MAP2M
2018 - 2019

Master [120] in Mathematical Engineering

At Louvain-la-Neuve - 120 credits - 2 years - Day schedule - In english
Dissertation/Graduation Project: YES - Internship: optional
Activities in other languages: YES
Activities on other sites: NO
Main study domain: Sciences de l'ingénieur et technologie
Organized by: Ecole Polytechnique de Louvain (EPL)
Programme acronym: map2m - Francophone Certification Framework: 7

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Introduction

This Master’s degree programme develops the necessary knowledge and expertise for mathematical engineering:

- the design, analysis and implementation of mathematical models for the engineering of the complex systems of the industrial sector and the elaboration of effective strategies to optimise their performance;
- the implementation of theoretical and methodological tools in all areas of engineering sciences as well as in other fields such as economics, finance, environmental and life sciences.

Your Profile

You

- have solid knowledge of mathematics
- are seeking an engineering programme with a focus on applied mathematics
- want access to engineering jobs (in manufacturing and services companies) or to the areas of life sciences, environment or finance;
- want to take advantage of the most recent research advances in your area of specialisation.

Your Future Job

Mathematical engineers are present in all industrial sectors: industrial chemistry, pharmaceutical and food industries, electronics and telecommunications, energy, metallurgy, aeronautics, civil engineering, mass distribution, banking or consulting services, nanotechnologies and medical technology.

They play a role in research and development, oversee production or management and work in marketing and sales (of high tech products).

We find them in departments of finance, computer science, training and quality control, in the public sector, higher education and in the Minister of equipment and transport (www.fabi.be)

Your Programme

This Master’s degree programme offers you

- training in mathematical modelling in all areas of engineering sciences;
- flexibility when it comes to building your programme (major and elective courses compose more than half of the programme);
- the opportunity to complete part of the programme abroad or at KULeuven;
- via complementary modules, direct access to the second year Master’s degree programme in general statistics, biostatistics or actuarial sciences.
MAP2M - Teaching profile

Learning outcomes

The Master in Mathematical Engineering is an interdisciplinary engineering master centred on the notion of mathematical model that has become instrumental in engineering sciences. Through a training in modelling, simulation and optimization (MSO), the students learn to design, analyse and implement mathematical models to be applied to complex systems of the industrial or corporate world, and to create efficient strategies to optimize their performance.

The mandatory courses provide the students with the necessary common skills in MSO. They span the domains of numerical analysis and scientific computing, dynamical systems, matrix computations, stochastic models, optimization models and methods.

Students are moreover offered several coherent lists of courses, called “options”. Some of the options provide them with advanced skills in various branches of MSO: optimization and operations research, dynamical systems and control, and computational engineering. The other options pertain to data science, financial mathematics, cryptography & information security, biomedical engineering, business risks and opportunities, and launching of small and medium-sized companies.

Below is the competency framework common to all the engineering masters. The Master in Mathematical Engineering distinguishes itself by the interdisciplinary engineering scope of the competencies and by the fact that modelling-related competencies are strengthened by the strong MSO background acquired by the students.

On successful completion of this programme, each student is able to:

1. demonstrating their mastery of a solid body of knowledge in basic engineering sciences allowing them to understand and solve problems related to their discipline
   1.1 Identify and use concepts, laws, and appropriate reasoning to solve a given problem
   1.2 Identify and use appropriate modelling and calculation tools to solve problems
   1.3 Verify the plausibility and confirm the validity of results

2. organise and carry out a procedure in applied engineering to develop a product (and/or service) that meets a need or solves a particular problem:
   2.1 Analyse the problem and formulate a corresponding specifications note
   2.2 Model the problem and design one or more original technical solutions that correspond to the specifications note
   2.3 Evaluate and classify the solutions in terms of all the criteria found in the specifications note: efficiency, feasibility, quality, ergonomics and environmental security
   2.4 Implement and test a solution through a mock up, a prototype or a numerical model
   2.5 Formulate recommendations to improve the operational character of the solution being studied

3. organise and carry out a research project in order to understand a physical phenomenon or a new problem relevant to the discipline
   3.1 Document and summarize the existing body of knowledge in the area under consideration
   3.2 Propose a model and/or an experimental device in order to simulate or test hypotheses relating to the phenomenon being studied
   3.3 Write a cumulative report that explains the potential of the theoretical or technical innovations resulting from the research project

4. contribute as part of a team to the planning and completion of a project while taking into account its objectives, allocated resources, and constraints
   4.1 Frame and explain the project’s objectives (in terms of performance indicators) while taking into account its issues and constraints (resources, budget, deadlines)
   4.2 Collaborate on a work schedule, deadlines and roles
   4.3 Work in a multidisciplinary environment with peers holding different points of view: manage any resulting disagreement or conflicts
   4.4 Make team decisions and assume the consequences of these decisions (whether they are about technical solutions or the division of labour to complete a project)

5. communicate effectively (orally or in writing) with the goal of carrying out assigned projects in the workplace.
   5.1 Identify the needs of the client or the user: question, listen and understand all aspects of their request and not just the technical aspects.
   5.2 Present your arguments and adapt to the language of your interlocutors: technicians, colleagues, clients, superiors
   5.3 Communicate through graphics and diagrams: interpret a diagram, present project results, structure information
   5.4 Read and analyse different technical documents (rules, plans, specification notes)
   5.5 Draft documents that take into account contextual requirements and social conventions
   5.6 Make a convincing oral presentation using modern communication techniques.

6. demonstrate that you are able to do your job with a professional conscience and in a socially responsible manner. Show that you can evaluate the socio-technical relevance of a solution before putting it into place.
   6.1 Rigorously apply the standards of your discipline (terminology, measurement units, quality standards and security)
   6.2 Find solutions that go beyond strictly technical issues by considering sustainable development and the socio-economic ethics of a project
   6.3 Demonstrate critical awareness of a technical solution in order to verify its robustness and minimize the risks that may occur during implementation.
6.4 Evaluate oneself and independently develop necessary skills for “lifelong learning” in the field

Programme structure

The Master's degree programme consists of:

- A core curriculum (30 credits)
- The professional focus (30 credits).
- Elective courses (in the options, modules, courses of interest, or other courses if suitably motivated) to reach a total of at least 120 credits, including at least 20 credits among options 1 (optimization), 2 (systems) and 3 (computational engineering).

The graduation (or end of studies) project is normally carried out at the end of the programme (second year). Depending on the students' programme, he/she may take the courses in the first or second year if the course prerequisites allow it. This may be particularly useful for those students who pursue a portion of their studies outside of UCL as part of an exchange programme.

If during the student's previous studies, he or she has already taken a course that is part of the programme (either required or elective) or they have participated in an academic activity that is approved by the programme commission, the student may count this activity toward their graduation requirements (but only if they respect programme rules). The student will also verify that he/she has obtained the minimum number of credits required for the approval of their diploma as well as for the approval of their major (in order to include their academic distinctions in the diploma supplement).

