

UNIVERSITÉ DE FRIBOURG SUISSE  
FACULTÉ DES SCIENCES

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UNIVERSITÄT FREIBURG SCHWEIZ  
MATHEMATISCH-NATURWISSENSCHAFTLICHE FAKULTÄT

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Curriculum for the award of the Degree of

**Master of Science  
in Chemistry**

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# 1 General Remarks

This curriculum describes all the regulations concerning the course of studies in chemistry at the University of Fribourg. It is based on the regulations of the Faculty of Science as defined in the *Règlement pour l'obtention des Bachelor of Science et des Master of Science de la Faculté des sciences [Regulation of 2 February 2004 for the Obtainment of the Bachelor of Science and Master of Science]* (subsequently called *the Regulation* for short).

## 1.1 Academic Titles and Programme of Study

The Faculty of Science of the University of Fribourg awards the following official academic titles to students who have successfully completed their respective course of studies:

- **Bachelor of Science in Chemistry**, subsequently called **BSc**.
- **Master of Science in Chemistry**, subsequently called **MSc**.

The **programme of study of the BSc** in Chemistry represents a university course of studies, comprising a basic scientific education in chemistry by its method- and problem-oriented nature. It enables one to enter a wide professional area. At the same time it provides the basis for life-long learning, an indispensable requirement for professional success. In addition, the BSc in Chemistry forms the basis for advanced studies leading to the MSc in Chemistry. Every person who is in possession of a federal general qualification for university entrance (*maturité fédérale / eidgenössisches Maturitätszeugnis*) or any equivalent document (cf. Art. 6 of the Regulation) will be admitted to the BSc degree programme.

The **programme of study of the MSc** in Chemistry represents a scientific course of studies, allowing one to specialize in a specific subject. The MSc in Chemistry gives access to various professional activities in research, education, industry, commerce, and administration. The MSc is furthermore the entry requirement for the scientific work and deepened scientific education leading to a doctorate. When accompanied by a subsidiary subject (biology, geography, informatics, mathematics, or physics), the MSc allows one to enter a complementary didactics programme leading to a qualification as a high-school teacher (*Diplôme d'aptitude à l'enseignement du secondaire II / Fähigkeitszeugnis für das Höhere Lehramt II*).

Persons in possession of a BSc in Chemistry of the University of Fribourg or any other Swiss university are admitted to the MSc course of studies (Art. 7 of the Regulation). Persons in possession of a BSc degree in a different subject or equivalent degrees (e.g. after graduating from an engineering school) can also be admitted to the MSc study programme by analogy. Provisional admission can be granted, which then depends on the fulfilment of additional requirements (cf. Section 2.5).

## 1.2 Course Structure

The degree courses leading to the BSc and MSc respectively are subdivided into **course units (UE)** comprising lectures, exercise classes, laboratories, seminars, student projects, etc. To each UE, a number of **ECTS<sup>1</sup> points** are assigned, which by assessment (e.g. successful exams) is converted into ECTS credits (see Section 1.3). The BSc degree course requires 180 ECTS credits

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<sup>1</sup> ECTS stands for *European Credit Transfer System*. One ECTS point corresponds to an amount of work of approximately 30 hours.

(corresponding to a length of study of 6 semesters), and the MSc degree an additional 90 ECTS credits (corresponding to a length of study of 3 semesters).

The BSc degree course is composed of a **major** of 150 ECTS, and a selectable **minor** of 30 ECTS. The major consists of the compulsory UE in chemistry and basic mathematics, physics, and biology (or biology/biochemistry). The minor may not overlap with the major. Otherwise all subjects taught at the University of Fribourg can potentially be selected as minors. Corresponding curricula exist for all branches of the Faculty of Science (mathematics, physics, biology, biochemistry, etc.), for industrial chemistry (at the Fribourg engineering school) and some other popular subjects (economics, law, psychology, etc.). If a student wishes to choose a different minor, he/she must consult the student advisor of chemistry in order to work out a suitable curriculum.

