

## SCIENCE, ENGINEERING & TECHNOLOGY GROUP



The **Science, Engineering & Technology Group (SET)** at KU Leuven comprises five faculties and fourteen departments. The five faculties organise the academic education at bachelor, master and PhD level. The fourteen departments are responsible for the research. A flexible structure of research centres across the departments facilitates the interdisciplinary character of the research. Most of the activities are organised in Leuven, but some take place in other campuses across Flanders.

### Education

Within the field of science, engineering and technology, KU Leuven offers five academic educational profiles organised in the five faculties: Science, Engineering Science, Bioscience Engineering, Engineering Technology and Architecture.

These five educational profiles have common characteristics but they differ in terms of the fundamental educational target being addressed, their position and horizon in the knowledge and application chain, and the key accents within the study programme and the relevant professional fields.

- The **Faculty of Science** offers programmes oriented towards generating new knowledge and insights by exploring uncharted territory in domains ranging from mathematics and physics over biology and chemistry to earth sciences. KU Leuven science graduates always aim at the deepest level of understanding of their subject. With this mindset they are able to discover, elucidate and explain phenomena in the natural sciences, on the basis of observation and experimentation or by developing models or (predictive) theories, strongly rooted in mathematical principles. They are focusing on the longer-term horizon. At the same time, students are encouraged to recognize innovation opportunities, and thus to contribute to the technologies of the future.
- The **Faculty of Engineering Science** (including engineering architecture) and the **Faculty of Bioscience Engineering** offer study programmes that educate students to design, engineer and optimise concepts for new products, processes, systems or services and to master technological innovation. They pay considerable attention to both conceptual aspects and methodological and experimental approaches.

While these study programmes have a number of common features, they are rooted on different fundamental sciences: for engineers this is mainly physics and mathematics followed by engineering courses; for engineering architects this is mainly physics, mathematics and architectural design studios followed by engineering and architecture courses; for bioscience engineers the focus is more on biology and chemistry followed by bioscience engineering courses. These study programmes focus on the medium-term horizon.

- The **Faculty of Engineering Technology** trains students to become experts in developing, applying, implementing and improving products, processes and systems towards specific applications. This study programme therefore focuses on the short to medium term. The programme, taught at the seven campuses of the Faculty of Engineering Technology, is more oriented towards practical applications and immediate usability in the professional field.
- The **Faculty of Architecture** offers programmes in Architecture, Interior Architecture and Urban Planning & Spatial Design and is located in campuses in Ghent and Brussels. Education is based on the century-old tradition of architectural education at the Sint-Lucas School of Architecture. The programme's uniqueness stems from the integration and interaction of design studios and technical, theoretical and explorative artistic courses and research. The teaching staff includes many leading international architects and researchers, all of whom bring extensive experience in the field of (interior) architecture and urban design.

#### ENGINEER-ARCHITECT OR ARCHITECT

The programmes in engineering, architecture (part of the Faculty of Engineering Science) and in architecture (organised by the Faculty of Architecture) are closely related, but have a different approach and focus on different competences. The programme in engineering-architecture focuses on a rational approach, supported by technical competences, and offers 50% science and technology courses, 25% architectural humanities and 25% design courses. The emphasis in the programme in architecture is on the design process with 50% design courses, 25% architectural humanities and 25% science and technology courses.

KU Leuven also offers a broad range of educational programmes in English, both at master's and doctoral level.



## Arenberg Doctoral School

The aim of the **Arenberg Doctoral School** is to coach, guide and educate PhD students so as to achieve their doctoral degree. The doctoral school provides an internationally competitive environment where doctoral students can tackle fundamental or more applied problems in their research field. The research is carried out in one of the 14 departments of the Group. In collaboration with the KU Leuven Career Centre, the Arenberg Doctoral School aims to ensure that researchers can maximally develop the transversal skills they need to further develop their career beyond the PhD or postdoc (YouReCa programme).

## Number of Students

KU Leuven	56000
Science, Engineering and Technology Group	17630
• Bachelor's students	7960
• Master's students	6940
• Advanced Master's students	680
• PhD students	2050
• International students	18%

## Research

KU Leuven conducts fundamental and applied research in all academic disciplines. Over the past years, the quality and quantity of KU Leuven's research efforts and output have increased considerably, positioning Leuven at the forefront of the European universities. Research in the Science, Engineering & Technology Group is characterised by originality and innovation, successful applications and valorisation, and strengthening of interdisciplinarity. Its basic orientation has always been and remains basic research, both in fundamental and application-driven areas, while also focusing on the valorisation of the research results.

At the same time, the Group remains open to contemporary scientific, industrial, economic, social and cultural realities, as well as to the society's needs and expectations.

The university has largely internationalised its competitive research, and has geared it toward the global community.

Innovation and cooperation across disciplinary, technological, cultural and geographical borders are key in the research activities.

The fourteen research departments in the Science, Engineering and Technology Group as well as the interdisciplinary research centres across the different departments create a stimulating environment to excel in several scientific fields and a dynamic research environment for creativity and innovation.

## Departments

For basic and applied research leading towards methodological and systematic innovation as well as towards sustainable contributions to the society's global challenges and economic growth, the SET Group has organised its research activities in 14 departments:

- Department of Architecture
- Department of Biology
- Department of Biosystems (BIOSYST)
- Department of Chemical Engineering
- Department of Chemistry
- Department of Computer Science
- Department of Civil Engineering
- Department of Earth and Environmental Sciences
- Department of Electrical Engineering (ESAT)
- Department of Materials Engineering (MTM)
- Department of Mathematics
- Department of Mechanical Engineering
- Department of Microbial and Molecular Systems (M2S)
- Department of Physics and Astronomy

The research is supported by outstanding research facilities and considerable infrastructure investments to build new core facilities for experimental research, such as in the area of chemistry, chemical engineering and nanotechnology.

## Academic Staff

Faculty	635
Postdoctoral researchers	630
PhD researchers	over 2050
International academic staff	almost 50%

## Research Centres

Interdisciplinary research centres, focusing either on research, networking or expertise, stimulate cooperation across the Science, Engineering, and Technology Group, the Biomedical Sciences Group and the Humanities and Social Sciences Group, transcending the existing organisational units of faculties and departments. The Centres aim to cluster and spread knowledge and expertise in a specific field or on a specific theme. They conduct inter- and multidisciplinary research, support the education of students and researchers through the faculties and doctoral schools, and contribute to the social services through workshops, lectures and diverse communications.



At present the following centres are active:

- Ethics@Arenberg
- Leuven Centre for Aero & Space Science, Technology and Applications (LASA)
- Leuven Centre for Bio-Science, Bio-Engineering and Bio-Technology (LBioSCENTer)
- Leuven Centre for Mobility (L-Mob)
- Leuven Engineering and Science Education Centre (LESEC)
- Leuven Food science and Nutrition Research Centre (LFoRCe)
- Leuven ICT Research Centre (LICT)
- Leuven Materials Research Centre (LMRC)
- Leuven Mathematical Modelling & Computational Science Research Centre (LMCC)
- Leuven Medical Technology Research Centre (LMTC)
- Leuven Space and Society Centre (LSAS)
- Leuven Statistics Research Centre (LSTAT)
- Leuven Sustainable Earth (LSUE)

Within the SET Group, there are many collaborations with research groups in the Humanities & Social Sciences and the Biomedical Sciences, as well as collaborations with Flemish research centres such as IMEC, iMinds, NERF, VITO, EnergyVille, etc. and with the University Hospitals.



## Research valorisation

Research is important both as the basis of knowledge growth and as the foundation of academic education. It can also result in important benefits for society. With the help of KU Leuven Research & Development (LRD), the SET Group strongly valorises the knowledge generated by its researchers. The organisation of development projects with industry, the patenting and licensing of research results to industry, and the creation of spin-offs have become important mechanisms to build bridges between university science and industry and to transfer knowledge and technologies to the marketplace. Since 1972, over 65 spin-off companies originated from research in the field of Science, Engineering and Technology.

## Arenberg library

The library building was once a Celestine abbey, unique in the Netherlands, founded in the beginning of the 16th century by Willem de Croy, who was a politician and counsellor to Philip the Fair and Charles V. Since 2002, it houses the library of the Science, Engineering & Technology group, together with the library of the Faculty of Physiotherapy and Rehabilitation Sciences. Thanks to the internationally renowned Spanish architect Rafaël Moneo, the library is now a very attractive combination of old and modern architecture.

The contemporary interior design within the ancient monastery provides an idyllic working environment and state-of-the-art library for academic staff and students. The library offers most journal and relevant conference databases in electronic version to the researchers. The full text of all the most important research articles is now available electronically. The library building is also used as learning centre for the students.



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# ARENBERG DOCTORAL SCHOOL OF SCIENCE, ENGINEERING & TECHNOLOGY



From infinity to atoms, from cells to people: creating knowledge, supporting lives.

The Arenberg Doctoral School of Science, Engineering and Technology stimulates new researchers in their endeavour to acquire scientific and technological knowledge. These young researchers drive the discoveries and developments in science, engineering and technology that not only lead to a better understanding of our world but can also ultimately be used to improve the world we live in. The research topics of the Arenberg Doctoral School span all the fields of science, engineering and technology, including the life sciences, computing and information science, environmental sustainability, human settlements, agriculture, food research, genomics and biomaterials, nano science and nanofabrication, advanced materials, energy and optimisation in engineering.

The Arenberg Doctoral School not only provides a stimulating research environment, but also attempts to ensure that researchers can maximally develop the personal skills they will need to further develop their career. We believe that by working with us you will become a researcher who has

the confidence and pride of a professional and who has the ability to conduct cutting-edge research and establish collaborations both within academia as well as with companies and government agencies. You will be able to advance the frontiers of knowledge and combine this scientific endeavour with unique professional experience. The Arenberg Doctoral School offers great opportunities to fulfil the aspirations and pursue the goals of young innovative researchers.

The main objective of the Arenberg Doctoral School administration is to provide you with guidance and assistance in carrying out your scientific mission.

More specifically, the administration aims:

- To inform you about all the possibilities to accomplish a PhD project in Science, Engineering and Technology at KU Leuven by announcing vacancies or guiding you towards funding agencies.
- To provide administrative support and guidance at any stage of your PhD project.
- To provide opportunities to develop your professional competence development by offering specialised courses in scientific disciplines and training in different skills.



## Doctoral Training

The Arenberg Doctoral School organises doctoral training for all the PhD researchers in Science, Engineering & Technology. Our aim is to train doctoral researchers both as future scientists and as scientifically trained professionals who are able to use their expertise and competences both in an academic and non-academic context. This requires a versatile programme that addresses both academic expertise and personal skills. The core of the doctoral education is research-based training. The focus on research as an instrument for professional and scientific development sets the doctorate apart from other types of education. In addition to the research-based training, PhD researchers also follow more formal training via seminars, workshops, summer schools and other course components.

The formal doctoral training focuses on thematic training as well as on generic skills. The main emphasis of the thematic training is on the development of academic, intellectual and technical skills related to your scientific field of interest. The transferable and generic skills are applicable in a wider context, e.g. a professional career outside the university. Examples of such skills are: interdisciplinary thinking, networking, goal-directedness, prioritising, creativity and innovation, etc.



The Arenberg Doctoral School considers generic skills to be an increasingly important element in doctoral training, which is in line with the strategy developed by the European Commission. In order to train PhD researchers to be employable in a broad range of high qualified positions, generic skills do indeed deserve to be a necessary part of the doctoral training programme. The Arenberg Doctoral School has built an extensive international network, including several Marie Curie Initial Training Networks and Erasmus Mundus Joint Doctorate Programmes to support this endeavour. In view of Horizon 2020 and Erasmus+, new opportunities are already being explored.

The Arenberg Doctoral School confers PhD degrees in the Faculty of Science, the Faculty of Engineering Science, the Faculty of Bioscience Engineering, the Faculty of Engineering Technology and the Faculty of Architecture.

Doctoral research at the Arenberg Doctoral School of Science, Engineering & Technology is supported by 14 departments and 13 research centres.

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## FACULTY OF SCIENCE



The Faculty of Science is one of KU Leuven's oldest faculties. Its origins can be traced back to the Artes Faculty of the Old University of Leuven, founded in 1425. It has existed as an independent faculty since the early nineteenth century. The Faculty consists of five departments: Biology, Chemistry, Earth and Environmental Sciences, Mathematics, and Physics and Astronomy.