These types of programmes will be submitted for approval by the relevant Master's degree programme jury

> Core curriculum for the Master’s degree in Engineering and Applied Mathematics
  [en-prog-2018-map2m-lmap220t.html]

> Professional focus  [en-prog-2018-map2m-lmap220s]

Options courses

> Majors for the Master's degree in mathematical engineering  [en-prog-2018-map2m-lmap902r.html]

  > Major in Optimization and operations research engineering  [en-prog-2018-map2m-lmap221o.html]
  > Major in Systems and control engineering  [en-prog-2018-map2m-lmap222o.html]
  > Major in Computational engineering  [en-prog-2018-map2m-lmap223o.html]
  > Major in Data science  [en-prog-2018-map2m-lmap224o.html]
  > Major in Financial mathematics  [en-prog-2018-map2m-lmap226o.html]
  > Major in Cryptography and information security  [en-prog-2018-map2m-lmap234o.html]
  > Major in biomedical engineering  [en-prog-2018-map2m-lmap230o.html]

> Majors in business creation and management  [en-prog-2018-map2m-lmap903r.html]

  > Major in small and medium sized business creation  [en-prog-2018-map2m-lmap232o.html]
  > Major in business risks and opportunities  [en-prog-2018-map2m-lmap231o.html]

> Elective courses  [en-prog-2018-map2m-lmap910r.html]

  > Elective courses available to students enrolled in the Master's degree in mathematical engineering  [en-prog-2018-map2m-lmap910r.html]
  > Elective courses : Transversal skills and professional contacts  [en-prog-2018-map2m-lmap951o.html]

MAP2M Detailed programme

Programme by subject

### CORE COURSES [30.0]

- **Mandatory**
  - Courses not taught during 2018-2019
  - Periodic courses not taught during 2018-2019
- **Optional**
  - Periodic courses taught during 2018-2019
- Activity with requisites

Click on the course title to see detailed informations (objectives, methods, evaluation...)

**Students may choose**

#### RELIGION COURSES FOR STUDENTS IN EXACT SCIENCES (2 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTECO2100</td>
<td>Questions of religious sciences: Biblical readings</td>
<td>Hans Ausloos</td>
<td>2</td>
<td>1q</td>
</tr>
<tr>
<td>LTECO2200</td>
<td>Questions of religious sciences: reflections about Christian faith</td>
<td>Dominique Martens</td>
<td>2</td>
<td>2q</td>
</tr>
<tr>
<td>LTECO2300</td>
<td>Questions of religious sciences: questions about ethics</td>
<td>Marcela Lobo Bustamante</td>
<td>1</td>
<td>x</td>
</tr>
</tbody>
</table>

#### RELIGION COURSES FOR STUDENTS IN EXACT SCIENCES (2 credits)

The students choose one course between:

The student shall select

#### PROFESSIONAL FOCUS [30.0]

- **Mandatory**
  - Courses not taught during 2018-2019
  - Periodic courses not taught during 2018-2019
- **Optional**
  - Periodic courses taught during 2018-2019
- Activity with requisites

Click on the course title to see detailed informations (objectives, methods, evaluation...)

#### PROFESSIONAL FOCUS [30.0]

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINMA2171</td>
<td>Numerical Analysis : Approximation, Interpolation, Integration</td>
<td>Pierre-Antoine Absil</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINMA2370</td>
<td>Modelling and analysis of dynamical systems</td>
<td>Jean-Charles Delvenne (coord.) Denis Dochain (compensates Jean-Charles Delvenne) Denis Dochain</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINMA2380</td>
<td>Matrix computations</td>
<td>Raphaël Jungers</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINMA2470</td>
<td>Stochastic modelling</td>
<td>Philippe Chevalier</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINMA2471</td>
<td>Optimization models and methods II</td>
<td>François Glineur</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINMA2710</td>
<td>Scientific computing</td>
<td>Pierre-Antoine Absil (coord.) Anthony Papavasiliou Dirk Roose (compensates Anthony Papavasiliou)</td>
<td>5</td>
<td>2q</td>
</tr>
</tbody>
</table>
OPTIONS

Majors for the Master's degree in mathematical engineering

> Major in Optimization and operations research engineering  [ en-prog-2018-map2m-lmap221o ]
> Major in Systems and control engineering  [ en-prog-2018-map2m-lmap222o ]
> Major in Computational engineering  [ en-prog-2018-map2m-lmap223o ]
> Major in Data science  [ en-prog-2018-map2m-lmap224o ]
> Major in Financial mathematics  [ en-prog-2018-map2m-lmap226o ]
> Major in Cryptography and information security  [ en-prog-2018-map2m-lmap234o ]
> Major in biomedical engineering  [ en-prog-2018-map2m-lmap230o ]

Majors in business creation and management

> Major in small and medium sized business creation  [ en-prog-2018-map2m-lmap232o ]
> Major in business risks and opportunities  [ en-prog-2018-map2m-lmap231o ]

Elective courses

> Elective courses available to students enrolled in the Master's degree in mathematical engineering  [ en-prog-2018-map2m-lmap229o ]
> Elective courses : Transversal skills and professional contacts  [ en-prog-2018-map2m-lmap951o ]

MAJORS FOR THE MASTER'S DEGREE IN MATHEMATICAL ENGINEERING

The student shall select at least 20 credits among the first three options

MAJOR IN OPTIMIZATION AND OPERATIONS RESEARCH ENGINEERING

This option provides the students with advanced skills in optimization models and methods (continuous or discrete, deterministic or stochastic) and introduces them to various domains of application, among which operations research (quantitative methods for decision making).

The student shall select De 20 à 25 credits parmi

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor</th>
<th>Credits</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINMA2415</td>
<td>Quantitative Energy Economics</td>
<td>Gauthier de Maere d'Aertrycke (compenses Anthony Papavasiliou)</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINMA2450</td>
<td>Combinatorial optimization</td>
<td>Daniele Catanzaro (compenses Jean-Charles Delvenne)</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINMA2460</td>
<td>Optimization : Nonlinear programming</td>
<td>Yuri Nesterov</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>Code</td>
<td>Course</td>
<td>Instructor</td>
<td>Credits</td>
<td>Year</td>
</tr>
<tr>
<td>---------</td>
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<td>------</td>
</tr>
<tr>
<td>LINMA2491</td>
<td>Operational Research</td>
<td>El-Houssaine Aghezzaf (compensates Anthony Papavasiliou)</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINMA2345</td>
<td>Game theory</td>
<td>Raphaël Jungers</td>
<td>5</td>
<td>2q</td>
</tr>
</tbody>
</table>
### MAJOR IN SYSTEMS AND CONTROL ENGINEERING

