming from other universities, however only taught in Dutch; international students must follow self-study programme, which is not very attractive for them.*
- *The share of the "soft skills" in the curriculum is low (7%) which does not draw remarks from the IAB*
- *As pointed out by the alumni, there is a lack of opportunities to acquire a real working experience during the Master's programme.*

- *The IAB strongly emphasizes the importance of international experience and mobility. In this context, they promote the shift of the classical industrial internship to an international internship.*
- *The relevance of the programme to industrial and societal needs is high*

Master en sciences EIT-KIC : énergie - EIT-KIC Master of Science in Energy (EN)

120 ECTS credits, taught in English, 160 students including the Master of Eng. Energy (2013)

The Master in Energy for Smart Cities programme addresses internationally-oriented and entrepreneurial engineering students who wish to implement modern energy technologies for end-users of the electrical value chain: citizens, companies and cities. Graduates of this custom-developed programme will be truly multi-disciplinary smart city experts: well qualified to work in industry or research, or to take on policy-making roles in energy issues related to secure, sustainable urban living and working.

The Master in Energy for Smart Cities programme balances exciting technological opportunities in energy with environmental and socio-economic aspects of smart cities, such as energy efficiency in buildings, electric transportation, energy economics, smart lighting and other city services. Students receive a broad education in electrical and mechanical energy systems, allowing them to participate fully in the design and operation of advanced energy solutions. They will also learn how to construct and employ contemporary energy conversion technologies and secure energy supply in general, while taking into account overriding technical limitations, environmental consequences and economic considerations (SER, page 109).

Analysis (specific to the programme):

- *The programme is internationally and entrepreneurially oriented, with close relationship with industry in joint activities and project-based courses.*
- *This programme is unique in Belgium and plays a pioneering role in Europe. It will benefit from the creation of the New Energy Research Centre "EnergyVille".*
- *The partnerships with European universities (France, Spain, Sweden) offer to the students the possibility to obtain a double degree.*
- *However, the number of students is low, with a significant rate of dropouts. Such a potentially attractive Master's degree deserves more promotion in Belgium and abroad.*
- *A preparatory programme is available, but only taught in Dutch. International students must follow a self-study programme, which is not very attractive for them.*
- *It opens up to various career opportunities*
- *Most students have an industry contract before they officially get their degree*

Master en sciences de l'ingénieur en génie mécanique - Master of Science in de ingenieurswetenschappen: werktuigkunde (VL) - Master of Science in Mechanical Engineering (EN)

120 ECTS credits, taught in Dutch and English, 268 students (2013)

The Master of Mechanical Engineering is a general training programme integrating all disciplines of basic sciences, engineering and technology. An essential element of the mechanical engineering curriculum at KU Leuven is the direct training of each student in a real-life industrial or research setting (..) There are three generic options:

- Manufacturing and Management: modern techniques for the design and production of discrete components, CAD and computer integration in production, management techniques, maintenance and logistics of a production company
- Mechatronics and Robotics: synergy of construction, sensing, actuation and control of machinery are concurrently defined and tuned for optimum integration;
- Thermo-technical Sciences: physical principles and analysis, design, construction and operation of combustion engines and thermal and flow machines, cooling machines, power plants, etc.

and two application oriented options: Aerospace technology and Vehicle technology (SER, page 113)

Analysis (specific to the programme):

- *The programme provides the students with an excellent scientific and innovation environment, a broad and dynamic networking with industry, an easy entry to the job market for graduates.*
- *It attracts many students which makes complex the foreign students' selection.*
- *The programme strongly relies on the research contracts of the department to maintain quantitatively and qualitatively – in terms of topics that need to be covered - the teaching assistants' workforce available for teaching, and to meet the challenges of heterogeneity and diversity of the student body.*
- *The setting up of an IAB would allow a more formal regular consultation procedure with industry and with alumni. It would help the programme management to define the appropriate level of students' exposure to non-academic work environment and of the balance between practical and theoretical skills.*
- *The programme should better define its policy for the outgoing international mobility and the recruitment of foreign students*

Master en sciences de l'ingénieur : trafic, logistique et systèmes de transport intelligents - Master of Science in ingenieurswetenschappen: verkeer, logistiek en intelligente transportsystemen (VL) - Master of Science in Engineering: Traffic, Logistics and Intelligent Transportation Systems (EN)

120 ECTS credits, taught in Dutch and English, 25 students (2013)

The Master of Engineering: Traffic, Logistics and Intelligent Transportation Systems, is a relatively new Master and admitted students for the first time in the academic year 2011-2012. The programme was created to meet a societal need, i.e., the demand for engineers can solve interrelated problems in the area of traffic, mobility and logistics (...).

