

**MAP2M**

2013 - 2014

## Master [120] in Mathematical Engineering

**At Louvain-la-Neuve - 120 credits - 2 years - Day schedule - In french**Dissertation/Graduation Project : **YES** - Internship : **optional**Activities in English: **optional** - Activities in other languages : **NO**Activities on other sites : **NO**Main study domain : **Sciences de l'ingénieur**Organized by: **Ecole Polytechnique de Louvain (EPL)**Programme code: **map2m** - European Qualifications Framework (EQF): 7**Table of contents**

|  |   |
|--|---|
| Introduction .....                                     | 2 |
| Admission .....  | 3 |
| Information .....                                      | 4 |
| - Learning outcomes .....                              | 4 |
| - Teaching method .....                                | 4 |
| - Evaluation .....                                     | 4 |
| - Mobility and/or Internationalisation outlook .....   | 4 |
| - Possible trainings at the end of the programme ..... | 5 |
| Contacts .....   | 6 |
| Detailed programme .....                               | 7 |
| - Programme structure .....                            | 7 |
| - Programme by subject .....                           | 7 |

## MAP2M - Introduction

## MAP2M - Admission

***For the specific conditions of this program : refer to the French version***

*General and specific admission requirements for this program must be satisfied at the time of enrolling at the university..*

## MAP2M - Information

### Learning outcomes

The Applied Mathematics degree will provide students with the competencies and expertise required in mathematical engineering. They will 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. Throughout their training, students will acquire both the theoretical and methodological tools which will be implemented in all fields of engineering, as well as in other walks of life in society, such as economics, environmental sciences or life sciences. The Master degree in Applied mathematics engineering is characterized by its great flexibility in setting up students' curriculum: half of the latter will be made up of elective courses. In particular, students are offered a wide spectrum of eleven coherent course modules (called « options »), some of these focussing on basic disciplines of applied mathematics (Optimization and operations research, Systems and control, Discrete mathematics and computer science), others relating to associated application fields (Financial mathematics, Information and signal processing, Biomedical engineering, Modelling and simulation of physical phenomena, Statistics), the remainder pertaining more specifically to the world of economics (Management, Economics and econometrics, Launching of small and medium-sized companies).

### Teaching method

. Features favouring interdisciplinarity :

The curriculum of the Masters in Applied mathematics engineering is intrinsically interdisciplinary. It aims to provide students with a training in mathematical modelling which is then implemented in the various disciplines of engineering, as well as in other walks of life in society, such as economics, environmental sciences or life sciences. In particular, the wide range of electives, some depending on other departments (Information and data processing, modelling and simulation of physical processes) or even other faculties (Financial mathematics, Biomedical engineering, Economics and econometrics, Statistics), will naturally contribute to strengthening this interdisciplinarity.

The final thesis, when carried out outside the department of engineering mathematics (which is often the case), is yet another source of interdisciplinarity.

. Variety of teaching situations

The pedagogy implemented in the engineering Master curriculum is aligned with that of the engineering Bachelor curriculum: active learning, a balanced mix of group and individual work, and substantial time devoted to the development of non-technical competencies.

The final thesis amounts to half of the workload of the final year ; it offers the possibility to thoroughly investigate a given subject and, through its mere volume and context, can be considered as a genuine introduction to the professional life of an engineer or a researcher. This activity can be carried out :

- either on a subject directly related to one or many basic disciplines of applied mathematics and its applications, within a research team of the department of mathematical engineering (possibly in cooperation with an external industrial partner),
- or else on a subject involving applied mathematics in some other department of the Faculty of applied sciences, or the Faculties of science, economics, management or actuarial science.

. Variety of learning situations :

The student will encounter a variety of pedagogical tools tailored to the various disciplines : formal lectures, individual projects in small groups, tutorials, project-based learning, case studies, imposed readings, experimental laboratory work, computer simulations, teachware, industrial or research training, individual and group work, seminars given by outside scientists, etc.

This variety of situations will help students to build their knowledge in an iterative and progressive manner, while developing their autonomy, organizational skills, time management, and capacity to use various modes of communication, à€The most advanced computer equipment (hardware, software, networks) is made available to assist students in their work.

The company launching specialization is based on an interactive approach and problem-based learning. Throughout the curriculum, students are required to perform group activities in multi-disciplinary groups. The final thesis is also multi-disciplinary and designed in such a way that groups of three students, ideally from three different faculties, should work on a company launching project.

### Evaluation

Les activités d'enseignement sont évaluées selon les règles en vigueur à l'Université (voir [le règlement des études et des examens](#)), à savoir à l'aide d'examens écrits et oraux, d'examens de laboratoire, de travaux personnels ou en groupe, de présentations publiques de projets et de la défense du mémoire de fin d'études.

### Mobility and/or Internationalisation outlook

## Global framework

The Faculty of Applied Sciences has taken part, since their inception, in all the various mobility programmes which have been set up at both the European and world levels.

The numerous contacts it has with professional circles, notably via its Advisory Board, have demonstrated to what extent employers are favourably impressed by a mobility experience in someone's CV. The ever-increasing internationalization of research via networks linking laboratories throughout the world, speaks in favour of encouraging this mobility.

Students' interest is aroused at the end of their Bachelor studies, notably via intensive courses such as those of the ATHENS ( ) or BEST ( ) networks.

In the course of the two-year Master's programme, students are encouraged to take part in a 1- or 2-semester exchange scheme.

Within Belgium, the Faculty of Applied Sciences is involved in a privileged partnership with the Faculteit Ingenieurswetenschappen of the Katholieke Universiteit Leuven, with whom it has set up an exchange scheme relating to the first year of the Master's curriculum ( ).

At the European level, the Faculty of Applied Sciences is strongly involved in the CLUSTER excellence network ( ). This network encourages internal mobility, since this is a guarantee of quality as concerns both the level of teaching and the hosting of exchange students. Moreover, Cluster partners have signed an agreement recognizing each other's Bachelor's curricula. This agreement stipulates that all Bachelors of network institutions will have access to the Master's studies in any institution on a par with local students.

Outside Europe, the Faculty of Applied Sciences is a partner in the Magalhaes network, which groups about fifteen European universities together with the best South American science and technology universities ( ).

Besides these network partnerships, the Faculty has also signed a number of individual agreements with various universities in Europe, North America or elsewhere in the world. A list of these agreements may be found on the website of UCL International Relations ( ).

## International possibilities (for UCL students)

UCL is also a partner in the TIME programme ( ) which gives students the opportunity to obtain two engineering degrees, via a specifically tailored curriculum.

Double engineering degree : students may replace the second year of their Master's by two years of study in a different institution within the TIME programme and conventions with the Ecole nationale supérieure du pétrole et des moteurs (ENSPM). Upon completion of their curriculum, students are automatically awarded the UCL degree following that of the host institution. Under certain conditions, students may take part in the selection process for a Master of Business Administration (MBA) at Chicago and Cornell universities (for further information, refer to website <https://www.uclouvain.be/10490.html>)

Besides intensive courses which are one component of international relations, FAS students with outstanding results are encouraged to apply for 5- or 10-month exchange programmes. When taking place during the first Master's year, exchanges are generally 10 months long. In the second year, they only last for a semester, either as courses or else research in a foreign laboratory as a complement to the final thesis.

Some other more specific exchange programmes have been set up with South America, where the academic year is naturally on an "austral" basis.

Students are informed about the various exchange programmes as from their second Bachelor's year. They are encouraged to prepare for their exchange in a timely manner, notably by taking language courses at the Modern Languages Institute of UCL.

## Possible trainings at the end of the programme

### Accessible complementary Master degrees

The Masters in Applied mathematics engineering provides the prerequisites for many other Masters degrees which can then be obtained after one year of studies :

1. 120 Master in actuarial science (UCL) A student with at least 35 credits within the Financial mathematics option has direct access to the second year of the 120 Master in actuarial science at UCL.
2. 120 Master in economics, general stream (specialized or advanced) (UCL) A student with at least 35 credits within the Economics and econometrics option has direct access to the second year of the 120 Master's in economics, general stream (specialized or advanced) at UCL.
3. 120 Master in statistics, general stream (specialized or advanced) (UCL) A student with at least 35 credits within the Statistics option has direct access to the second year of the 120 Master's in statistics, general stream (specialized or advanced) at UCL.

### Accessible Ph.D. studies

Registration for a Ph.D. in applied science is open to any bearer of a Master in engineering. The department of mathematical engineering is a partner in various thematic doctoral schools, in particular the « Systems, Optimization, Control and Networks » school of which it is the coordinator (for additional details, refer to <https://www.inma.ucl.ac.be/graduate/>).