Research in the Faculty of Science addresses fundamental questions. Its curiosity-driven and often multidisciplinary approach is recognised around the world. Among its staff are some of Europe's top scientists, including ERC grant holders in all five of its departments. The Faculty is also very active in international research infrastructures for basic science, such as CERN, ESA, ESRF, and ESO. And with over 100 doctoral theses defended each year, the Faculty has the highest PhD vs Masters ratio of the university.

The study programmes offered at the Faculty of Science take an interdisciplinary approach and are strongly embedded in the research carried out in the five departments.

Each of these departments conduct top research in the pure natural and mathematical sciences. The basic fields of mathematics, physics, computer science, chemistry, biochemistry, biology, geology and geography combine with new domains of study located at the interplay of these fields, such as astronomy, biophysics, nanoscience, statistics, sustainable territorial development, etc.

Although the Faculty of Science takes the lead in basic, knowledge-driven research at the university, its researchers and students are always on the lookout for opportunities to innovate, develop and valorise their research. This enterprising attitude is omnipresent in both the lab and the classroom. The Faculty also strives to implement innovative teaching strategies. Students are continuously made aware of the relevance of fundamental scientific research and of novel education strategies as the necessary and essential ingredients for innovation. The Faculty nurtures its links with society and with the corporate world.

### Study programmes

#### Bachelor's programmes (taught in Dutch)

- Biochemistry and Biotechnology
- Biology
- Chemistry
- Informatics
- Geography
- Geology
- Mathematics
- Physics

### Initial master's programmes

- Applied Computer Sciences (Dutch only)
- Astronomy and Astrophysics
- Biochemistry and Biotechnology (Dutch only)
- Biology
- Biophysics, Biochemistry and Biotechnology (English only)
- Chemistry
- Geography (in collaboration with VUB, Brussels)
- Geology (in collaboration with UGent, Ghent)
- Mathematics
- Physics
- Bio-informatics
- Erasmus Mundus Master of Sustainable Territorial Development
- Erasmus Mundus Master of Theoretical Chemistry and Computational Modelling
- Nanoscience and Nanotechnology
- Statistics
- Tourism (Dutch only; in collaboration with other universities and graduate schools)

### Advanced master's programmes

- Medical Radiation Physics (Dutch only)
- Space Studies
- Artificial Intelligence
- Financial and Actuarial Engineering
- Digital Humanities

## Location

The study programmes offered by the Faculty of Science are hosted at KU Leuven's main campus in Leuven. Most of the bachelor programmes are also offered at Kulak, KU Leuven's undergraduate campus in Kortrijk. A number of the master's programmes (Geography, Geology, Space Studies, and Tourism) are organised in collaboration with other universities, and some classes may meet at these collaborating universities.

## International orientation

For decades – even centuries – KU Leuven has welcomed international students seeking a high-quality, research-embedded education. Each year, the Faculty of Science welcomes students from all over the globe, be it for a summer school, an exchange semester or for graduate or PhD studies. The Faculty also has a strong tradition in collaborating with universities abroad and has a commendable track record in stimulating research-based education in developing countries.



## Science@Leuven Fund

Motivated and talented international students interested in participating in an international master's programme offered at the Faculty of Science are invited to apply for a scholarship: [sc.kuleuven.be/scienceatleuven scholarship](https://sc.kuleuven.be/scienceatleuven scholarship)

## Figures

Bachelor's students:	1400
Master's students:	1140
Advanced Master's students:	160
PhD students:	610

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## FACULTY OF ENGINEERING SCIENCE



The Faculty of Engineering Science was founded in 1864 as the Ecoles Spéciales des Arts et Manufactures, du Génie Civil et des Mines. Today, it is a multidisciplinary school forming academic engineers with a sound scientific background, advanced technical knowledge, stimulated creativity, a concept-oriented approach and with an open view on social issues.

The educational philosophy of the Engineering Science programmes is based upon a gradual specialization. Problem solving and design competences are introduced from the very beginning in team projects.

Intensive research is the heart beat for the education programmes.

It is carried out in the Department of Architecture, the Department of Chemical Engineering, the Civil Engineering Department, the Department of Computer Science, the Department of Electrical Engineering, the Department of Mechanical Engineering, and the Department of Materials Engineering.

There is also a lively interaction with national and international universities, research institutes and industrial partners. With over a hundred different nationalities the student population is a very international community: 25% of the students come from all over the world.

On average every year three new spin-off companies emerge from research conducted at the Faculty of Engineering Science, becoming world players in their respective commercial market. IMEC, LMS, Materialise, ...

In worldwide rankings the Faculty of Engineering Science (KU Leuven) features among the best technical universities.

### Study programmes

#### Bachelor's programmes (in Dutch only)

- Bachelor in de ingenieurswetenschappen majoring in
  - civil engineering
  - chemical technology
  - computer science
  - materials engineering
  - electrical engineering
  - mechanical engineering
- Bachelor in de ingenieurswetenschappen: architectuur

#### Initial Master's programmes

- Master in de ingenieurswetenschappen: architectuur
- Master in de ingenieurswetenschappen: biomedische technologie
- Master of Biomedical Engineering
- Master in de ingenieurswetenschappen: bouwkunde
- Master in de ingenieurswetenschappen: chemische technologie
- Master of Chemical Engineering
- Master in de ingenieurswetenschappen: computerwetenschappen
- Master of Engineering: Computer Science
- Master in de ingenieurswetenschappen: elektrotechniek
- Master of Electrical Engineering
- Master in de ingenieurswetenschappen: energie
- Master of Engineering: Energy
- EIT-KIC Master in Energy\*
- Master in de ingenieurswetenschappen: materiaalkunde
- Master of Materials Engineering

- Master in de ingenieurswetenschappen: verkeer, logistiek en intelligente transportsystemen
- Master in de ingenieurswetenschappen: werktuigkunde
- Master of Mechanical Engineering
- Master in de ingenieurswetenschappen: wiskundige ingenieurstechnieken
- Master of Mathematical Engineering
- Master in de nanowetenschappen en de nanotechnologie\*\*
- Master of Nanoscience and Nanotechnology\*\*
- Erasmus Mundus Master of Science in Nanoscience and Nanotechnology\*
- Master in de bio-informatica\*
- Master of Bioinformatics\*
- Master in de statistiek\*
- Master of Statistics\*



### Advanced programmes (all taught in English)

- Master of Artificial Intelligence\*
- Master of Conservation of Monuments and Sites
- Master of Human Settlements
- Master of Nuclear Engineering\*\*\*
- Master of Safety Engineering
- Master of Urbanism and Strategic Planning
- Master in de medische stralingsfysica\*
- Master of Space Studies\*
- Postgraduate Programme in Biomedical Engineering
- Postgraduate European Module Spatial Development Planning

\* *interfaculty programme*

\*\* *international programme*

\*\*\* *interuniversity programme*

## International orientation

The Faculty of Engineering Science is one of the founding members of **CESAER** (Conference of European Schools for Advanced Engineering Education and Research, [www.cesaer.org](http://www.cesaer.org)), an international association of nearly 60 European Technical Universities, active in the promotion of the Engineering Science education and research at the European level.

The Faculty of Engineering Science is also an active member of **CLUSTER** (Consortium Linking Universities of Science and Technology for Education and Research, [www.cluster.org](http://www.cluster.org)), a network of 12 leading European Universities of Technology.

The Faculty of Engineering Science is an institutional member of **SEFI** (Société Européenne pour la Formation des Ingénieurs, [www.sefi.be](http://www.sefi.be)), the European Society for Engineering Education.

Students of the Faculty of Engineering Science are actively involved in several networks: BEST, IAESTE, Academics for Companies, Academics for Development, IEEE, ...

Other international opportunities for students of the Faculty of Engineering Science range from an intensive course of a week within the ATHENS- network, over exchanges within the Erasmus+ framework and far beyond, to dual and joint degree programmes.

All of the students are encouraged to participate in [internationalisation@home](mailto:internationalisation@home).

## Location

**Main Campus:** Leuven (Heverlee)

**except for the Master of Nuclear Engineering:** SCK (Mol)

## Figures

Bachelor's students:	1630
Master's students:	1730
Advanced Master's students:	410
PhD students:	920

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## FACULTY OF BIOSCIENCE ENGINEERING



The Faculty of Bioscience Engineering, established in 1878, focusses on the great global challenges facing our society: the environment, health, food production, water and energy.

The Faculty offers a broad range of bachelor's and master's programmes for students all over the world. Our various programmes reflect the all-around character of the Faculty and are embedded in the innovative, world-class research that takes place here. Research activities are carried out in three departments: the Department of Earth and Environmental Sciences, the Department of Biosystems and the Department of Microbial and Molecular Systems. Our teaching and research activities are bolstered by several, external facilities, including the Centre for Fruit Culture, the Zootechnical Centre, the Agricultural and Biosystems Engineering Centre and the Greenhouse Facility, which has both temperate as well as (sub)tropical environments.

Through our study programmes, we strive to instill leadership, critical thinking skills and a sense of comradeship in each of our students. Student representatives actively participate in the daily management of the Faculty, particularly when it comes to questions of education. The Faculty's student association also organises cultural, sports and other social activities throughout the academic year and distributes course readers.

The Faculty of Bioscience Engineering covers all aspects of plant protection, plant production, animal production, agricultural engineering, landscape planning and architecture, soil science, agricultural and food economics, environmental science and technology, land, water and forest management, Master of Bioscience Engineering: Biomolecular Engineering, catalytic science and technology, surface chemistry, food technology, nutrition and health, brewing and malting, tropical and subtropical agriculture and natural resources management, bio-informatics, molecular biology, nanoscience and nanotechnology, geomatics engineering and earth observation.

The study programmes in these fields encompass theoretical knowledge as well as practical training in laboratories and field environments in Belgium and abroad.

### Study programmes

#### Programmes taught in Dutch

**BACHELOR OF SCIENCE IN BIOSCIENCE ENGINEERING (180 CREDITS)**

**MASTER OF SCIENCE IN BIOSCIENCE ENGINEERING (120 CREDITS):**

- Agricultural Sciences
- Biosystems Engineering
- Catalytic Science and Technology
- Master of Bioscience Engineering: Biomolecular Engineering
- Environmental Technology
- Food Science and Technology
- Land Management

#### Programmes taught in English (120 credits)

- Master of Science in Agro- and Ecosystems Engineering
- Master of Science in Bioinformatics
- Master of Science in Bioscience Engineering: Human Health Engineering
- Master of Science in Food Technology (with Ghent University)
- Master of Science in Molecular Biology (with VUB and Antwerp University)
- Master of Science in Nanoscience and Nanotechnology
- Master of Science in Statistics
- Master of Science in Water Resources Engineering (with VUB)

## Figures

Bachelor's students:	750
Master's students:	860
PhD students:	430



## International orientation

The Faculty of Bioscience Engineering has a long tradition of **international collaboration and exchange** of both staff and students. Students have a wide array of opportunities to complete part of their curriculum abroad: a semester abroad within the Erasmus+ framework, an internship in an international company, the change to conduct research for their master's thesis in an international institution, or an international specialisation semester at one of the international partner universities. Thanks to this extensive policy on internationalisation, **30% of the Faculty's graduates** have an international experience during their study programme.

**IAAS**, is a worldwide network of students in agricultural and related sciences and has its headquarters in our Faculty buildings in Heverlee. Its mission is to promote the exchange of experience, knowledge and ideas, and to improve mutual understanding between students in the fields of agricultural and related sciences all over the world.

The Faculty of Bioscience Engineering is a member of:

- **ICA**: Interuniversity Consortium for Agricultural and Related Sciences in Europe ([www.ica-ls.com/](http://www.ica-ls.com/))
- **Agriatura**: The European Alliance on Agricultural Knowledge for Development ([www.agriatura.eu/](http://www.agriatura.eu/))
- **CEDIA**: European Confederation of Agronomist Associations ([www.cedia.eu/](http://www.cedia.eu/))

The Faculty of Bioscience Engineering hosts:

**Bioversity International** Musa Germplasm Transit Centre ([www.bioversityinternational.org/](http://www.bioversityinternational.org/))

**IAAS** ([www.iaasworld.org](http://www.iaasworld.org))

**ISHS** - International Society for Horticultural Science ([www.ishs.org](http://www.ishs.org))



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## FACULTY OF ENGINEERING TECHNOLOGY



The Faculty of Engineering Technology gathers all **programmes in Engineering Technology and Bioengineering Technology** offered by the KU Leuven at 7 campuses throughout Flanders. The Bachelor's and Master's programmes are offered in both English and Dutch.