This option provides students with advanced skills in the modelling and analysis of dynamical systems and in the design of control laws, with applications in biological systems and ecological and epidemiological processes in particular.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>LGBIO2060</td>
<td>Modelling of biological systems</td>
<td>Frédéric Crevecoeur (compensates Philippe Lefèvre) Philippe Lefèvre</td>
<td>5</td>
<td>1q x x</td>
</tr>
<tr>
<td>LINMA2300</td>
<td>Analysis and control of distributed parameter systems</td>
<td>Denis Dechaine</td>
<td>5</td>
<td>1q x x</td>
</tr>
<tr>
<td>LINMA2361</td>
<td>Nonlinear dynamical systems</td>
<td>Pierre-Antoine Absil</td>
<td>5</td>
<td>1q x x</td>
</tr>
<tr>
<td>LINMA2671</td>
<td>Advanced control and applications</td>
<td>Julien Hendrickx</td>
<td>5</td>
<td>1q x x</td>
</tr>
<tr>
<td>LINMA2875</td>
<td>System Identification</td>
<td>Julien Hendrickx, Vincent Wertz (compensates Julien Hendrickx)</td>
<td>5</td>
<td>2q x x</td>
</tr>
<tr>
<td>LINMA2510</td>
<td>Mathematical ecology</td>
<td>Eric Deleersnijder (coordin.) Emmanuel Hanert Thierry Van Effelterre</td>
<td>5</td>
<td>2q x x</td>
</tr>
</tbody>
</table>

The student shall select De 20 à 30 credits parmi

- **Mandatory**
- **Optional**
- **Courses not taught during 2018-2019**
- **Periodic courses taught during 2018-2019**
- **Activity with requisites**

Click on the course title to see detailed informations (objectives, methods, evaluation...).
MAJOR IN COMPUTATIONAL ENGINEERING

This option provides students with advanced skills in modelling techniques and numerical simulation methods to analyse and solve various engineering problems.

- **Mandatory**
- **Optional**
- **Courses not taught during 2018-2019**
- **Periodic courses taught during 2018-2019**
- **Activity with requisites**

Click on the course title to see detailed informations (objectives, methods, evaluation...)

The student shall select
De 20 à 25 credits parmi

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Period</th>
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</thead>
<tbody>
<tr>
<td>LGCIV2041</td>
<td>Numerical analysis of civil engineering structures</td>
<td>Jean-François Remacle</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINMA2111</td>
<td>Discrete mathematics II : Algorithms and complexity</td>
<td>Vincent Blondel, Jean-Charles Delvenne (coord.), Olivier Pereira (compensates Jean-Charles Delvenne), Thomas Peters (compensates Vincent Blondel)</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LINMA2720</td>
<td>Mathematical modelling of physical systems</td>
<td>Roland Keunings</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LMECA2170</td>
<td>Numerical Geometry</td>
<td>Philippe Chatelain, Christophe Craeye, Vincent Legat, Jean-François Remacle</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td>LMECA2300</td>
<td>Advanced Numerical Methods</td>
<td>Philippe Chatelain, Christophe Craeye, Vincent Legat, Jean-François Remacle</td>
<td>5</td>
<td>2q</td>
</tr>
</tbody>
</table>
**MAJOR IN DATA SCIENCE**

This option proposes a selection of courses of statistics, data mining, algorithmics and data architectures that introduce the students to several facets of Data Science.

<table>
<thead>
<tr>
<th>Mandatory Courses</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Courses not taught during 2018-2019</td>
<td></td>
</tr>
<tr>
<td>Periodic courses taught during 2018-2019</td>
<td></td>
</tr>
<tr>
<td>Activity with requisites</td>
<td></td>
</tr>
</tbody>
</table>

The student may choose

De 20 à 30 credits parmi

### Compulsory courses in data science

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINMA2472</td>
<td>Algorithms in data science</td>
<td>Vincent Blondel, Jean-Charles Delvenne (coord.), Gautier Klings, Vladimir</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td></td>
<td>(compensates Vincent Blondel) Lelo Peel (compensates Jean-Charles Delvenne)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30h + 22.5h</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Elective courses in data science

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>LELEC2870</td>
<td>Machine Learning : regression, dimensionality reduction and data visualization</td>
<td>John Lee (compensates Michel Verleysen), Michel Verleysen</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30h + 30h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LINGI2145</td>
<td>Cloud Computing</td>
<td>Etienne Riviere</td>
<td>5</td>
<td>1q</td>
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<tr>
<td></td>
<td></td>
<td>30h + 15h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LINGi2172</td>
<td>Databases</td>
<td>Siegfried Nijssen</td>
<td>6</td>
<td>2q</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30h + 30h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LINGI2262</td>
<td>Machine Learning : classification and evaluation</td>
<td>Pierre Dupont</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30h + 30h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LINGI2364</td>
<td>Mining Patterns in Data</td>
<td>Siegfried Nijssen</td>
<td>5</td>
<td>1q</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30h + 15h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSINF2275</td>
<td>Data mining &amp; decision making</td>
<td>Marco Saerens</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30h + 15h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSTAT2020</td>
<td>Statistical computing</td>
<td>Céline Bugli (compensates Bernadette Govaerts)</td>
<td>6</td>
<td>1q</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20h + 20h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSTAT2360</td>
<td>Seminar in data management: basic</td>
<td>Catherine Legrand</td>
<td>5</td>
<td>1q</td>
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<tr>
<td></td>
<td></td>
<td>7.5h + 10h</td>
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</tbody>
</table>
MAJOR IN FINANCIAL MATHEMATICS

The objective of this major is to introduce students to quantitative financial techniques and actuarial sciences by presenting deterministic and stochastic mathematical methods used in financial markets. The main subjects covered deal with the evaluation of financial assets and insurance products in continuous-time. Special attention is paid to numerical simulation methods.

In addition, students taking INMA2725, ACTU2020, ACTU2030, ACTU2070 and at least 15 credits from the complementary module in financial mathematics (see the section on "elective courses") as part of their elective courses are automatically admitted to the second year of the Master’s degree programme (120) in actuarial sciences.