## MAP2M - Contacts

### Curriculum Managment

Entite de la structure MAP

|                         |   |
|-------------------------|---|
| Acronyme                | <b>MAP</b>  |
| Dénomination            | Commission de programme - Ingénieur civil en mathématiques appliquées                                     |
| Adresse                 | Avenue Georges Lemaître, 4-6 bte L4.05.01<br>1348 Louvain-la-Neuve<br>Tél 010 47 25 97 - Fax 010 47 21 80 |
| Secteur                 | Secteur des sciences et technologies ( <a href="#">SST</a> )  |
| Faculté                 | Ecole Polytechnique de Louvain ( <a href="#">EPL</a> )  |
| Commission de programme | Commission de programme - Ingénieur civil en mathématiques appliquées ( <a href="#">MAP</a> )             |

**Academic Supervisor :** [Pierre-Antoine ABSIL](#)

### Jury

Président du Jury : **Piotr SOBIESKI**

Secrétaire du Jury : **François GLINEUR**

### Usefull Contacts

Secrétariat : **Nathalie PONET**

## MAP2M - Detailed programme

### Programme structure

The Master curriculum in Applied mathematics engineering will consist of at least 120 credits covering two years, with a minimum of 60 credits per year, and comprising :

- a fixed set of 60 credits, consisting of a 30-credit core curriculum and a 30-credit specialization module;
- a flexible set of 60 credits, made up of elective courses and possibly one or more « options » (15 to 30 credits apiece) chosen amongst the eleven available options : Optimization and operations research, Systems and control, Discrete mathematics and computer science, Information and signal processing, Biomedical engineering, Modelling and simulation of physical phenomena, Management, Economics and econometrics, Launching of small and medium-sized companies, Financial mathematics, Statistics.

The final thesis is generally written during the last year. However, students may choose to take any given course in the first or second year, subject to possible prerequisites. This will be the case in particular for students pursuing part of their education abroad.

If, in the course of his (her) former curriculum, a student has already been credited with a subject included in the compulsory core curriculum, or any training deemed equivalent, this subject will be replaced by any recommended elective course of the Applied mathematics curriculum, within the imposed constraints. The student is responsible for checking whether the minimum total number of credits has been reached, as well as those of the specialized field, which will appear on the final diploma.

The student's curriculum will be scrutinized for acceptance by the Mechanical engineering diploma committee.

*Whatever the focus or the options chosen, the programme of this master shall totalize 120 credits, spread over two years of studies each of 60 credits.*

#### Core study

> [core curriculum](#) [ en-prog-2013-map2m-lmap220t.html ]

> [Professional focus](#) [ en-prog-2013-map2m-lmap220s ]

#### Options courses

- > [Options du master ingénieur civil en mathématiques appliquées](#) [ en-prog-2013-map2m-lmap902r.html ]
  - > [Option in optimization and operations research](#) [ en-prog-2013-map2m-lmap221o.html ]
  - > [Control and dynamical systems](#) [ en-prog-2013-map2m-lmap222o.html ]
  - > [Discrete mathematics and computer science](#) [ en-prog-2013-map2m-lmap223o.html ]
  - > [Financial mathematics](#) [ en-prog-2013-map2m-lmap226o.html ]
  - > [Information and signal processing](#) [ en-prog-2013-map2m-lmap233o.html ]
  - > [Option in biomedical engineering](#) [ en-prog-2013-map2m-lmap230o.html ]
  - > [option : Cryptography & Information Security](#) [ en-prog-2013-map2m-lmap234o.html ]
  - > [Modelling and simulation of physical systems](#) [ en-prog-2013-map2m-lmap224o.html ]
  - > [Statistics](#) [ en-prog-2013-map2m-lmap227o.html ]
  - > [Business risks and opportunities](#) [ en-prog-2013-map2m-lmap231o.html ]
  - > [Economics and econometrics](#) [ en-prog-2013-map2m-lmap225o.html ]
  - > [Option in launching of small and medium-sized companies](#) [ en-prog-2013-map2m-lmap232o.html ]
- > [Elective courses accessible to master's student in applied mathematics engineering](#) [ en-prog-2013-map2m-lmap229o.html ]

### Programme by subject

## Core courses [30.0]

○ Mandatory

△ Courses not taught during 2013-2014

⊕ Periodic courses taught during 2013-2014

⊗ Optional

⊖ Periodic courses not taught during 2013-2014

‡ Two years course

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

The student shall select

|             |                         |    |  |            |  | Year |   |
|-------------|-------------------------|----|--|------------|--|------|---|
|             |                         |    |  |            |  | 1    | 2 |
| ○ LINMA2990 | Travail de fin d'études | N. |  | 28 Credits |  |      | x |

### ○ Religion courses for student in exact sciences

The student shall select 2 credits from amongst

The student shall select

|             |  |                    |     |           |    |   |   |
|-------------|--|--------------------|-----|-----------|----|---|---|
| ⊗ LTECO2100 | Questions of religious sciences: biblical readings                 | Hans Ausloos       | 15h | 2 Credits | 1q | x | x |
| ⊗ LTECO2200 | Questions of religious sciences: reflections about christian faith | Dominique Martens  | 15h | 2 Credits | 2q | x | x |
| ⊗ LTECO2300 | Questions of religious sciences: questions about ethics            | Philippe Cochinaux | 15h | 2 Credits | 1q | x | x |

## Professional focus [30.0]

○ Mandatory

△ Courses not taught during 2013-2014

⊕ Periodic courses taught during 2013-2014

⊗ Optional

⊖ Periodic courses not taught during 2013-2014

‡ Two years course

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

|             |  |  |               |           |    | Year |   |
|-------------|--|--|---------------|-----------|----|------|---|
|             |  |  |               |           |    | 1    | 2 |
| ○ LINMA2171 | Numerical Analysis : Approximation, Interpolation, Integration | Pierre-Antoine Absil                             | 30h<br>+22.5h | 5 Credits | 1q | x    |   |
| ○ LINMA2370 | Modelling and analysis of dynamical systems                    | Jean-Charles Delvenne,<br>Denis Dochain (coord.) | 30h<br>+22.5h | 5 Credits | 1q | x    |   |
| ○ LINMA2380 | Matrix theory  | Paul Van Dooren                                  | 30h<br>+22.5h | 5 Credits | 1q | x    |   |
| ○ LINMA2470 | Discrete stochastic models                                     | Philippe Chevalier                               | 30h<br>+22.5h | 5 Credits | 2q | x    |   |
| ○ LINMA2471 | Optimization models and methods                                | François Glineur                                 | 30h<br>+22.5h | 5 Credits | 1q | x    |   |

### ○ Cours au choix de la finalité spécialisée du master en Mathématiques Appliquées (5 credits)

L'étudiant complète son programme en choisissant un des deux cours suivants. S'il les a déjà suivi au cours de son parcours académique antérieur, il choisit un autre cours de 5 crédits du master ingénieur civil en mathématiques appliquées.

|             |  |  |         |           |    |   |   |
|-------------|--|--|---------|-----------|----|---|---|
| ⊗ LINMA1510 | Linear Control                                   | Denis Dochain  | 30h+30h | 5 Credits | 2q | x | x |
| ⊗ LINMA1731 | Stochastic processes : Estimation and prediction | Pierre-Antoine Absil,<br>Luc Vandendorpe<br>(coord.) | 30h+30h | 5 Credits | 2q | x | x |





## Options

L'étudiant complète son programme avec des options et/ou des cours au choix. Il sélectionne 60 crédits parmi ce qui suit.

### Options du master ingénieur civil en mathématiques appliquées

- > [Option in optimalization and operations research](#) [ en-prog-2013-map2m-lmap221o ]
- > [Control and dynamical systems](#) [ en-prog-2013-map2m-lmap222o ]
- > [Discrete mathematics and computer science](#) [ en-prog-2013-map2m-lmap223o ]
- > [Financial mathematics](#) [ en-prog-2013-map2m-lmap226o ]
- > [Information and signal processing](#) [ en-prog-2013-map2m-lmap233o ]
- > [Option in biomedical engineering](#) [ en-prog-2013-map2m-lmap230o ]
- > [option : Cryptography & Information Security](#) [ en-prog-2013-map2m-lmap234o ]
- > [Modeling and simulation of physical systems](#) [ en-prog-2013-map2m-lmap224o ]
- > [Statistics](#) [ en-prog-2013-map2m-lmap227o ]
- > [Business risks and opportunities](#) [ en-prog-2013-map2m-lmap231o ]
- > [Economics and econometrics](#) [ en-prog-2013-map2m-lmap225o ]
- > [Option in launching of small and medium-sized companies](#) [ en-prog-2013-map2m-lmap232o ]
- > [Elective courses accessible to master's student in applied mathematics engineering](#) [ en-prog-2013-map2m-lmap229o ]

### OPTIONS DU MASTER INGÉNIEUR CIVIL EN MATHÉMATIQUES APPLIQUÉES

L'étudiant sélectionne une ou plusieurs options parmi les suivantes.

#### OPTION IN OPTIMALIZATION AND OPERATIONS RESEARCH

Cette option a pour objectif d'introduire l'étudiant à certaines méthodes et concepts avancés en optimisation (utilisation de variables entières ou de fonctions non-linéaires, caractère stochastique) et à le familiariser avec certains de leurs domaines d'application, parmi lesquels la recherche opérationnelle (méthodologie quantitative d'aide à la prise de décisions).