The strength of the Engineering Technology programmes lies in **their unique combination of research-based curricula and practice-based courses**, in the tight organizational and functional links with regional and international companies and the specifically student-oriented educational approach.

The long standing tradition of intensive **research** collaboration with industry has been further strengthened by merging the research groups in 7 **technology clusters**: Bioengineering Technology, Construction, Computer Science Technology, Electrical Engineering, Materials Technology, Mechanical Engineering Technology and Sustainable Chemical Process Technology.

In addition to their research activities, most lecturers have practical experience in the implementation of knowledge and technology in different companies or in spin-offs. The link to the professional field in research and scientific service creates a learning and working environment very close to the application of knowledge and new technologies, and functionally linked to industrial practice. That's how we can provide our future engineers with a strong and specific position in the innovation chain, close to implementation.

***"The multi campus model not only leads to strong local ties and a large network of companies and enterprises, but also to in-depth knowledge and expertise that can be exchanged and developed. This turns the faculty into a very dynamic, future-oriented and research-based environment."***

### Study programmes

#### Bachelor's Programmes\*

- Engineering Technology, major in:
  - Chemical Engineering
  - Civil Engineering\*\*
  - Electromechanical Engineering
  - Electronics and ICT Engineering
  - Polymer Technology\*\*
  - Nuclear Technology\*\*
  - Packaging Engineering\*\*
- Bioengineering Technology\*\*

#### Master's Programmes\*

- Engineering Technology: Biochemical Engineering
- Engineering Technology: Civil Engineering\*\*
- Engineering Technology: Chemical Engineering
- Engineering Technology: Electromechanical Engineering
- Engineering Technology: Electronics and ICT Engineering
- Engineering Technology: Energy Engineering\*\*
- Engineering Technology: Polymer Processing Engineering\*\*
- Engineering Technology: Nuclear Technology\*\*
- Engineering Technology: Packaging Engineering\*\*
- Bioengineering Technology: Agricultural and Horticultural Engineering\*\*
- Bioengineering Technology: Food Industry Engineering\*\*
- Food Science, Technology and Nutrition (Erasmus Mundus)

\* The English Bachelor's and Master's programmes of Science in Engineering Technology are called Bachelor or Master of Science in Industrial Sciences

\*\* Only in Dutch

### Advanced Master's Programme

- Welding Engineering

### Postgraduate Programmes

- Innovation and Entrepreneurship Engineering
- Enterprising

### Doctoral Programme

PhD in Engineering Technology via the Arenberg Doctoral School

[www.set.kuleuven.be/phd](http://www.set.kuleuven.be/phd)



## Location

The Faculty of Engineering Technology offers the engineering programmes in Ostend, Ghent, Aalst, Leuven, Sint-Katelijne-Waver, Geel and Diepenbeek. Each campus is characterised by its own specific educational and research specialisation. The English Bachelor's and Master's programmes are only offered at Campus Group T Leuven.



## International orientation

The Faculty of Engineering Technology has a long tradition of international collaboration and exchange of both staff and students. All campuses are active in the field of Erasmus exchanges, international curriculum development projects, cooperation initiatives in developing countries etc.

The Group T campus in Leuven also attracts a high number of international students from its four priority regions (China, India, Mekong area, Ethiopia) and has set up intensive collaboration with these countries. Via the Erasmus Mundus Master's programme the campus in Ghent receives students from a variety of countries worldwide.

The Faculty of Engineering Technology is an active member of **SEFI** (Société Européenne pour la Formation des Ingénieurs, [www.sefi.be](http://www.sefi.be)), the European Society for Engineering Education.

## Figures

Bachelor's students:	3640
Master's students:	1930
Preparatory and bridging programmes students:	870
Advanced Master's students:	30
PhD students:	100

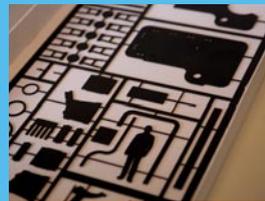
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KU Leuven. Inspiring the outstanding.

## FACULTY OF ARCHITECTURE



The **Faculty of Architecture** was founded in 2012 as the most recent embodiment of a century-old tradition of excellence in architectural education at the Sint-Lucas School of Architecture. The uniqueness of the programmes taught at **campus Sint-Lucas Ghent** and **campus Sint-Lucas Brussels** stems from the integration and interaction of design studios and technical, theoretical and explorative artistic courses and research.



### Study programmes

The faculty offers the following programmes

#### Taught in Dutch:

- Bachelor in Architecture
- Master in Architecture
- Bachelor in Interior Architecture
- Master in Interior Architecture
- Master in Urban Design and Spatial Planning

#### Taught in English:

- International Master of Architecture

#### Continuing education:

- Module Spatial project management
- Module Management of an architect's firm

Interaction between the different programmes is stimulated through shared reviews, exhibitions, seminars, workshops, excursions, etc.

In the Faculty of Architecture, the design process – and particularly its social and cultural role – is the core of the education. It also defines the trajectory of graduates' later practice or research career.

The teaching staff at the Sint-Lucas campuses include many leading international architects and researchers, all of whom bring extensive experience in the field of Interior Architecture, Architecture and Urban Design and Strategic Planning to the classroom and design studio.

## Locations

Situated in the heart of Europe, Brussels and Ghent are two culturally vibrant and diverse international university cities. Both cities are centrally located and are easily accessible from anywhere in Europe or beyond. Both Ghent, the historic heart of Flanders, and Brussels, the capital of Europe, provide students with a particularly invigorating environment, combining the most diverse aspects of architecture with unexpected cultural opportunities to widen one's own frame of reference. Brussels and Ghent are simultaneously historical cities and dynamic, modern architectural and cultural centres, offering a full-option architectural, social and historical landscape. The Sint-Lucas campuses are well-equipped base points to further develop and engage the contemporary discourse on architecture from multiple critical vantage points.

## International orientation

Several programmes of the **Faculty of Architecture** were awarded a 'strong international orientation' recommendation by the NVAO (Dutch-Flemish Accreditation Organisation). They are the first and currently the only architecture programmes in Flanders and the Netherlands to receive this distinction. In awarding the commendation, the NVAO acknowledges the structural incorporation and thematic depth of the international dimension of our curriculum.

The Faculty of Architecture takes its international dimension as the basis for its own quality assessment. The faculty's international activities are extensive and diversified and include student mobility and staff exchange on a European and intercontinental level, internationally oriented programmes for incoming students, international workshops and competitions, international research projects, international internships, development cooperation, etc. The faculty works hard to consolidate and enrich its network of architecture professionals and researchers. This network spans Europe, Australia, the United States, Latin America, Africa and Asia. Students are granted special access to this international forum.



## Figures

Bachelor's students:	1030
Master's students:	780
Phd students:	20

## Contact

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# KU LEUVEN

## DEPARTMENT OF ARCHITECTURE



The new Department of Architecture of KU Leuven brings together researchers from the Faculty of Engineering Science and the Faculty of Architecture. With locations in Leuven, Brussels and Ghent. With over 75 professors, 15 postdoc and 90 PhD researchers, this is Flanders' largest research department within the domain of Architecture. The department is at the crossroads of various research methodologies and traditions. It stems from a polytechnic as well as an artistic tradition, comprising a wide range of social-scientific dimensions.

### Mission and vision

We aim to set the standard for policy-oriented, and applied research, including research by design in Flanders. The research performed at this department will thus inform Belgian and Flemish policies in architecture, urbanism and spatial planning and will foster the advancement of architecture in Flanders. Our explicit goal is to assure that sustainability, technical robustness, social innovation and spatial quality are further developed and will stay high on the political agenda, both in the near future and in the long run. The department moreover will contribute to fortifying the basis for research in (interior) architecture, conservation, as well as urbanism and spatial planning. To that end, we maintain relationships with various stakeholders, such as public institutions, industry, professional federations, social organizations and architectural and engineering offices.

On an international level, the department continues to be a stronghold in a number of key domains: architectural theory and history, conservation, urbanism and spatial planning (including human settlements). Research by design, sustainable architecture and design optimization are priority fields within our research portfolio. In each of these domains the department aims to lead the way by directing European projects, supporting international organizations and promoting the international exchange of researchers. Interdisciplinary and transdisciplinary collaborations with the arts, with other scholarly fields, with technical and technological disciplines, and with societal actors, are driving our research practices.



## Research Profile

Research in architecture is informed by different paradigms and by different fields of knowledge: the arts, the humanities and technical (engineering) sciences. The department therefore consists of three sections, which accommodate different research groups which lean towards one of these three corner points.

The section '**Architecture and Society**' groups professors and research groups that actively engage with the humanities and social sciences, using a broad variety of relevant methodologies from these fields. Its research ranges from theory to practice and experimentation, across all spatial scales from the building element to the territorial, and through time from the past (history) to the future (planning). Its main areas of interest are: architectural history and conservation; architectural theory; planning and development.

### KEY-WORDS:

architectural history • theory and criticism • spatial planning • construction history • interior architecture • urban studies

The section '**Architecture and Design**' aims to understand and foster design as a way of knowing and as a means of knowledge production, within the context of scientific research, university education, and the professional practice of architecture and urbanism. Its research comprises a

dialectic process of analytical investigation and operational synthesis, with a focus on creativity as a catalyst for innovation and foresight.

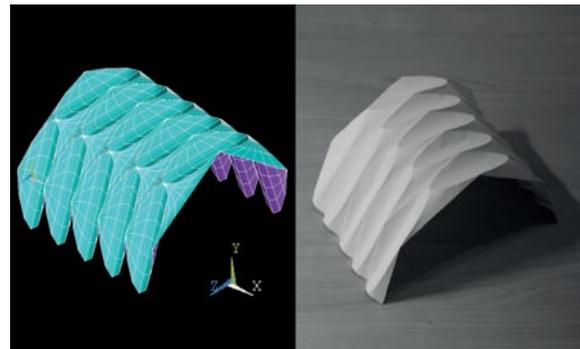
### KEY-WORDS:

design studies • matter and materiality • research by design • curation • human-computer interaction • urban projects

The section '**Architectural Engineering**' aims for innovation in building design by approaching architecture from an engineering viewpoint. The focus is on the technical aspects of architecture such as structural systems or building physics, and on the design collaboration and communication of engineers and architects. These issues are tackled in a multidisciplinary setting in order to develop integrated design and to assess and improve life cycle costs, overall performance and sustainability of buildings and the built environment.

### KEY-WORDS:

sustainability • life cycle assessment • cost modeling • industrialized building systems • building information modeling • computational modeling • design optimization



## Figures

Professors	75
Postdoctoral researchers	15
PhD researchers	90

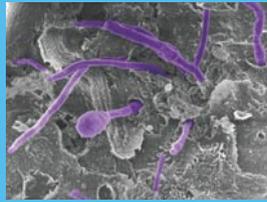
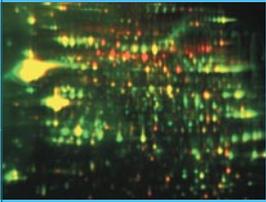
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## DEPARTMENT OF BIOLOGY



### Research Profile: Evolving insights in life

The department consists of four divisions, whose diverse activities range from molecular and physiological research at the level of cells and organisms to ecological research on populations, communities and ecosystems. Our research is internationally renowned and embedded in well established worldwide collaborations with other universities, research institutes and companies.



Although our primary motivation is to obtain insight into patterns and processes at different levels of biological organization and to understand the basis and evolution of mechanisms allowing organisms to adapt to their continuously changing environment, this knowledge often leads to applications with important economic or societal benefits.