The student shall select
De 15 à 20 credits parmi

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Teacher(s)</th>
<th>Credits</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINMA2725</td>
<td>Financial mathematics</td>
<td>Pierre Devolder</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>LACTU2020</td>
<td>Fixed income mathematics</td>
<td>Pierre Devolder</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>LACTU2030</td>
<td>LIFE INSURANCE 1</td>
<td>Pierre Devolder, François Gilles, Donatien Hainaut</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>LACTU2070</td>
<td>STOCHASTIC FINANCE 1</td>
<td>Donatien Hainaut</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>
### MAJOR IN CRYPTOGRAPHY AND INFORMATION SECURITY

As with the Master’s degree engineering programmes in electricity, computer sciences and applied mathematics, this major provides students with the knowledge of fundamental algorithms and mathematics in order to better understand information security as well as the design and implementation of solutions for problems related to electronic circuits and information systems.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>LELEC2760</td>
<td>Secure electronic circuits and systems</td>
<td>François-Xavier Standaert</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2144</td>
<td>Secured systems engineering</td>
<td>Axel Legay</td>
<td>5</td>
<td>2q</td>
</tr>
<tr>
<td>LINGI2347</td>
<td>Computer system security</td>
<td>Ramin Sadre</td>
<td>5</td>
<td>2q</td>
</tr>
</tbody>
</table>
| LINGI2348  | Information theory and coding                    | Christophe De Vleeschouwer (compensates Benoît Macq)  
Jérôme Louveaux  
Benoît Macq  
Olivier Pereira | 5       | 2q     |
| LMAT2440   | Number theory                                     | Olivier Pereira (coord.) Jean-Pierre Tignol                                 | 5       | 1q     |
| LMAT2450   | Cryptography                                      | Olivier Pereira                                                               | 5       | 1q     |
| LELEC2770  | Privacy Enhancing technology                      | Olivier Pereira (coord.) François-Xavier Standaert                            | 5       | 1q     |

The student shall select
De 15 à 30 credits parmi
MAJOR IN BIOMEDICAL ENGINEERING

As with most of the civil engineering programmes, the goal of this major is to train engineers who are capable of meeting the future technological challenges in the scientific and technical areas of biomedical engineering. This major provides students with basic knowledge of several areas of biomedical engineering such as bioinstrumentation, biomaterials, medical imaging, mathematical modelling, artificial organs and rehabilitation, and biomechanics. Through the collaboration between the Louvain School of Engineering and the School of Medicine, students benefit from an interdisciplinary programme where the art of engineering is applied to the complex and varied biomedical field.

<table>
<thead>
<tr>
<th>Type</th>
<th>Course</th>
<th>Instructor</th>
<th>Credits</th>
<th>Period</th>
<th>Activity with requisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>MANDATORY</td>
<td>LGBIO2010</td>
<td>Bioinformatics</td>
<td>Pierre Dupont</td>
<td>30h+30h</td>
<td>5 Credits</td>
</tr>
<tr>
<td>MANDATORY</td>
<td>LGBIO2020</td>
<td>Bioinstrumentation</td>
<td>André Mouraux Michel Verleysen</td>
<td>30h+30h</td>
<td>5 Credits</td>
</tr>
<tr>
<td>MANDATORY</td>
<td>LGBIO2030</td>
<td>Biomaterials</td>
<td>Sophie Demoustier Christine Dupont</td>
<td>30h+30h</td>
<td>5 Credits</td>
</tr>
<tr>
<td>MANDATORY</td>
<td>LGBIO2040</td>
<td>Biomechanics</td>
<td>Greet Kerckhofs</td>
<td>30h+30h</td>
<td>5 Credits</td>
</tr>
<tr>
<td>MANDATORY</td>
<td>LGBIO2050</td>
<td>Medical Imaging</td>
<td>Anne Bol John Lee (compensates Benoît Macq)</td>
<td>30h+30h</td>
<td>5 Credits</td>
</tr>
<tr>
<td>OPTIONAL</td>
<td>LGBIO2060</td>
<td>Modelling of biological systems</td>
<td>Frédéric Crevecoeur (compensates Philippe Lefèvre) Philippe Lefèvre</td>
<td>30h+30h</td>
<td>5 Credits</td>
</tr>
</tbody>
</table>

The student may choose
De 15 à 30 credits parmi

### Required courses in biomedical engineering

Students enrolled in this major must select a minimum of 15 credits among the following required courses except for those students enrolled in the Master's degree programme in computer science and engineering who are required to take 20 credits.

### Elective courses in biomedical engineering for students enrolled in the ELEC Master's degree programme

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Instructor</th>
<th>Credits</th>
<th>Period</th>
<th>Activity with requisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>LELEC2870</td>
<td>Machine Learning : regression, dimensionality reduction and data visualization</td>
<td>John Lee (compensates Michel Verleysen) Michel Verleysen</td>
<td>30h+30h</td>
<td>5 Credits</td>
<td>1q</td>
</tr>
<tr>
<td>LELEC2885</td>
<td>Image processing and computer vision</td>
<td>Christophe De Vleeschouwer (coord.) Laurent Jacques</td>
<td>30h+30h</td>
<td>5 Credits</td>
<td>1q</td>
</tr>
</tbody>
</table>
MAJORS IN BUSINESS CREATION AND MANAGEMENT

MAJOR IN SMALL AND MEDIUM SIZED BUSINESS CREATION

In keeping with most of the Masters’ degrees in civil engineering, the goal of this major is to familiarize the civil engineering student with the specifics of entrepreneurship and business development in order to develop the necessary abilities, knowledge and tools to create a business.

It is a truly interdisciplinary initiative where students from different faculties are brought together in cross-disciplinary teams to create an entrepreneurial project.

The Interdisciplinary program in entrepreneurship (CPME) is spread over two years and is integrated into more than 20 Masters (8 faculties). The program includes a collective and interdisciplinary master thesis focused on an entrepreneurial project (start-up or spin-off) and realized in teams of 3 to 4 students from 3 to 4 different faculties. The access is reserved for a small number of students by a selection procedure.

Additional information may be found at www.uclouvain.be/cpme.

This major is not available in English and may not be taken at the same time as the major “Business risks and opportunities”.

De 20 à 25 credits parmi

Required courses for the major in small and medium sized businesses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCPME2001</td>
<td>Entrepreneurship Theory (in French)</td>
<td>Frank Janssen</td>
<td>5</td>
<td>1q x</td>
</tr>
<tr>
<td>LCPME2002</td>
<td>Managerial, legal and economic aspects of the creation of a company (in French)</td>
<td>Yves De Cordt, Marine Falize</td>
<td>5</td>
<td>1q x</td>
</tr>
<tr>
<td>LCPME2003</td>
<td>Business plan of the creation of a company (in French)</td>
<td>Julie Hermans, Frank Janssen</td>
<td>5</td>
<td>2q x</td>
</tr>
<tr>
<td>LCPME2004</td>
<td>Advanced seminar on Enterpreneurship (in French)</td>
<td>Roxane De Hoe, Frank Janssen</td>
<td>5</td>
<td>2q x</td>
</tr>
</tbody>
</table>

Prerequisite CPME courses

Student who have not taken management courses during their previous studies must enroll in LCPME2000.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCPME2000</td>
<td>Venture creation financement and management I</td>
<td>Yves De Rongé, Olivier Giacomin</td>
<td>5</td>
<td>1q x</td>
</tr>
</tbody>
</table>
### MAJOR IN BUSINESS RISKS AND OPPORTUNITIES

This major is not available in English and may not be taken at the same time as the major « Interdisciplinary program in entrepreneurship – CPME ».