Since the societal support for new transportation infrastructure is nearly non-existing we need especially a smart and efficient exploitation of its using e.g. proper management techniques, technical skills, and intelligent transportations systems. In this way the programme is unique in Belgium (SER page 117).

Analysis (specific to the programme):

- *The strongest assets of this programme are high scientific quality, broad contents, dynamic and committed teaching staff and management team, and a demand for the graduates' profile.*
- *However, one may regret its lack of visibility and the small intake of students.*
- *A more formal organization of the stakeholders' consultation (particularly with the creation of an IAB) would help the management to positioning this programme in the broader European context on the basis of a benchmark of similar programmes*

- *A structured action plan should be set up with objectives as the total target number of incoming students and the distribution of their backgrounds, in relation with the potentially available human resources*
- *The IAB would help the management to define the appropriate balance between scientific and non-scientific skills and the place given to the international and/or industrial student mobility.*

Master en sciences de l'ingénieur en génie informatique - Master of Science in de ingenieurwetenschappen: computerwetenschappen (VL) - Master of Science in Engineering: Computer Science (EN)

120 ECTS credits, taught in Dutch and English, 208 students (2013)

The programme forms engineers specialised in the field of computer science. Within the programme, central key aspects are the acquisition of expert knowledge in one or more sub disciplines of computer science, a scientific approach towards modelling the real world, problem-solving and design, and the development of various intellectual skills (law, economy, privacy, ...) that relate to the specific role of software engineers in society. The main objective of the programme is to teach students how to specify, design, implement, test and maintain advanced software systems. Also, it teaches how to handle complexity and how to deal with various requirements such as functionality, reliability, user friendliness, security, efficiency and cost; all Major aspects in today's software design (SER, page 125).

Analysis (specific to the programme):

- *Well-balanced programme which offers to the students after a broad scientific culture, six specializations linked to the active research areas of the department*
- *The programme is part of the few one in FES which have not yet set an Industrial Advisory Board; the networking with the alumni has to be set on a systematic basis.*
- *The above features seem to confirm some reluctance of the programme management to improve the students' exposure to non-academic work environment*

Master en sciences de l'ingénieur en génie mathématique - Master of Science in de ingenieurwetenschappen: wiskundige ingenieurstechnieken (VL) - Master of Science in Mathematical Engineering (EN)

120 ECTS credits, taught in Dutch and English, 35 students (2013)

The programme of Mathematical Engineering was created in 2007 as an 'interdepartmental programme' by the departments of Computer Science and Electrical Engineering (ESAT), and the English-language programme is organised since 2014. The aim of the programme is to bring together advanced mathematical engineering topics based on research by the two departments. The goal is to prepare students for a multidisciplinary context, i.e., the design of solutions of technical problems in a multidisciplinary environment, where mathematics plays an important role. In particular, the focus lies on technical skills in the context of process control, numerical simulation, data mining, cryptography, and visualization.

The emphasis is not on mathematical theory but the design, analysis, implementation and use of mathematical models and algorithms in order to solve mathematical problems from industry (SER, page 129)

Analysis (specific to the programme):

- *The strong assets of this programme are high scientific quality, engineering background of the recruited students, a dynamic and concerned programme management and an efficient IAB and a demand for the graduates' profile.*
- *In a domain which is on the borderline of the classical "engineering" studies, the programme management makes significant efforts to define an outcome profile for the graduates in better fit with the professional expectations.*
- *The programme provides appreciated graduates for several niches in the job market which are not fulfilled neither by pure mathematicians nor computer scientists.*
- *The students' intake remains below the targeted 25 owing to the lack of the visibility of the domain for potential candidates. However, the capacity of growth is limited by the reliance of the programme on the human resources of different departments.*
- *Many efforts remain to be done to increase the job relevance of the curriculum, to increase the students' awareness of the needs and contexts of their future professional life.*
- *Finally, in reference with the international standards, it will remain difficult (but not impossible) for this programme to cover all the graduates' attributes expected for engineers (in particular the "engineering practice").*

Master en sciences de l'ingénieur en génie chimique - Master of Science in de ingenieurwetenschappen: chemische technologie (VL) - Master of Science in Chemical Engineering (EN)

120 ECTS credits, taught in Dutch and English, 117 students (2013)

The Master of Chemical Engineering programme aims at applying chemical engineering principles to develop products and to design, control and improve industrial processes, taking into account environmental, safety and economical aspects. With a focus on process, product and planet engineering, the programme guarantees a solid classical chemical engineering background.