#### Research goals include

- Understanding evolution in natural and anthropogenic populations
- Providing strategies to sustainably manage the natural resources
- Understanding ecology and diversity from molecular mechanisms
- Genetic analysis and identification of the molecular basis of life threatening diseases and complex traits
- Understanding neural and endocrine regulation of physiological processes, development and behavior in model organisms
- Advancing fundamental and conceptual insight in cells and organisms to provide integrative and innovative solutions to increase crop production, to identify disease biomarkers, to develop diagnostic tools and identify effective therapeutics

#### Recent achievements

- Reconstruction of evolution in natural systems via "resurrection ecology"
- Tracing individuals to their source population
- Discovery that a genome triplication occurred at the origin of 75% of flowering plants
- Discovery of nutrient transceptors: plasma membrane nutrient transporters with an additional nutrient sensing function
- Elucidation of carbohydrate and energy metabolism and sensing mechanisms in plants and yeast and their impact on growth, development and stress tolerance
- Discovery of novel processes by which microbial interactions cause systemic diseases
- Understanding of the molecular mechanisms underlying healthy ageing

- Novel insight in neuropeptidergic control of associative and complex learning
- Elucidation of cellular processes involved in protein aggregation management
- Establishment animal vision center: functionality from retina to cortex
- Alternatives for animal testing: body-on-a-chip

## Divisions

### Division Ecology, Evolution and Biodiversity

#### Conservation:

- Aquatic Ecology, Evolution and Conservation
- Socio-ecology and Social Evolution
- Biodiversity and Evolutionary Genomics
- Plant Conservation and Population Biology

#### Division Animal Physiology and Neurobiology:

- Neuroplasticity and Neuroproteomics
- Insect Physiology and Molecular Ethology
- Functional Genomics and Proteomics
- Molecular Developmental Physiology and Signal Transduction
- Comparative Endocrinology
- Neural Circuit Development and Regeneration

#### Division Molecular Physiology of Plants and Micro-organisms:

- Functional Biology
- Molecular Plant Biology

#### Division Molecular Microbiology and Biotechnology:

- Molecular Cell Biology

#### Metacognition in Science Education:

- Metacognition in Science

#### Research at Kulak:

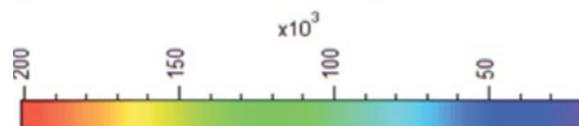
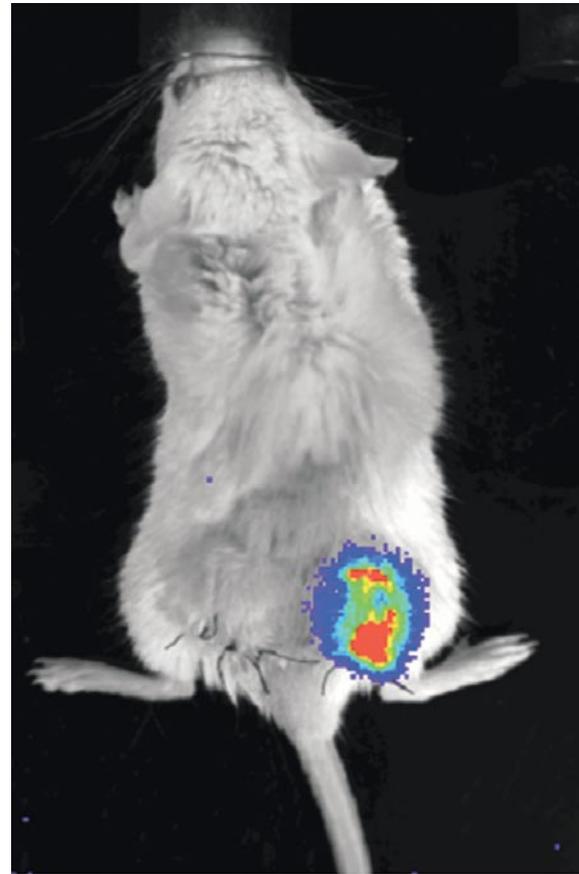
- Aquatic Biology

#### NERF collaboration:

- Neuro-Electronics Research Flanders (NERF) located within the Imec campus in Leuven.

## Spin-offs

- **ReMYND:** [www.remynd.com/](http://www.remynd.com/)
- **ADx NeuroSciences:** [www.adxneurosciences.com/](http://www.adxneurosciences.com/)



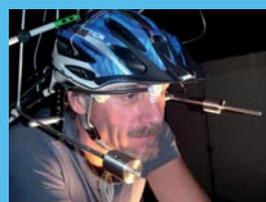
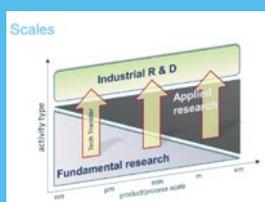
## Figures

Professors	30
Postdoctoral researchers	45
PhD researchers	190

## Contact

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## DEPARTMENT OF BIOSYSTEMS (BIOSYST)



The Department of Biosystems is a multidisciplinary group of scientists who use their scientific knowledge and technical skills to conduct fundamental and applied research into prokaryotic and eukaryotic biosystems.

The department aims to:

- generate fundamental scientific knowledge on the physiological processes within these biosystems, their genetic control and their interaction with the environment;
- provide technical solutions for sustainable agro-production, better health, and animal and human welfare in the industrial and developing world;
- maintain and expand a scientific platform for top education and training.

### Research profile

Our research focuses on cellular and molecular characterization at the genomic, transcriptomic, proteomic and metabolomic level of crops, animals (including humans) and micro-organisms, and their interaction with the environment. Advancing from this fundamental scientific understanding, our research measures, models and predicts bioresponses. We also design and empirically explore technical control and interventions by physical and genetic means with an eye toward sustainable agriculture, the food chain and improving animal/human health. This includes research in the following areas:

- **Plants:** germplasm identification, description and preservation; genetic diversity and breeding; improved crop production and harvesting; diseases and pest controls; postharvest storage; and food quality and safety
- **Farm animals:** improved growth, reproduction, and embryonic development; nutrition and disease protection; and animal welfare in management, housing and transport
- **Humans:** comfort, health, fitness and safety
- **Collaborations and services:** upon demand

### Keywords

Subunit vaccines • animal welfare • meat quality • epidemiology • production and quality systems • nutrition • mucosal immunity • disease diagnosis • egg quality • egg production • chicken physiology • cryopreservation • proteomics • genetic engineering • breeding • genomics • transcriptomics • metabolomics • bacteriophage • Pseudomonas • phage display • yeast two-hybrid • fingerprinting • genetic maps • plant physiology • biocontrol • agricultural machinery • postharvest • processing • sensor • food • biostatistics • predictive microbiology • computational biology • systems biology • precision engineering for humans • precision livestock farming • tropical crop production • farming systems, phenotyping • microfluidics • biosensors • biomechanics • biofluidics • fluxomics • biophotonics • agro-ecosystem modelling • life cycle assessment • technical sustainability

## Divisions

### Division of Mechatronics, Biostatistics and Sensors (MeBioS)

MeBioS investigates the interaction between biological systems and physical processes. The emphasis is on the measurement of properties of biological products and process variables, the analysis of measured signals by means of advanced statistical methods, process and equipment design, optimization and control. Mathematical models to describe the working principles of biological systems at different spatial and temporal scales are essential for this purpose ([www.mebios.be](http://www.mebios.be))

### Division M3-BIORES: Measure, Model & Manage Bioresponses

The main focus of research in this division is to integrate the dynamic responses of living organisms in the monitoring and control of biological processes and this for humans (athletes, drivers of a car, workers in a factory, etc.), animals (pigs, chicken, cows, horses, etc.) and plants. Accordingly, we develop new strategies for data acquisition and statistical and system dynamical analysis of experimental and/or historical data drawn from the integrated farming system. This information is leveraged to evaluate technical sustainability through biophysical modelling, life cycle assessments and optimization.

### Division of Crop Biotechnics

The Division of Crop Biotechnics conducts fundamental and applied research into biological processes – e.g. plant resistance, at the cell/tissue-plant-field level – that support the durable production of high qualitative food crops and ornamental plants in temperate and tropical regions. Controlling the genetic and environmental aspects of these processes provides the basis for improving culture techniques and breeding more durable cultivars.

### Division of Livestock-Nutrition-Quality

The Division of Livestock-Nutrition-Quality conducts fundamental and applied research on farm animals focusing particularly on their physiological and behavioural responses to environmental, nutritional and social factors in order to improve production, welfare and health.

### Division of Gene Technology

The Division of Gene Technology focuses on the exploration of macromolecular interactions in biosystems and the elucidation of genetic complexity in microbial, plant and animal genomes.

## Unique infrastructure

Research at the Department of Biosystems is supported by a robust and unique infrastructure, including the following facilities and centres: a greenhouse infrastructure; Zootechnical Centre; Centre of Fruit Culture; L3 laboratory for infectious pathogens; respiration chambers; cryopreservation facilities; controlled atmosphere storage pilot plant; world banana in vitro reference collection; a mass spectrometry facility platform

## Spin-offs

Research at the Department of Biosystems has led to the founding of various spin-offs, including:

- **BioRICS**, which is developing a new generation of measurement and prediction systems for the sports and health industries. ([www.biorics.com/](http://www.biorics.com/))
- **The Flanders Centre of Postharvest Technology**, provides technology support, extension and research in the area of fresh fruit and vegetables ([www.vcbt.be](http://www.vcbt.be))
- **Better3Fruit**, breeding, development and marketing of new fruit varieties ([www.better3fruit.com/](http://www.better3fruit.com/))
- **Porphyrio**, which delivers advanced statistical technologies for modern livestock production.
- **Aqua4C**, production unit for Omega Perch™ ([www.aqua4c.com](http://www.aqua4c.com))
- **Lysando AG**, development of enzyme-based antimicrobials (Artilyns™) ([www.lysando.com](http://www.lysando.com))

## Associated Research Centres

**Soil Service of Belgium**, fertilization and irrigation expertise, ([www.bdb.be](http://www.bdb.be))

## Figures

Professors:	25
Postdoctoral researchers:	30
PhD researchers:	160

## Contact

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## DEPARTMENT OF CIVIL ENGINEERING



### The department

Civil engineering is a very broad field covering infrastructure systems, sustainable construction materials, building technology, geotechnical engineering, structural engineering, building and urban physics, hydrology and hydraulics, environmental engineering, durability and sustainability, construction management and traffic engineering.

The Department of Civil Engineering aims at responding to important societal and economical needs by performing high quality fundamental and applied research in an international context, focusing on important problems such as the effects of climate change on the built environment, the response of structures under various loads, the development of sustainable building materials, energy efficient buildings, monitoring and conservation of historical structures, and acoustic and vibration comfort in buildings.



### Research

Research in the Department of Civil Engineering is focusing on four core areas: building materials, building physics, hydraulics and structural mechanics where fundamental research is performed and new applications are developed in close connection with engineering practice and the construction sector. Research is based on experiments, both in the laboratory and in situ, and numerical modeling on the material, component, structural and environmental level.

- Building Materials and Building Technology Section, focusing on the development of sustainable building materials, structural behavior of building materials and components, and conservation and renovation of historical structures and built heritage.
- Building Physics Section, focusing on energy efficient buildings, hygrothermal performance of building components, and urban physics.
- Hydraulics Section, focusing on urban and river hydrology and hydraulics, coastal and estuarine hydrodynamics, and sediment mechanics.
- Structural Mechanics Section, focusing on vibrations in the built environment, vibration based structural identification and evaluation, building acoustics, and shape and topology optimization.
- Technology Cluster Construction, which groups researchers at KU Leuven campuses offering programmes in Engineering Technology. Focus is on practical construction applications.

## Education

The Department of Civil Engineering aims to educate civil engineers that meet the needs of the building sector and can operate in an international and competitive environment. Education is based on fundamental and applied research, with strong links to the construction industry and engineering practice.

The department is responsible for the Bachelor and Master of Science in Civil Engineering and the Bachelor of Science in Engineering: Geotechnics and Mining. It very actively supports the Bachelor and Master of Science in Engineering: Architecture, as well as several other advanced master programs, e.g. the Master of Science in Conservation of Monuments and Sites and the Master of Science in Water Resources Engineering.



## Service to society and industry

The Department of Civil Engineering is a key partner for providing high quality scientific support to (inter)national partners in the construction industry, consultancy offices, government and research institutes, via testing in laboratory and in situ, software, consultancy, pilot studies, product development, and by policy making.

## Unique infrastructure

Research, education and consultancy at the Department of Civil Engineering is supported by different laboratories that are well equipped for full and small scale testing.

- Reyntjens Laboratory with large scale mechanical test equipment for building components and equipment for mechanical and chemical analysis of building materials.
- Unique Vliet test building and hot-box/cold-box facility for the analysis of the hygrothermal behavior of highly insulated building components, under real or controlled climatic conditions.
- Building Acoustics Laboratory (collaboration with the Department of Physics and Astronomy) including a sound transmission suite and an anechoic chamber.
- Equipment for structural vibration measurements, applied for vibration monitoring, dynamic system identification, and structural health monitoring.
- Hydraulics Laboratory, equipped with an autonomous water circulation system, test flumes and measuring equipment, for tests on combined sewer overflow structures and storage sedimentation tanks.
- Infrastructure at the Technology Cluster Construction, including IEA EBC Annex 58 full-scale testing facilities, large equipment for structural component testing, laser equipment for on-site high-resolution measurements, Welding Engineering Centre, and cyclic triaxial testing apparatus.

