



## MAP2M - Introduction

### Introduction

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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.

## 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

## Programme structure

The Master's degree programme consists of:

- A core curriculum (27 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

## MAP2M Programme

## Detailed programme by subject

### CORE COURSES [27.0]

- Mandatory
- ✘ Optional
- △ Not offered in 2024-2025
- Not offered in 2024-2025 but offered the following year
- ⊕ Offered in 2024-2025 but not the following year
- △ ⊕ Not offered in 2024-2025 or the following year
- Activity with requisites
- ⊗ Open to incoming exchange students
- ⊗ Not open to incoming exchange students
- (FR) Teaching language (FR, EN, ES, NL, DE, ...)

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

Year

1 2

● LINMA2990	<p><b>Graduation project/End of studies project</b></p> <p><i>The graduation project can be written and presented in French or English, in consultation with the supervisor. It may be accessible to exchange students by prior agreement between the supervisors and/or the two universities.</i></p>		(FR) [q1+q2] [ ] [25 Credits] ⊗	
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## PROFESSIONAL FOCUS [30.0]

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- Mandatory
- ✂ Optional
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- Activity with requisites
- 🌐 Open to incoming exchange students
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[Click on the course title to see detailed informations \(objectives, methods, evaluation...\)](#)

**MAJORS FOR THE MASTER'S DEGREE IN MATHEMATICAL ENGINEERING**

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

**MAJOR IN OPTIMIZATION AND OPERATIONS RESEARCH ENGINEERING**

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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).

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  - ✘ Optional
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  - △ ⊕ Not offered in 2024-2025 or the following year
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## 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.

- Mandatory
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- Activity with requisites
- ⊗ Open to incoming exchange students
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[Click on the course title to see detailed informations \(objectives, methods, evaluation...\)](#)

From 20 to 30credit(s)

Year

1 2

### Content:

⊗ LGBIO2060	Modelling of biological systems	Hari Teja Kalidindi (compensates Philippe Lefèvre] 0 d 2 w 099 1 cm 0 1 -1 0 0cm 329987 227.102005 I 353.329987 2
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## MAJOR IN COMPUTATIONAL ENGINEERING

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

- Mandatory
- ✂ Optional
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- 🌐 Open to incoming exchange students
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[Click on the course title to see detailed informations \(objectives, methods, evaluation...\)](#)

*From 20 to 24credit(s)*

## MAJOR IN DATA SCIENCE

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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.

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- ✘ Optional
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[Click on the course title to see detailed informations \(objectives, methods, evaluation...\)](#)

*From 20 to 30credit(s)*



## **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.

- Mandatory
  - ✘ Optional
  - △ Not offered in 2024-2025
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## MAJOR IN BIOMEDICAL ENGINEERING

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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.

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- Activity with requisites
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[Click on the course title to see detailed informations \(objectives, methods, evaluation...\)](#)

From 15 to 30credit(s)

Year

1 2

### o Content:

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#### o Elective courses in biomedical engineering

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

⌘ LGBIO2010	Bioinformatics	Vincent Branders (compensates)
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[Click on the course title to see detailed informations \(objectives, methods, evaluation...\)](#)

Year

1 2

○ **Content:**

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⌘ **Complement to the major in financial mathematics**

*In addition, students w8.373001 cm -1 0 0 -1 0 0 cm 0 0 m 127.558998 0 l 127.558998 1 l 0 1 l h W n 1 G [] 0 d 2 w 0 0 m 127.558998 0 l S Q Q q 1 0*



*OPTIONS ET COURS AU CHOIX EN CONNAISSANCES SOCIO-ÉCONOMIQUES*  
*[3.0]*

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## MAJOR IN INTERDISCIPLINARY PROGRAM IN ENTREPRENEURSHIP - INEO

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Commune à la plupart des masters de l'EPL, cette option a pour objectif de familiariser l'étudiant-e avec les spécificités de l'entrepreneuriat et de la création d'entreprise afin de développer chez lui les aptitudes, connaissances et outils nécessaires à la création d'entreprise.