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Period</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>LFSA1290</td>
<td>Introduction to financial and accounting management</td>
<td>André Nsabimana (compensates Gerrit Sarens) Gerrit Sarens</td>
<td>4</td>
<td>2q</td>
<td>1, 2</td>
</tr>
<tr>
<td>LFSA140</td>
<td>Elements of law for industry and research</td>
<td>Vincent Cassiers Werner Derijcke Bénédicte Inghels</td>
<td>3</td>
<td>1q</td>
<td>1, 2</td>
</tr>
<tr>
<td>LFSA2210</td>
<td>Organisation and human resources</td>
<td>John Cultiaux</td>
<td>3</td>
<td>2q</td>
<td>1, 2</td>
</tr>
<tr>
<td>LFSA2230</td>
<td>Introduction to management and to business economics</td>
<td>Benoît Gaillly</td>
<td>4</td>
<td>2q</td>
<td>1, 2</td>
</tr>
<tr>
<td>LFSA2245</td>
<td>Environment and business</td>
<td>Thierry Bréchet Jean-Pierre Tack (compensates Thierry Bréchet)</td>
<td>3</td>
<td>1q</td>
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</table>

#### De 16 à 20 credits parmi

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Period</th>
<th>Year</th>
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<tbody>
<tr>
<td>LFSA2202</td>
<td>Ethics and ICT</td>
<td>Axel Gosseries Olivier Pereira</td>
<td>3</td>
<td>2q</td>
<td>1, 2</td>
</tr>
<tr>
<td>LLSMS2280</td>
<td>Business Ethics and Compliance Management</td>
<td>Carlos Desmet</td>
<td>5</td>
<td>1q</td>
<td>1, 2</td>
</tr>
</tbody>
</table>

#### Alternative to the major in business risks and opportunities for computer science students

Computer science students who have already taken courses in this field while pursuing their Bachelor's degree may choose between 16-20 credits from the courses offered in the management minor for computer sciences.
ELECTIVE COURSES

ELECTIVE COURSES AVAILABLE TO STUDENTS ENROLLED IN THE MASTER'S DEGREE IN MATHEMATICAL ENGINEERING

<table>
<thead>
<tr>
<th>Mandatory</th>
<th>Optional</th>
<th>Periodic courses not taught during 2018-2019</th>
<th>Activity with requisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☑</td>
<td>☐</td>
<td>☐</td>
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</tbody>
</table>

Students must accumulate a minimum of 120 credits over the course of their Master's degree programme.

Complement to the major in financial mathematics

Students taking 15 credits in this module as well as LINMA2725, LACTU2030 and LACTU2070 will be automatically admitted to the second year of the Master's degree programme in actuarial sciences. This module is intended only for students who plan to use the financial mathematics major to eventually enrol in the actuarial sciences programme.

<table>
<thead>
<tr>
<th>Year</th>
<th>Course Title</th>
<th>Credits</th>
<th>Period</th>
<th>Requisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LACTU2010</td>
<td>5</td>
<td>1q</td>
<td>30h+15h</td>
</tr>
<tr>
<td>2</td>
<td>LACTU2040</td>
<td>5</td>
<td>2q</td>
<td>30h+15h</td>
</tr>
<tr>
<td>2</td>
<td>LACTU2060</td>
<td>5</td>
<td>2q</td>
<td>30h</td>
</tr>
<tr>
<td>2</td>
<td>LACTU2080</td>
<td>5</td>
<td>2q</td>
<td>30h</td>
</tr>
</tbody>
</table>

Module en biostatistique et technométrie

Les étudiants qui suivent 30 crédits dans ce module pourront réaliser en un an le Master en statistique, orientation biostatistique [120 crédits]. Plus d'informations concernant ces cours et cette passerelle peuvent être obtenues via le Secrétariat de l'Ecole en statistique, biostatistique et sciences actuarielles (LSBA): info-stat-actu@uclouvain.be

<table>
<thead>
<tr>
<th>Year</th>
<th>Course Title</th>
<th>Credits</th>
<th>Period</th>
<th>Requisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LBIRA2101</td>
<td>4</td>
<td>1q</td>
<td>30h+15h</td>
</tr>
<tr>
<td>1</td>
<td>LBIRC2106</td>
<td>3</td>
<td>1q</td>
<td>22.5h+15h</td>
</tr>
<tr>
<td>2</td>
<td>LSTAT2040</td>
<td>5</td>
<td>2q</td>
<td>30h+15h</td>
</tr>
<tr>
<td>2</td>
<td>LSTAT2130</td>
<td>4</td>
<td>2q</td>
<td>15h+5h</td>
</tr>
<tr>
<td>2</td>
<td>LSTAT2220</td>
<td>4</td>
<td>1q</td>
<td>15h+5h</td>
</tr>
<tr>
<td>2</td>
<td>LSTAT2310</td>
<td>4</td>
<td>1q</td>
<td>15h+5h</td>
</tr>
<tr>
<td>2</td>
<td>LSTAT2330</td>
<td>5</td>
<td>2q</td>
<td>22.5h+7.5h</td>
</tr>
<tr>
<td>2</td>
<td>LSTAT2360</td>
<td>5</td>
<td>1q</td>
<td>7.5h+10h</td>
</tr>
<tr>
<td>2</td>
<td>LSTAT2370</td>
<td>6</td>
<td>2q</td>
<td>7.5h+25h</td>
</tr>
</tbody>
</table>

Module en statistique générale et mathématique

Les étudiants qui suivent 30 crédits dans ce module pourront réaliser en un an le Master en statistique, orientation générale [120 crédits]. Plus d'informations concernant ces cours et cette passerelle peuvent être obtenues via le Secrétariat de l'Ecole en statistique, biostatistique et sciences actuarielles (LSBA): info-stat-actu@uclouvain.be

<table>
<thead>
<tr>
<th>Year</th>
<th>Course Title</th>
<th>Credits</th>
<th>Period</th>
<th>Requisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LELEC2870</td>
<td>5</td>
<td>1q</td>
<td>30h+30h</td>
</tr>
<tr>
<td>2</td>
<td>LINGI2262</td>
<td>2</td>
<td>2q</td>
<td>30h+30h</td>
</tr>
</tbody>
</table>