In addition, it focuses on modern aspects of chemical engineering such as process and product intensification, energy efficient and sustainable processing routes, biochemical processes and product-based thinking. The programme has been optimized in close contact with the industrial stakeholders, represented by the Industrial Advisory Board of the Department of Chemical Engineering. The Department was the first of the Faculty of Engineering Science in establishing such an Advisory Board (founded in 2004) (SER, page 133).

Analysis (specific to the programme):

- *Programme designed to respond to the strong and evolving needs of the Belgium Chemical Industry*
- *The department has set for long an IAB and organizes initiatives to establish links of the teachers and the students with the industry.*
- *The choice, fully endorsed by the IAB, is to focus more on a core curriculum than on options.*
- *It is attractive for students, although the recruitment of foreign students could be improved in quantity and in quality (selection process)*
- *The links with the alumni should be organized on a more formal basis.*

Master en sciences de l'ingénieur en génie des matériaux - Master of Science in de ingenieurwetenschappen: materiaalkunde (VL) - Master of Science in Materials Engineering (EN)

120 ECTS credits, taught in Dutch and English, 80 students (2013)

The programme aims at educating engineers who will be able to design new materials and/or processes to manufacture them, and who can make sustainable choices in materials selection problems, both in industrial and academic environment. These capabilities will be based on a thorough understanding and sovereign use of the relationships between the internal structure (crystal structure, microstructure, architecture...) of materials and their properties (mechanical, electrical, chemical...), and the processes that shape them (the 'materials triangle'). Materials Science is an interdisciplinary subject at the crossroads of Physics, Chemistry, Mechanics and Thermodynamics.

As an academic programme, the Master of Materials Engineering focuses on teaching the knowledgeable application of generic principles to a broad gamut of materials challenges rather than on transferring encyclopaedic knowledge on specific material families. The economic and societal context is considered both in engineering and in general interest courses. Scarcity, sustainable materials management in closed materials loops ('cradle to cradle'), life cycle analysis and recycling processes are broadly covered in both research and teaching (SER, page 137).

Analysis (specific to the programme):

- *The programme has been revised recently with the wide involvement of teachers, students and of the IAB*
- *There are international mobility opportunities offered to the students with high level European universities*
- *More attention should be put on the soft skills and on the internship organization*
- *The number of students is relatively low and may weaken the programme future.*

Advanced Masters (“Master na Master”)

These Masters-after-a-Master offer specializations in engineering education, generally to the Master's degree holders. However, they are open to holders of Master's degree other than engineering Master's degree and to holders of (foreign) Bachelor's degrees. Therefore, at the end of these programmes, the competences in engineering (ACQA, CTI reference framework, EUR-ACE standards) of all graduates are difficult to ascertain.

Master avancé en sciences en urbanisme et aménagement humain – Advanced Master of Science in Human Settlements (EN)

60 ECTS credits, taught in English, 30 students (2013)

The Master of Science in Human Settlements (MaHS) addresses rapid urbanization in the developing world and contemporary urban transformations within the scope of sustainable development. This intensive, one-year programme focuses on issues of housing, building and urban transformation in a context of development with scarce resources and pressing social and environmental constraints. Architecture, urbanism and spatial planning are the core disciplines of the programme.

Indeed, the discipline of Human Settlements emerged from concerns about the built environment in relation to the global urban development agenda of the UN formulated at the first Habitat Conference (Vancouver 1976). The programme aims to provide insight into the problems of Human Settlements as related to rapid change and to the interaction between modernity and tradition, formal and informal city-making. It also aims to strengthen capacities to tackle the growth of spontaneous settlements, the design of large scale housing projects, the development of appropriate building materials and techniques, the systematic approach to complex programmes (e.g. hospitals, schools) and the planning of neighbourhoods, villages, towns with up-to-date techniques. Its graduates have a thorough understanding of the dynamic and multi-functional aspects of the built environment, they have the skills to devise interventions that are context-responsive and sustainable and are at ease in moving

back-and-forth between academic theory and day-to-day professional practice (SER page 77).

Analysis (specific to the programme):

- *This programme is well established, relevant, has a strong research rooting, adequate international partnerships and an excellent reputation.*
- *The actions planned are qualitatively adequate but not fully structured in an action plan with clearly defined and measurable objectives. For instance: profiling again the website is only one of series of well-connected actions required to reinforce the marketing culture of the staff. The targeted number of incoming students is not defined, etc.*
- *The programme should reinforce its governance, define a combined strategy and assess the resources needed to deploy it.*
- *The long-term sustainability of the programme would need more support from the University; as well as extra funding at all levels, including the governmental.*

**Master avancé en sciences en urbanisme et planification stratégique -
Advanced Master of Science in Urbanism and Strategic Planning (EN)**

120 ECTS credits, taught in English, 33 students (2013)

The Master of Science in Urbanism and Strategic Planning (MaUSP) is a four-semester academic programme, developing a critical understanding of contemporary conditions and challenges of both cities and urbanizing regions. It aims to cultivate innovative concepts and strategies for high-quality interventions in urban territories through design, planning, and policy-formulation. The MaUSP programme is part of the European Postgraduate Masters in Urbanism (EMU), and students can apply to attend one or two semesters abroad at one of the partner universities - UPC Barcelona, TU Delft, or IUAV Venezia - to obtain the additional degree.

