Curriculum for the award of the Degree of

Master of Science in Chemistry

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CONTENTS

CONTENTS .................................................................................................................................. 2

1 GENERAL REMARKS .......................................................................................................... 3
1.1 Academic Titles and Programme of Study ........................................................................ 3
1.2 Course Structure .................................................................................................................. 3
1.3 Acquired skills ...................................................................................................................... 4
1.4 Assessment of Course Units (UE) and Acquisition of ECTS Credits ............................... 4
1.5 Teaching Languages ........................................................................................................... 5
1.6 Ethics and Science ............................................................................................................... 5
1.7 Regulations and Additional Information ........................................................................... 5

2 MASTER OF SCIENCE (MSC) .......................................................................................... 6
2.1 Course Units of the MSc ..................................................................................................... 6
2.2 Content of the UE of the MSc ........................................................................................... 7
   Lectures .......................................................................................................................................... 7
   Lab work ......................................................................................................................................... 7
2.3 MSc Exams and Assessment ............................................................................................. 8
2.4 Master Project / Thesis and Assessment ........................................................................... 8
2.5 Regulations of Admission to the Master Programme ........................................................... 8
   2.5.1 Admission Procedure ...................................................................................................... 8
   2.5.2 Standard Transfers ........................................................................................................... 9

3 ADDITIONAL MODULE PROGRAMMES ........................................................................ 10
3.1 Content of the Teaching Units of the MSc ..................................................................... 10
3.2 Exams of MSc and Validation ........................................................................................... 10
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 and Medicine as defined in the Règlement pour l’obtention des Bachelor of Science et des Master of Science de la Faculté des sciences et de médecine, which entered into force on 2 February 2004 (hereafter called the Regulation for short). In case of discrepancies of translation, the French version will be considered authoritative.

1.1 Academic Titles and Programme of Study

The Faculty of Science and Medicine 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 lifelong 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’enseignement pour les écoles de maturité (DEEM) / Lehrdiplom für Maturitätsschulen (LDM)].

Candidates in possession of a BSc in Chemistry of the University of Fribourg or any other Swiss university are admitted to the MSc in Chemistry (Art. 7 of the Regulation). Candidates 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 program based on a decision of the Faculty of Science and Medicine to be made in each individual case. Provisional admission can be granted and depends on the fulfilment of additional requirements set by the Faculty (cf. Section 2.5).

1.2 Course Structure

The degree courses leading to the BSc and MSc respectively are subdivided into teaching units (UE) comprising lectures, exercise classes, laboratories, seminars, student projects, etc. To each UE, a number of ECTS¹ 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

¹ ECTS stands for European Credit Transfer System. One ECTS point corresponds to approx. 30 hours of work. See https://ec.europa.eu/education/resources/european-credit-transfer-accumulation-system_en for more information.
Curriculum of the Master of Science in Chemistry

(or 6 semesters of full-time studies), and the MSc degree additional 90 ECTS credits (or 3 semesters of full-time studies).

The BSc degree course is composed of a major of 150 ECTS credits, and a selectable minor of 30 ECTS credits. 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 and Medicine (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. (cf. 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.
- **Research report** is preparing the students for acquiring knowledge in a specific field and disseminating the learned in a written form.
- **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 on-line in the student web portal MyUniFR within the stipulated delays for each exam according to the on-line procedure (https://my.unifr.ch). 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 packages 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, be this 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 Chemistry can be found in the documents referenced on the web page http://www3.unifr.ch/scimed/en/plans which can also be obtained from the Office of the Department of Chemistry, chemin du Musée 9, CH-1700 Fribourg.
2 Master of Science (MSc)

[Version 2019, validation packages: PV-SCH.0000018, PV-SCH.0000019]

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 credits in total. They consist of 4 compulsory modules (42 ECTS) and of 2 elective modules (18 ECTS) to be chosen among the thematic modules.

The compulsory Research module MO-SCH.4900 consists of 2 laboratory projects – to be carried out in two research groups of the Department of Chemistry, each project being the equivalent of 3 full-time weeks – and one written report (bibliography). These three parts have to be carried out in a field of a module followed by the student.