The Department of Civil Engineering also develops numerical modeling packages for, among others, heat and mass transfer in building materials and components, building energy consumption, computational fluid dynamics, structural analysis, dynamic soil-structure interaction, vibrations in the built environment, dynamic system identification, building acoustics, sediment transport and river, estuarine and coastal hydraulics. Several of these packages are licensed to universities, research institutes, consultancy offices and industrial partners.

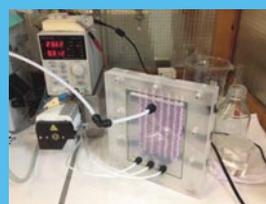
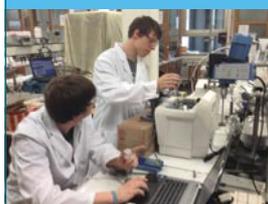
## Figures

Professors	30
Postdoctoral researchers	15
PhD researchers	70

## Contact

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## DEPARTMENT OF CHEMICAL ENGINEERING



The chemical industry plays an important economic role in Belgium, representing more than 20% of the gross national product. High-level scientific research in conventional and frontier areas of chemical and biochemical technology as well as in-depth education and training of chemical engineers are required to maintain this capacity and to introduce the necessary innovations in a changing socio-economic context. The Chemical Engineering Department guarantees the highest quality for both of them.

To this end, numerous industrial collaborations exist and an industrial advisory board, consisting of CEOs of leading chemical companies, provides valuable feedback on the department's strategic decisions.

The international dimension of the department is strengthened by a multitude of longstanding international collaborations and by the Chemical Technology master, which is offered in English. The latter not only attracts international scholars but also enables exchanges and even dual degrees with prestigious universities in Europe (Nancy, Aachen) and North America (Delaware, Montréal).

[https://onderwijsaanbod.kuleuven.be/opleidingen/e/SC\\_51370066.htm](https://onderwijsaanbod.kuleuven.be/opleidingen/e/SC_51370066.htm)

In order to meet changing industrial demands and to keep up with major new developments in the field of technical and occupational safety, the advanced academic programme on Safety Engineering was conceived. This master is a joint initiative of the KU Leuven (with the Chemical Engineering department taking the lead) and essencia (the Belgian umbrella organization of companies that are active in the field of chemistry and life sciences).

[www.kuleuven.be/studieaanbod/manamas/opleidingen/safetyengineering.html](http://www.kuleuven.be/studieaanbod/manamas/opleidingen/safetyengineering.html)

### Research profile

In general terms, chemical technology deals with the transformation of matter. It represents a major contribution to the quality of life at various levels. The department of Chemical Engineering has chosen to develop strong research groups in novel areas which have a large potential for impacting the future of (bio)chemical engineering and technology.

#### Chemical engineering and industrial biotechnology

Exploitation at process level of advances in biotechnology will result in novel and cleaner (bio)chemical process technology. Furthermore, the research line on biological wastewater treatment links sustainability and bioreactor technology concepts to evolve to a resource efficient economy.

#### Chemical product design of soft matter

Creation of added value lies in the final stages of product design. Chemical engineers are well equipped to rationally design products with more stable and better controlled properties, for example, in the area of nanomaterials and renewables.

#### Sustainability and innovation in chemical process engineering

Improvement of conventional processes is targeted by using hybrid or multifunctional technologies, down-sized equipment and novel energy sources leading to devices and flow sheets with reduced raw material and energy consumption. All of this will lead to more resource efficiency, intrinsic safety and process intensification.

## Keywords

### Process

process engineering and control • (bio)reactors • industrial biotechnology • transport phenomena • membrane separation • membrane & other separation technology • pervaporation • ultrasound, light, microwaves and plasma • microstructured reactors • electrochemistry

### Product

chemical product design • (bio)polymer technology • polymer processing and recycling • nanotechnology • interface design • colloid technology • coating technology • rheology • nanoparticle self-assembly • renewable materials design

### Planet

process intensification • resource recovery and recycling • biological wastewater treatment • (chemical and biological) safety • predictive microbiology and food safety

### Computational approaches

multi-objective optimization • computational fluid dynamics

## Divisions

The above mentioned research lines are covered by the five divisions of the department.

- Chemical and Biochemical Process Technology and Control
- Soft Matter, Rheology and Technology (SMaRT)
- Process Engineering for Sustainable Systems (ProcESS)
- Renewable Materials and Nanotechnology Research Group, Campus Kortrijk
- Sustainable Chemical Process Technology Cluster

## Unique infrastructure

### Process & Planet

- Parallel bioreactor systems
- Pilot scale submerged 30L Membrane Bioreactor (MBR) and filterability set-ups
- Lab scale activated sludge systems
- Standard wastewater analysis equipment
- Respirometry set-ups

- Ultrafiltration – nanofiltration – reverse osmosis – pervaporation – (s)electrodialysis – membrane distillation equipment
- Sono-, photo- microwave and plasma reactors
- Micro- and millistructured flow reactors
- Autoclave reactors for solid-liquid processes
- Galvanic line
- Chemical analysis for inorganic (ICP-MS, IC, AAS, (MP-)AES) and organic (GC, GC-MS, HPLC, TOC, LC-MS, AOX, FTIR) compounds
- Inverted fluorescence microscopy equipped with camera and tailor made image analysis software
- Public and other modeling software: GInaFit, RAYMOND, CFD software, geochemical models

### Product

- Rotational, elongational and capillary rheological devices to characterize flow behaviour of structural liquids from water-like to highly viscous ones
- 2D rheological devices to study interfacial dynamics
- Rheo-optical equipment to characterize microstructures during flow using confocal and traditional microscopy, birefringence, dichroism and SALS
- Polymer, dispersion and nanomaterial processing equipment
- Special devices: Rheo-DSC, electrospinning, counter rotating and microgap rheometers, and Isothermal Titration Calorimetry
- Elementary Analysis
- Dynamic light scattering and zeta potential measurements

## Industrial collaborations

Genencor International, SABIC, DSM, Campbell Foods, Keppel Seghers, AGFA Gevaert, Cytec Surface Specialties, IPCOS, Pantarein, DSM, BASF, Nestlé, Arkema, Dupont, Solvay, P&G, Johnson & Johnson, Group Machiels, Umicore, Akzo Nobel, Smart Materials, SAIREM, Nitto Europe, Citrique, DEME, ENVISAN, Recmix, Devan chemicals, ...

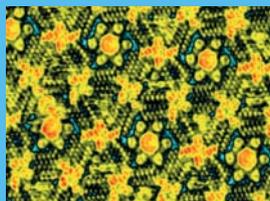
## Figures

Professors	30
Postdoctoral researchers	15
PhD researchers	90

## Contact

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## DEPARTMENT OF CHEMISTRY



### Research profile

Research in chemistry and biochemistry will be instrumental in solving some of the most urgent challenges faced by humanity, such as the increasing scarcity of commodities and energy supply.

Although the department's primary goal is to obtain insight into the composition, structure and properties of chemical compounds and the design, synthesis and development of new (bio)molecular materials, the knowledge thus gained often leads to applications with significant economic or societal benefits

The department aims at developing and maintaining leading, internationally renowned research programmes on fundamental and applied problems in the fields of:

- The design, synthesis and characterization of new compounds (organic-inorganic, polymers)
- The simulation of the properties and reactivity of (bio)molecules and clusters by quantum chemical and molecular modelling methods
- The determination of the chemical and physical properties of (bio)molecules by spectroscopy, microscopy, and other characterization tools as related to their structure

The Department attracts many international students at the Masters or PhD level, which results in a multicultural and social environment

### Sections

The Department of Chemistry consists of five sections conducting high-quality research, embedded in well-established collaborations with other universities, research institutes and companies across the world. Its academic staff is committed to excellence in teaching and research.

#### Biochemistry, Molecular and Structural Biology

- Biomolecular Architecture
- Biomolecular Modelling
- Molecular and Synthetic Biology
- Biomolecular Network Dynamics
- Nanopore Devices
- Thrombosis Research

#### Quantum Chemistry and Physical Chemistry

- Computational Molecular Science and Materials
- Computational Coordination Chemistry
- Computational Inorganic chemistry
- Theory of Nanomaterials
- Reaction Kinetics
- Nano-Engineered Thin Films

#### Molecular Design and Synthesis

- Intensified Synthetic Methodology
- Heterocyclic and Medicinal Chemistry
- Inorganic Chemistry
- Bioinorganic Chemistry
- Surface and Interface

### Molecular Imaging and Photonics

- Nanoscopy and Single Molecule Detection
- Surface Nanochemistry
- Plasmonics
- Photochemistry and Spectroscopy
- Molecular Electronics and Photonics

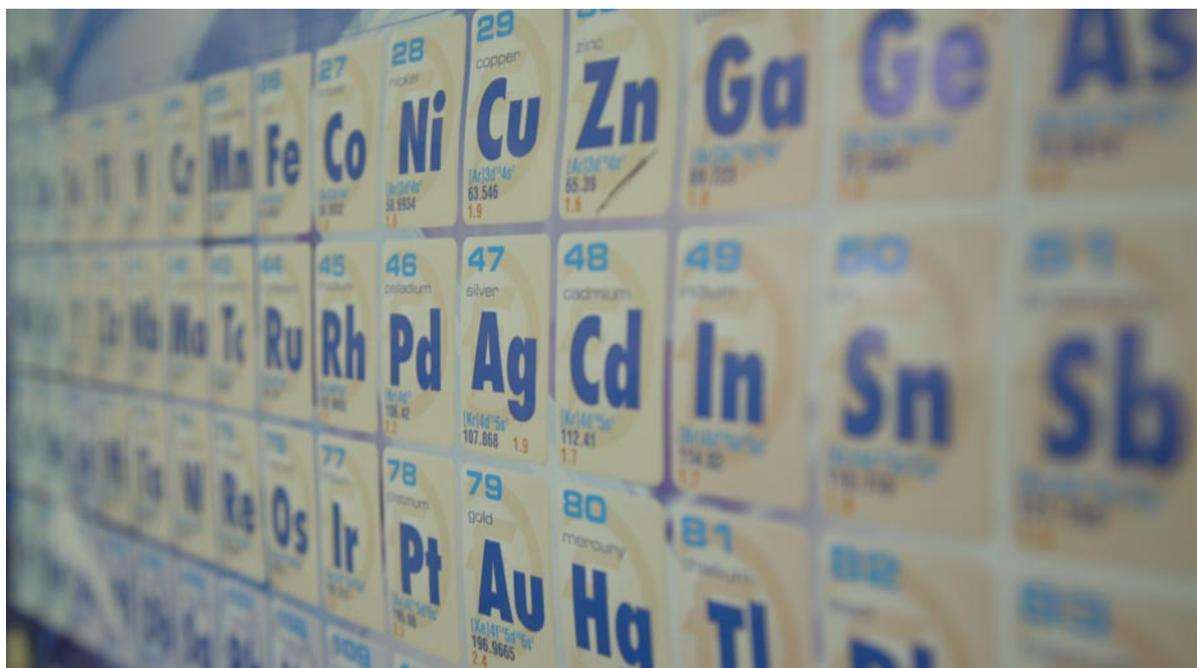
### Polymer chemistry and -materials

- Physical Chemistry of Polymeric Materials
- Macromolecular Structures
- Polymer Synthesis
- Synthesis of Organic Materials



## Figures

Professors	35
Postdoctoral researchers	60
PhD researchers	170



## Contact

Department of Chemistry  
Celestijnenlaan 200F box 2404  
3001 LEUVEN, Belgium  
[chem.kuleuven.be/en/research/mds](http://chem.kuleuven.be/en/research/mds)

## THE DEPARTMENT OF COMPUTER SCIENCE



### Introduction

The Department of Computer Science engages in software research and education. Its researchers study methods and develop tools to master the ever-increasing complexity of designing, implementing and maintaining reliable software systems, including numerical computations. The Department organizes the curricula in Informatics, Computer Science, Artificial Intelligence, Mathematical Engineering and Digital Humanities in the Faculty of Engineering Science and in the Faculty of Science.

The Department consists of four units: the Informatics Section and the Numerical Analysis and Applied Mathematics Section at Campus Leuven, a unit at Campus Kortrijk, and a Technology Cluster which groups our researchers at other campuses in Flanders.

### Teaching responsibilities

Members of the Department of Computer Science propose the curricula and teach courses in the Faculty of Engineering Science and in the Faculty of Science.

