MAP2M - Introduction

Introduction

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
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 (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

PROFESSIONAL FOCUS [30.0]

- Mandatory
- Optional
- Not offered in 2023-2024
- Not offered in 2023-2024 but offered the following year
- Offered in 2023-2024 but not the following year
- Not offered in 2023-2024 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...)

Content:

				Year 1	Year 2
LINMA2171	Numerical Analysis : Approximation, Interpolation, Integration	Pierre-Antoine Absil Simon Vary (compensates Pierre-Antoine Absil)	EN [q1] [30h+22.5h] [5 Credits] > French-friendly	x	
LINMA2370	Modelling and analysis of dynamical systems	Jean-Charles Delvenne	EN [q1] [30h+22.5h] [5 Credits] > French-friendly	x	
LINMA2380	Matrix computations	Raphaël Jungers	EN [q1] [30h+22.5h] [5 Credits] > French-friendly	x	
LINMA2470	Stochastic modelling	Philippe Chevalier Mehdi Madani (compensates Philippe Chevalier)	EN [q2] [30h+22.5h] [5 Credits] > French-friendly	x	
LINMA2471	Optimization models and methods II	François Glineur Geovani Nunes Grapiglia	EN [q1] [30h+22.5h] [5 Credits] > French-friendly	x	
LINMA2710	Scientific computing	Pierre-Antoine Absil Karl Meerbergen	EN [q2] [30h+22.5h] [5 Credits] > French-friendly	x	

OPTIONS

Dans la rubrique "Options du master ingénieur civil en mathématiques appliquées", l'étudiant·e sélectionne au moins 20 crédits parmi les trois premières options.
Dans la rubrique "Options .tions.

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).

- O Mandatory
- ⊠ Optional
- △ Not offered in 2023-2024
- ⊘

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.

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From 20 to 30credit(s)

Year
1 2

Content:

- LGBIO2060

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
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- Not offered in 2023-2024 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...)

From 20 to 24credit(s)

Content:

				Year 1	Year 2
Optional LGCIV2041	Numerical analysis of civil engineering structures	Hadrien Rattez João Saraiva Esteves Pacheco De Alm	EN [q2] [20h+15h] [4 Credits] *> French-friendly*	x	x
Optional LINMA2111	Discrete mathematics II : Algorithms and complexity	Jean-Charles Delvenne Jean-Charles Delvenne (compensates) Vincent Blondel)	EN [q1] [30h+22.5h] [5 Credits] *> French-friendly*	x	x
Optional LINMA2720	Mathematical modelling of physical systems		EN [q2] [30h+22.5h] [5 Credits] Δ *> French-friendly*	x	x
Optional LMECA2170	Numerical Geometry	Vincent Legat Jean-François Remacle	EN [q1] [30h+30h] [5 Credits] *> French-friendly*	x	x
Optional LMECA2300	Advanced Numerical Methods	Philippe Chatelain Christophe Craeye (coord.) Vincent Legat Jean-François Remacle	EN [q2] [30h+30h] [5 Credits] *> French-friendly*	x	x

MAJOR IN DATA SCIENCE

Gautier Krings

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.

- Mandatory
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- Activity with requisites
- Open to incoming exchange students
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From 20 to 30credit(s)

Year
1 2

Content:

Compulsory courses in data science

LINMA2472	Algorithms in data science	Jean-Charles Delvenne (coord.) Gautier Krings (compensates

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, for students who will to enroll in the Master's degree programme in actuarial sciences, all the compulsory courses of the programme ACTU2M validated in this major will be valorized.

- Mandatory
- Optional
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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 20credit(s)

Content:

				Year 1	Year 2
Optional	LINMA2725	Financial mathematics	Pierre Devolder	[FR] [q1] [30h+22.5h] [5 Credits]	x	x
Optional	LACTU2020	Fixed income mathematics	Pierre Devolder	[FR] [q1] [45h+15h] [7 Credits]	x	x
Optional	LACTU2030	LIFE INSURANCE	Donatien Hainaut	[FR] [q1] [45h] [7 Credits]	x	x
Optional	LACTU2170	STOCHASTIC FINANCE	Donatien Hainaut	[FR] [q2] [30h] [5 Credits]		

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.

- O Mandatory
- ⊠ Optional
- △ Not offered in 2023-2024
- ⊘ Not offered in 2023-2024 but offered the following year
- ⊕ Offered in 2023-2024 but not the following year
- △ ⊕

MAJOR IN BIOMEDICAL ENGINEERING

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.

- Mandatory
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- Activity with requisites
- Open to incoming exchange students
- Not open to incoming exchange students
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Click on the course title to see detailed informations (objectives, methods, evaluation...)

From 15 to 30credit(s)

Year
1 2

Content:

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

- Mandatory
- Optional
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- Not offered in 2023-2024 or the following year
- Activity with requisites
- Open to incoming exchange students
- Not open to incoming exchange students
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Year
1 2

x

				Year 1	2
LSTAT2150	Nonparametric statistics: smoothings methods	Rainer von Sachs	EN [q1] [15h+5h] [4 Credits]	x	x
LSTAT2170	Times series	Rainer von Sachs	EN [q2] [30h+7.5h] [5 Credits]	x	x
LDATS2360	Seminar in data management: basic	Céline Bugli	EN [q1] [15h+10h] [5 Credits]	x	x

x

Courses of interest

LECON2021	Economic Fluctuations and Foundations of Macro Policy	Grégory de Walque (compensates David De la Croix)	FR [q2] [30h] [5 Credits]	x	x
LECON2031	Applied Econometrics : Time Series	Francesca Monti	EN [q1] [30h+12h] [5 Credits]	x	x
LECON2033	Applied econometrics: Microeconometrics		FR [q1] [30h+12h] [5 Credits]	x	x
LELEC1360	TELECOMMUNICATIONS	Luc Vandendorpe			

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

BUSINESS RISKS AND OPPORTUNITIES

- Mandatory
- Optional
- Not offered in 2023-2024
- Not offered in 2023-2024 but offered the following year
- Offered in 2023-2024 but not the following year
- Not offered in 2023-2024 or the following year
- Activity with requisites
- Open to incoming exchange students
- Not open to incoming exchange students

[FR]

COURS AU CHOIX EN CONNAISSANCES SOCIO-ÉCONOMIQUES

- ⭘ Mandatory
- 🗵 Optional

OTHERS ELECTIVE COURSES

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- Mandatory
- Optional
- Not offered in 2023-2024
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- Not offered in 2023-2024 or the following year
- Activity with requisites
- Open to incoming exchange students
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Click on the course title to see detailed informations (objectives, methods, evaluation...)

Year
1 2

Content:

Les étudiant·e·s peuvent également inscrire à leur programme tout cours faisant partie des programmes d'autres masters de l'EPL moyennant l'approbation du jury restreint.

Languages

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

Optional LALLE2500	Professional development seminar German	

MAP2M - Information

			degree may have an adapted master programme.
Bachelor in Engineering	For others institutions	Access based on application	See personalized access

Non university Bachelors

> Find out more about links to the university

Holders of a 2nd cycle University degree

Diploma	Special Requirements	Access	Remarks
"Licenciés"			

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

Curriculum Management

EntityStructure entity

Structure entity	SST/EPL/MAP
Denomination	(MAP)
Faculty	Louvain School of Engineering (EPL)
Sector	Sciences and Technology (SST)