

## Besluit **Equivalentie- en accreditatiebesluiten met positief eindoordeel voor 4 masteropleidingen in de ingenieurswetenschappen aan de Katholieke Universiteit Leuven**

<b>Datum</b>	<b>Oordeel van de accreditatieorganisatie</b>
19 juni 2017	De Commission des Titres d'Ingénieur (CTI) heeft vastgesteld dat de volgende opleidingen in de ingenieurswetenschappen van de Katholieke Universiteit Leuven voldoen aan de generieke kwaliteitswaarborgen:
<b>Onderwerp</b>	
Definitief Equivalentie- en accreditatiebesluiten MSc in de ingenieurswetenschappen van de Katholieke Universiteit Leuven	
<b>bijlagen</b>	
2	<ul style="list-style-type: none"><li>– Master of Science in de ingenieurswetenschappen: computerwetenschappen / Master of Science in Engineering: Computer Science (master) (005520);</li><li>– EIT-KIC Master of Science in Energy (master) (005527) i.s.m. INP Grenoble Institute of Technology, KTH Royal Institute of Technology in Stockholm, Universitat Politècnica de Catalunya / BarcelonaTech, Technische Universiteit Eindhoven en Institut national des sciences appliquées de Lyon;</li><li>– Erasmus Mundus Master of Science in Nanoscience and Nanotechnology (master) (005528) i.s.m. Chalmers Tekniska Högskola, Université Joseph Fourier Grenoble en Technische Universität Dresden;</li><li>– Master of Science in Nuclear Engineering (master na master) (005529) i.s.m. Vrije Universiteit Brussel, Universiteit Gent, Université de Liège, Université Libre de Bruxelles, Université Catholique de Louvain en SCK-CEN (Mol).</li></ul>

### **Samenvatting van de beoordeling**

#### *General presentation*

KU Leuven is one of the oldest universities in Europe. The research-oriented school was established in 1425 as the "Studium generale Lovaniense." In 1833, it was reformed and renamed "Katholieke Universiteit Leuven" and included a large French-speaking section. Following a political crisis, the francophone sections of Leuven split from the university in 1968 and the "Université Catholique de Louvain" was established on the new campus in Louvain-la-Neuve. "Katholieke Universiteit Leuven" later adopted the official name "KU Leuven".

During the 2014-2015 academic year, 25,220 students were enrolled in Bachelor's programmes and 18,770 students in Master's studies in KU Leuven's 15 faculties. The university has a total of 57,284 students, 19% of which are from abroad. Enrolment in the Faculty of Engineering Science (FES) stands at approximately 3,400 (2013-2014, SER). The university also has a Faculty of Science, a Faculty of Bioscience Engineering, a Faculty of Architecture and a Faculty of Engineering Technology.

Pagina 2 van 12 This accreditation process only applies to the FES programmes:

- 2 Bachelor's programmes (180 ECTS credits): Bachelor of Engineering (1,262 students) and the Bachelor of Engineering: Architecture (315 students). The teaching language is Dutch.
- 12 Master's programmes (120 ECTS credits) with a total of 1579 students. These programmes must be primarily taught in Dutch (in compliance with Flemish Law) but may be supplemented by English options.
- 6 Master's programmes (60 ECTS credits) with a total of 254 students ("Master na Master" in Dutch), offering specialisations theoretically for students with Master of Engineering degrees, but in reality open to students with a much broader profile, in particular foreign students.

These programmes are all delivered on the main campus of Leuven (Heverlee). The Faculty of Engineering Technology at KU Leuven offers "Masters of Industrial Engineering" degrees, which were formerly 4-year programmes offered by independent institutions throughout the country.

In comparison with the "Masters of Engineering" degrees of the FES, "Masters of Industrial Engineering" have kept their strong professionally-focussed approach with less theory. Opportunities are often provided to enable students or graduates in "Industrial Engineering" to transfer to FES programmes.