● Mandatory

△ Courses not taught during 2013-2014

⊕ Periodic courses taught during 2013-2014

⊗ Optional

⊖ Periodic courses not taught during 2013-2014

⊞ Two years course

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

The student shall select

De 15 à 27 credits parmi

|             |  |  |               |           |    | Year |   |
|-------------|--|--|---------------|-----------|----|------|---|
|             |  |  |               |           |    | 1    | 2 |
| ⊗ LINMA2360 | <a href="#">Project in mathematical engineering</a>  | <a href="#">Pierre-Antoine Absil,</a><br><a href="#">François Glineur</a><br>(coord.),<br><a href="#">Yurii Nesterov,</a><br><a href="#">Paul Van Dooren</a> | 30h<br>+22.5h | 5 Credits | 2q | x    | x |
| ⊗ LINMA2415 | <a href="#">Quantitative Energy Economics</a>        | <a href="#">Anthony Papavasiliou</a>   | 30h<br>+22.5h | 5 Credits | 2q | x    | x |
| ⊗ LINMA2450 | <a href="#">Combinatorial optimization</a>           | <a href="#">Jean-Charles Delvenne</a>  | 30h<br>+22.5h | 5 Credits | 1q | x    | x |
| ⊗ LINMA2460 | <a href="#">Optimization : Nonlinear programming</a> | <a href="#">Yurii Nesterov</a>   | 30h<br>+22.5h | 5 Credits | 2q | x    | x |
| ⊗ LINMA2491 | <a href="#">Operational Research</a>                 | <a href="#">Anthony Papavasiliou</a>   | 30h<br>+22.5h | 5 Credits | 2q | x    | x |



**CONTROL AND DYNAMICAL SYSTEMS**

Cette option a pour objectif de familiariser l'étudiant avec certains concepts avancés en automatique et théorie des systèmes dynamiques, parmi lesquels l'identification des systèmes dynamiques, la synthèse des lois de commande et la mise en oeuvre de la régulation numérique, la modélisation et l'analyse des phénomènes dynamiques non linéaires.

● Mandatory

△ Courses not taught during 2013-2014

⊕ Periodic courses taught during 2013-2014

⊗ Optional

⊖ Periodic courses not taught during 2013-2014

‡ Two years course

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

The student shall select  
De 15 à 30 crédits parmi

Year

1 2

**⊗ Cours conseillés en automatique et systèmes dynamiques**

L'étudiant sélectionne au minimum 10 crédits parmi

|             |   |   |               |           |    |   |   |
|-------------|---|---|---------------|-----------|----|---|---|
| ⊗ LINMA2120 | <a href="#">Applied mathematics research seminar</a>  | <a href="#">Pierre-Antoine Absil, Vincent Blondel, Philippe Chevalier, Jean-Charles Delvenne (coord.), François Glineur, Julien Hendrickx, Raphaël Jungers, Philippe Lefèvre, Yurii Nesterov, Paul Van Dooren, Mathieu Van Vyve</a> | 30h           | 3 Credits |    | X | X |
| ⊗ LINMA2345 | <a href="#">Game theory</a>                           | <a href="#">Raphaël Jungers</a>   | 30h<br>+22.5h | 5 Credits | 2q | X | X |
| ⊗ LINMA2360 | <a href="#">Project in mathematical engineering</a>   | <a href="#">Pierre-Antoine Absil, François Glineur (coord.), Yurii Nesterov, Paul Van Dooren</a>  | 30h<br>+22.5h | 5 Credits | 2q | X | X |
| ⊗ LINMA2361 | <a href="#">Nonlinear systems</a>                     | <a href="#">Pierre-Antoine Absil</a>  | 30h<br>+22.5h | 5 Credits | 1q | X | X |
| ⊗ LINMA2671 | <a href="#">Automatic : Theory and implementation</a> | <a href="#">Julien Hendrickx</a>  | 30h+30h       | 5 Credits | 1q | X | X |
| ⊗ LINMA2875 | <a href="#">System Identification</a>                 | <a href="#">Julien Hendrickx</a>  | 30h+30h       | 5 Credits | 2q | X | X |

**⊗ Cours d'intérêt en automatique et systèmes dynamiques**

|             |  |   |               |           |    |   |   |
|-------------|--|---|---------------|-----------|----|---|---|
| ⊗ LELEC2870 | <a href="#">Machine Learning : regression, dimensionality reduction and data visualization</a> | <a href="#">Michel Verleysen</a>                    | 30h+30h       | 5 Credits | 1q | X | X |
| ⊗ LGBIO2060 | <a href="#">Modelling of biological systems</a>  | <a href="#">Philippe Lefèvre</a>                    | 30h+30h       | 5 Credits | 1q | X | X |
| ⊗ LINGI2262 | <a href="#">Machine Learning :classification and evaluation</a>                                | <a href="#">Pierre Dupont</a>                       | 30h+30h       | 5 Credits | 1q | X | X |
| ⊗ LMAPR2510 | <a href="#">Mathematical ecology</a>   | <a href="#">Eric Deleersnijder, Emmanuel Hanert</a> | 30h<br>+22.5h | 5 Credits | 2q | X | X |
| ⊗ LMECA2732 | <a href="#">INTRODUCTION TO ROBOTICS</a>   | <a href="#">Renaud Ronsse</a>                       | 30h+30h       | 5 Credits | 2q | X | X |

**DISCRETE MATHEMATICS AND COMPUTER SCIENCE**

Cette option a pour objectif de familiariser l'étudiant avec certains concepts avancés des mathématiques discrètes tels que l'analyse d'algorithmes (complexité), le calcul numérique, les problèmes combinatoires ainsi qu'avec les outils informatiques spécifiques au domaine des mathématiques appliquées.

● Mandatory

△ Courses not taught during 2013-2014

⊕ Periodic courses taught during 2013-2014

⊗ Optional

⊖ Periodic courses not taught during 2013-2014

‡ Two years course

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

*The student shall select  
De 15 à 30 credits parmi*

|             |   |   |               |           |      | Year |   |
|-------------|---|---|---------------|-----------|------|------|---|
|             |   |   |               |           |      | 1    | 2 |
| ⊗ LINGI1123 | <a href="#">Computability and complexity</a>                        | <a href="#">Yves Deville</a>  | 30h+30h       | 4 Credits | 2q   | x    | x |
| ⊗ LINMA2111 | <a href="#">Discrete mathematics II : Algorithms and complexity</a> | <a href="#">Vincent Blondel</a>   | 30h<br>+22.5h | 5 Credits | 2q △ | x    | x |
| ⊗ LINMA2450 | <a href="#">Combinatorial optimization</a>                          | <a href="#">Jean-Charles Delvenne</a>   | 30h<br>+22.5h | 5 Credits | 1q   | x    | x |
| ⊗ LINMA2472 | <a href="#">Advanced topics in discrete mathematics</a>             | <a href="#">Vincent Blondel</a><br>(coord.),<br><a href="#">Jean-Charles Delvenne</a> ,<br><a href="#">Jean-Charles Delvenne</a><br>(compensates Vincent Blondel) | 30h<br>+22.5h | 5 Credits | 1q   | x    | x |
| ⊗ LINMA2710 | <a href="#">Numerical algorithms</a>                                | <a href="#">Paul Van Dooren</a>   | 30h<br>+22.5h | 5 Credits | 2q   | x    | x |
| ⊗ LMAT2450  | <a href="#">Cryptography</a>  | <a href="#">Olivier Pereira</a>   | 30h+15h       | 5 Credits | 1q   | x    | x |
| ⊗ LMAT2460  | <a href="#">Finite mathematics and combinatorial structures</a>     | <a href="#">Jean-Charles Delvenne</a> ,<br><a href="#">Jean-Pierre Tignol</a>   | 30h           | 5 Credits | 1q   | x    | x |
| ⊗ LSINF1121 | <a href="#">Algorithmics and data structures</a>                    | <a href="#">Pierre Dupont</a>   | 30h+30h       | 5 Credits | 1q   | x    | x |

**FINANCIAL MATHEMATICS**

L'objectif de cette option est d'initier l'étudiant aux techniques de la finance quantitative et des sciences actuarielles en présentant les méthodes mathématiques déterministes et stochastiques modernes de la finance de marché. Les principaux sujets abordés concernent l'évaluation en temps continu des actifs financiers et des produits d'assurance. Une attention toute particulière sera donnée aux méthodes numériques de simulation.

De plus, l'étudiant qui suivra INMA2725, ACTU2020, ACTU2030, ACTU2070 et au moins 15 crédits au sein du module complémentaire en mathématiques financières (voir la rubrique "cours au choix") dans le cadre de ses cours au choix bénéficiera d'un accès direct à la seconde année du [Master 120 en sciences actuarielles](#).