The aim of the MaUSP programme is to deliver graduates who are able to work in a critical and independent way in the disciplines of urbanism and spatial planning. They are knowledgeable about urban developments in an array of different contexts, in Europe and in the world, and can address urban problems on different scale levels. They are familiar with design methods based upon thorough analysis of spatial phenomena, taking into account social forces and societal challenges. They are capable of intervening by way of strategic projects that are politically and economically feasible and that have structuring effects beyond their immediate impact.

Graduates are recognized in Flanders as urban planners, if they comply with certain rules pertaining to their choice of design studios and courses, thus being eligible for certain positions as public servants. The Master of Human Settlements (MaHS) and the Master of Urbanism and Strategic Planning (MaUSP) overlap and complement each other – mandatory courses and studios in one programme constitute elective courses and studios in the other. Hence graduates of MaHS (a one-year programme) can, under certain conditions, be admitted into the second year of MaUSP (SER page 81)

Analysis (specific to the programme):

- *This relatively new programme is well established, relevant, has a strong research rooting, adequate international partnerships and an excellent reputation.*
- *The actions planned are qualitatively adequate and some of them are described in a concrete, although not quantified, manner: e.g. more regular meetings of the EC, LinkedIn alumni group follow-up, more collaboration with other Masters. However, these actions are not fully structured in an action plan with clearly defined and measurable objectives.*

- *The programme should reinforce its governance, define a combined strategy in liaison with its stakeholders – teaching staff, students, other Master's degree holders, alumni, employers, international partners - and assess the resources needed to deploy it in a structured action plan.*
- *The long-term sustainability of the programme would need more support from the University; as well as extra funding at all levels, including the governmental.*

Master avancé en sciences en conservation des monuments et des sites – Advanced Master of Science in Conservation of Monuments and Sites (EN)

90 ECTS credits, taught in English, 61 students (2013)

The Advanced Master's programme of Conservation in Monuments and Sites aims at educating young professionals in the conservation and restoration of immovable heritage (buildings, structures and sites), both into the tradition of the discipline and into new scientific methods. At the end of the programme, the participants will have acquired and developed sufficient knowledge in all basic fields of conservation and restoration; acquired specialised knowledge in those conservation and restoration subjects which are closest to the student's own (first) discipline; acquired the necessary common language needed for interdisciplinary communication in a restoration team or heritage management project, so as to advance professional practice and/or scientific research in the heritage preservation field.

The new programme of the Master in Conservation of Monuments and Sites started at the University of Leuven, Faculty of Engineering Science in the academic year 2014-2015. It is a revised programme of the famous Raymond Lemaire International Centre for Conservation Conservation (RLICC) as a response to the self-evaluation process and to the advices given by the last visitation commission in 2011. When maintaining the international and interdisciplinary character of its Advanced Master's programme, the new programme aims at strengthening its major assets (SER page 101).

Analysis (specific to the programme):

- *This new programme is already well established, relevant, has a strong research rooting, extended partnerships with international organisations and foreign universities, an efficient alumni network and an excellent reputation as a continuation of the previous programme. It is truly interdisciplinary and internationalised.*
- *With its strong assets, the main threat seems to be the limitation of resources.*
- *The actions planned are qualitatively adequate and some of them are described in a concrete, although not quantified, manner.*
- *These actions point out to a possible strategic approach. However, they are not fully structured in a prioritised action plan with clearly defined and measurable objectives.*
- *The programme should reinforce its governance, define a complete and combined strategy in liaison with its stakeholders – teaching staff, students, other Masters, alumni, employers, international organisations and academic partners - and assess the resources needed to deploy it in a structured action plan.*
- *The long-term sustainability of the programme would need more support from the University; as well as extra funding at all levels, including the governmental.*

Master avancé en sciences de l'ingénieur en génie nucléaire – Advanced Master of Science in Nuclear Engineering (EN)

60 ECTS credits, taught in English, 9 students (2013)

The interuniversity BNEN programme is the outcome of a (...) interuniversity collaboration in a highly specific scientific & technological area and in a Belgian context. The programme Master in Nuclear Engineering is organised by a consortium of six universities and one

national research centre, in alphabetical order, Katholieke Universiteit Leuven (KU Leuven), Université Catholique de Louvain (UCL), Université de Liège (ULg), Université Libre de Bruxelles (ULB), Universiteit Gent (UGent) and Vrije Universiteit Brussel (VUB), as universities, and the Studiecentrum voor Kernenergie – Centre d'étude de l'Energie Nucléaire (SCK•CEN), as nuclear research centre. This consortium was established in 2002 under the name Belgian Nuclear Higher Education Network (BNEN), originally with five partners as the ULB joined only in 2006.