Their main responsibilities include:

- Bachelor and Master in Applied Informatics (Faculty of Science); this MSc offers three fields of specialization (software development and distributed systems, multimedia, artificial intelligence);
- Bachelor and Master of science in Engineering: Computer Science (Faculty of Engineering Science); this MSc offers six areas of specialization: software engineering, distributed systems, artificial intelligence, human-computer interaction, secure software, computational informatics);
- Master of science in Mathematical Engineering;
- Master of science in Artificial Intelligence;
- Master of science in Digital Humanities;
- PhD programme in Computer Science (Faculty of Engineering Science);
- PhD programme in Informatics (Faculty of Science).

See [wms.cs.kuleuven.be/cs/onderwijs](https://wms.cs.kuleuven.be/cs/onderwijs) (Dutch programmes) and [wms.cs.kuleuven.be/cs/english/education](https://wms.cs.kuleuven.be/cs/english/education) (English programmes)





## Research Profile

Research in the Department of Computer Science focuses on:

- methods, languages and tools to model, design, implement and maintain very complex (distributed) software systems which are agile, mobile, reliable and secure;
- declarative methods in programming and knowledge representation, machine learning and data mining;
- multimedial databases and human-computer interaction;
- realistic scene visualisation;
- the development of reliable and efficient numerical methods and mathematical software.

## Research Units

Research in Leuven and Kortrijk is organized in the following research units:

- **Distributed and Secure Software** (DistriNet): web applications and service oriented systems, embedded and ubiquitous systems, mobile systems and cloud computing platforms, security in software engineering, software architecture and systems implementation, high assurance through software verification, multi-agent systems and autonomic computing, sensor networks and Internet of Things and middleware and software development environments
- **Declarative Languages and Artificial Intelligence** (DTAI): machine learning, data mining, uncertainty in AI, knowledge representation, declarative programming, constraint programming, program optimization and predictive medicine

- **Combinatorial Optimisation and Decision Support** (CODeS): (decentralized) decision making, metaheuristics, combinatorial optimization, scheduling, vehicle routing, cutting & packing in industry, bioinformatics, e-learning and geo-information systems
- **Human-Computer Interaction** (HCI): information visualisation, learning analytics awareness & sense-making, (social) information retrieval, natural language and multimedia processing, text mining, computer graphics, photorealistic rendering and procedural texturing & modeling
- **Scientific Computing** (TWR): numerical simulation, optimization and control, high performance computing dynamical systems, multiscale methods and uncertainty quantification
- **Numerical Approximation and Linear Algebra Group** (NALAG): tensor computations, structured matrix computations, large scale matrix problems, multivariate approximation, orthogonal functions (in one and more variables), splines, wavelets and matrix manifold optimization
- **Numerical Integration, Nonlinear Equations and Software** (NINES): approximation of multi-dimensional integrals, quasi-Monte Carlo methods, highly oscillatory quadrature, integral equation methods and mathematical software

## Figures

Professors	50
Postdoctoral researchers	55
PhD researchers	150

## Contact

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 Celestijnenlaan 200A box 2402  
 3001 LEUVEN, Belgium  
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[info@cs.kuleuven.be](mailto:info@cs.kuleuven.be)

## DEPARTMENT OF EARTH AND ENVIRONMENTAL SCIENCES



The Department of Earth and Environmental Sciences aims at innovative scientific research on the functioning of geo- and ecosystems at different spatial and temporal scales, including the interaction between socio-economic aspects and bio-, litho-, hydro- and atmosphere. The department provides attractive and high-quality academic training at BSc, MSc and PhD level in the fields of bio-engineering, geology, geography and tourism. In addition, the department aspires to make a significant contribution to the scientific understanding of societal issues such as environmental pollution, food production, climate change, nature and landscape management, soil and water management, exploitation of underground resources, rural and urban development, international development collaboration and tourism.

### Research profile

Research focuses on the fundamental understanding of the processes and interactions in the earth system, the interaction between society and its environment, the sustainable management of natural resources and the spatial dimension of human societies. Besides fundamental research, there are strong programmes on applied topics such as environmental pollution, the provision of raw materials and the exploitation of the subsoil, soil conservation, town planning and bio-economic aspects.

### Keywords

Agricultural and food economics • global food supply chains • food security • biodiversity • bioenergy • biogeology • building materials mineralogy • Cenozoic stratigraphy • desertification • clay geology • ecotoxicology • environmental change and biogeochemical cycles • environmental geochemistry • forestry • geoarchaeology • geodynamics • geofluids • geomatics and remote sensing • GIS • green roofs • heavy metals • hydrogeology • integrated land use analysis • magmatic petrology • nature conservation • ore geology • population geography • regional climate modelling • remote sensing • soil and water management • soil chemistry • soil degradation • soil erosion • soil fertility • soil water transport processes • structural geology • sustainable management of natural resources • tourism and recreation • urban geography • urban green

### Divisions

#### Division of Geography

The Division of Geography focuses on a broad range of topics: geomorphic processes, soil degradation and soil conservation; society and environment; terrestrial ecosystems and environmental change; regional climate studies; learning and teaching processes within geography; socio-economic geography of settlements; economic geography, regional development and spatial policy; tourism and leisure; prehistoric archaeology.

### Division of Geology

The Division of Geology concentrates on the study of Planet Earth, i.e. the 'solid' Earth in particular aiming to figure out the significance of processes in the geosphere with respect to the functioning of Earth's systems from global to local scale. Researchers look into 'deep time', but always in the perspective of the challenges the society faces today and in the future. Besides the fundamental research questions, this research is often driven by societal and economic aspects of geology (e.g. non-renewable natural resources, geohazards, water, climate change and waste management).

### Division of Soil and Water Management

The Division of Soil and Water Management focuses on nutrient and contaminant cycling in soils and water with applications to soil fertility management, land use planning, irrigation advice and risk assessment. The expertise encompasses environmental microbiology and biodegradation of pesticides, risk assessments of heavy metals in the environment, soil mapping and analysis of land-use, modelling transport processes of water and solutes (nutrients-contaminants) in soils, expert systems for efficient crop water use, long-term trends in tropical soil fertility and speciation of metals and phosphorous species in soil and water.

### Division of Forest, Nature and Landscape

The Division of Forest, Nature and Landscape focuses on forest, nature, urban green and its sustainable management. This includes topics such as evaluating environmental impacts on ecosystems (including agro-ecosystems), their components and optimizing its sustainability using a variety of data analysis and decision supporting tools.

### Division of Bioeconomics

The Division of Bioeconomics focuses on the social and economic components of sustainability. A first research focus is on global and local supply chains of food and other bio-based products, specifically on supply chain innovations and their impact towards creating more sustainable food systems. A second research focus is on the sustainable use of land and other natural resources for the production of food, feed, fiber, fuel and fun, with specific focus on the interaction between social, economic and environmental aspects in the exploitation of land and other natural resources.

## Unique infrastructure

The research infrastructure of the Department of Earth and Environmental Sciences includes two plant growth chambers as well as equipment for the simulation of wind and water processes. The department has an extensive research infrastructure for mineralogical, chemical and microbial analysis including XRD for mineral identification, X-ray pole figure goniometer, AMS analysis, DTA-TGA for mineralogical studies, ICPMS, AES and SEM for chemical and mineral analysis, laser diffraction size analysis, X-ray settling analysis and advanced microscopes for cathodoluminescence, fluorescence and fluid inclusion analysis. Of course, the necessary computer infrastructure for GIS and remote sensing applications is also available.

## Collaboration and users

The department has intensive links with a large number of other universities and research institutions both in Europe and elsewhere. It has a long tradition in collaboration with developing countries.

The department contributes significantly to **LSUE – The Leuven Sustainable Earth Research Centre** – which brings together scientists from different disciplines with a common interest in sustainable development.

Various recent ad hoc collaborative projects between archeologists and natural scientists at KU Leuven gave rise to the **Centre for Archaeological Sciences**.

## Spin-offs

**Spatial Applications Division Leuven (SADL)**

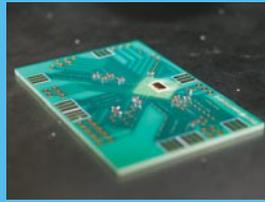
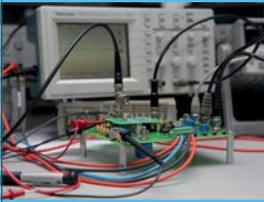
## Figures

Professors:	40
Postdoctoral researchers:	25
PhD researchers:	190

## Contact

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balie@ees.kuleuven.be  
<http://ees.kuleuven.be>

## DEPARTMENT OF ELECTRICAL ENGINEERING (ESAT)



The department of Electrical Engineering is a team of professors, researchers and students who deliver high-quality international research and education in the area of electrical engineering, electronics and information processing. The defining characteristic of this department is the strong combination of research and education activities. Within the department of electrical engineering, we work on the broad field of electricity and electronics and their applications. As a department, we contribute to technical innovations in the fields of energy, integrated circuits, information processing, image- and speech processing and telecommunication systems. This is clearly shown in the numerous top level publications, national and international research projects and awards. Furthermore, the department has a strong record in bridging the innovation gap between academia and industry. This is shown in particular by the start-up of many spin-off companies. The regional presence of the department especially facilitates the technological support of SMEs.



### Research profile

The department focuses its research on the design and application of electronics (hardware and software), signal processing and energy applications. Major challenges that electrical engineering faces today are in the areas of

- Energy
- Telecommunications
- Microelectronics (digital and analogue)
- Imaging and speech
- Signal and data processing
- Cryptography

These fields roughly correspond to the sections of the department. The department is also characterised by its direct link via Insys and Ac@imec to the Interuniversity MicroElectronics Centre ([www.imec.be](http://www.imec.be)), Europe's leading independent research centre in the field of microelectronics and nanotechnology, by its strong implications in bio-medical applications, in particular through collaboration with the Leuven University Hospitals, one of Europe's largest University Hospitals and by its association with the research center EnergyVille where the energy system of the future is investigated.

## Keywords

Analogue and digital electronics Integrated circuits • bio-informatics • biomedical engineering • chip technology • computer architectures • control theory • cryptography • data communication • data visualisation • design of micromotors • information security • electronic computer-aided design • electric energy converters • highly dynamic actuators • image processing • microelectronics • modelling of systems and circuits • nanoelectronics • power electronics • power engineering • radiation - automatic control • RF and microwave circuits • signal processing • smart grids • speech processing • telecommunication

## Divisions

### ELECTA – Electrical Energy & Computer Architectures

- Smart grids
- Power systems
- Rational use of energy
- Robust industrial automation
- Power electronics
- Energy markets

### MICAS – Microelectronics and Sensors

- Analogue and mixed-signal circuit design
- Analogue and mixed-signal design methodology
- Sensor and biomedical systems
- Design of digital circuits and architectures
- MEMS and Microsystems
- Design of RF and microwave integrated circuits

### PSI – Centre for Processing Speech and Images

- Medical image computing
- Vision for industry, communications and services
- Speech processing

### STADIUS – Center for Dynamical Systems, Signal Processing and Data Analytics

- Bio-informatics
- Biomedical data processing
- Digital signal processing for audio and telecom
- Systems, models and control

### COSIC – Computer Security And Industrial Cryptography

- Security technologies
- Embedded systems security
- Privacy technologies
- Cybercrime awareness
- Mobile and wireless security

### TELEMIC – Telecommunication and Microwaves

- EM theory and radiation
- Devices and circuits
- Propagation
- Networking

### Electrical Engineering (ESAT) TC

ESAT conducts its research mainly in Leuven, but also in Kortrijk and at the Technology Campuses of the KU Leuven throughout Flanders: Gent, De Nayer Sint-Katelijne-Waver, Geel, Diepenbeek, Groep T Leuven and Oostende.

### INSYS – Integrated Systems

ESAT-INSYS (INtegrated SYStems) is an affiliated section of ESAT associated with the MicroElectronics Centre IMEC ([www.imec.be](http://www.imec.be)). The section coordinates all teaching activities of the KU Leuven academic staff members who conduct research at IMEC.