● Mandatory

△ Courses not taught during 2013-2014

⊕ Periodic courses taught during 2013-2014

⊗ Optional

⊖ Periodic courses not taught during 2013-2014

‡ Two years course

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

*The student shall select*

*De 15 à 20 credits parmi*

|             |  |  |               |           |    | Year |   |
|-------------|--|--|---------------|-----------|----|------|---|
|             |  |  |               |           |    | 1    | 2 |
| ⊗ LINMA2725 | <a href="#">Financial mathematics</a>    | <a href="#">Pierre Devolder</a>  | 30h<br>+22.5h | 5 Credits | 1q | x    | x |
| ⊗ LACTU2020 | <a href="#">Fixed income mathematics</a> | <a href="#">Pierre Devolder</a>  | 30h+15h       | 5 Credits | 1q | x    | x |
| ⊗ LACTU2030 | <a href="#">LIFE INSURANCE 1</a>         | <a href="#">Michel Denuit,</a><br><a href="#">Françoise Gilles,</a><br><a href="#">Françoise Gilles</a><br>(compensates Michel Denuit) | 30h+15h       | 5 Credits | 1q | x    | x |
| ⊗ LACTU2070 | <a href="#">STOCHASTIC FINANCE 1</a>     | <a href="#">Pierre Devolder</a>  | 30h           | 5 Credits | 2q | x    | x |

**INFORMATION AND SIGNAL PROCESSING**

Commune aux masters ingénieur civil électricien, électromécanicien et en mathématiques appliquées, cette option a pour objectif de fournir aux étudiants de nouveaux outils liés aux graphes, aux mathématiques discrètes, aux matrices et à l'optimisation; il pourra utiliser ces outils par exemple dans des problèmes de communications, d'analyse et de reconnaissance de données et de signal, de cryptographie et d'identification des systèmes.

● Mandatory

△ Courses not taught during 2013-2014

⊕ Periodic courses taught during 2013-2014

⊗ Optional

⊙ Periodic courses not taught during 2013-2014

‡ Two years course

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

*The student shall select  
De 15 à 30 credits parmi*

Year

1 2

**○ Cours préalable en traitement de l'information et du signal**

Les étudiants qui n'ont pas suivi LINMA 1510 ou un équivalent au cours de leur parcours antérieur doivent l'inclure dans leur programme d'option. Dans ce cas le minimum de crédits requis par l'option passe à 20 crédits

|             |                |               |         |           |    |   |   |
|-------------|----------------|---------------|---------|-----------|----|---|---|
| ○ LINMA1510 | Linear Control | Denis Dochain | 30h+30h | 5 Credits | 2q | X | X |
|-------------|----------------|---------------|---------|-----------|----|---|---|

**○ Cours obligatoires (ELEC/ELME) / conseillés (MAP) en traitement du signal**

|             |  |  |         |           |    |   |   |
|-------------|--|--|---------|-----------|----|---|---|
| ○ LINGI2348 | Information theory and coding  | Jérôme Louveaux,<br>Benoît Macq (coord.),<br>Olivier Pereira   | 30h+15h | 5 Credits | 2q | X | X |
| ○ LELEC2870 | Machine Learning : regression, dimensionality reduction and data visualization | Michel Verleysen   | 30h+30h | 5 Credits | 1q | X | X |
| ○ LELEC2885 | Image processing and computer vision   | Christophe De<br>Vleeschouwer (coord.),<br>Laurent Jacques<br>(compensates<br>Benoît Macq),<br>Benoît Macq | 30h+30h | 5 Credits | 1q | X | X |

**⊗ Cours au choix en traitement du signal**

|             |   |                                     |               |           |      |   |   |
|-------------|---|-------------------------------------|---------------|-----------|------|---|---|
| ⊗ LELEC2880 | Modem design  | Jérôme Louveaux,<br>Luc Vandendorpe | 30h+30h       | 5 Credits | 2q   | X | X |
| ⊗ LINGI2262 | Machine Learning : classification and evaluation    | Pierre Dupont                       | 30h+30h       | 5 Credits | 1q   | X | X |
| ⊗ LINMA2111 | Discrete mathematics II : Algorithms and complexity | Vincent Blondel                     | 30h<br>+22.5h | 5 Credits | 2q △ | X | X |
| ⊗ LMAT2450  | Cryptography  | Olivier Pereira                     | 30h+15h       | 5 Credits | 1q   | X | X |
| ⊗ LINMA2875 | System Identification                               | Julien Hendrickx                    | 30h+30h       | 5 Credits | 2q   | X | X |

**⊗ Cours au choix exclusivement pour les étudiants du master ELEC/ELME**

|             |  |   |               |           |    |   |   |
|-------------|--|---|---------------|-----------|----|---|---|
| ⊗ LINMA1691 | Discrete mathematics - Graph theory and algorithms | Vincent Blondel,<br>Jean-Charles Delvenne<br>(compensates Vincent<br>Blondel)                             | 30h<br>+22.5h | 5 Credits | 1q | X | X |
| ⊗ LINMA1702 | Applied mathematics : Optimization I               | Vincent Blondel,<br>François Glineur<br>(compensates Vincent<br>Blondel),<br>François Glineur<br>(coord.) | 30h<br>+22.5h | 5 Credits | 2q | X | X |
| ⊗ LINMA2380 | Matrix theory                                      | Paul Van Dooren   | 30h<br>+22.5h | 5 Credits | 1q | X | X |

**⊗ Cours au choix uniquement pour les étudiants du master MAP**

|             |                    |                                 |         |           |    |   |   |
|-------------|--------------------|---------------------------------|---------|-----------|----|---|---|
| ⊗ LELEC1360 | TELECOMMUNICATIONS | Luc Vandendorpe                 | 30h+30h | 5 Credits | 2q | X | X |
| ⊗ LELEC2900 | Signal processing  | Benoît Macq,<br>Luc Vandendorpe | 30h+30h | 5 Credits | 2q | X | X |





**OPTION IN BIOMEDICAL ENGINEERING**

Commune à la plupart des masters ingénieur civil, cette option a pour objectif d'assurer la formation d'ingénieurs capables de répondre aux défis technologiques futurs dans les domaines scientifiques et techniques liés au génie biomédical. Cette option procurera aux étudiants des connaissances de base dans plusieurs domaines du génie biomédical comme la bioinstrumentation, les biomatériaux, l'imagerie médicale, la modélisation mathématique, les organes artificiels et la réhabilitation, la biomécanique. Par la collaboration entre l'Ecole polytechnique de Louvain et la Faculté de médecine, la formation dispensée vise à développer chez les étudiants une formation interdisciplinaire où l'art de l'ingénieur s'applique au domaine biomédical, à la fois complexe et varié.

○ Mandatory

△ Courses not taught during 2013-2014

⊕ Periodic courses taught during 2013-2014

⊗ Optional

⊖ Periodic courses not taught during 2013-2014

⊞ Two years course

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

*The student shall select  
De 15 à 30 credits parmi*

Year

1 2

**o Compulsory courses in biomedical engineering**

Students who have chosen this option shall select at least 15 credits from amongst the following compulsory courses, except engineering Master's students in computer science who shall take 20 credits.

|             |  |   |         |           |    |   |   |
|-------------|--|---|---------|-----------|----|---|---|
| ⊗ LGBIO2010 | <a href="#">Bioinformatics</a>                       | <a href="#">Pierre Dupont,</a><br><a href="#">Michel Ghislain</a>   | 30h+30h | 5 Credits | 2q | x | x |
| ⊗ LGBIO2020 | <a href="#">Bioinstrumentation</a>                   | <a href="#">André Mouraux,</a><br><a href="#">Michel Verleysen</a>  | 30h+30h | 5 Credits | 1q | x | x |
| ⊗ LGBIO2030 | <a href="#">Biomaterials</a>                         | <a href="#">Sophie Demoustier,</a><br><a href="#">Christine Dupont,</a><br><a href="#">Gaëtane Leloup</a>   | 30h+30h | 5 Credits | 1q | x | x |
| ⊗ LGBIO2040 | <a href="#">Biomechanics</a>                         | <a href="#">François Henrotte</a><br>(compensates <a href="#">Emilie Marchandise</a> ),<br><a href="#">Emilie Marchandise</a>   | 30h+30h | 5 Credits | 2q | x | x |
| ⊗ LGBIO2050 | <a href="#">Medical Imaging</a>                      | <a href="#">Anne Bol,</a><br><a href="#">John Lee,</a><br><a href="#">John Lee</a> (compensates <a href="#">Benoît Macq</a> ),<br><a href="#">Benoît Macq,</a><br><a href="#">Frank Peeters</a> | 30h+30h | 5 Credits | 1q | x | x |
| ⊗ LGBIO2060 | <a href="#">Modelling of biological systems</a>      | <a href="#">Philippe Lefèvre</a>  | 30h+30h | 5 Credits | 1q | x | x |
| ⊗ LGBIO2070 | <a href="#">Artificial organs and rehabilitation</a> | <a href="#">Luc-Marie Jacquet,</a><br><a href="#">Philippe Lefèvre,</a><br><a href="#">Renaud Ronsse</a>  | 30h+30h | 5 Credits | 2q | x | x |

**⊗ Elective courses in biomedical engineering for ELEC students**

|             |  |   |         |           |    |   |   |
|-------------|--|---|---------|-----------|----|---|---|
| ⊗ LELEC2870 | <a href="#">Machine Learning : regression, dimensionality reduction and data visualization</a> | <a href="#">Michel Verleysen</a>  | 30h+30h | 5 Credits | 1q | x | x |
| ⊗ LELEC2885 | <a href="#">Image processing and computer vision</a>   | <a href="#">Christophe De Vleeschouwer</a> (coord.),<br><a href="#">Laurent Jacques</a><br>(compensates <a href="#">Benoît Macq</a> ),<br><a href="#">Benoît Macq</a> | 30h+30h | 5 Credits | 1q | x | x |

**OPTION : CRYPTOGRAPHY & INFORMATION SECURITY**

Commune aux masters ingénieur civil en électricité, en informatique et en mathématiques appliquées, cette option fournit les compétences permettant d'aborder les questions de sécurité de l'information tant du point de vue de leurs fondements algorithmiques et mathématiques, que de la conception et de la mise en oeuvre de solutions dans le contexte de circuits électroniques et de systèmes informatiques.