#### *General characteristics*

Like other faculties at KU Leuven, the FES manages its human and financial resources with a great degree of independence. It is made up of seven departments that are "responsible for their own research and for managing their own human resources and administration office" (SER page 5). Research is the backbone of the faculty. Teaching is a cross-cutting activity managed by education committees chaired by a programme director who relies on the human and equipment resources 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 or her a research based education in scientific and engineering fundamentals" (SER page 3). The research based education strategy is clearly emphasised, with a bottom-up approach to programme development. This approach is based on the skills of research teams and can lead to problems managing non-scientific and cross-cutting issues.

In addition to the strong focus on research, the Faculty of Engineering Science (supported by KU Leuven) is highly involved in education science and quality assurance:

- Strong emphasis is placed on student success, with several important initiatives: monitoring student pathways, staff (6 or 7 people) dedicated to individually supporting Bachelor's students, teacher training for new teachers, academic committees involving teachers and students, etc.
- Through its own initiative or in implementing the national strategies of the Flemish Interuniversity Council (VLIR) and the Accreditation Organisation of the Netherlands and Flanders (NVAO), the faculty has established a remarkable framework for implementing the "Learning outcomes" approach. The general ACQA framework defines academic competencies and methods for evaluating study programmes. The description of competencies is completely in line with the Dublin Descriptors for the three cycles of the Bologna Process, and largely consistent with the competencies in the CTI and EUR-ACE standards.

The competencies for learning units and teaching methods have been mapped out for each programme.

However, coordination between this outcome-based strategy and the content-based approach described above can be improved. There is a potential imbalance in the arbitration between the portion dedicated to scientific skills required by research needs and resources, and the portion dedicated to "soft skills".

- The self-evaluation report reflects a clear culture of quality assurance. It contains the strategic objectives, a SWOT analysis for the whole institution and for each programme, references to internal surveys (KONDOR) and action plans.

#### *General analysis*

##### **Strengths**

- KU Leuven is a research-driven university, which provides a first-rate scientific environment (in terms of both staff and equipment) for engineering studies.
- With the support of the university, the Faculty has a well-defined training policy centred on student competencies, with outstanding initiatives, such as the ACQA framework for learning outcomes or the Problem-solving and Design (PS&D) approach.
- Through the bottom-up, research-driven approach to designing programmes, graduates achieve a high level of scientific competency
- The overall structure of engineering education seems coherent with the Bachelor's degree, providing a strong common basis for all students and a Major/Minor system preparing students for the Master's programmes at the end of the Bachelor's degree.
- The Self-evaluation Report and the documents provided for the visit demonstrate a good culture of quality assurance in the area of teaching.

##### **Weaknesses**

- The Faculty relies strongly on the research departments, and therefore lacks a comprehensive view and proper management of non-scientific learning outcomes.
- The considerable independence of the programmes' departments leads to inconsistent implementation of Faculty policies (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 programme content and outcomes.
- The high demand for engineers in Flanders does not motivate the staff to invest deeply in the employability of graduates (such as graduate follow-up, internship policies).
- The Faculty does not take full advantage of its geographical position and international reputation for the outbound mobility of its students and to attract 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 in preparing the international accreditation deserves mention. Efforts need to be made to continue their involvement in order to achieve long-term benefits.

### **Masters of Engineering**

#### 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 the 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 awards a common (joint) degree to graduate students of the programme. The consortium has developed a common set of standards and mechanisms for applications, admissions, 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 a broad vision of the topic.
- The programme offers various 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 the consortium decide to do at that time? The tuitions fees for Master's programmes will be more expensive for non-European students and the impact is difficult to anticipate.
- Like all Erasmus Mundus programmes, it is difficult to ascertain that all learning objectives are equally shared by all the partners.
- Industrial experience during the studies should be developed.

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 relationships 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 students the possibility to obtain a double degree.
- However, the number of students is low, with a significant dropout rate. 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 get a job contract in the industry before they officially get their degree

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)

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

The programme trains engineers specialised in the field of computer science. Within the programme, central key aspects are the acquisition of expert knowledge in one or more subdisciplines 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, etc.) 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.

Pagina 6 van 12 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, after a broad scientific culture, offers students six specializations linked to the active research areas of the department
- The programme is one of few FES programmes which have not yet established an Industrial Advisory Board. Networking with alumni needs to be established on a systematic basis.
- The above features seem to confirm some reluctance of the programme management team to improve the students' exposure to non-academic work environments

#### **Advanced Masters ("Master na Master")**

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

#### 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 an (...) 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), a 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 is to educate young engineers in nuclear engineering and its applications and to develop and maintain high-level nuclear expertise 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 competencies in 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 competencies. (SER page 121).