The primary objective of the BNEN programme remains to educate young engineers in nuclear engineering and its applications and to develop and maintain high-level nuclear competences in Belgium and abroad. To be admitted to this programme, students must already hold a university degree in engineering (5-year Master) or equivalent. For students not fulfilling this requirement, special entrance considerations apply based on the specific background of each candidate. (...The programme) relies on knowledge, skills and competences in the domains of mathematics, fluid mechanics, thermodynamics, heat transfer, general physics, chemistry and electromagnetism that were acquired in students' initial Master's programme in engineering. But clearly, the tools, knowledge and competencies acquired in previous studies are further intensively developed in the nuclear-related lectures, exercises, laboratory sessions and Master's thesis comprising the BNEN programme, as such defining the discipline-specific competences. (SER page 121).

Analysis (specific to the programme):

- *A high academic quality programme with experts from various origins (industry, research labs)*
- *A major threat to the nuclear academic programme is the changing attitude towards nuclear electricity generation by the authorities, nationally and internationally, leading to a fluctuating inflow of new students, which may lead to less involvement/engagement by the 6 university faculties.*
- *The need for a very complicate organization with many partners is questionable, considering the low number of students*

Master avancé en sciences de l'ingénieur en génie de la sûreté – Advanced Master of Science in Safety Engineering (EN)

60 ECTS credits, taught in English, 36 students (2013)

Our modern society is being confronted with safety-related problems in many different areas, such as traffic and transport, logistics, consumer products, work place and environment. At the European level there are a growing number of rules and regulations with respect to health and safety issues. Also for industry it is becoming increasingly difficult and more complex to correctly manage industrial processes due to the different aspects of safety, quality, reliability, efficiency, technical and regulatory constraints that need to be considered. The Master of Safety Engineering meets this existing need and growing demand for safety experts coming from society and from industry. To this end, the programme offers a university-level education that gives the participants a broad overview and a scientifically based understanding of professional expertise in the many and different domains of safety specialisation. Attention is paid to the development and acquisition of competences that are of importance to safety: from the identification, analysis and evaluation of hazards and risks associated with products and processes, to the implementation of safety systems in an industrial context where people-related, organisational and management aspects also need to be considered. The graduates are thus well prepared to function professionally as safety officer in a work environment that is most often technical-industrial in nature (SER, page 141).

Analysis (specific to the programme):

- *Attractive programme which fills an employment niche, but needs to be more promoted to attract more students and to be more selective.*
- *The experts noted the involvement of the stakeholders in the design of the programme and the contributions of external lecturers from industry.*
- *The role of “human behaviour” as well as more real-life and hands-on exercises in safety matters should be developed in the curriculum, in particular with the support of external guest speakers.*
- *The follow-up of alumni should be improved to get a better feed-back on the careers opportunities and to improve the programme.*
- *The follow-up of alumni should be improved to get a better feed-back on the carriers’ opportunities and to improve the programme.*
- *The diversity of the incoming students’ profile does not insure that every graduate has acquired the outcomes expected from an engineer (CTI and EUR-ACE outcomes)*

En conséquence,

Premièrement, la Commission des titres d’ingénieur **émet un avis favorable à l’admission par l’Etat pour une durée maximale de 6 ans** à compter du 1er septembre 2016 des 10 diplômes suivants délivrés par la Faculté des sciences de l’ingénieur de l’Université KU Leuven (Belgique) :

- **Master en sciences de l’ingénieur : architecture** - *Master of Science in de ingenieurwetenschappen: architectuur (VL) - Master of Science in Engineering: Architecture (EN)*
- **Master en sciences de l’ingénieur en génie civil** - *Master of Science in de ingenieurwetenschappen: bouwkunde (VL) - Master of Science in Civil Engineering (EN)*
- **Master en sciences de l’ingénieur en génie électrique** - *Master of Science in de ingenieurwetenschappen: elektrotechniek (VL) - Master of Science in Electrical Engineering (EN)*
- **Master en sciences de l’ingénieur en nanoscience, nanotechnologie et en nanogénie** - *Master of Science in de nanowetenschappen, nanotechnologie en nano-engineering (VL) - Master of Science in Nanoscience, Nanotechnology and Nanoengineering (EN)*
- **Master en sciences de l’ingénieur en génie biomédical** - *Master of Science in de ingenieurwetenschappen: biomedische technologie (VL) - Master of Science in Biomedical Engineering (EN)*
- **Master en sciences de l’ingénieur en génie énergétique** - *Master of Science in de ingenieurwetenschappen: energie (VL) - Master of Science in Engineering: Energy (EN)*
- **Master en sciences de l’ingénieur en génie mécanique** - *Master of Science in de ingenieurwetenschappen: werktuigkunde (VL) - Master of Science in Mechanical Engineering (EN)*