Click on the course title to see detailed informations (objectives, methods, evaluation...)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Duration</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINMA2472</td>
<td>Algorithms in data science</td>
<td>Vincent Blondel (co-ordinator), Gautier Krings, Leto Peel (compensates Blondel)</td>
<td>30h + 22.5h</td>
<td>5</td>
<td>1x2</td>
</tr>
<tr>
<td>LSINF2275</td>
<td>Data mining &amp; decision making</td>
<td>Marco Saerens</td>
<td>30h + 15h</td>
<td>5</td>
<td>2x</td>
</tr>
<tr>
<td>LSTAT2020</td>
<td>Statistical computing</td>
<td>Céline Bugli (co-ordinator), Bernadette Govaerts</td>
<td>20h + 20h</td>
<td>6</td>
<td>1x</td>
</tr>
<tr>
<td>LSTAT2040</td>
<td>Statistical analysis</td>
<td>Benjamin Collin (co-ordinator), Anouar El Ghouch</td>
<td>30h + 15h</td>
<td>5</td>
<td>2x</td>
</tr>
<tr>
<td>LSTAT2110</td>
<td>Data Analysis</td>
<td>Johan Segers</td>
<td>22.5h + 7.5h</td>
<td>5</td>
<td>1x</td>
</tr>
<tr>
<td>LSTAT2120</td>
<td>Linear models</td>
<td>Christian Hafner</td>
<td>30h + 7.5h</td>
<td>5</td>
<td>2x</td>
</tr>
<tr>
<td>LSTAT2130</td>
<td>Introduction to Bayesian statistics</td>
<td>Philippe Lambert</td>
<td>15h + 5h</td>
<td>4</td>
<td>1x</td>
</tr>
<tr>
<td>LSTAT2150</td>
<td>Nonparametric statistics: smoothings methods</td>
<td>Rainer von Sachs</td>
<td>15h + 5h</td>
<td>4</td>
<td>1x</td>
</tr>
<tr>
<td>LSTAT2170</td>
<td>Times series</td>
<td>Rainer von Sachs</td>
<td>22.5h + 7.5h</td>
<td>5</td>
<td>2x</td>
</tr>
<tr>
<td>LSTAT2180</td>
<td>Resampling methods with applications</td>
<td>Eugen Pircalabelu</td>
<td>15h + 5h</td>
<td>4</td>
<td>1x</td>
</tr>
<tr>
<td>LSTAT2280</td>
<td>Seminar in data management: basic</td>
<td>Catherine Legrand</td>
<td>7.5h + 10h</td>
<td>5</td>
<td>1x</td>
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</tbody>
</table>

**Courses of interest**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Duration</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>LECN2021</td>
<td>Economic Fluctuations and Foundations of Macro Policy</td>
<td>David De la Croix</td>
<td>30h</td>
<td>5</td>
<td>2x</td>
</tr>
<tr>
<td>LECN2031</td>
<td>Applied Econometrics : Time Series</td>
<td>Zhengyuan Gao</td>
<td>30h + 12h</td>
<td>5</td>
<td>1x</td>
</tr>
<tr>
<td>LECN2033</td>
<td>Applied econometrics: Microeconometrics</td>
<td>Muriel Dejemeppe</td>
<td>30h + 12h</td>
<td>5</td>
<td>1x</td>
</tr>
<tr>
<td>LELEC1350</td>
<td>APPLIED ELECTROMAGNETISM</td>
<td>Christophe Craye, Danielle Janvier (co-rd.)</td>
<td>30h + 30h</td>
<td>5</td>
<td>1x</td>
</tr>
<tr>
<td>LELEC1360</td>
<td>TELECOMMUNICATIONS</td>
<td>Luc Vandendorpe</td>
<td>30h + 30h</td>
<td>5</td>
<td>2x</td>
</tr>
<tr>
<td>LELEC2880</td>
<td>Modern design</td>
<td>Jérôme Louveau, Luc Vandendorpe</td>
<td>30h + 30h</td>
<td>5</td>
<td>2x</td>
</tr>
<tr>
<td>LELEC2885</td>
<td>Image processing and computer vision</td>
<td>Christophe De Vleeschouwer (co-rd.), Laurent Jacques</td>
<td>30h + 30h</td>
<td>5</td>
<td>1x</td>
</tr>
<tr>
<td>LELEC2900</td>
<td>Signal processing</td>
<td>Laurent Jacques (co-ordinator), Benoît Macq, Luc Vandendorpe</td>
<td>30h + 30h</td>
<td>5</td>
<td>2x</td>
</tr>
<tr>
<td>LING1123</td>
<td>Computability and complexity</td>
<td>Yves Deville</td>
<td>30h + 30h</td>
<td>5</td>
<td>2x</td>
</tr>
<tr>
<td>LING2348</td>
<td>Information theory and coding</td>
<td>Christophe De Vleeschouwer (co-ordinator), Benoît Macq, Olivier Pereira</td>
<td>30h + 15h</td>
<td>5</td>
<td>2x</td>
</tr>
<tr>
<td>LMAT1371</td>
<td>Probability Theory</td>
<td>Johan Segers</td>
<td>30h + 22.5h</td>
<td>5</td>
<td>2x</td>
</tr>
<tr>
<td>LMAT2130</td>
<td>Partial differential equations: Poisson and Laplace equations</td>
<td>Heiner Olbermann</td>
<td>30h + 30h</td>
<td>5</td>
<td>1x</td>
</tr>
<tr>
<td>LMAT2410</td>
<td>Partial differential equation: heat equation, brownian moves and numerical aspects</td>
<td>Augusto Ponce</td>
<td>30h + 15h</td>
<td>5</td>
<td>2x</td>
</tr>
<tr>
<td>LMAT2460</td>
<td>Finite mathematics and combinatorial structures</td>
<td>Jean-Charles Delvenne, Jérôme Louveau (co-ordinator), Jean-Pierre Tignol</td>
<td>30h</td>
<td>5</td>
<td>1x</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Instructor(s)</td>
<td>Credits</td>
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<tr>
<td>LMECA1100</td>
<td>Deformable solid mechanics.</td>
<td>Issam Doghri</td>
<td>5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>LMECA1321</td>
<td>Fluid mechanics and transfer phenomena.</td>
<td>Vincent Legat, Grégoire Winckelmans</td>
<td>5</td>
<td>2, x</td>
<td></td>
</tr>
<tr>
<td>LMECA2141</td>
<td>Rheology</td>
<td>Vincent Legat, Evelyne Van Ruymbeke</td>
<td>5</td>
<td>1, x</td>
<td></td>
</tr>
<tr>
<td>LMECA2660</td>
<td>Numerical methods in fluid mechanics</td>
<td>Grégoire Winckelmans</td>
<td>5</td>
<td>2, x</td>
<td></td>
</tr>
<tr>
<td>LMECA2771</td>
<td>Thermodynamics of irreversible phenomena.</td>
<td>Miltiadis Papalexandris</td>
<td>5</td>
<td>2, x</td>
<td></td>
</tr>
<tr>
<td>LMECA2732</td>
<td>Introduction to robotics</td>
<td>Renaud Ronsse</td>
<td>5</td>
<td>2, x</td>
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<tr>
<td>LSINF1121</td>
<td>Algorithmics and data structures</td>
<td>Pierre Schaus</td>
<td>5</td>
<td>1, x</td>
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<tr>
<td>LSTAT2100</td>
<td>Discrete data analysis</td>
<td>Anouar El Ghouch</td>
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<tr>
<td>LSTAT2350</td>
<td>Data Mining</td>
<td>Tim Verdonck</td>
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<td>2, x</td>
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### ELECTIVE COURSES : TRANSVERSAL SKILLS AND PROFESSIONAL CONTACTS

#### De 3 à 21 credits parmi

<table>
<thead>
<tr>
<th>mandatory</th>
<th>optional</th>
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</table>

<table>
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<tr>
<th>Courses not taught during 2018-2019</th>
<th>Periodic courses not taught during 2018-2019</th>
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<tbody>
<tr>
<td>Activity with requisites</td>
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</table>

Click on the course title to see detailed informations (objectives, methods, evaluation...)