The MSc degree programme consists of a one-year taught programme comprising lectures, lab work, and seminars, and the **MSc project** lasting 4-6 months leading to the **MSc thesis**. Examinations of the UE of the MSc are only possible after all the requirements for the BSc have been completed. (c.f. 1.3).

The purpose of the different forms of UE is as follows:

- **Lectures** give an introduction to the scientific methods in chemistry and advance thinking in a scientific way. They help acquiring the required knowledge and understanding the fundamental concepts, and introduce the formalisms used in data processing.
- **Lab work** complements the lectures and provides essential help for working with and understanding a lecture's content. They give students the opportunity to practise and apply the acquired principles, techniques, and models.
- **Seminar presentations** are used for working on as well as presenting orally existing scientific results.
- The preparation of the **Master thesis**, under the supervision of an experienced researcher, is the actual starting point of scientific research.

### 1.3 Acquired skills

The aim of the studies leading to the award of an MSc in Chemistry is to deepen knowledge and perfect competence in the chosen field and at the same time develop skills in scientific English. Thus, at the end of the course, a student will have shown that he/she can apply their knowledge to accomplish a research project and will have learned how to work independently or how to integrate into an interdisciplinary research team. The award of the degree requires creative and self-critical talents as well as the ability to communicate ideas and work both in English and their native language.

### 1.4 Assessment of Course Units (UE) and Acquisition of ECTS Credits

Acquisition of ECTS credits occurs in three steps: assessment of the UE, grouping of UE into validation package, and awarding the respective credits.

Lab work is assessed following the criteria given at the beginning of the course. Admission to the exam corresponding to a lecture course can be subject to meeting the requirements of the corresponding lab work section. **Assessment** of lectures is made by an oral and/or written exam, whose type and duration are regulated in an appendix to this curriculum. Exams take place during the official exam periods (sessions) in spring, summer, and autumn. Students register in GESTENS within the stipulated delays for each exam according to the on-line procedure (<http://www.unifr.ch/science/gestens>). The marks range from 6 (highest mark) to 1 (lowest mark). An exam marked below 4 can be repeated once at the next exam session at the earliest.

**Validation packages** comprise multiple, separately assessed UE. Art. 18 of the Regulation determines the number of these package whereas this curriculum determines their content.

ECTS points are credited according to art. 19 of the Regulation if

- the weighted average of the exam marks of a validation package is at least 4. The weighting is given by the number of ECTS points assigned to an UE.
- the assessment criteria of UE not examined (lab work, seminars, etc.) are met.
- no mark is equal to 1.0.

Under these prerequisites, validation packages are validated and the corresponding ECTS points are converted into ECTS credits. By request, the Dean's office issues confirmations in which exam results and credits awarded are acknowledged (Art. 22 of the Regulation), provided the exam fee has been paid.

## 1.5 Teaching Languages

Each course of the BSc is taught in either German or French. Students can decide, in which of the two languages they want to express themselves. Occasionally, courses may be taught in English.

MSc courses are taught in English, German or French. For exams and written work (project reports, MSc thesis, etc.) students can choose between English, German or French.

## 1.6 Ethics and Science

Ethical principles are an integral part of a scientific education. Accepted international conventions must be respected during research and upon the writing up of any scientific work whether it be a project, a lecture, a thesis or a report. In particular, every external source of information (articles, lectures, web pages, etc.) must be correctly cited.

## 1.7 Regulations and Additional Information

Detailed information about studying computer science can be found in the following documents, which can be obtained from the Office of the Department of Computer Science, chemin du Musée 3, CH-1700 Fribourg:

- Regulation concerning the admission to the University of Fribourg [Réglement d'admission de l'Université de Fribourg / *Zulassungsreglement der Universität Freiburg*; ([www.unifr.ch/rectorat/reglements](http://www.unifr.ch/rectorat/reglements))]
- Regulation of 2 February 2004 for the Obtainment of the Bachelor of Science and Master of Science ([http://www.unifr.ch/science/current/plans\\_e.php](http://www.unifr.ch/science/current/plans_e.php))
- Curriculum for the basic and subsidiary subjects of the Faculty of Science of the University of Fribourg ([http://www.unifr.ch/science/current/plans\\_e.php](http://www.unifr.ch/science/current/plans_e.php))
- Study programme of the University of Fribourg ([www.unifr.ch/guide](http://www.unifr.ch/guide))
- Course Program of the University of Fribourg ([www.unifr.ch/main/programmecours](http://www.unifr.ch/main/programmecours))
- UE database (<http://gestens.unifr.ch/>)
- The current examination session calendar of the University of Fribourg

