UCLouvain

BIRC2M

2024 - 2025

Master [120] in Chemistry and Bioindustries

At Louvain-la-Neuve - 120 credits - 2 years - Day schedule - In French
Dissertation/Graduation Project : **YES** - Internship : **optional**
Activities in English: **YES** - Activities in other languages : **NO**
Activities on other sites : **NO**
Main study domain : **Sciences agronomiques et ingénierie biologique**
Organized by: **Faculty of bioscience engineering (AGRO)**
Programme acronym: **BIRC2M** - Francophone Certification Framework: 7

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Learning outcomes

Master in Chemistry and Bio-industries students must endeavour to diagnose and solve complex and original issues in bioengineering through a multidisciplinary approach in order to develop and implement innovative and sustainable solutions.

This Master's programme aims to train experts in the field of applied chemistry and bio-industries.

The future bioengineers acquire the knowledge and skills required to become:

• professionals able to tackle and diagnose problems in applied chemistry and bio-industries: production and quality, traceability, new processes, bioengineering with a high level of innovation, etc.;

• scientists able to understand complex processes on different scales, used to multidisciplinary approaches (chemistry, physico-chemistry, microbiology, etc.) and consultation with other specialists;

• innovators able to develop new methods in applied chemistry and biology: biotechnologes, nanotechnologies, catalysis, remediation, etc.

Highly versatile and multidisciplinary in character, the course dispensed by the Faculty of Biological, Agricultural and Environmental Engineering focuses on acquiring skills which combine theory and practice to train "bioengineers" mastering a broad base of scientific and technological knowledge and skills, allowing them to adopt an integrated approach to biological, agricultural and environmental systems.

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

1. To explore a body of knowledge (knowledge, methods and techniques, models and processes) in natural and human sciences which serves as the foundation from which to operate with expertise in the fields of applied chemistry and bioindustries.

1.1 To build an advanced knowledge base in the field of applied chemistry and bioindustries and more specifically in the following disciplines [1]:

• Analytical chemistry
• Organic analysis
• Biochemical analysis
• Physical chemistry and physico-chemical calculations
• Chemistry of colloids and surfaces
• Reactor design

1.2 To build highly specialised scientific knowledge in one of the following bioengineering specialisations [2]:

• Science, technology and food quality
• Biomolecular and cell engineering
• Nanobiotechnologies, materials and catalysis
• Environmental technologies: water, soil, air
• Information analysis and management in biological engineering

1.3 To master procedural skills in conducting experiments: analytical chemistry techniques, organic and biochemical analysis techniques, technical analysis of complex matrices, chemometrics or biometrics, as well as specific techniques in relation to their choice of specialisation[3].

1.4 To apply their knowledge critically to tackle a complex problem in the field of applied chemistry or bioindustries by incorporating processes at different scales ranging from the atomic scale to the organism and matter scale, and up to the process scale.

1.5 To apply multiple strands of knowledge to resolve a multidisciplinary problem in the field of applied chemistry or bioindustries in order to develop relevant and innovative solutions.

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[1] Refers to the choice of the Master (core subjects and professional focus). The knowledge of some of these disciplines will have been partially acquired in the Bachelor's degree (in the advanced minor).

[2] Refers to the option / module choice in the Master.

[3] Refers to mastering all the laboratory and field techniques used for the characterisation or monitoring of a system.

2. To explore an integrated body of "engineering and management knowledge" which serves as the foundation from which to operate with expertise in the field of environmental sciences.

2.1 To build an advanced knowledge base (e.g.: concepts, laws, technologies) and tools (e.g. modelling, programming) in engineering sciences:

• Chemometrics and Biometrics
• Biochemical and microbial engineering
• Thermodynamics
• Process engineering: unit operations
• Reactor design

2.2 To build and master highly specialised knowledge and tools in one of the following bioengineering specialisations:

• Science, technology and food quality
• Biomolecular and cell engineering
• Nanobiotechnologies, materials and catalysis
• Environmental technologies: water, soil, air

• Information analysis and management in biological engineering

2.3 To master the operational use of specialised tools in engineering sciences (e.g.: systems analysis, statistical analysis, programming, modelling, etc.)[1]]:

• Chemometrics and biometrics

• Thermodynamics

• Specific tools in relation to the choice of specialisation

2.4 To activate and apply their knowledge of engineering with a critical mind and using a quantitative approach to tackle a complex problem in the field of applied chemistry or bioindustries by incorporating processes at different scales ranging from the atomic scale to the organism and matter scale, and up to the process scale.

2.5 To locate and understand how companies and organisations operate, including the role of the different players, their financial and social realities and responsibilities and the challenges and constraints which characterise their environment.

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[1] The tools are explained on the basis of the radioscopy of the programme and courses.