## Unique infrastructure

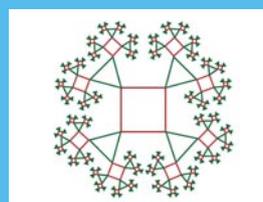
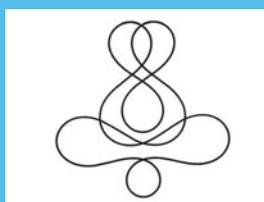
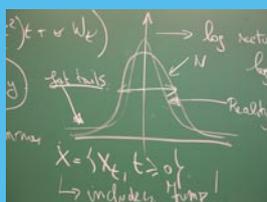
The ESAT Department is equipped with a top-notch computer infrastructure. For medical applications, it cooperates with the internationally renowned university hospital 'Gasthuisberg' and its state-of-the-art hospital infrastructure. Among other things, the department its own clean room and measuring facilities for IC design, an integrated antenna measuring site and non-linear vector network analyser for telecommunication research, a fully equipped smart grids laboratory and multimedia setups (lighting stage, 3D screen, audio lab a light and lightning laboratory).

## Figures

Professors	85
Postdoctoral researchers	85
PhD researchers	370

## Contact

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[Info@esat.kuleuven.be](mailto:Info@esat.kuleuven.be)



### Research profile

Mathematics is essential to all the natural sciences. It is the most abstract and pure of scientific disciplines and has applications in all other sciences.

The academic staff at the Department of Mathematics not only includes researchers in pure mathematics with international expertise in algebraic geometry, number theory, differential geometry, functional analysis, and real/complex analysis, but also mathematical statisticians dealing with extreme values, non- and semiparametric statistics and robust statistics as well as applied mathematicians working in plasma-astrophysics and computational fluid dynamics.

### Research Groups

#### Algebraic Geometry and Number Theory

- polynomial equations in several variables, singularities, algebraic curves and surfaces
- zeta functions (Igusa, topological, motivic, Hasse-Weil), Bernstein polynomials
- non-archimedean geometry, toric and tropical geometry, rational points over discretely valued fields
- asymptotics of oscillating integrals, exponential sums
- computational number theory
- mathematical logic, model theory

#### Algebraic Topology and Group Theory

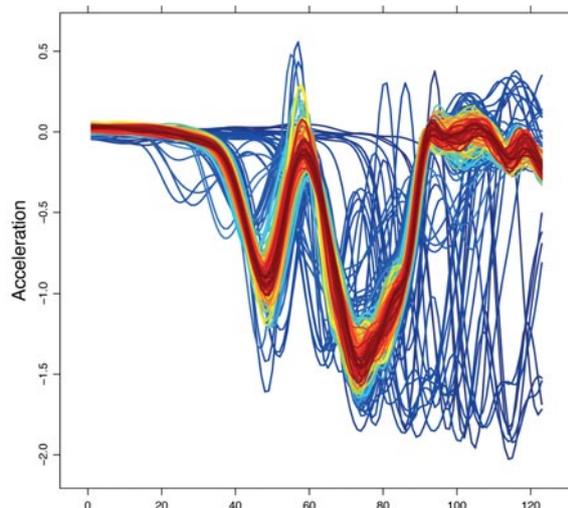
- Crystallographic actions of polycyclic-by-finite groups
- Expanding maps and Anosov diffeomorphisms of infra-nilmanifolds
- Cohomology of infra-nilmanifolds, virtually nilpotent groups and solvable Lie algebras
- Fixed point and coincidence theory for infra-nilmanifolds

#### Classical analysis

- Riemann-Hilbert methods and non-intersecting Brownian motions
- Asymptotic analysis of special functions
- Discrete and continuous Painlevé equations
- Hermite-Padé rational approximation
- Eigenvalues of random matrices
- Orthogonal and multiple orthogonal polynomials

#### Functional analysis

- Von Neumann algebras
- Kazhdan's property (T), rigidity phenomena and operator algebras
- Subfactors and II<sub>1</sub> factors
- Ergodic theory of measure preserving group actions
- Geometric group theory
- Quantum groups and quantum metric spaces
- Non-commutative geometry



### Differential Geometry

- Riemannian manifolds and submanifolds (e.g. intrinsic and extrinsic curvatures and their relations, constant mean curvature surfaces in homogeneous spaces, calibrated submanifolds)
- Lorentzian geometry and applications to general relativity
- Poisson and symplectic geometry, generalized complex geometry
- L-infinity algebras and deformation theory
- singular foliation theory, Lie algebroids and Lie groupoids
- centro-affine and affine differential geometry
- applications of differential geometry in exact, applied, medical and human sciences

### Financial Mathematics and Actuarial Statistics

- Lévy jump models and jump driven models
- Modelling financial risks
- Multivariate financial engineering
- Extreme value analysis
- Loss reserving models
- Stochastic mortality models

### Non- and Semiparametric Statistics and Smoothing

- Smoothing techniques
- Investigating dependencies between variables, via e.g. copula functions
- Flexible modelling and generalised regression models
- Varying coefficients models and additive models
- Variable selection and sparsity issues
- Estimation of frontiers and boundaries

### Robust Statistics

- High-breakdown estimators for covariance and regression
- Robust estimators for high-dimensional data
- Robust inference and model selection
- Robust functional data analysis
- Robust multiway analysis
- Depth-based procedures

### Plasma Astrophysics

- The magnetohydrodynamic model describing all large-scale plasma dynamics in the known universe
- Kinetic theory for particle-based descriptions of plasma phenomena
- Solar physics applications, modeling plasma dynamics in the solar corona, coronal seismology
- Relativistic plasma dynamics in astrophysical jets, pulsar wind nebulae, up to gamma-ray bursts
- Parallel grid-adaptive computations of fluid and plasma dynamics.

### Space Weather

- Study of variabilities in the heliosphere and the Earth's magnetosphere which are caused and driven by the solar activity
- Mathematical modeling of space weather aspects
- Magnetic reconnection and particle acceleration
- High performance computing for multi-scale plasma dynamics

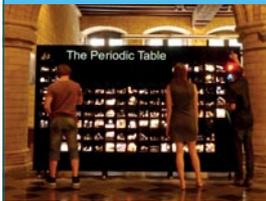
## Figures

Professors	30
Postdoctoral researchers	35
PhD researchers	60

## Contact

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## DEPARTMENT OF MATERIALS ENGINEERING



The Department of Materials Engineering (MTM) is involved in several strategic fields of materials research and development, and is currently active in the field of advanced alloys and production processes, ceramics, nanomaterials, high temperature processing of liquid metals, intermetallics, polymers and composites, thermodynamics, deformation processing, materials performance and degradation, non-destructive testing, surface engineering, biomaterials, and modelling of materials and processes. The department operates as one unit, with state of the art scientific infrastructure. A flexible organisation allows tackling scientific and industrial problems in a multidisciplinary way. MTM is the driving force behind the KU Leuven Materials Research Centre (LMRC) and intensively cooperates with imec. MTM organises a Dutch and an international Master of Materials Engineering programme.

[www.mtm.kuleuven.be/studeermateriaalkunde/voorwoord](http://www.mtm.kuleuven.be/studeermateriaalkunde/voorwoord) (Dutch programme)

[www.mtm.kuleuven.be/English/Education/studymaterials/welcome](http://www.mtm.kuleuven.be/English/Education/studymaterials/welcome) (international programme)

### Research profile

The Department of Materials Engineering (MTM) focuses on research in materials science, balancing fundamental and applied research under the umbrella of sustainability. MTM has a multi-cultural and international profile, currently representing over 30 nationalities. Important values are relevance for society, continuity and trust and confidentiality in long-term-cooperation with strong industrial and societal partners.

### Keywords

#### Materials

metals • intermetallics • ceramics • polymer based composites • porous materials • biomaterials • refractory materials • textiles • cellular materials • coatings • thin films • functionally graded materials • shape memory alloys • nanomaterials and nanocomposites

#### Characterisation

microstructural, micro-analytical and mechanical characterisation • tribochemistry • corrosion • fatigue • non-destructive testing • friction and wear

#### Processing

solidification • powder metallurgy • metal forming • sintering • electrochemistry • aqueous and non-aqueous electrodeposition • conversion layers • electrophoretic deposition • high temperature processing of liquid metals • valorisation of waste streams in high-temperature metallurgical processes

#### Modelling

thermodynamics • kinetics • phase field and lattice Boltzmann methods • multi-scale modelling of mechanical behaviour of metals - forming - FEM of metals • textiles and composites

### Divisions

There are four divisions at MTM, each of them covering different research lines and topics.

- Surface and Interface Engineered Materials (SIEM)
- Structural Composites and Alloys, Integrity and Non-destructive Testing (SCALINT)
- Sustainable Metals Processing and Recycling (SeMPeR)
- Materials Technology Cluster (TC)

## Unique infrastructure

### Characterisation:

Electrochemical techniques, thermal analysis measurements, physical properties (elastic properties, internal friction), electron microscopy (TEM, ESEM, dual-beam SEM-FIB, FEG-SEM, EBSD/OIM, EPMA), confocal scanning laser microscopy, X-ray radiography diffraction including texture measurement, suspension characterisation equipment, non-destructive testing (AE, microfocus X-ray radiography, micro- and nano-CT, acousto-optic technique, optical fibres for damage detection, high-frequency ultrasonic C-scan), friction and wear test rigs, nano-indentation and contactless surface roughness techniques, full range of tensile, bending and fatigue test equipment (with in-situ strain mapping), instrumented impact testing, etc.

### Processing:

Equal Channel Angular Extrusion (ECAE), high temperature processing of metals, microwave and spark plasma sintering, hot pressing, electrochemical transient techniques, lab-scale composite manufacturing (prepreggers, autoclave, compression moulding, etc.), powder metallurgy (gas atomisation, CIP), materials processing in strong magnetic fields, etc.

### Modelling:

Home-made software for analysis and simulation of textiles and textile composites (WiseTex, LamTex, FlowTex, TexComp), commercially available thermodynamic software (ThermoCalc, FactSage, DICTRA, ChemApp), finite element codes, home-made software for quantitative texture analysis, phase field models, lattice Boltzmann models, etc.

### Facilities:

See [www.mtm.kuleuven.be/Onderzoek/equipment/scientific-equipment](http://www.mtm.kuleuven.be/Onderzoek/equipment/scientific-equipment)

## Collaboration and users

MTM is by far the largest department of its kind in Belgium. MTM is the driving force of the KU Leuven Materials Research Centre (LMRC), is active in European framework programmes and collaborates with universities and industries worldwide.

Research funding of MTM is provided mainly by the Research Council of KU Leuven and the Research Foundation Flanders (FWO, fundamental research), IWT and SIM (applied research jointly with Flemish industries) and national (Belspo, Belgian Science Policy) and international research programmes, including European programmes such as EU FP7, Horizon 2020, the Marie Curie PEOPLE programme, the M2i-Institute in The Netherlands and various COST-actions. MTM also intensively cooperates with many research institutes and with the Belgian and European industry. Bilateral collaborations and direct industrial funding with companies is organised through LRD-KU Leuven.

## Figures

Professors	40
Postdoctoral researchers	45
PhD researchers	140

## Spin-offs

**EconCore** aims to commercialise innovative lightweight sandwich materials with honeycomb core structures for structural applications in the automotive, furniture and building industry and packaging applications.

[www.econcore.com](http://www.econcore.com)

**Falex Tribology N.V.** offers standardised tribological test equipment on friction, wear and tribocorrosion, consulting, and testing, in support of industrial developments.

[www.falexint.com](http://www.falexint.com)

**Formac** is a pharmaceutical R&D company engaged in drug delivery and development.

[www.formacpharma.com](http://www.formacpharma.com)

**InsPyro** improves and develops new sustainable high-temperature metallurgical processes.

[www.inspyro.be](http://www.inspyro.be)

**LayerWise**, now part of 3D Systems, is active in metal rapid additive manufacturing.

[www.layerwise.com](http://www.layerwise.com)

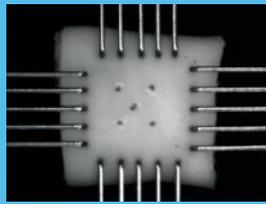
**METALogic** is an integrated service provider in the field of corrosion.

[www.metalogic.be](http://www.metalogic.be)

## Contact

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[info@mtm.kuleuven.be](mailto:info@mtm.kuleuven.be)

## DEPARTMENT OF MECHANICAL ENGINEERING



Mechanical Engineering, being one of the oldest engineering disciplines, is showing more vitality than ever before. Questions on the sustainability of energy supply, the mobility problem in our main agglomerations, healthcare for an ageing population, and safeguarding our welfare by continuing industrial innovation, point to the major challenges our society is facing. The Mechanical Engineering department is already 'making' the future by creating solutions fulfilling the needs of our future society. We do this by addressing these challenges in research but perhaps even more by preparing the future generations of engineers. An educational programme with emphasis on research-driven problem solving in socio-economic relevant fields is our major lever to a better future. The department has a staff of about 250 strong, including 26 full-time professors, and over 400 third year bachelor and master students.