All modules have to be chosen within the programme of the Department of Chemistry of the University of Fribourg (one module can be taken at the EIF, see below). The study advisor can allow exceptions.

The MSc degree programme is completed by a 6 months master research project of 30 ECTS credits in total, which includes writing a master thesis and its 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 2nd Semester (Autumn and/or Spring)

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Unit</th>
<th>tot. h.</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Compulsory</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MO-SCH.04021</td>
<td>Inorganic chemistry module, consisting of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCH.04021</td>
<td>Inorganic chemistry I (lectures)</td>
<td>28</td>
<td>3</td>
</tr>
<tr>
<td>SCH.04022</td>
<td>Inorganic chemistry II (lectures)</td>
<td>28</td>
<td>3</td>
</tr>
<tr>
<td>SCH.04024</td>
<td>Selected topics in materials and inorganic chemistry (lectures)</td>
<td>28</td>
<td>3</td>
</tr>
<tr>
<td>MO-SCH.04140</td>
<td>Organic chemistry module, consisting of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCH.04141</td>
<td>Organic chemistry I (lectures)</td>
<td>28</td>
<td>3</td>
</tr>
<tr>
<td>SCH.04142</td>
<td>Organic chemistry II (lectures)</td>
<td>28</td>
<td>3</td>
</tr>
<tr>
<td>SCH.04143</td>
<td>Selected topics in organic chemistry (lectures)</td>
<td>28</td>
<td>3</td>
</tr>
<tr>
<td>MO-SCH.04850</td>
<td>Physical chemistry module, consisting of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCH.04851</td>
<td>Physical chemistry I (lecture)</td>
<td>28</td>
<td>3</td>
</tr>
<tr>
<td>SCH.04852</td>
<td>Physical chemistry II (lecture)</td>
<td>28</td>
<td>3</td>
</tr>
<tr>
<td>SCH.04853</td>
<td>Selected topics in physical chemistry (lecture)</td>
<td>28</td>
<td>3</td>
</tr>
<tr>
<td>MO-SCH.04900</td>
<td>Research module, consisting of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCH.04901</td>
<td>Bibliographical work (project)</td>
<td>56</td>
<td>3</td>
</tr>
<tr>
<td>SCH.04902</td>
<td>Laboratory project I (practical course)¹</td>
<td>112</td>
<td>6</td>
</tr>
<tr>
<td>SCH.04903</td>
<td>Laboratory project II (practical course)¹</td>
<td>112</td>
<td>6</td>
</tr>
</tbody>
</table>

42

¹ To be carried out in two different research groups

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² Grouped units constitute a master module, which can only be chosen as a whole. Students who followed the industrial chemistry course during their bachelor studies may choose the optional "Industrial chemistry" module at the University of Applied Sciences Fribourg.
Elective at the Chemistry Department

**MO-SCH.04250 Analytical chemistry module, consisting of:**

- **SCH.04251 Analytical chemistry I (lectures)**
  - 28学时
  - 3学分

- **SCH.04252 Analytical chemistry II (lectures)**
  - 28学时
  - 3学分

- **SCH.04253 Selected topics in analytical chemistry (lectures)**
  - 28学时
  - 3学分

**MO-SCH.04702 Advanced inorganic chemistry module, consisting of:**

- **SCH.04701 Nanomaterials (lecture)**
  - 28学时
  - 3学分

- **SCH.04705 Crystallography and crystal growth and technology (lecture)**
  - 28学时
  - 3学分

- **SCH.04706 Solid state chemistry (lecture)**
  - 28学时
  - 3学分

**MO-SCH.04013 Advanced organic chemistry module, consisting of:**

- **SCH.04011 Bioorganic chemistry (lectures)**
  - 28学时
  - 3学分

- **SCH.04012 Physical organic chemistry (lectures)**
  - 28学时
  - 3学分

- **SCH.04213 Synthesis of complex molecules (lectures)**
  - 28学时
  - 3学分

**MO-SCH.04802 Polymers module, consisting of:**

- **SCH.04804 Basic polymer chemistry (lecture and exercises)**
  - 42学时
  - 4.5学分