3. To design and execute a research project, implementing an analytical scientific and, if applicable, systematic approach, to further understanding of an original research problem in their field of specialisation, incorporating several disciplines.

This skill set will develop throughout the 5 years. Amongst others it requires the use of a set of skills as described below. These skills correspond in fact to the different stages of the scientific approach.

The majority of these skills are developed in the Bachelor and Master programmes, with differentiation predominately on 3 levels:

- the level of detail and complexity applied to the scientific problem/research studied;

- the degree of innovation shown by the student;

- the degree of autonomy demonstrated by the student throughout the process.

3.1 To summarise the state of knowledge on a complex research problem which relates to their choice of specialisation: to research information, to select and validate its reliability based on the nature of the source of the information and comparing several sources.

3.2 To specify and define the research question.

3.3 To examine the research question using conceptual abstraction and formulate hypotheses.

3.4 To develop and implement a rigorous methodology to answer the research question.

3.5 To master and apply statistical data analysis tools in the context of a complex scientific issue.

3.6 To analyse and interpret the results to produce a substantiated critique on a complex scientific question.

3.7 To demonstrate an ability to summarise and formulate conclusions on a complex scientific question.

3.8 In each of the skills mentioned above, to demonstrate rigour, precision and the critical thinking essential for any scientific method.

3.9 To demonstrate innovation in at least one of the skills mentioned above.

4. To formulate and resolve a complex environmental engineering problem related to new situations presenting a degree of uncertainty. The student will be able to design appropriate, sustainable and innovative solutions through a systematic approach integrating processes from the nanoscale (atoms, chemical mechanisms,....) to the microscopic and macroscopic scales (organisms, reactor,...). This problem may relate to the management and use of resources (soil, water, plant) and ecosystems, to land management, to the impact of human activities on the capacity of the environment to provide goods and services to humanity.

This skill set will develop throughout the 5 years. Amongst others it requires the use of a set of skills as described below. These skills correspond in fact to the different stages of the engineering approach.

The majority of these skills are developed in the Bachelor and Master programmes, with differentiation predominately on 3 levels:

- the complexity and scope of the problem addressed;

- the degree of autonomy demonstrated by the student throughout the process;

- the degree of depth in each skill.

4.1 To strategically differentiate the key elements from the less critical elements relating to a complex chemical engineering or bioindustries problem, in order to define and determine the field of action for this problem.

4.2 To identify the knowledge acquired and that to be acquired to resolve the complex chemical engineering or bioindustries problem.

4.3 To analyse a complex chemical engineering or bioindustries problem using a systematic and multidisciplinary approach in order to carry out diagnostics and formulate the specifications.

4.4 To demonstrate an ability for conceptual abstraction and formalisation in analysing and resolving the complex chemical engineering or bioindustries problem.

4.5 To develop scientifically and technologically relevant and innovative solutions, through a multidisciplinary (integration and articulation of knowledge) and quantitative approach, making it possible to develop products, systems, processes or services in the field of applied chemistry and bioindustries.

4.6 To test solutions and evaluate their impact in relation to an economic, environmental, social and cultural context.

4.7 To formulate concrete and responsible recommendations to encourage sustainable development in relation to the efficient operational and sustainable implementation of the solutions proposed.

5. To design and implement a multidisciplinary project, alone and in a team, with the stakeholders concerned while taking the objectives into account and incorporating the scientific, technical, environmental, economic and human factors.

The graduate must be able to manage a project alone and in a team, not only the scientific and technological dimensions but also the financial and, if applicable social aspects and with a degree of complexity representative of typical professional scenarios.

5.1 To know and understand the principles and factors of group dynamics (including the constructive role of conflict).

5.2 To know and understand the project management process (project cycles): formulation and definition of the project, project management, monitoring and evaluation of the project.

5.3 To situate a multidisciplinary project within its environment and identify the issues, constraints and stakeholders and to clearly define

5.4 To plan and develop all the stages of a multidisciplinary project, alone and in a team, and to work together after having allocated the tasks.

CORE COURSES

- O 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

Year
1 2

Stage d'insertion socio-professionnelle (10 credits)

Stage d'insertion socio-professionnelle ou unités d'enseignement à choisir dans le programme alternatif

⊠ LBIR2004	Masters Internship	

Juray De Wilde [redacted]

				Year 1	Year 2
⊠ LBIR2050	Challenges of sustainable development and transition	Valentin Couvreur Nathalie Delzenne Valérie Swaen (coord.)	FR [q2] [30h] [5 Credits]		x
⊠ LBIR2050A	Challenges of sustainable development and transition	Valentin Couvreur Nathalie Delzenne Valérie Swaen	FR [q1 or q2] [22.5h] [3 Credits]		x
⊠ LBIRA2113	Systèmes alimentaires du Futur	Marleen Abdel Massih Philippe Baret (coord.)	FR [q2] [42.5h] [5 Credits]		x
⊠ LEPL2211	Business issues introduction	Benoît Gailly	EN [q2] [30h] [3 Credits] *> French-friendly*		x
⊠ LLSMG2054	Management humain	Laurent Taskin	FR [q1] [30h] [5 Credits] ⊕		x
⊠ LMAPR2001A	Project "chemical & materials engineering for a sustainable future"	Juray De Wilde Pascal Jacques			