- **Master en sciences de l'ingénieur en génie mathématique** - Master of Science in de ingenieurwetenschappen: wiskundige ingenieurstechnieken (VL) - Master of Science in Mathematical Engineering (EN)
- **Master en sciences de l'ingénieur en génie chimique** - Master of Science in de ingenieurwetenschappen: chemische technologie (VL) - Master of Science in Chemical Engineering (EN)
- **Master en sciences de l'ingénieur en génie des matériaux** - Master of Science in de ingenieurwetenschappen: materiaalkunde (VL) - Master of Science in Materials Engineering (EN)

Cet avis s'accompagne des **recommandations** suivantes :

Pour la Faculté des sciences de l'ingénieur de l'université KU LEUVEN :

- Prendre appui sur le travail déjà réalisé pour préparer l'accréditation pour mettre en place durablement la culture d'assurance qualité au sein de la faculté, avec la participation de toutes les parties prenantes.
- Développer le référentiel des « learning outcomes » non seulement pour décrire les programmes d'études, mais comme un outil pour leur conception et leur amélioration continue.
- Définir et appliquer une politique pour les compétences transférables (soft skills), commune à la Faculté et puis adaptée à chaque programme ; le recrutement des ressources humaines transversales en charge de ce domaine pourrait être envisagée.
- Profiter de la position géographique et la réputation internationale de l'université pour développer une politique ambitieuse pour la mobilité sortante des étudiants et l'attraction des meilleurs étudiants étrangers ; la mise en commun des ressources des départements avec l'aide de l'Université doit être recherchée.
- Renforcer les liens avec les Anciens pour obtenir leurs avis sur les études et pour établir un suivi précis de l'emploi et de la carrière des diplômés.

Les recommandations pour chaque formation sont les suivantes :

Master en sciences de l'ingénieur : architecture - Master of Science in de ingenieurwetenschappen: architectuur (VL) - Master of Science in Engineering: Architecture (EN)

- Développer l'interaction entre les professionnels intervenant dans la formation avec le personnel enseignant à temps-plein plus axé sur la recherche.
- Activer le rôle du Conseil consultatif industriel (Industrial Advisory Board) et les liens avec les Anciens.
- Promouvoir la mobilité internationale et l'exposition des étudiants à un environnement non-académique.

Master en sciences de l'ingénieur en génie civil - Master of Science in de ingenieurwetenschappen: bouwkunde (VL) - Master of Science in Civil Engineering (EN)

- Mettre à jour les programmes des deux options en lien avec les attentes du marché du travail.
- Organiser plus formellement les relations avec les parties prenantes.

Master en sciences de l'ingénieur en génie électrique - Master of Science in de ingenieurwetenschappen: elektrotechniek (VL) - Master of Science in Electrical Engineering (EN)

- Ouvrir davantage le programme aux parties prenantes et à la société.
- Elargir le Conseil consultatif industriel au-delà du cercle des Anciens.

Master en sciences de l'ingénieur en nanoscience, nanotechnologie et en nanogénie - *Master of Science in de nanowetenschappen, nanotechnologie en nano-engineering (VL)* - *Master of Science in Nanoscience, Nanotechnology and Nanoengineering (EN)*

- Analyser l'emploi des diplômés (en particulier dans l'industrie des nanotechnologies).
- Développer les possibilités pour les étudiants d'acquérir des expériences professionnelles et leur exposition à des problèmes industriels.
- Préparer l'organisation des programmes d'études dans le domaine des nanotechnologies à la fin du contrat Erasmus Mundus.

Master en sciences de l'ingénieur en génie biomédical - *Master of Science in de ingenieurswetenschappen: biomedische technologie (VL)* - *Master of Science in Biomedical Engineering (EN)*

- Améliorer le contrôle de la qualité pour le recrutement international.
- Organiser le suivi de l'emploi des diplômés.