Finally, each student obtains a personal and secure space that can be reached using an individual university e-mail password. This space can be reached by the link "Connexion" on web page [www.unifr.ch/science/gestens](http://www.unifr.ch/science/gestens) and allows inscription to courses and exams, access to exam results, the initiation of the process of attestation, etc..

## 2 Master of Science (MSc)

[Version 2006, validation packages: MSc1-CH.1008, MSc2-CH.1004]

The programme of study of the MSc in Chemistry spans one and a half years, corresponding to 90 ECTS credits. The courses (UE) of the MSc correspond to 60 ECTS in total. They consist of 4 modules, each consisting of lectures, lab works, and seminars. Up to two of these modules can be followed in other domains of the Science Faculty of Fribourg as well as in Science Faculties of other Swiss universities. The MSc degree programme is completed by a master research project of 30 ECTS in total, which includes writing a master thesis and their oral defence.

UE of the MSc can only be assessed and recognized after successful completion of the BSc.

### 2.1 Course Units of the MSc

#### 1st and 2<sup>nd</sup> Semester (Winter and/or Summer)

Code	Course Unit	hours	ECTS
<b>Elective at the Chemistry Department <sup>2</sup></b>			
<i>MO-CH.4105</i>	<i>Analytical Chemistry Module, consisting of:</i>		
CH.4115	Analytical Chemistry Part A (lectures)	3	4
CH.4124	Analytical Chemistry (lab work or project)	8	6
CH.4125	Analytical Chemistry Part B (lectures)	3	4
CH.4134	Analytical Chemistry (seminar)	1	1
<i>MO-CH.4205</i>	<i>Advanced Synthetic Tools Module, consisting of:</i>		
CH.4215	Advanced Synthetic Tools Part A (lectures)	2	3
CH.4224	Advanced Synthetic Tools (lab work or project)	8	5
CH.4225	Advanced Synthetic Tools Part B (lectures)	4	6
CH.4234	Advanced Synthetic (seminar)	1	1
<i>MO-CH.4600</i>	<i>Molecular modelling, consisting of:</i>		
CH.4601	Computational chemistry (lectures)	5	7.5
CH.4602	Femto-second reaction dynamics (lectures)	1	1.5
CH.4603	Molecular modelling (seminar)	1	1
CH.4604	Molecular modelling (lab work)	10	5
<i>MO-CH.4700</i>	<i>Materials, consisting of:</i>		
CH.4701	Nanomaterials (lecture)	2	3
CH.4702	Crystallography & solid state chemistry (lecture)	4	6
CH.4703	Materials (seminar)	1	1
CH.4704	Materials (lab work)	8	5
<i>MO-CH.4800</i>	<i>Polymers, consisting of:</i>		
CH.4801	Polymer science I (lectures)	4	6
CH.4802	Polymer science II (lectures)	2	3
CH.4803	Polymer science lab (lab work )	8	6
<b>Other choices</b>			
–	<i>See section 3</i>		
			<b>60</b>

<sup>2</sup> Grouped units constitute a Master module, which can only be chosen as a whole.

**3rd Semester**

Code	Course Unit	hours	ECTS
<b>Compulsory</b>			
CH.5014	Master Project / Thesis		30
			<b>30</b>

**2.2 Content of the UE of the MSc**Lectures

All modules comprise thematically focused lectures given by several professors. The offer at the chemistry department includes teachers from the Fribourg engineering school and professors from Neuchâtel and Berne with the following thematics:

- *Analytical Chemistry (Statistics, sample preparation, analytical methods, analytics in industry, validation);*
- *Polymers (Polymer synthesis, analysis and properties; biopolymers, hybrid materials);*
- *Materials (Nanoparticles, properties and applications; Solid state chemistry, soft matter, oxide materials, superconductors, surface coating; typical methods for solid state analysis);*
- *Modelling (Interaction of radiation field and matter, femtosecond reaction dynamics, excited states and magnetism, computation of Rayleigh and Raman scattering, Fourier transform infrared spectroscopy, photoelectron spectroscopy);*
- *Advanced Synthetic Tools (Asymmetric synthesis of complex molecules, transition metals in synthesis, chemistry of unpaired electrons, supramolecular and biopolymer chemistry).*

Lab work and/or projects

Each module contains as an integral part a practical lab work or a project, in which students exercise themselves in field closely related to the lecture thematic.

Seminars

Some modules contain in addition to lectures and practical work also a seminar, in which each participant is obliged to provide an active contribution in the form of an oral contribution on a provided subject from the current scientific literature.

**2.3 MSc Exams and Assessment**

Assessment criteria for courses are specified in the appendix to the curriculum in Chemistry.

All of the 1<sup>st</sup> year UE of the MSc, i.e. the sum of the 4 chosen modules, form the **validation package MSc1**, enabling one to obtain 60 ECTS credits.

**2.4 Master Project / Thesis and Assessment**

The master thesis (CH.5014) forms the **validation package MSc2**. As a matter of principle, work on the master thesis can only be started after at least half of the modules of the validation package MSc1 has been evaluated.

The master project, a thesis of 30 ECTS points and duration of 4-6 months, introduces the students to scientific research. Normally, students will work on it during the third semester, and it represents the summit of the course of studies. It is a research work of a considerable volume under the supervision of an experienced researcher. During the master project and thesis, students can test their interest and ability to do research. They produce a thesis in the form of a scientific report and give an oral presentation of 30 minutes.



The master thesis is assessed by two examiners with a mark ranging from 6 (best mark) to 1 (worst mark). One of the examiners establishes a written report. A pass is accorded if the mark is at least 4. A failed master thesis can be repeated once on a different subject.

The successful completion of validation packages MSc1 and MSc2 awards the right to title **Master of Science in Chemistry, University of Fribourg (MSc)**.

## **2.5 Regulations of Admission to the Master Programme**

### **2.5.1 Admission Procedure**

Admission to the Master degree programme in chemistry is linked to two requirements: fulfilment of the admission requirements of the University – defined in the Regulations for the Admission to the University of Fribourg [*Règlement d'admission à l'Université de Fribourg / Reglement über die Zulassung an der Universität Freiburg*] – and possession of a Bachelor degree in chemistry from the University of Fribourg or an academic degree considered equivalent by the Faculty of Science.

The faculty possesses a list of academic titles that it recognizes as equivalent. Persons in possession of such a title will be admitted automatically. Persons in possession of an academic qualification not in the list can send the Faculty of science an application letter, on which the *Commission for student requests* – appointed by the faculty board – will make a decision.

Depending on the academic qualification, the Commission for student requests can make its acceptance dependent on the fulfilment of additional requirements, provided they are of a minor scope and can be completed in parallel to the master degree programme. Otherwise, applicants can be admitted to a “pre-master programme” and can start with the master degree programme only after fulfilling the requirements initially laid down for the pre-master.

### **2.5.2 Standard Transfers**

Particular admission transfers to the master are regularly used, especially by candidates in possession of a Bachelor HES in Chemistry. Detailed descriptions of these standard transfers represent an appendix to this curriculum and can be obtained from the Dean's Office of the Faculty of Science or the Office of the Department of Chemistry.



### 3. Additional module programmes

In order to obtain 60 ECTS required from teaching units during the first year of the Master studies, a maximum of two modules of 15 ECTS credits each can be chosen at Master level among the Master modules proposed by other Departments within the Faculty of Sciences. Nevertheless, a minimum of 30 ECTS (e. g. as minor during the bachelor) is required in the chosen field, allowing to follow the courses at Master level. Each student is responsible to acquire the basic level needed for these Chemistry-external Master modules.