Year
1 2

				Year 1	2
⊠ LINGE1322	Computer science: Analysis and Design of Information Systems	Jean Vanderdonckt	FR [q2] [30h+15h] [5 Credits]	x	
⊠ LINMA2472	Algorithms in data science				

				Year 1	2
LGBIO2060	Modelling of biological systems	Hari Teja Kalidindi (compensates Philippe Lefèvre) Laurent Opsomer (compensates Philippe Lefèvre)	EN [q1] [30h+30h] [5 Credits] > *French-friendly*	x	

OPTIONS

From 23 to 25credit(s)

> Option 1C - Food & quality *[en-prog-2024-birc2m-lbirc201o]*
> Option 2C - Biomolecules & cells *[en-prog-2024-birc2m-lbirc202o]*
> Option 3C - Nano(bio)materials and catalysis

OPTION 2C - BIOMOLECULES & CELLS [24.0]

- 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]dents

OPTION 3C - NANO(BIO)MATERIALS AND CATALYSIS [24.0]

- 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

OPTION 10C - DATA SCIENCE [25.0]

- O 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...)

Content:

				Year 1	Year 2
O LBRAI2219	Systems Biology Modelling	Valentin Couvreur (compensates Mathieu Javaux) Xavier Draye (coord.) Guillaume Lobet	FR [q2] [30h] [3 Credits] > *English-friendly*		x
O LBRTI2101B	Data Science in bioscience engineering	Patrick Bogaert Emmanuel Hanert	FR [q1] [30h] [2 Credits] > *English-friendly*	x	
O LBRTI2102	Process-based modelling in bioscience engineering	Emmanuel Hanert	EN [q1] [30h+15h] [5 Credits] > *French-friendly*	x	
O LSTAT2340	Statistical Analyses of ¿omics Data	Laura Symul	FR [q2] [15h+5h] [5 Credits]	x	

Courses to be chosen for 10 credits minimum

⊠ LCOMU2600	Scientific popularisation	Jerry Jacques	FR [q1] [30h] [5 Credits]		x
⊠ LDATS2030	Statistique et data sciences avec R: Programmation avancée	Anouar El Ghouch	FR [q2] [15h+15h] [5 Credits]		x
⊠ LELEC2870	Machine learning : regression, deep networks and dimensionality reduction				

OPTION 18C : HUMAN HEALTH [24.0]

- O 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

Course prerequisites

There are no prerequisites between course units (CUs) for this programme, i.e. the programme activity (course unit, CU) whose learning

BIRC2M - Information

Access Requirements

Master course admission requirements are defined by the French Community of Belgium Decree of 7 November 2013 defining the higher education landscape and the academic organisation of courses.

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

Unless explicitly mentioned, the bachelor's, master's and licentiate degrees listed in this table or on this page are to be understood as those issued by an institution of the French, Flemish or German-speaking Community, or by the Royal Military Academy.

In the event of the divergence between the different linguistic versions of the present conditions, the French version shall prevail.

SUMMARY

University Bachelors

Diploma	Special Requirements	Access	Remarks
UCLouvain Bachelors			
Bachelor in Bioengineering		Direct access	
Autre Bachelier du domaine des sciences et technologies		Access based on application	Le ou la futur·e étudiant·e prend contact avec le Conseiller aux études.
Others Bachelors of the French speaking Community of Belgium			
Bachelier en Sciences de l'ingénieur, orientation bioingénieur		Direct access	
		Access based on application	
Bachelors of the Dutch speaking Community of Belgium			
		Direct access	Les conditions d'accès seront définies au cas par cas en fonction des prérequis nécessaires.
		Access based on application	
Foreign Bachelors			
		Access based on application	Les conditions d'accès seront définies au cas par cas en fonction des prérequis nécessaires.
		Access based on application	

Non university Bachelors

> Find out more about links to the university

Diploma	Access	Remarks
BA en agronomie, orientation agro-industries et biotechnologies - crédits supplémentaires entre 45 et 60 BA en agronomie, orientation agronomie des régions chaudes - crédits supplémentaires entre 45 et 60	Les enseignements supplémentaires éventuels peuvent être consultés dans le module complémentaire.	Type court

BA en agronomie, orientation environnement - crédits supplémentaires entre 45 et 60

BA en agronomie, orientation forêt et nature - crédits supplémentaires entre 45 et 60