Master en sciences de l'ingénieur en génie énergétique - *Master of Science in de ingenieurswetenschappen: energie (VL)* - *Master of Science in Engineering: Energy (EN)*

- Améliorer la préparation des étudiants internationaux en ligne avec ce qui est fait pour les étudiants néerlandophones provenant d'autres universités.
- Développer les possibilités pour les étudiants d'obtenir des expériences industrielles et d'être exposés à des problèmes industriels.

Master en sciences de l'ingénieur en génie mécanique - *Master of Science in de ingenieurswetenschappen: werktuigkunde (VL)* - *Master of Science in Mechanical Engineering (EN)*

- Mettre en place rapidement un comité consultatif industriel pour organiser plus formellement une participation des parties prenantes dans le programme.
- En relation avec les parties prenantes, définir la politique du programme en matière d'exposition à l'environnement de travail non-universitaire et de mobilité internationale (entrante et sortante).
- Améliorer le contrôle de la qualité pour le recrutement international.

Master en sciences de l'ingénieur en génie mathématique - *Master of Science in de ingenieurswetenschappen: wiskundige ingenieurstechnieken (VL)* - *Master of Science in Mathematical Engineering (EN)*

- Travailler à la définition des résultats d'apprentissage pour les diplômés en meilleure adéquation avec les attentes professionnelles.
- Accroître la sensibilisation des élèves aux besoins et au contexte de leur vie professionnelle future.

Master en sciences de l'ingénieur en génie chimique - *Master of Science in de ingenieurswetenschappen: chemische technologie (VL)* - *Master of Science in Chemical Engineering (EN)*

- Améliorer le processus de recrutement international.
- Organiser sur une base plus formelle les liens avec les Anciens.

Master en sciences de l'ingénieur en génie des matériaux - *Master of Science in de ingenieurswetenschappen: materiaalkunde (VL)* - *Master of Science in Materials Engineering (EN)*

- Porter attention à la baisse du nombre d'étudiants.

- Porter attention à l'organisation des « soft skills » dans le curriculum.

L'établissement établira, pour le 15 septembre 2019, **un rapport** sur la prise en compte des recommandations.

Le **label EUR-ACE Master** pourra être **attribué aux 10 diplômes cités ci-dessus**, sur demande de l'établissement, pour la même période.

Deuxièmement, la commission a évalué favorablement la **recevabilité** des diplômes suivants, globalement conformes aux référentiels d'évaluation :

Master en sciences de l'ingénieur : trafic, logistique et systèmes de transport intelligents - *Master of Science in ingenieurswetenschappen: verkeer, logistiek en intelligente transportsystemen (VL)* - *Master of Science in Engineering: Traffic, Logistics and Intelligent Transportation Systems (EN)*
Master en sciences de l'ingénieur en génie informatique - *Master of Science in de ingenieurswetenschappen: computerwetenschappen (VL)* - *Master of Science in Engineering: Computer Science (EN)*

Suite à l'évaluation, la CTI émet les recommandations suivantes pour ces deux formations :

- **Master en sciences de l'ingénieur : trafic, logistique et systèmes de transport intelligents** - *Master of Science in ingenieurswetenschappen: verkeer, logistiek en intelligente transportsystemen (VL)* - *Master of Science in Engineering: Traffic, Logistics and Intelligent Transportation Systems (EN)*
 - Mettre en place rapidement un comité consultatif industriel pour organiser plus formellement une participation des parties prenantes dans le programme.
 - En relation avec les parties prenantes, définir la politique du programme pour l'équilibre entre les compétences scientifiques et non-scientifiques et pour la mobilité internationale (entrante et sortante)
 - Élaborer un plan d'action structuré pour augmenter le nombre des étudiants.
- **Master en sciences de l'ingénieur en génie informatique** - *Master of Science in de ingenieurswetenschappen: computerwetenschappen (VL)* - *Master of Science in Engineering: Computer Science (EN)*
 - Définir rapidement un plan d'action structuré pour l'implication des parties prenantes (y compris un conseil consultatif industriel) dans la définition et la mise en œuvre d'une politique pour l'exposition des étudiants à un environnement de travail non-académique
 - Plus généralement, ouvrir les spécialisations à des thèmes non uniquement liés aux besoins de la recherche.

La demande d'Admission par l'État de ces 2 masters pourra être à nouveau examinée par la CTI dans 3 ans en fonction des évolutions mises en œuvre suite aux recommandations exprimées par la CTI.

Le **label EUR-ACE Master** pourra être **attribué à ces 2 diplômes**, sur demande de l'établissement, pour une période de 6 ans, à compter du 1^{er} septembre 2016.

Troisièmement, la Commission a évalué favorablement la conformité des 2 cursus de « Bachelor de transition » aux référentiels d'évaluation. Ces diplômes ne peuvent faire l'objet ni d'une admission par l'état ni du label EUR-ACE Master.