Cette option rassemble des étudiants de différentes facultés en équipes interdisciplinaires afin de créer un projet entrepreneurial. La formation interdisciplinaire en entrepreneuriat (INEO) est une option qui s'étend sur 2 ans et s'intègre dans plus de 30 Masters de 9 facultés/écoles de l'UCLouvain. Le choix de l'option INEO implique la réalisation d'un mémoire interfacultaire (en équipe) portant sur un projet de création d'entreprise. L'accès à cette option, ainsi qu'à chacun des cours, est limité aux étudiant-es sélectionnés sur dossier. Toutes les informations sur <https://uclouvain.be/fr/etudier/ineo>.

L'étudiant.e qui choisit de valider cette option doit sélectionner au minimum 20 crédits et au maximum 25 crédits. Cette option n'est pas accessible en anglais et ne peut être prise simultanément avec l'option « Enjeux de l'entreprise ».

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

Year

1 2

### o Content:

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#### o Required courses

● LINEO2001	Théorie de l'entrepreneuriat	
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## COURS AU CHOIX EN CONNAISSANCES SOCIO-ÉCONOMIQUES

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Year

1 2

### o Content:

				Year	
				1	2
⊗ LFSA2995	<a href="#">Company Internship</a>	Dimitri Lederer Jean-Pierre Raskin	(FR) [q1+q2] [30h] [10 Credits] 🌐	x	x
⊗ LINMA2360	<a href="#">Project in mathematical engineering</a>	Pierre-Antoine Absil Laurent Jacques	EN [q1+q2] [30h+22.5h] [5 Credits] 🌐 > <i>French-friendly</i>	x	



**OTHERS ELECTIVE COURSES**

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- 🚫🌐 Not open to incoming exchange students

[FR]

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## Course prerequisites

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There are no prerequisites between course units (CUs) for this programme, i.e. the programme activity (course unit, CU) whose learning outcomes are to be certified and the corresponding credits awarded by the jury before registration in another CU.

## The programme's courses and learning outcomes

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For each UCLouvain training programme, a [reference framework of learning outcomes](#) specifies the skills expected of every graduate on completion of the programme. Course unit descriptions specify targeted learning outcomes, as well as the unit's contribution to reference framework of learning outcomes.



Bachelor in Engineering	For others institutions	Access based on application	degree may have an adapted master programme. See <a href="#">personalized access</a>
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## Non university Bachelors

> Find out more about [links](#) to the university

## Holders of a 2nd cycle University degree

Diploma	Special Requirements	Access	Remarks
<b>"Licenciés"</b>			

### Masters

Master in Engineering	Direct access
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## Holders of a non-University 2nd cycle degree

### Access based on validation of professional experience

> It is possible, under certain conditions, to use one's personal and professional experience to enter a university course without having the required qualifications. However, validation of prior experience does not automatically apply to all courses. Find out more about [Validation of priori experience](#).

### Access based on application

Access based on application : access may be granted either directly or on the condition of completing additional courses of a maximum of 60 ECTS credits, or refused.

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 ([epl-admission@uclouvain.be](mailto:epl-admission@uclouvain.be)).

## Admission and Enrolment Procedures for general registration

## Teaching method

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### 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.



## Possible trainings at the end of the programme

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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] in Actuarial Science (UCLouvain)

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 [120] in Statistics: Biostatistics (UCLouvain)

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 [120] in Statistics: General (UCLouvain)

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 UCLouvain Master's degree programmes (generally 60) are open to UCLouvain Master's degree diploma holders. For example:

- Different Master's degree programmes (60) in management (automatic admission based on written application)
- The [Master \[60\] in Information and Communication](#) at Louvain-la-Neuve or the [Master \[60\] 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

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### Curriculum Management

Entity

Structure entity

SST/EPL/MAP

Denomination

(MAP)

Faculty

Louvain School of Engineering (EPL)

Sector

Sciences and Technology (SST)

Acronym

MAP

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Academic supervisor: [Raphaël Jungers](#)

Jury

- Président du Jury: [Claude Oestges](#)
- Secrétaire du Jury: [Geovani Nunes Grapiglia](#)

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- Secrétariat: [Pascale Premereur](#)