### Compétences transversales et contact avec l'entreprise

L'étudiant choisira minimum 3 crédits parmi un stage, un ou plusieurs cours de l'option "Enjeux de l'entreprise", l'option "CPME", une UE d'activité professionnelle liée à la discipline

\[
\text{min} = 3 \text{ credits parmi}
\]

#### Internship

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Period</th>
<th>Requisites</th>
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<tbody>
<tr>
<td>LFSA2995</td>
<td>Company Internship</td>
<td>Jean-Pierre Raskin</td>
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<td>1 + 2q</td>
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<tr>
<td>LFSA2996</td>
<td>Company Internship</td>
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#### Professional integration activity specific to the program

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Period</th>
<th>Requisites</th>
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</thead>
<tbody>
<tr>
<td>LINMA2120</td>
<td>Applied mathematics seminar</td>
<td>Pierre-Antoine Absil, Jean-Charles Delverne, François Glineur, Julien Hendrick, Yurii Nesterov, Anthony Papavasiloiou</td>
<td>5</td>
<td>1 + 2q</td>
<td></td>
</tr>
<tr>
<td>LINMA2360</td>
<td>Project in mathematical engineering</td>
<td>Pierre-Antoine Absil, Nikoatas Deligiannis, Anthony Papavasiloiou, Yurii Nesterov, Anthony Papavasiloiou</td>
<td>5 + 22.5</td>
<td>1 + 2q</td>
<td></td>
</tr>
</tbody>
</table>

### Communication

L'étudiant choisit maximum 8 crédits visant le développement de ses compétences de communication

\[
\text{max} = 8 \text{ credits parmi}
\]

#### Languages

Students may select from any language course offered at the ILV. Special attention is placed on the following seminars in professional development:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Period</th>
<th>Requisites</th>
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<tbody>
<tr>
<td>LALLE2500</td>
<td>Professional development seminar German</td>
<td>Ann Rinder (coord.)</td>
<td>3</td>
<td>1 ou 2q</td>
<td></td>
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<tr>
<td>LALLE2501</td>
<td>Professional development seminar-German</td>
<td>Ann Rinder (coord.)</td>
<td>5</td>
<td>1 + 2q</td>
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</tr>
<tr>
<td>LESPA2600</td>
<td>Vocational Induction Seminar - Spanish (B2.2/C1)</td>
<td>Paula Lorente Fernandez (coord.)</td>
<td>3</td>
<td>1q</td>
<td></td>
</tr>
<tr>
<td>LESPA2601</td>
<td>Vocational Induction Seminar - Spanish (B2.2/C1)</td>
<td>Paula Lorente Fernandez (coord.)</td>
<td>5</td>
<td>1q</td>
<td></td>
</tr>
<tr>
<td>LNEER2500</td>
<td>Seminar of Entry to professional life in Dutch - Intermediate level</td>
<td>Isabelle Demulemaere (coord.), Markken Smit, Quentin Zéques</td>
<td>3</td>
<td>1 ou 2q</td>
<td></td>
</tr>
<tr>
<td>LNEER2600</td>
<td>Seminar of entry to professional life in Dutch - Upper-Intermediate level</td>
<td>Isabelle Demulemaere (coord.)</td>
<td>3</td>
<td>1 ou 2q</td>
<td></td>
</tr>
</tbody>
</table>

#### Group dynamics

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Instructor(s)</th>
<th>Credits</th>
<th>Period</th>
<th>Requisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEPL2351</td>
<td>Dynamique des groupes - Q1</td>
<td>Laurent Francis, Benoit Raucen, Piotr Sobieski (coord.), Vincent Wertz</td>
<td>3</td>
<td>1q</td>
<td></td>
</tr>
</tbody>
</table>
### LEPL2352
**Dynamique des groupes - Q2**
Laurent Francis
Benoît Raucen
Piotr Sobieski (coord.)
Vincent Wertz
15h+30h
3 Credits
2q

**Autre UE non disciplinaires**

L'étudiant peut proposer maximum 8 crédits d'ouverture vers d'autres disciplines (maximum un cours BEST ou des UE hors EPL).
*max=8 credits parmi*
Course prerequisites

A document entitled en-prerequis-2018-map2m.pdf specifies the activities (course units - CU) with one or more pre-requisite(s) within the study programme, that is the CU whose learning outcomes must have been certified and for which the credits must have been granted by the jury before the student is authorised to sign up for that activity.

These activities are identified in the study programme: their title is followed by a yellow square.

As the prerequisites are a requirement of enrolment, there are none within a year of a course.

The prerequisites are defined for the CUs for different years and therefore influence the order in which the student can enrol in the programme’s CUs.

In addition, when the panel validates a student’s individual programme at the beginning of the year, it ensures the consistency of the individual programme:

- It can change a prerequisite into a corequisite within a single year (to allow studies to be continued with an adequate annual load);
- It can require the student to combine enrolment in two separate CUs it considers necessary for educational purposes.

For more information, please consult regulation of studies and exams.

The programme’s courses and learning outcomes

For each UCLouvain training programme, a reference framework of learning outcomes specifies the competences expected of every graduate on completion of the programme. You can see the contribution of each teaching unit to the programme’s reference framework of learning outcomes in the document "In which teaching units are the competences and learning outcomes in the programme’s reference framework developed and mastered by the student?"

For each UCLouvain training programme, a reference framework of learning outcomes specifies the competences expected of every graduate on completion of the programme. You can see the contribution of each teaching unit to the programme’s reference framework of learning outcomes in the document "In which teaching units are the competences and learning outcomes in the programme’s reference framework developed and mastered by the student?"

The document is available by clicking this link after being authenticated with UCL account.
### Specific Admission Requirements

This programme is taught in English with no prerequisite in French. The student is supposed to have at least a B2 level in the European Framework of Reference. A certificate is required for the holders of a non-Belgian degree, see selection criteria of the personalized access.