Suite à l'évaluation, la CTI émet les recommandations suivantes pour ces deux formations :

- **Bachelor en sciences de l'ingénieur : architecture** - *Bachelor of Science in de ingenieurwetenschappen: architectuur (VL) - Bachelor of Science in Engineering: Architecture (EN)*
 - Prendre en compte les problèmes de charge de travail élevée et le faible taux de réussite des étudiants, qui peuvent être connectés.
 - Améliorer le positionnement du programme par rapport aux programmes en architecture, en génie civil, et
 - Définir un plan d'action de promotion dans l'enseignement secondaire pour faire face aux difficultés de recrutement.

- **Bachelor en sciences de l'ingénieur** – *Bachelor of Science in de ingenieurwetenschappen (VL) - Bachelor of Science in Engineering (EN)*
 - Renforcer la part dans l'emploi du temps et l'organisation de la formation pour la partie non-scientifique du programme d'études.
 - Travailler pour rendre moins rigide le système majeur-mineur et l'adapter à l'évolution de l'offre des Masters.

Quatrièmement, la Commission a examiné des masters ne pouvant faire l'objet d'une admission par l'état compte tenu qu'il s'agissait de cursus spécifiques durant une ou deux années. Comme pour les autres masters la Commission a examiné ces masters au regard des référentiels ESG 2009 et EAFSG (EUR-ACE Master).

La Commission des titres d'ingénieur émet un **avis favorable à l'attribution du label EUR-ACE Master, pour une période de 6 ans, à partir du 1^{er} septembre 2016**, des 3 diplômes suivants délivrés par la Faculté des sciences de l'ingénieur de l'Université KU Leuven :

- **Master en sciences Erasmus Mundus en nanoscience et nanotechnologie** - Erasmus Mundus Master of Science in Nanoscience and Nanotechnology (EN)
- **Master en sciences EIT-KIC : énergie** - EIT-KIC Master of Science in Energy (EN)
- **Master avancé en sciences de l'ingénieur en génie nucléaire** – Advanced Master of Science in Nuclear Engineering (EN)

Le label EUR-ACE Master pourra être attribué aux 3 diplômes ci-dessus, sur demande de l'établissement.

Le label EUR-ACE Master n'est pas attribué aux diplômes suivants en raison de leur domaine hors ingénierie ou de leur orientation recherche :

- **Master avancé en sciences en urbanisme et aménagement humain** – Advanced Master of Science in Human Settlements (EN)

- **Master avancé en sciences en urbanisme et planification stratégique** - Advanced Master of Science in Urbanism and Strategic Planning (EN)
- **Master avancé en sciences de l'ingénieur en génie de la sûreté** – Advanced Master of Science in Safety Engineering (EN)
- **Master avancé en sciences en conservation des monuments et des sites** – Advanced Master of Science in Conservation of Monuments and Sites (EN)

Le présent avis sera transmis au Ministère en charge de l'Enseignement supérieur et de la recherche français qui statuera sur les admissions par l'État demandées.

La liste de tous les diplômes français habilités ou étrangers admis par l'État est publiée, chaque année, au Journal Officiel de la République Française. Ces diplômes feront donc partie le cas échéant de cette liste, pour les années indiquées.

Les titulaires de ces diplômes délivrés durant la période couverte par l'admission par l'État seront dès lors autorisés à porter en France le titre d'ingénieur diplômé.

Délibéré en séance plénière à Paris, les 13 et 14 septembre 2016, et le 11 octobre 2016

Approuvé en séance plénière à Paris, le 8 novembre 2016

Le président
Laurent MAHIEU



**Complément de l'avis n° 2016/09-11
relatif à l'Admission par l'Etat de diplômes de master de
la Faculté des sciences de l'ingénieur de l'université KU Leuven
à Louvain en Belgique (FES, KU Leuven)
à délivrer le titre d'ingénieur diplômé**

Objet

Rapport intermédiaire demandé dans l'avis n°2016/09-11 concernant la Faculté des sciences de l'ingénieur de l'université KU Leuven (Belgique) portant sur la mise en œuvre des recommandations.

- Vu les documents transmis au Greffe de la CTI par la Faculté des sciences de l'ingénieur de l'université KU Leuven à Louvain en Belgique (FES, KU Leuven)
- Vu la note de synthèse établie par Anne-Marie JOLLY, membre de la CTI, et présentée lors de la séance plénière du 12 février 2020,

La Commission des titres d'ingénieur a adopté le complément d'avis suivant :

La Commission prend acte favorablement du rapport intermédiaire transmis par l'école.

Délibéré et approuvé en séance plénière à Talence, le 12 février 2020.

La présidente,
Elisabeth CREPON