Pagina 7 van 12 Analysis (specific to the programme):

- A high academic quality programme with experts from various backgrounds (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 by the 6 university faculties.
- The need for a very complex organization with many partners is questionable, considering the low number of students

#### *Recommendations*

##### **For the Faculty of Engineering Science at KU Leuven:**

- Draw on the work already carried out to prepare for the accreditation in order to establish the long-term culture of quality assurance within the faculty, with the involvement of all stakeholders.
- Develop learning outcome standards that serve not only to describe study programmes, but as a tool for design and continuous improvement.
- Define and implement a Faculty-wide soft skills policy that is then adapted to each programme. Recruiting cross-disciplinary human resources responsible for this aspect could be a possibility.
- Take advantage of the university's geographical position and international reputation to develop an ambitious policy for the outbound mobility of its students and to attract the best foreign students. Efforts must be made to pool resources between the various departments with the help of the University.
- Improve ties with alumni to gather their opinions on their studies and to accurately monitor graduate employment and careers.

**The recommendations for each programme are as follows.**

##### **Masters of Engineering**

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

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

/

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)

- Quickly develop a structured action plan for involving stakeholders and the Industrial Advisory Board in the development and implementation of a policy to expose students to a non-academic job environment
- In general, open up specialisations to subjects that are not solely related to research.

##### **Advanced Masters ("Master na Master")**

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

##### **Aanbevelingen**

De NVAO onderschrijft alle aanbevelingen geformuleerd door deze accreditatieorganisatie.

De NVAO verklaart de accreditatiebesluiten van CTI equivalent op basis van de volgende vaststellingen:

- De buitenlandse accreditatieorganisatie geeft een positieve beoordeling van de kwaliteit van de betrokken opleidingen;
- De buitenlandse accreditatiebesluiten zijn voldoende actueel;
- De buitenlandse accreditatiebesluiten zijn gebaseerd op een openbare externe beoordeling;
- De buitenlandse accreditatieorganisatie is EQAR-geregistreerd;
- De buitenlandse accreditatieorganisatie heeft een methodologische aanpak vergelijkbaar met de Vlaamse.

#### **Besluit**

betreffende de Equivalentie- en accreditatiebesluiten met positief eindoordeel voor 4 masteropleidingen in de ingenieurswetenschappen aan de Katholieke Universiteit Leuven.

De NVAO,  
Na beraadslaging,  
Besluit:

Met toepassing van de Codex Hoger Onderwijs, in het bijzonder de artikel II.149, besluit de NVAO accreditatie te verlenen aan de volgende opleidingen:

- Master of Science in de ingenieurswetenschappen: computerwetenschappen / Master of Science in Engineering: Computer Science (master) (005520);
- EIT-KIC Master of Science in Energy (master) (005527), i.s.m. INP Grenoble Institute of Technology, KTH Royal Institute of Technology in Stockholm, Universitat Politècnica de Catalunya / BarcelonaTech, Technische Universiteit Eindhoven en Institut national des sciences appliquées de Lyon;
- Erasmus Mundus Master of Science in Nanoscience and Nanotechnology (master) (005528), i.s.m. Chalmers Tekniska Högskola, Université Joseph Fourier Grenoble en Technische Universität Dresden;
- Master of Science in Nuclear Engineering (master na master) (005529) i.s.m. Vrije Universiteit Brussel, Universiteit Gent, Université de Liège, Université Libre de Bruxelles, Université Catholique de Louvain en SCK-CEN (Mol). De opleiding wordt aangeboden te Leuven, Brussel en Gent.

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1 Het ontwerp van accreditatiebesluit werd aan de instelling bezorgd voor eventuele opmerkingen en bezwaren. Bij e-mail van 12 juni 2017 heeft de instelling van de gelegenheid gebruik gemaakt om te reageren. Dit heeft geleid tot enkele tekstuele aanpassingen.