○ Mandatory

△ Courses not taught during 2013-2014

⊕ Periodic courses taught during 2013-2014

⊗ Optional

⊙ Periodic courses not taught during 2013-2014

‡ Two years course

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

*The student shall select  
De 15 à 30 credits parmi*

Year

1 2

**○ Cours obligatoires ELEC,INFO, et MAP**

| Course ID   | Course Title   | Instructor  | Hours   | Credits   | Period | Year 1 | Year 2 |
|-------------|--|---|---------|-----------|--------|--------|--------|
| ○ LMAT2450  | <a href="#">Cryptography</a>                           | Olivier Pereira   | 30h+15h | 5 Credits | 1q     | x      | x      |
| ○ LINGI2347 | <a href="#">Computer system security</a>               | Gildas Avoine,<br>Marco Canini<br>(compensates Gildas Avoine) | 30h+15h | 5 Credits | 2q     | x      | x      |
| ○ LELEC2760 | <a href="#">Secure electronic circuits and systems</a> | François-<br>Xavier Standaert                                 | 30h+30h | 5 Credits | 2q     | x      | x      |

**⊗ Cours au choix ELEC INFO et MAP**

Pour être validés dans l'option, ces cours nécessitent la validation préalable des cours LELEC 2760, LINGI 2347 et LMAT 2450

|             |  |  |               |           |      |   |   |
|-------------|--|--|---------------|-----------|------|---|---|
| ⊗ LINGI2144 | <a href="#">Secured systems engineering</a>  | Gildas Avoine  | 30h+15h       | 5 Credits | 1q △ | x | x |
| ⊗ LINGI2348 | <a href="#">Information theory and coding</a>  | Jérôme Louveaux,<br>Benoît Macq (coord.),<br>Olivier Pereira | 30h+15h       | 5 Credits | 2q   | x | x |
| ⊗ LINMA2111 | <a href="#">Discrete mathematics II : Algorithms and complexity</a>  | Vincent Blondel  | 30h<br>+22.5h | 5 Credits | 2q △ | x | x |
| ⊗ LELEC2620 | <a href="#">Modeling and implementation of analog and mixed analog/<br/>digital circuits and systems on chip</a> | David Bol  | 30h+30h       | 5 Credits | 2q   | x | x |
| ⊗ LELEC2870 | <a href="#">Machine Learning : regression, dimensionality reduction and<br/>data visualization</a>               | Michel Verleysen   | 30h+30h       | 5 Credits | 1q   | x | x |
| ⊗ LMAT2440  | <a href="#">Number theory</a>  | Olivier Pereira,<br>Jean-Pierre Tignol                       | 30h+15h       | 5 Credits | 1q   | x | x |

**⊗ Cours au choix ELEC et MAP**

Pour être validé dans l'option, ce cours nécessite la validation préalable des cours LELEC2760, LINGI 2347 et LMAT 2450

|             |   |                     |         |           |    |   |   |
|-------------|---|---------------------|---------|-----------|----|---|---|
| ⊗ LINGI2141 | <a href="#">Computer networks: information transfer</a> | Olivier Bonaventure | 30h+30h | 6 Credits | 1q | x | x |
|-------------|---|---------------------|---------|-----------|----|---|---|

**MODELING AND SIMULATION OF PHYSICAL SYSTEMS**

Cette option a pour objectif de familiariser l'étudiant avec la modélisation des phénomènes physiques, notamment dans le domaine de la mécanique des milieux continus (fluides, écoulements, transferts, solides déformables) et de l'électromagnétisme, ainsi qu'avec les méthodes et outils informatiques de simulation numérique correspondants.

● Mandatory

△ Courses not taught during 2013-2014

⊕ Periodic courses taught during 2013-2014

⊗ Optional

⊙ Periodic courses not taught during 2013-2014

‡ Two years course

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

*The student shall select  
De 15 à 30 credits parmi*

|             |   |   |                |           |    | Year |   |
|-------------|---|---|----------------|-----------|----|------|---|
|             |   |   |                |           |    | 1    | 2 |
| ⊗ LELEC1350 | <a href="#">APPLIED ELECTROMAGNETISM</a>  | <a href="#">Christophe Craeye,<br/>Danielle Janvier</a> | 30h+30h        | 5 Credits | 1q | x    | x |
| ⊗ LMAPR2510 | <a href="#">Mathematical ecology</a>  | <a href="#">Eric Deleersnijder,<br/>Emmanuel Hanert</a> | 30h<br>+22.5h  | 5 Credits | 2q | x    | x |
| ⊗ LMAT2130  | <a href="#">Partial differential equations : Poisson and Laplace equations</a>                      | <a href="#">Augusto Ponce,<br/>Jean Van Schaftingen</a> | 30h+30h        | 5 Credits | 1q | x    | x |
| ⊗ LMAT2410  | <a href="#">Partial differential equation : heat equation, brownian moves and numerical aspects</a> | <a href="#">Augusto Ponce,<br/>Jean Van Schaftingen</a> | 30h+15h        | 5 Credits | 2q | x    | x |
| ⊗ LMECA1100 | <a href="#">Deformable solid mechanics.</a>   | <a href="#">Issam Doghri</a>                            | 30h+30h        | 5 Credits | 2q | x    | x |
| ⊗ LMECA1321 | <a href="#">Fluid mechanics and transfer phenomena.</a>   | <a href="#">Vincent Legat,<br/>Grégoire Winckelmans</a> | 30h+30h        | 5 Credits | 2q | x    | x |
| ⊗ LMECA1120 | <a href="#">Introduction to finite element methods.</a>   | <a href="#">Vincent Legat</a>                           | 30h+30h        | 5 Credits | 2q | x    | x |
| ⊗ LMECA2131 | <a href="#">Introduction to nonlinear solid mechanics.</a>  | <a href="#">Issam Doghri</a>                            | 30h+30h        | 5 Credits | 2q | x    | x |
| ⊗ LMECA2141 | <a href="#">Rheology.</a>   | <a href="#">Christian Bailly,<br/>Vincent Legat</a>     | 30h+30h        | 5 Credits | 1q | x    | x |
| ⊗ LMECA2660 | <a href="#">Numerical methods in fluid mechanics.</a>   | <a href="#">Grégoire Winckelmans</a>                    | 30h+30h        | 5 Credits | 2q | x    | x |
| ⊗ LPHY1352A | <a href="#">Physique des fluides</a>  | N.  | 22.5h<br>+7.5h | 4 Credits |    | x    | x |
| ⊗ LINMA2720 | <a href="#">Mathematical modelling of physical systems</a>  | <a href="#">Roland Keunings</a>                         | 30h<br>+22.5h  | 5 Credits | 2q | x    | x |

## STATISTICS

---

Cette option permet à l'étudiant d'acquérir les concepts fondamentaux des probabilités et de la statistique mathématique et lui propose une formation aux principaux outils utiles dans la plupart des domaines d'applications de la statistique.

De plus, les étudiants qui suivent 25 crédits dans cette option bénéficieront d'un accès direct à la seconde année du [Master 120 en statistiques](#) (finalité spécialisée ou approfondie).