### Research profile

The department is involved in a large number of research projects and is also well connected to the industry interfaces of the university and to government-sponsored technology transfer institutes at Flemish and European level. Over the years, the department has accumulated a unique research infrastructure supporting our research. The department is particularly active in spin-off creation, which is illustrating the socio-economic relevance of our research. Many of these spin-offs are technology leaders in their fields, and their products and services have world reputation.

### Keywords

structural design • structural analysis • noise engineering • vibration engineering • thermal engineering • fluid engineering • manufacturing processes • metrology • quality control • CAD/CAM • process planning • production planning • mechatronics • robotics • micro-systems • precision engineering • energy • environment • combustion • safety • biomedical engineering • functional biomechanics • bone mechanics • mechanobiology • logistics • life cycle engineering • maintenance management • routing • automotive

### Sections

**Applied Mechanics and Energy Conversion (TME)** involved in mainly concerning subjects in the fields of our energy-expertise, including thermodynamics, heat transfer, fluid dynamics, thermal- and energy systems, combustion and combustion engines, etc ...

Main research lines:

- Thermal and Fluids Engineering
- Thermotech
- Energy & Environment
- Simulation of thermal systems
- Turbulent Flow Simulation & Optimization

### Production Engineering, Machine Design and Automation (PMA)

provides education and research in the field of advanced manufacturing, noise and vibration engineering and mechatronics & robotics at a high scientific level and with international recognition

Main research lines:

- Advanced manufacturing
- Noise and Vibration engineering
- Mechatronics & Robotics
- Micro- and precision engineering

### Biomechanics (BMe)

strong expertise in both numerical and experimental analyses of human structure and function

Main research lines:

- Mechanics of bone and bone-implant system
- Mechanobiology and tissue engineering
- Computer integrated surgery systems
- Rehabilitation and prevention biomechanics

### Centre for Industrial Management/ Traffic and Infrastructure (CIB)

solid expertise in the areas of production planning, transportation, logistics and supply chain management

Main research lines:

- Logistics & Production Planning
- Design Methodologies and Life Cycle Engineering
- Traffic and Infrastructure
- Planning for the Public Sector
- Maintenance

## Collaboration and users

Close collaboration takes place with complementary laboratories in the Science and Technology group, as well as with various medical laboratories. In many of these projects, the Department plays an important role:

- The Department collaborates with all University Colleges (UCs) of the KU Leuven Association, though a system of associated and affiliated researchers as set-up by KU Leuven.
- The Department leads LMTC – Leuven Medical Technology Centre. LMTC acts as a distributed centre created to foster biomedical engineering research and

development in the Group of Science, Engineering and Technology, and in the Group of Biomedical Sciences.

- The Department also leads LASA – The Leuven Centre for Aero & Space Science, Technology and Applications – in which research groups from the entire university together with university colleges from the KU Leuven association bring together all research activities in aeronautics, space and aerospace.
- Department staff members serve as principal investigator in 4 of the strategic research lines of Leuven Mathematical Modelling and Computational Sciences Center LMCC.
- The Department is actively involved in the Leuven Materials Research centre, this also includes collaboration within the Leuven-Sirris Composites application lab.
- The Department actively participates in and holds the directorship of the KU Leuven Energy Institute and participates in the Science and Technology Core facility for nanomanufacturing where all activities on micro and nanomanufacturing and characterization will be grouped in a high-tech facility.
- The Department is a strategic partner of Flanders Make ([www.flandersmake.be](http://www.flandersmake.be)).

## Spin-offs

- Adinex, [www.adinex.be](http://www.adinex.be)
- Custom8, [www.custom8.com](http://www.custom8.com)
- dyNAVic, [www.citytripplanner.com](http://www.citytripplanner.com)
- EconCore, [www.econcore.com](http://www.econcore.com)
- Instrumen, [www.instrumen.be](http://www.instrumen.be)
- LAB, [www.leuvenairbearings.com](http://www.leuvenairbearings.com)
- 3D-systems/Layerwise, [www.layerwise.com](http://www.layerwise.com)
- Siemens/LMS International, [www.lmsintl.com](http://www.lmsintl.com)
- Materialise, [www.materialise.com](http://www.materialise.com)
- Nikon Metrology, [www.nikonmetrology.com](http://www.nikonmetrology.com)
- OptiDrive, [www.optidrive.be](http://www.optidrive.be)
- SoundTalks, [www.soundtalks.be](http://www.soundtalks.be)
- Transport & Mobility Leuven (TML), [www.tmlleuven.be](http://www.tmlleuven.be)

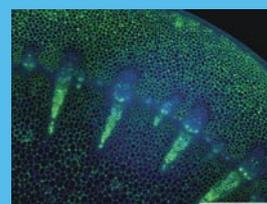
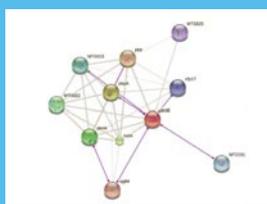
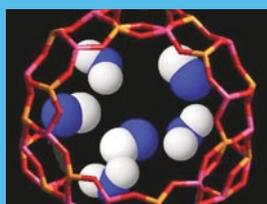
## Figures

Professors	65
Postdoctoral researchers	45
PhD researchers	230

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## DEPARTMENT OF MICROBIAL AND MOLECULAR SYSTEMS (M<sup>2</sup>S)



### Research profile

The research mission of the Department of Microbial and Molecular Systems is to gain scientific insight into complex biological and molecular systems, and specifically into micro-organisms, plants, food and catalysts. The research conducted in the department's three centres and in its technology cluster is fundamental, interdisciplinary and internationally oriented. The holistic approach necessitates input from different disciplines, including chemistry, biochemistry, microbiology, cellular biology, genetics, phytopathology, bio-informatics, catalysis, statistics, food technology and nutrition.

Experimental and computational approaches are involved. Networking and collaboration between the department's divisions and with complementary teams within and outside the university are essential. The department has an active valorisation policy of its expertise and intellectual property via project research, consulting and spin off initiatives. Members of the department contribute actively to the public debate on topics including environmental protection, natural resources, energy and fuels, food and health issues of mankind, animal and plant.

### Keywords

catalysis • green chemistry • porous materials • heterogeneous catalysts • zeolites • metalorganic frameworks • renewable resources • X-ray diffraction • solid-state NMR • porosimetry • nanofiltration • pervaporation • controlled release • membrane technology • high-throughput technology • Molecular

microbiology • plant molecular biology • biochemistry • biological chemistry • physiology • bioinformatics • systems biology • food chemistry • food biochemistry • food microbiology • food technology • food safety • microbial ecology • texture • flavour • health relevant components • high pressure processing • pulsed electric field processing • cereals • fruits and vegetables • malting and brewing

### Divisions

#### Centre for Surface Chemistry and Catalysis (COK)

The Centre for Surface Chemistry and Catalysis studies all aspects of the preparation, characterisation and industrial use of catalysts and membranes. Catalysts enable the formation of (fine) chemicals with minimal to zero formation of waste, while membranes allow separations down to a molecular level. Sustainability and green chemistry are core themes.

#### Centre for Food and Microbial Technology

The research activities of the Centre for Food and Microbial Technology evidently focus on food systems. Due to their intrinsic complexity, we follow a multidisciplinary and integrated systems approach studying different levels of organisation including molecular, macromolecular, cellular and multicellular scales. The main objective is to gain basic insights into constituents, micro-organisms and processes in the complex chain from raw material to final food product, and to translate this knowledge into product and process innovations in terms of food safety (microbiological and chemical) and quality (organoleptic properties, shelf life, and health related properties).

### Centre of Microbial and Plant Genetics (CMPG)

The core activity of the Centre of Microbial and Plant Genetics is to generate and exploit knowledge on evolution, genetic networks and biochemical pathways for a selection of bacteria, fungi and plants, taking into account different environmental conditions. The experimental systems studied are various bacteria in relation to plant (e.g. Azospirillum, Rhizobium, Pseudomonas), and human health (e.g. Lactobacillus, Pseudomonas), Saccharomyces cerevisiae, Candida albicans, Arabidopsis thaliana and crop plants. The experimental approaches combine wet lab analysis and computational biology, aiming for a systems approach by integration of biology, chemistry, bio-informatics and engineering, exemplified by the systems microbiology which is strongly developed in the CMPG.

### Cluster for Bio-engineering Technology (CBeT)

The cluster groups researchers active within the Leuven University Colleges in the broad domain of bio-engineering technology. Activities are spread over the campus locations of Ghent, Sint-Katelijne Waver and Geel. Typical application domains include industrial microbiology, plant protection, meat technology, malting and brewing, enzyme technology, food preservation technology, aroma technology, etc. Expertises involved are enzymology, fermentation, microbiology, texture analysis, microbiology and microbial ecology, functional molecular biology, plant and animal sciences.

## Unique infrastructure

- **The Centre for Microbial and Plant Genetics** is equipped with up-to-date instruments for molecular biology and biochemistry and is developing algorithms and databanks for computational biology.
- **The Centre for Food and Microbial Technology** is equipped with high pressure reactors including multivessel systems, pilot retort for thermal processing, micro-brewery, extended park for chromatography (HPLC, GC), ...

- **The Centre for Surface Chemistry and Catalysis** is equipped with: MAS-NMR using cross polarization and double rotation technique, (CPMAS/DOR) multiple quantum MAS NMR and double resonance MAS NMR (MQ MAS NMR/TRAPDOR), gas chromatography with mass spectrometry, (GC-MS) liquid chromatography with ion trap mass spectrometry (LC-MS/LC-MSn), high pressure reactors, vapor phase reactors and catalytic membrane reactors, high throughput reactors for batch and continuous flow catalysis, high throughput system for membrane testing.

## Spin-offs

- **M4E NV** (Magnets for Emulsions) markets a novel, patented emulsion technology that is easier, cheaper and in most cases better performing than the actual existing technologies ([www.m4e.be/](http://www.m4e.be/)).
- **FORMAC Pharmaceuticals NV** is a pharmaceutical R&D company engaged in drug delivery and development. Their mission is to increase pharmaceutical R&D productivity and product value by enhancing the performance of (pre)clinical drug candidates and marketed drugs ([www.formacpharma.com/](http://www.formacpharma.com/)).
- **IFAST ('Innovative Flavor and Aroma Science and Technology')** develops catalytic transformations for natural compounds in beverages. The particular expertise domain is the transformation of hop compounds for beer bittering.

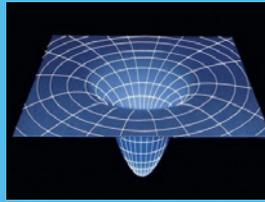
## Figures

Professors	50
Postdoctoral researchers	75
PhD researchers	250

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## DEPARTMENT OF PHYSICS AND ASTRONOMY



### Research profile

The research in our department is dedicated to the exploration of physical realities with experimental, observational, computational and mathematical techniques.

The department attracts many international students at the Master or PhD level, which results in a multicultural and social environment.

Fifteen teams within the department undertake internationally competitive research. The department's primary concern is the study of physics and astronomy and the development of innovative techniques, leading to state-of-the-art research and technical platforms. The research groups are embedded in multiple international collaborative networks and facilities and they maintain close links with industry (e.g., consulting, patents) and society (science communication, societal problems such as radio-isotopes, noise pollution, ...).

### Research Topics

#### Hard condensed matter

- Nanosystems and interfaces
- Superconductivity and magnetism
- Semiconductors

#### Soft matter and biophysics

- Polymers, thin films and interfaces
- Acoustics and thermal physics
- Wave propagation in complex media
- Biophysics

#### Nuclear physics

- Fundamental interactions
- Nuclear structure
- Nuclear reactions

#### Theoretical physics

- High-energy physics and cosmology
- Statistical physics
- Mathematical physics

#### Stellar astrophysics

- Stellar evolution
- Asteroseismology
- Exoplanets
- Astronomical instrumentation



## Research units

- Laboratory for Semiconductor Physics
- Institute for Nuclear and Radiation Physics
- Laboratory for Solid State Physics and Magnetism
- Laboratory for Soft Matter and Biophysics
- Institute for Theoretical Physics
- Institute of Astronomy

Several of the research groups in the department are involved in the following interdisciplinary research centres of the Science, Engineering & Technology group:

- Leuven Materials Research Centre (LMRC)
- Leuven centre of Aero and Space science, technology and Applications (LASA)

## Figures

Professors:	45
Postdoctoral researchers:	85
PhD researchers:	170

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