Pagina 9 van 12 De accreditatie geldt, overeenkomstig de door CTI aangegeven periode van zes jaar, van 1 september 2016 tot en met 31 augustus 2022.

Den Haag, 19 juni 2017

De NVAO  
Voor deze:

A handwritten signature in blue ink, consisting of several loops and a long horizontal stroke extending to the right.

Marc Luwel  
(bestuurder)

Naam instelling	Katholieke Universiteit Leuven
Adres instelling	Naamsestraat 22 – bus 5000 B-3000 LEUVEN
Aard instelling	ambtshalve geregistreerd
Naam associatie	Associatie KU Leuven
Naam opleidingen	<ul style="list-style-type: none"> <li>– Master of Science in de ingenieurswetenschappen: computerwetenschappen / Master of Science in Engineering: Computer Science (005520);</li> <li>– EIT-KIC Master of Science in Energy (005527), <i>i.s.m. INP Grenoble Institute of Technology, KTH Royal Institute of Technology in Stockholm, Universitat Politècnica de Catalunya / BarcelonaTech, Technische Universiteit Eindhoven en Institut national des sciences appliquées de Lyon;</i></li> <li>– Erasmus Mundus Master of Science in Nanoscience and Nanotechnology (005528), <i>i.s.m. Chalmers Tekniska Högskola, Université Joseph Fourier Grenoble en Technische Universität Dresden;</i></li> <li>– Master of Science in Nuclear Engineering (005529) <i>i.s.m. Vrije Universiteit Brussel, Universiteit Gent, Université de Liège, Université Libre de Bruxelles, Université Catholique de Louvain en SCK-CEN (Mol).</i></li> </ul>
Niveau en oriëntatie	<ul style="list-style-type: none"> <li>– Master;</li> <li>– Master-na-master.</li> </ul>
Bijkomende titel	Master of Science: Burgerlijk ingenieur
Opleidingsvarianten:	Erasmus Mundus Master of Science in Nanoscience and Nanotechnology:
– Afstudeerrichtingen:	<ul style="list-style-type: none"> <li>– Biophysics;</li> <li>– Nanophysics;</li> <li>– Nanoelectronics;</li> <li>– Bionanotechnology</li> </ul>
– Studietraject voor werkstudenten	geen
Onderwijstaal	Engels  <i>Met uitzondering van:</i> <ul style="list-style-type: none"> <li>– Master of Science in de ingenieurswetenschappen: computerwetenschappen / Master of Science in Engineering: Computer Science:</li> </ul> Nederlands met Engelstalige variant

Studieomvang (in  
studiepunten)

- Master variant: 120 studiepunten;
- Master-na-master: 60 studiepunten.

Studiegebied(en)

- Toegepaste Wetenschappen
- Toegepaste biologische wetenschappen
- Wetenschappen

ISCED benaming  
studiegebied

- 05: Natural sciences, mathematics and statistics  
052: Environment
- 06: Information and Communication Technologies (ICTs)  
061: Information and Communication Technologies (ICTs)
- 07: Engineering, manufacturing and construction  
071: Engineering and engineering trades  
072: Manufacturing and processing  
073: Architecture and construction

Pagina 12 van 12 **Bijlage 2: Samenstelling van het accreditatiepanel**

*Voorzitter:*

- B. (Bernard) Remaud, CTI expert, chair;
- A. (Anne-Marie) Jolly, CTI member and co-chair;
- G. (Gabriel) Henrist, CTI member and co-chair;

*Leden:*

- J. (Jean-Claude) Arditti, CTI expert;
- A. (Aris) Avdelas, CTI international expert;
- L. (Laurent) Bedat, CTI expert;
- H. (Hugo) Curto, CTI engineering student expert;
- J. (Jeanne) Duvallet, CTI member;
- D. (David) Elbaze, CTI engineering student expert;
- D. (Denis) Lemaitre, CTI expert;
- J. (Jean) Le Quenven, CTI expert;
- J. (Jean-Jacques) Maillard, CTI expert;
- S.J. (Sape J.) Mullender, CTI international expert;
- P. (Pascal) Ray, CTI member;
- W. (Wim) van den Bergh, CTI international expert.