● Mandatory

△ Courses not taught during 2013-2014

⊕ Periodic courses taught during 2013-2014

⊗ Optional

⊖ Periodic courses not taught during 2013-2014

⊞ Two years course

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

*The student shall select*

*De 15 à 30 credits parmi*

|             |  |   |                |           |    | Year |   |
|-------------|--|---|----------------|-----------|----|------|---|
|             |  |   |                |           |    | 1    | 2 |
| ⊗ LMAT1371  | <a href="#">Probability</a>                          | <a href="#">Jan Johannes, Johan Segers</a>  | 30h<br>+22.5h  | 5 Credits | 2q | x    | x |
| ⊗ LSTAT2020 | <a href="#">Statistical computing</a>                | <a href="#">Céline Bugli (compensates Bernadette Govaerts), Bernadette Govaerts</a> | 20h+20h        | 5 Credits | 1q | x    | x |
| ⊗ LSTAT2040 | <a href="#">Statistical analysis</a>                 | <a href="#">Anouar El Ghouch, Ingrid Van Keilegom</a>                               | 30h+15h        | 4 Credits | 2q | x    | x |
| ⊗ LSTAT2100 | <a href="#">Discrete data analysis.</a>              | <a href="#">Patrick Bogaert, Anouar El Ghouch</a>                                   | 22.5h<br>+7.5h | 4 Credits | 2q | x    | x |
| ⊗ LSTAT2110 | <a href="#">Data Analysis</a>                        | <a href="#">Christian Hafner, Johan Segers</a>                                      | 22.5h<br>+7.5h | 4 Credits | 1q | x    | x |
| ⊗ LSTAT2120 | <a href="#">Linear models</a>                        | <a href="#">Christian Hafner</a>  | 22.5h<br>+7.5h | 4 Credits | 1q | x    | x |
| ⊗ LSTAT2130 | <a href="#">Introduction to Bayesian statistics.</a> | <a href="#">Philippe Lambert</a>  | 15h+5h         | 3 Credits | 2q | x    | x |
| ⊗ LSTAT2170 | <a href="#">Times series</a>                         | <a href="#">Rainer von Sachs</a>  | 22.5h<br>+7.5h | 4 Credits | 2q | x    | x |
| ⊗ LSTAT2320 | <a href="#">Design of experiment.</a>                | <a href="#">Patrick Bogaert, Bernadette Govaerts</a>                                | 22.5h<br>+7.5h | 4 Credits | 2q | x    | x |
| ⊗ LSTAT2350 | <a href="#">Data Mining</a>                          | <a href="#">Libei Chen</a>  | 15h+15h        | 4 Credits | 2q | x    | x |

**BUSINESS RISKS AND OPPORTUNITIES**

Commune à la plupart des masters ingénieur civil, cette option a pour objectif de familiariser l'étudiant avec les principes de base de la gestion des entreprises.

Les étudiants peuvent être dispensés de certains de ces cours sur base d'activités jugées équivalentes pour lesquelles ils ont obtenu des crédits dans le cadre de leur formation antérieure. Les cours dont les étudiants sont dispensés sont remplacés par des cours approfondis du tronc commun du master ingénieur de gestion et/ou un projet technologique en commun avec des étudiants de la LSM.

● Mandatory

△ Courses not taught during 2013-2014

⊕ Periodic courses taught during 2013-2014

⊗ Optional

⊖ Periodic courses not taught during 2013-2014

‡ Two years course

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

De 16 à 20 credits parmi

|            |  |   |         |           |      | Year |   |
|------------|--|---|---------|-----------|------|------|---|
|            |  |   |         |           |      | 1    | 2 |
| ⊗ LFSA2140 | <a href="#">Elements of law for industry and research</a>            | <a href="#">Fernand De Visscher,</a><br><a href="#">Werner Derijcke,</a><br><a href="#">Bénédicte Inghels</a> | 30h     | 3 Credits | 1q   | x    | x |
| ⊗ LFSA2230 | <a href="#">Introduction to management and to business economics</a> | <a href="#">Benoît Gailly</a>   | 30h+15h | 4 Credits | 2q   | x    | x |
| ⊗ LFSA1290 | <a href="#">Introduction to financial and accounting management</a>  | <a href="#">Gerrit Sarens</a>   | 30h+15h | 4 Credits | 2q   | x    | x |
| ⊗ LFSA2202 | <a href="#">Ethics and ICT</a>                                       | <a href="#">Axel Gosseries,</a><br><a href="#">Olivier Pereira</a>  | 30h     | 3 Credits | 2q   | x    | x |
| ⊗ LFSA2245 | <a href="#">Environment and Enterprise</a>                           | <a href="#">Thierry Bréchet</a>   | 30h     | 3 Credits | 1q   | x    | x |
| ⊗ LFSA2210 | <a href="#">Organisation and human resources</a>                     | <a href="#">John Cultiaux</a>   | 30h     | 3 Credits | 1+2q | x    | x |

**⊗ Alternative to the "Business risks and opportunities" for computer science students**

Computer science students who have already followed various courses of this discipline during their Bachelor's curriculum can select between 16 and 20 credits in the program "mineure en gestion pour les sciences informatiques" <http://www.uclouvain.be/xprog-2013-min-lgesc100i>

**ECONOMICS AND ECONOMETRICS**

L'objectif de cette option est de former des universitaires capables de comprendre et d'analyser les questions économiques et sociales concrètes de leur temps, qu'elles soient de nature « microéconomique » (stratégies d'entreprises, problèmes de concurrence, etc.) ou « macroéconomique » (croissance, inégalités, taux de change et politique monétaire, etc.). Les cours de cette option permettent de comprendre et utiliser les concepts et outils fondamentaux de l'analyse économique, ainsi que les méthodes quantitatives qui y sont associées, en particulier l'économétrie. Ils donnent les bases nécessaires pour une éventuelle spécialisation en économie.

De plus, l'étudiant qui suivra INMA2415, ECON2011 ECON2021, au moins un cours parmi la paire ECON2031/ECON2033 et au moins 15 crédits au sein du module complémentaire en économie et économétrie (voir la rubrique "cours au choix") dans le cadre de ses cours au choix bénéficiera d'un accès direct à la seconde année du [Master 120 en sciences économiques, orientation générale](#) (finalité spécialisée ou approfondie).

● Mandatory

△ Courses not taught during 2013-2014

⊕ Periodic courses taught during 2013-2014

⊗ Optional

⊖ Periodic courses not taught during 2013-2014

⊞ Two years course

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

*The student shall select*

*De 15 à 25 credits parmi*

|             |   |   |               |           |      | Year |   |
|-------------|---|---|---------------|-----------|------|------|---|
|             |   |   |               |           |      | 1    | 2 |
| ⊗ LECON2011 | <a href="#">Interdependencies and Strategic Behavior</a>              | N.  | 30h+12h       | 5 Credits | 2q △ | x    | x |
| ⊗ LECON2021 | <a href="#">Economic Fluctuations and Foundations of Macro Polici</a> | <a href="#">David De la Croix</a>   | 30h           | 5 Credits | 2q   | x    | x |
| ⊗ LECON2031 | <a href="#">Applied Econometrics : Time Series</a>                    | <a href="#">Arnaud Dufays</a><br>(compensates <a href="#">Sébastien Van Bellegem</a> ),<br><a href="#">Sébastien Van Bellegem</a> | 30h+12h       | 5 Credits | 1q   | x    | x |
| ⊗ LECON2033 | <a href="#">Applied econometrics: Microeconometrics</a>               | <a href="#">Muriel Dejemepe</a> ,<br><a href="#">Vincenzo Verardi</a><br>(compensates Muriel Dejemepe)                            | 30h+12h       | 5 Credits | 1q   | x    | x |
| ⊗ LINMA2415 | <a href="#">Quantitative Energy Economics</a>                         | <a href="#">Anthony Papavasiliou</a>  | 30h<br>+22.5h | 5 Credits | 2q   | x    | x |

**OPTION IN LAUNCHING OF SMALL AND MEDIUM-SIZED COMPANIES**

Commune à la plupart des masters ingénieur civil, cette option a pour objectif de familiariser l'étudiant ingénieur civil avec les spécificités des P.M.E., de l'entrepreneuriat et de la création afin de développer chez lui les aptitudes, connaissances et outils nécessaires à la création d'entreprise. L'accès en est réservé uniquement à un nombre restreint d'étudiants sélectionnés sur base d'un dossier de motivation et d'interviews individuelles.

Les dossiers de motivation pour cette filière doivent être introduits avant la rentrée académique de Master1 auprès du :

Secrétariat CPME - Place des Doyens 1  
1348 Louvain-la-Neuve (tél 010/47 84 59).

Les étudiants sélectionnés remplaceront le mémoire prévu dans le tronc commun par un mémoire spécifique en création d'entreprise (nombre de crédits inchangé).