- **SCH.04805 Advanced polymer chemistry (lecture)**
  - 28学时
  - 3学分

- **SCH.04806 Selected topics in polymer science (seminar)**
  - 14学时
  - 1.5学分

<table>
<thead>
<tr>
<th>3rd Semester</th>
<th>Code</th>
<th>Course Unit</th>
<th>tot. h.</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Compulsory</strong></td>
<td>SCH.05014</td>
<td>Master project / Thesis</td>
<td>–</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 2.2 Content of the UE of the MSc

**Lectures**

All modules comprise thematically focused lectures and seminars given by several professors. Some lectures may be presented by teachers from the Fribourg engineering school and professors from Neuchâtel and Berne. The following thematic is covered:

- Inorganic chemistry module (In depth presentation of subjects from inorganic chemistry);
- Organic chemistry module (In depth presentation of subjects from organic chemistry);
- Physical chemistry module (In depth presentation of subjects from organic chemistry);
- Research module (Individual research work);
- Analytical chemistry (2D NMR interpretation, mass spectroscopy, chromatography, sample preparation, analytics in industry, validation);
- Advanced inorganic chemistry (Nanoparticles, properties and applications; Solid state chemistry, soft matter, oxide materials, superconductors, surface coating; typical methods for solid state analysis);
- Advanced organic chemistry module (Asymmetric synthesis of complex molecules, chemistry in biology and medicine, mechanistic investigations of organic reactions);
- Polymers (Polymer synthesis, analysis and properties; biopolymers, hybrid materials);

**Lab work**

Lab work is an integral part of chemistry. Students are exposed to the research performed in the Department of Chemistry of the University of Fribourg and exercise themselves in a field closely related to a lecture thematic.
2.3 MSc Exams and Assessment

Assessment criteria for courses are specified in the appendix to the curriculum in Chemistry. All of the 1st year UE of the MSc, i.e., the sum of the 4 compulsory + 2 elective modules, form the first validation package, enabling one to obtain 60 ECTS credits.

2.4 Master Project / Thesis and Assessment

The master thesis (SCH.05014) forms the second validation package. As a matter of principle, work on the master thesis can only be started after at least half of the modules of the first validation package have been evaluated.

The master project, a thesis of 30 ECTS credits 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 the two validation packages awards the right to the 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’s programme may be granted provided the following two conditions have been met by the applicant:

- Satisfying the University admission requirements as defined in the Règlement concernant l’admission à l’Université de Fribourg (https://www3.unifr.ch/apps/legal/fr/document/274904),
- The student possesses a Bachelor of Science in Chemistry from the University of Fribourg or an academic degree judged equivalent by the Faculty of Science and Medicine.

For candidates with degrees that are not judged equivalent by the Faculty of Science and Medicine, the Commission for Students’ Requests will decide on eligibility (Commission des requêtes des étudiant-e-s, Dean’s Office, Faculty of Science and Medicine, ch. du Musée 8, CH-1700 Fribourg, Switzerland).

Based on the candidate’s academic qualification, the Commission for Students’ Requests can accept the application on the condition that additional requirements are fulfilled, provided they are of a minor scope and can be completed simultaneously with the Master studies. Otherwise, access is denied or applicants can be admitted to a “pre-master programme” and can begin the Master programme only after having fulfilled the requirements initially set for the pre-master. Final acceptance to the Master programme for a qualifying student depends on the successful completion of the additional requirements.
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 and Medicine or the Office of the Department of Chemistry.
3. **Additional Module Programmes**

One module of 9 ECTS credits, the “Industrial Chemistry”, can be chosen from the Master program of the HES Fribourg, provided that the courses in “Industrial Chemistry” have been followed during the Bachelor studies.

3.1 **Content of the Teaching Units of the MSc**

For the description of the content and the learning outcomes, please refer to the student web portal MyUniFR (https://my.unifr.ch).

3.2 **Exams of MSc and Validation**

The chosen module will be examined under the responsibility of the corresponding department which offers it. Refer to the appendix specific to the domain.