The following options are currently offered:

#### 3.1 Teaching Units within the MSc

##### 3.1.1 Module « Developmental Biology »

[Version 2010, module: MO-BL.4103]

Code	Course Unit	hours	ECTS
BL.0114	Experimental genetics	1	1
BL.0115	The RNA world	1	1.5
BL.0116	DNA damage response pathways	1	1
BL.0117	Neurogenetics	2	3
BL.0119	Molecular genetics of model organism development (BeFri lecture)	2	3
BL.0120	Topics in developmental biology	2	3
MA.6001	Modelling	2	3
<b>Total</b>			<b>15.5</b>

##### 3.1.2 Module « Plant Biology »

[Version 2009, module: MO-BL.4102]

Code	Course Unit	hours	ECTS
BL.0301	Molecular basis of innate immunity	3	1.5
BL.0302	Plant biotechnology	3	1.5
BL.0305	Survival of plants in a hostile environment	3	1.5
BL.0306	Cell biology: how the cell modulate the life of a plant	3	1.5
BL.0307	Symbiosis: how plants and microbes communicate	3	1.5
BL.0308	Plant development: life of a sessile organism	3	1.5
BL.0309	Diagnostics of fungal disease of plants	3	1.5
BL.0311	Plant bacteria and viruses	2	1.5
BL.0315	Plant secondary metabolites: biosynthesis and function	3	1.5
BL.0316	Recent highlights in plant biology	3	1.5
<b>Total</b>			<b>15</b>

3.1.3 Module Biochemistry/Biology

[Version 2009, module: MC-BC.4101]

Code	Course Unit	hours	ECTS
BC.0025	Genomics	1	1.5
BC.0115	Human Molecular Genetics	1	1.5
BC.4020	Biochemistry Lunch Seminars	2 (3 sem)*	3
BC.4101			6x1
to	6 Topical Research Issues (see below)		
BC.4130			
BL.0115	The RNA world	1	1.5
BL.0400	Seminars in Biology	1 (3 sem)*	1.5
<b>Total</b>			<b>15</b>

\* Must be continuously attended during 3 semesters.

## Topical Research Issues:

- Three courses are given each semester.
- Any course is presented not more than once in 2.5 years.
- Topics may change with time.
- Currently, topics are: •4101. Cancer Biology, •4102. Gene therapy, •4103. Epigenetics, •4104. HIV virus, •4105. Gene regulation, •4106. Cell cycle regulation, •4107. Membrane lipid biosynthesis, •4108. Lipids as second messengers, •4109. Protein lipidation, •4110. Protein glycosylation, •4111. Autoimmune diseases, •4112. Obesity and diabetes mellitus, •4113. PI3 Kinases, •4114. Chaperones, •4115. Protein aggregation diseases, •4116. Neurobiology of drug addiction, •4117. Molecular clocks and circadian rhythms, •4118. Synaptic Plasticity, •4119 Other (to be announced).

3.1.4 Earth Science Module

[Version 2009, module: MC-ST.4103]

Code	Course Unit	hours	ECTS
<b>Mandatory courses</b>			
ST.0505	Technical Mineralogy	2	3
ST.0520	Cement and Silicate Cramics	block course	2.5
ST.0521	TEM and Spectroscopic Methods		2.5
S7402	Electron Microbeam Analysis	block course	2
			<b>10</b>
<b>Elective courses</b>			
ST.0405	Life, Oceans and Climate Evolution through time	2	3
ST.0406	Sedimentary Environments	2	3
ST.0522	Contaminated sites		2
ST.0524	Electron Microbeam Techniques, laboratory	block course	1
W7392	Aqueous Geochemistry		2.25
W7401	Geochemical Modelling		2.25
			<b>≥ 5</b>

S and W labelled courses are given within the BeNeFri Master in Earth Sciences at the Institute of Geology in Bern.

3.1.5 Module Physics

No offers currently. A program can be established on demand.

### **3.2 Content of the teaching units of the MSc**

For the description of the content and the learning outcomes, please refer to GestEns ([www.unifr.ch/science/gestens](http://www.unifr.ch/science/gestens)).

### **3.3 Exams of MSc and validation**

The chosen modules will be examined under the responsibility of the corresponding department which offer these modules. Refer to the appendix specific to the domain.