○ Mandatory

△ Courses not taught during 2013-2014

⊕ Periodic courses taught during 2013-2014

⊗ Optional

⊖ Periodic courses not taught during 2013-2014

‡ Two years course

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

De 20 à 25 credits parmi

Year

1 2

**○ Compulsory courses**

|             |   |  |         |           |    |   |   |
|-------------|---|--|---------|-----------|----|---|---|
| ○ LCPME2001 | <a href="#">Entrepreneurship Theory (in French)</a>   | <a href="#">Frank Janssen</a>                                      | 30h+20h | 5 Credits | 1q | x |   |
| ○ LCPME2003 | <a href="#">Business plan of the creation of a company (in French)</a>                          | <a href="#">Frank Janssen</a>                                      | 30h+15h | 5 Credits | 2q |   | x |
| ○ LCPME2002 | <a href="#">Managerial, legal and economic aspects of the creation of a company (in French)</a> | <a href="#">Régis Coeurderoy,</a><br><a href="#">Yves De Cordt</a> | 30h+15h | 5 Credits | 1q | x | x |
| ○ LCPME2004 | <a href="#">Advanced seminar on Entrepreneurship (in French)</a>                                | <a href="#">Frank Janssen</a>                                      | 30h+15h | 5 Credits | 2q | x | x |

**⊗ Prerequisite CPME course**

Students who have not taken a management course within their former curriculum shall include LCPME2000 in their current curriculum.

|             |   |   |         |           |      |   |  |
|-------------|---|---|---------|-----------|------|---|--|
| ○ LCPME2000 | <a href="#">Venture creation financing and management I</a> | <a href="#">Régis Coeurderoy,</a><br><a href="#">Olivier Giacomini</a><br>(compensates<br>Régis Coeurderoy),<br><a href="#">Paul Vanzeveren</a> | 30h+15h | 5 Credits | 1+2q | x |  |
|-------------|---|---|---------|-----------|------|---|--|

## ELECTIVE COURSES ACCESSIBLE TO MASTER'S STUDENT IN APPLIED MATHEMATICS ENGINEERING

● Mandatory

△ Courses not taught during 2013-2014

⊕ Periodic courses taught during 2013-2014

⊗ Optional

⊙ Periodic courses not taught during 2013-2014

‡ Two years course

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

|             |                |                |         |           |    | Year |   |
|-------------|----------------|----------------|---------|-----------|----|------|---|
|             |                |                |         |           |    | 1    | 2 |
| ⊗ LFSA2351A | Group dynamics | Piotr Sobieski | 15h+30h | 3 Credits | 1q | x    | x |
| ⊗ LFSA2351B | Group dynamics | Piotr Sobieski | 15h+30h | 3 Credits | 2q | x    | x |

### ⊗ Cours de base

Il est conseillé aux étudiants n'ayant pas suivi durant leur parcours académique antérieur les trois cours ci après (ou des équivalents) de les intégrer à leur programme.

|             |                                     |   |               |           |    |   |  |
|-------------|-------------------------------------|---|---------------|-----------|----|---|--|
| ⊗ LINMA1315 | Mathematical analysis : complements | Michel Willem                             | 30h<br>+22.5h | 5 Credits | 2q | x |  |
| ⊗ LMECA1901 | Continuum mechanics.                | Philippe Chatelain,<br>Emilie Marchandise | 30h+30h       | 5 Credits | 1q | x |  |
| ⊗ LMAT1222  | Complex analysis                    | Luc Haine                                 | 30h+15h       | 5 Credits | 2q | x |  |

### ⊗ Cours recommandés

Parmi les 60 crédits de cours au choix et d'options, l'étudiant sélectionne au minimum 30 crédits parmi la liste ci-dessous et celle des cours de base.

|             |   |  |               |           |    |   |   |
|-------------|---|--|---------------|-----------|----|---|---|
| ⊗ LELEC2900 | Signal processing                                   | Benoît Macq,<br>Luc Vandendorpe  | 30h+30h       | 5 Credits | 2q | x | x |
| ⊗ LGBIO2060 | Modelling of biological systems                     | Philippe Lefèvre   | 30h+30h       | 5 Credits | 1q | x | x |
| ⊗ LINGI2348 | Information theory and coding                       | Jérôme Louveaux,<br>Benoît Macq (coord.),<br>Olivier Pereira   | 30h+15h       | 5 Credits | 2q | x | x |
| ⊗ LINMA2111 | Discrete mathematics II : Algorithms and complexity | Vincent Blondel  | 30h<br>+22.5h | 5 Credits | 2q | △ | x |
| ⊗ LINMA2120 | Applied mathematics research seminar                | Pierre-Antoine Absil,<br>Vincent Blondel,<br>Philippe Chevalier,<br>Jean-Charles Delvenne<br>(coord.),<br>François Glineur,<br>Julien Hendrickx,<br>Raphaël Jungers,<br>Philippe Lefèvre,<br>Yurii Nesterov,<br>Paul Van Dooren,<br>Mathieu Van Vyve | 30h           | 3 Credits |    |   | x |
| ⊗ LINMA2345 | Game theory   | Raphaël Jungers  | 30h<br>+22.5h | 5 Credits | 2q | x | x |
| ⊗ LINMA2360 | Project in mathematical engineering                 | Pierre-Antoine Absil,<br>François Glineur<br>(coord.),<br>Yurii Nesterov,<br>Paul Van Dooren   | 30h<br>+22.5h | 5 Credits | 2q | x | x |
| ⊗ LINMA2361 | Nonlinear systems                                   | Pierre-Antoine Absil   | 30h<br>+22.5h | 5 Credits | 1q | x | x |
| ⊗ LINMA2415 | Quantitative Energy Economics                       | Anthony Papavasiliou   | 30h<br>+22.5h | 5 Credits | 2q | x | x |
| ⊗ LINMA2450 | Combinatorial optimization                          | Jean-Charles Delvenne  | 30h<br>+22.5h | 5 Credits | 1q | x | x |
| ⊗ LINMA2460 | Optimization : Nonlinear programming                | Yurii Nesterov   | 30h<br>+22.5h | 5 Credits | 2q | x | x |
| ⊗ LINMA2472 | Advanced topics in discrete mathematics             | Vincent Blondel<br>(coord.),<br>Jean-Charles Delvenne,<br>Jean-Charles Delvenne<br>(compensates Vincent<br>Blondel)  | 30h<br>+22.5h | 5 Credits | 1q | x | x |



|             |  |  |               |            |    | Year |   |
|-------------|--|--|---------------|------------|----|------|---|
|             |  |  |               |            |    | 1    | 2 |
| ⌘ LINMA2491 | Operational Research   | Anthony Papavasiliou                   | 30h<br>+22.5h | 5 Credits  | 2q | x    | x |
| ⌘ LINMA2671 | Automatic : Theory and implementation                          | Julien Hendrickx                       | 30h+30h       | 5 Credits  | 1q | x    | x |
| ⌘ LINMA2710 | Numerical algorithms   | Paul Van Dooren                        | 30h<br>+22.5h | 5 Credits  | 2q | x    | x |
| ⌘ LINMA2720 | Mathematical modelling of physical systems                     | Roland Keunings                        | 30h<br>+22.5h | 5 Credits  | 2q | x    | x |
| ⌘ LINMA2725 | Financial mathematics  | Pierre Devolder                        | 30h<br>+22.5h | 5 Credits  | 1q | x    | x |
| ⌘ LINMA2875 | System Identification  | Julien Hendrickx                       | 30h+30h       | 5 Credits  | 2q | x    | x |
| ⌘ LMAT2130  | Partial differential equations : Poisson and Laplace equations | Augusto Ponce,<br>Jean Van Schaftingen | 30h+30h       | 5 Credits  | 1q | x    | x |
| ⌘ LMAT2450  | Cryptography   | Olivier Pereira                        | 30h+15h       | 5 Credits  | 1q | x    | x |
| ⌘ LMECA1120 | Introduction to finite element methods.                        | Vincent Legat                          | 30h+30h       | 5 Credits  | 2q | x    | x |
| ⌘ LFSA2995  | Stage en entreprise  | Claude Oestges                         | 30h           | 10 Credits |    | x    | x |
| ⌘ LFSA2996  | Stage en entreprise  | Claude Oestges                         |               | 5 Credits  |    | x    | x |

### ⌘ Advanced courses for applied math. Master

Students should note that any course appearing in the options of their Master, but not selected as such, remains a possible elective.

|            |                                      |               |         |           |    |   |   |
|------------|--------------------------------------|---------------|---------|-----------|----|---|---|
| ⌘ LMAT2110 | Éléments de géométrie différentielle | Luc Haine     | 30h+30h | 5 Credits | 1q | x | x |
| ⌘ LMAT2160 | Mathematics seminar                  | Enrico Vitale | 0h+45h  | 6 Credits | 2q | x | x |

### ⌘ Languages

Students may include in their electives any language course of the Institute of Modern Languages (ILV) for a maximum of 3 credits within the 120 basic credits of their Masters. Their attention is drawn to the following professional insertion seminars:

Students may include in their electives any language course of the Institute of Modern Languages (ILV) for a maximum of 3 credits within the 120 basic credits of their Master?s. Their attention is drawn to the following professional insertion seminars:

|             |   |   |     |           |      |   |   |
|-------------|---|---|-----|-----------|------|---|---|
| ⌘ LNEER2500 | Seminar of professional integration: Dutch - intermediate level       | Isabelle Demeulenaere<br>(coord.),<br>Mariken Smit                                      | 30h | 3 Credits |      | x | x |
| ⌘ LNEER2600 | Seminar of professional integration: Dutch - upper-intermediate level | Isabelle Demeulenaere   | 30h | 3 Credits |      | x | x |
| ⌘ LALLE2500 | German - Seminar of professional integration, intermediate level      | Caroline Klein,<br>Ann Rinder (coord.)  | 30h | 3 Credits | 1+2q | x | x |
| ⌘ LALLE2501 | German - Seminar of professional integration, intermediate level      | Caroline Klein,<br>Ann Rinder (coord.)  | 30h | 5 Credits | 1+2q | x | x |
| ⌘ LESPA2600 | Séminaire d'insertion professionnelle - espagnol                      | Isabel Baeza Varela,<br>Carmen Vallejo Villamor<br>(compensates Isabel<br>Baeza Varela) | 30h | 3 Credits | 1q   | x | x |
| ⌘ LESPA2601 | Spanish - Seminar of professional integration                         | Paula Lorente<br>Fernandez (coord.)   | 30h | 5 Credits | 1q   | x | x |

### ⌘ Short term exchanges

Students may include in their curriculum any BEST or ATHENS courses subject to approval by the Program committee. These courses are worth 2 credits  
Students may include in their curriculum any BEST or ATHENS subject to approval by the Diploma committee. These courses are worth 2 credits

### ⌘ General knowledge courses

Students can also include in their curriculum any course given at UCL, KULeuven or Von Karman Institute subject to approval of the program committee.  
Students can also include in their curriculum any course given at UCL or FIW / KULeuven subject to approval of the Diploma committee.

|             |   |                                   |     |           |    |   |   |
|-------------|---|-----------------------------------|-----|-----------|----|---|---|
| ⌘ LMECA2645 | Major technological hazards in industrial activity. | Denis Dochain,<br>Alexis Dutrieux | 30h | 3 Credits | 2q | x | x |
|-------------|---|-----------------------------------|-----|-----------|----|---|---|

|             |   |  |               |           |    |   | Year |   |
|-------------|---|--|---------------|-----------|----|---|------|---|
|             |   |  |               |           |    |   | 1    | 2 |
| ⊗ LDROP2063 | Environmental Law   | Nicolas de Sadeleer,<br>Damien Jans                      | 30h           | 5 Credits | 2q | x | x    |   |
| ⊗ LECGE1223 | Production and Operations Management                                  | Pierre Semal   | 30h           | 4 Credits | 1q | x | x    |   |
| ⊗ LELEC2811 | Instrumentation and sensors   | Laurent Francis,<br>Ernest Matagne                       | 30h+30h       | 5 Credits | 1q | x | x    |   |
| ⊗ LINMA2671 | Automatic : Theory and implementation                                 | Julien Hendrickx   | 30h+30h       | 5 Credits | 1q | x | x    |   |
| ⊗ LMAPR2018 | Rheometry and Polymer Processing                                      | Christian Bailly,<br>Evelyne Van Ruymbeke                | 30h<br>+22.5h | 5 Credits | 2q | x | x    |   |
| ⊗ LMAPR2510 | Mathematical ecology  | Eric Deleersnijder,<br>Emmanuel Hanert                   | 30h<br>+22.5h | 5 Credits | 2q | x | x    |   |
| ⊗ LMAPR2680 | Treatments of gaseous wastes  | Jacques Devaux,<br>Olivier Françoisse                    | 30h+7.5h      | 4 Credits | 1q | x | x    |   |
| ⊗ LPHY2150  | Physique et dynamique de l'atmosphère et de l'océan I                 | Michel Crucifix,<br>Thierry Fichet                       | 45h+9h        | 6 Credits | 1q | x | x    |   |
| ⊗ LPHY2153  | Introduction à la physique du système climatique et à sa modélisation | Hugues Goosse,<br>Jean-Pascal van<br>Ypersele de Strihou | 30h+15h       | 5 Credits | 1q | x | x    |   |

### ⊗ Cours de sciences humaines.

Les étudiants peuvent choisir des cours de sciences humaines pour un maximum de 6 crédits. Cette possibilité n'est cependant pas ouverte aux étudiants qui ont déjà 6 crédits de sciences humaines dans leurs options.

### ⊗ Module complémentaire en mathématiques financières.

Les étudiants qui suivent 15 crédits dans ce module, ainsi que LINMA 2725, LACTU 2020, LACTU 2030 et LACTU 2070, bénéficieront d'un accès direct en 2ème année du master en sciences actuarielles. Ce module n'est destiné qu'aux étudiants qui prévoient cette passerelle avec l'option en mathématiques financières.

|             |                      |  |         |           |    |   |   |
|-------------|----------------------|--|---------|-----------|----|---|---|
| ⊗ LACTU2010 | NON LIFE INSURANCE 1 | Cindy Courtois<br>(compensates Michel<br>Denuit),<br>Michel Denuit | 30h+15h | 5 Credits | 1q | x | x |
| ⊗ LACTU2040 | PENSION FUNDING      | Pierre Devolder  | 30h+15h | 5 Credits | 2q | x | x |
| ⊗ LACTU2060 | LIFE INSURANCE 2     | Michel Denuit  | 30h     | 5 Credits | 2q | x | x |
| ⊗ LACTU2080 | Reinsurance          | Jean-François Walhin   | 30h     | 5 Credits | 2q | x | x |

### ⊗ Module complémentaire en économie et économétrie

Les étudiants qui suivent 15 crédits dans ce module, ainsi que LINMA 2415, LECON 2011 et LECON 2021, ainsi qu'un des 2 cours LECON 2031 ou LECON 2033 bénéficieront d'un accès direct en 2ème année du master en sciences économiques, orientation générale. Ce module n'est destiné qu'aux étudiants qui prévoient cette passerelle avec l'option en économie et économétrie.

|             |  |   |     |           |    |   |   |
|-------------|--|---|-----|-----------|----|---|---|
| ⊗ LECON2041 | International Trade                          | Fabio Mariani   | 30h | 5 Credits | 2q | x | x |
| ⊗ LECON2051 | Labour, unemployment and Politics            | Muriel Dejemeppe,<br>Bruno Van der Linden<br>(compensates Muriel<br>Dejemeppe),<br>Bruno Van der Linden | 30h | 5 Credits | 2q | x | x |
| ⊗ LECON2061 | Philosophy and epistemology of the economics | Christian Arnsperger  | 30h | 5 Credits | 1q | x | x |
| ⊗ LECON2421 | History of Economic and Social Development   | Isabelle Cassiers   | 30h | 5 Credits | 1q | x | x |
| ⊗ LECON2372 | Economics of Competition Policy              | Elisabeth Van Hecke   | 30h | 5 Credits | 1q | x | x |

### ⊗ Cours pour lequel le cours LECON 2031 est conseillé

|             |  |   |     |           |    |   |   |
|-------------|--|---|-----|-----------|----|---|---|
| ⊗ LECON2311 | Business cycle analysis and short-term macroeconomic forecasts | Vincent Bodart,<br>Philippe Ledent,<br>Fateme Shadman<br>Valavi | 30h | 5 Credits | 2q | x | x |
| ⊗ LECON2312 | Macroeconomics of the development                              | Frédéric Docquier   | 30h | 5 Credits | 2q | x | x |

|             |  |                   |     |           |    |   | Year |   |
|-------------|--|-------------------|-----|-----------|----|---|------|---|
|             |  |                   |     |           |    |   | 1    | 2 |
| ⌘ LECON2314 | Economic Geography                                 | Florian Mayneris  | 30h | 5 Credits | 2q | x | x    |   |
| ⌘ LECON2382 | Seminar on Contemporary Economic Issues III        | Bernard Delbecque | 30h | 5 Credits | 1q | x | x    |   |
| ⌘ LECON2310 | Topics in Economic Growth: Theory and Applications | Hélène Latzer     | 30h | 5 Credits | 2q | x | x    |   |

### ⌘ Cours pour lesquels le cours LECON2033 est conseillé

|             |  |                  |     |           |    |   |   |
|-------------|--|------------------|-----|-----------|----|---|---|
| ⌘ LECON2350 | Public Management                              | Jean Hindriks    | 30h | 5 Credits | 2q | x | x |
| ⌘ LECON2352 | Methods for the evaluation of public policies  | William Parienté | 30h | 5 Credits | 1q | x | x |
| ⌘ LECON2370 | Industrial Organization and Competition Policy | Mathieu Parenti  | 30h | 5 Credits | 1q | x | x |

### ⌘ Company training periods

Students may include in their curriculum a company training period worth 10 credits. However, if this activity is related to their final thesis, they shall choose the 5-credit LFSA 2996 course.

Students may include in their curriculum a company training period worth 10 credits. However, if this activity is related to their final thesis, they shall choose the 5-credit FSA 2996 course.

|            |                     |                |     |            |  |   |   |
|------------|---------------------|----------------|-----|------------|--|---|---|
| ⌘ LFSA2995 | Stage en entreprise | Claude Oestges | 30h | 10 Credits |  | x | x |
| ⌘ LFSA2996 | Stage en entreprise | Claude Oestges |     | 5 Credits  |  | x | x |