#### University Bachelors

<table>
<thead>
<tr>
<th>Diploma</th>
<th>Special Requirements</th>
<th>Access</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCLouvain Bachelors</td>
<td></td>
<td>Direct Access</td>
<td>Students who have neither major nor minor in the field of their civil engineering Master's degree may have an adapted master programme.</td>
</tr>
<tr>
<td>Bachelor in Engineering</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others Bachelors of the French speaking Community of Belgium</td>
<td></td>
<td>Direct Access</td>
<td>Students with a Bachelor's degree in engineering sciences who have not taken the equivalent of a minor in the field of their civil engineering master degree may have an adapted master programme.</td>
</tr>
<tr>
<td>Bachelor in Engineering</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bachelors of the Dutch speaking Community of Belgium</td>
<td></td>
<td>Access with additional training</td>
<td>Students who have no specialisation in the field of their civil engineering master degree may have an adapted master programme with up to 60 additional credits.</td>
</tr>
<tr>
<td>Bachelor in engineering</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign Bachelors</td>
<td></td>
<td>Direct Access</td>
<td>Students with a Bachelor’s degree in engineering sciences who have not taken the equivalent of a minor in the field of their civil engineering master degree may have an adapted master programme.</td>
</tr>
<tr>
<td>Bachelor in engineering</td>
<td>Bachelors degree of Cluster Institution</td>
<td></td>
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</tr>
<tr>
<td>Bachelor in Engineering</td>
<td>For others institutions</td>
<td>Based on application: accepted, conditional on further training, or refusal</td>
<td>See personalized access</td>
</tr>
</tbody>
</table>

#### Non university Bachelors

General and specific admission requirements for this program must be satisfied at the time of enrolling at the university.
Holders of a 2nd cycle University degree

<table>
<thead>
<tr>
<th>Diploma</th>
<th>Special Requirements</th>
<th>Access</th>
<th>Remarks</th>
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<tbody>
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<td>&quot;Licenciés&quot;</td>
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Masters

<table>
<thead>
<tr>
<th>Master in Engineering</th>
<th>Direct Access</th>
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</thead>
</table>

Holders of a non-University 2nd cycle degree

Adults taking up their university training

> See the website Valorisation des acquis de l'expérience

It is possible to gain admission to all masters courses via the validation of professional experience procedure.

Access on the file

Reminder: all Masters (apart from Advanced Masters) are also accessible on file.

The first step of the admission procedure requires to submit an application online: https://uclouvain.be/en/study/inscriptions/futurs-etudiants.html

Selection criteria are summarized here.

Admission and Enrolment Procedures for general registration
Teaching method

Interdisciplinary methods

The Master’s degree programme in engineering and Applied Mathematics is by its very nature interdisciplinary because it consists of a wide range of major courses some of which are research-based (Cryptography and information security, biomedical engineering) and offered by other academic departments (financial mathematics); this naturally reinforces the interdisciplinary nature of the programme.

The programme aims to give students knowledge and skills in mathematical modelling that is used in all engineering disciplines as well as in other areas such as economics, environmental sciences or life sciences.

A final interdisciplinary aspect to the programme is the graduation project, which is frequently completed outside the department of mathematical engineering. The graduation project makes up half of the workload for the second year of the programme. It offers students the opportunity to work in-depth on a given subject and due to its size and context, introduces students to the engineering or research professions. This project may focus on a topic relating to an applied mathematics research cluster (or possibly in collaboration with an external industrial partner); or it may focus on subjects related to applied mathematics in other research clusters at the Louvain School of Engineering as well as the faculties of science, economics, management or actuarial sciences.

Diverse learning situations

The pedagogy used in the Master’s degree programme in engineering is similar to that in the Bachelor’s degree programme in engineering. Students are exposed to a variety of pedagogies: lectures, individual projects and small group work, exercise and problem-solving sessions, case studies, experimental laboratories, computer simulations, educational software, internships in industry or research, individual or group work, seminars given by external scientists.

These various learning situations develop students’ knowledge of their discipline in a way that is interdisciplinary and non-technical. They permit students to build their knowledge in an iterative and progressive manner all the while developing their independence, organisational and time management skills as well as their ability to communicate. Students have access to the newest information technology (materials, software, networks) during their studies.

For example, the Business Creation major has an interactive approach and promotes “problem-based learning”. Throughout the programme, students must work as part of multidisciplinary teams. The project has an interdisciplinary focus and groups of three students, ideally from different faculties, may collaborate on a business creation project.

Evaluation

The evaluation methods comply with the regulations concerning studies and exams. More detailed explanation of the modalities specific to each learning unit are available on their description sheets under the heading “Learning outcomes evaluation method”.

Evaluation methods conform to the rules used to evaluate coursework and exams. Further details about the methods specific to each academic department may be found in their respective evaluation descriptions (“Evaluating students’ knowledge”).

Student work is evaluated according to University rules (see the rules for evaluating coursework and exams) namely written and oral exams, laboratory exams, individual or group work, public presentations of projects and theses defences.

For more information on evaluation methods, students may consult the relevant evaluation descriptions.

To obtain a passing grade, the marks received for the teaching units are offset by their respective credits.

Mobility and/or Internationalisation outlook

Since its creation, the Louvain School of Engineering (EPL) has participated in diverse exchange programs that were put into place at the European level and beyond.

Possible trainings at the end of the programme

The Master’s degree programme in engineering and Applied Mathematics satisfies the prerequisites for other Master’s degree programmes that may be obtained upon completion of an additional year:

1. Master [120] en sciences actuarielles (UCL)

Students who take LINMA2725, LACTU2020, LACTU2030, LACTU2070 and at least 15 credits in the Complement to the major in financial mathematics (see “Elective courses”) will get direct access to the second year of the Master [120] en sciences actuarielles.

2. Master’s degree [120] in general economics (UCL)

Students who take 30 credits in the Module en biostatistique et technométrie will be able to complete in one year the Master [120] en statistique, orientation biostatistique.

3. Master’s degree [120] in general statistics (UCL)
Students who take 30 credits in the Module en statistique générale et mathématique will be able to complete in one year the Master [120] en statistique, orientation générale.

Furthermore, most of the UCL Master’s degree programmes (generally 60) are open to UCL Master’s degree diploma holders. For example:

- The Master’s degree (120) in sciences and environmental management and the Master’s degree (60) in sciences and environmental management (automatic admission with possible complementary coursework)
- Different Master’s degree programmes (60) in management (automatic admission based on written application): see this list
- The Master’s degree (60) in information and communication at Louvain-la-Neuve or the Master’s degree (60) in information and communication at Mons

Doctoral degree programmes

Enrolment in a doctoral degree programme in engineering sciences is open to students holding a Master’s degree in civil engineering. The Institute ICTEAM is associated with several specialised doctoral schools in particular the school “Systems, Optimization, Control and Networks” (for details see https://uclouvain.be/sites/socn/).

Contacts

Curriculum Management

Entity

<table>
<thead>
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<th>Structure entity</th>
<th>SST/EPL/MAP</th>
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<td>Tel: +32 (0)10 472 597   -  Fax: +32 (0)10 472 180</td>
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Academic supervisor: Pierre-Antoine Absil

Jury

• Président du Jury: Jean-Didier Legat
• Secrétaire du Jury: Raphaël Jungers

Usefull Contact(s)

• Secrétariat: Pascale Premereur