

**FACULTY OF SCIENCE
TEACHING AND EXAMINATION REGULATIONS
PART B**

Academic year 2016-2017

MASTER'S PROGRAMME CHEMISTRY

University of Amsterdam

VU University Amsterdam

Single degree and Joint degree

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Chapter 1. General Provisions

Article 1.1 – Definitions

In addition to part A, the following definitions are used in part B

Personal Education Plan	An individual study plan for the student's master programme.
Research Project	Compulsory internship-master thesis always resulting in a written report

Article 1.2 – General information master's programme

1. The master's programme Chemistry, CROHO 66857 (single degree) and CROHO 65012 (joint degree) are offered on a full-time and part-time basis and the language of instruction is English.
2. The programme has a workload of 120 EC.
3. Within the Joint degree programme the following tracks are offered:
 - Analytical Sciences;
 - ATOSIM (joint operation with Ecole Normale Supérieure in Lyon and La Sapienza University in Rome);
 - Molecular Sciences;
 - Science for Energy and Sustainability;
 - Science, Business & Innovation.
4. Within the Single degree programme the following tracks are offered:
 - Analytical Sciences;
 - ATOSIM (joint operation with Ecole Normale Supérieure in Lyon and La Sapienza University in Rome);
 - Molecular Simulation and Photonics;
 - Molecular Design, Synthesis and Catalysis
 - Science for Energy and Sustainability;
5. In each research track (see bullet 3 for the tracks) the student may choose one out of these majors or minors (see Article 4.1).
 - Major Science Communication
 - Major Science in Society
 - Major Teaching
 - Minor Tesla
 - Minor Science for Sustainability
 - Minor Teaching
6. The student determines the content of the master's programme in consultation with the coordinator of the master's programme and according to the rules of Chapter 3. The coordinator of the master's programme will lay down the content chosen by the student in a Personal Education Plan (PEP). The coordinator submits this PEP together with his recommendation to the Examinations Board. If the student wants to change the contents of the study programme, the student promptly consults with the coordinator of the study programme. If this results in a new PEP the student coordinator submits this to the Examinations Board.

Article 1.3 – Enrolment

The programme starts at the beginning of the first semester (September) and second semester (February) of the study year. This enrolment date ensures a programme that can be expected to be completed within the official period.

Chapter 2. Aim of the programme and exit qualifications

Article 2.1 – Aim of the programme

The master's programme in Chemistry aspires to be a study programme with international prestige, emanating from, and based on the strong research areas of Chemistry. The aim of the master's programme (MSc) in Chemistry is to:

- a. educate students to become independent professionals, enabling them to conduct fundamental scientific research, to deal with current scientific knowledge, and to apply this knowledge in new and continuously changing practical situations;
- b. actively stimulate interdisciplinary collaboration in the development of science, based on knowledge in the field of chemistry;
- c. offer students the possibility to develop skills, knowledge and insight in a specialism in the field of chemistry, with emphasis on formulating relevant scientific questions and on the approach to find answers to these questions;
- d. provide student-oriented education that is of a high, internationally recognised quality;
- e. offer students the opportunity to gain knowledge and insight in an international setting;
- f. provide an inspiring academic learning environment, and to offer feasible study tracks to a demanding and heterogeneously composed student population;
- g. develop the ability of students to convey acquired knowledge to others.

Article 2.2 – Exit qualifications

1. The graduate of the master's programme Chemistry has:
 - a. a thorough theoretical and practical knowledge of modern chemistry, including the knowledge of other disciplines required for that purpose;
 - b. a thorough knowledge of theoretical and experimental methods and research experience in at least one sub-area within the discipline of chemistry;
 - c. the ability to become acquainted with other sub-areas of the discipline within a reasonable period of time;
 - d. the ability to formulate a research plan based on a realistic problem within the discipline of chemistry;
 - e. the ability to analyse research results and to draw conclusions therefrom;
 - f. the ability to write a report or an internationally accessible scientific publication, and to participate in discussions on a topic in the field of study;
 - g. the ability to consult (international) professional literature in the relevant sub-areas and to apply the knowledge gained from that;
 - h. the ability to apply one's knowledge of chemistry in a broader (multidisciplinary) context;
 - i. the ability to deal with the safety and environmental aspects of chemistry;
 - j. an employability in those positions for which knowledge and research skills in the field of chemistry are a prerequisite;
 - k. sufficient knowledge and insight in the social role of chemistry in order to be able to make a sound choice regarding one's profession, as well as in the exertion of this profession;
 - l. the ability to cooperate with, and to convey knowledge to other people and to give a presentation both to discipline specialists and to a broader audience.
 - m. Has good receptive and written productive skills in the English language.
2. In addition to paragraph 1, the student who has completed the track Analytical Sciences has obtained the following track-specific qualifications:
 - a. a thorough knowledge of and insight in the principles and performance of the main analytical methods and techniques;
 - b. the proficiency to select suitable strategies and methods for specific analytical questions;
 - c. the proficiency to translate analytical data into relevant information;
 - d. the ability to communicate with others about analytical questions and problems.

3. In addition to paragraph 1, the student who has completed the track ATOSIM has obtained the following track-specific qualifications:
 - a. a thorough scientific knowledge of the field of atomic scale modelling;
 - b. a proficiency in analysing and solving scientific problems in the field of atomic scale modelling;
 - c. the ability to communicate with others about questions and problems in the field of atomic scale modelling.
4. In addition to paragraph 1, the student who has completed the track Molecular Simulation and Photonics has obtained the following track-specific qualifications:
 - a. a thorough scientific knowledge of the field of molecular simulation and spectroscopy;
 - b. a proficiency in analysing and solving scientific problems in the field of molecular simulation and spectroscopy;
 - c. the ability to communicate with others about questions and problems in the field of molecular simulation and spectroscopy.
5. In addition to paragraph 1, the student who has completed the track Molecular Design, Synthesis and Catalysis has obtained the following track-specific qualifications:
 - a. a thorough scientific knowledge and understanding of the field of synthesis and catalysis;
 - b. a proficiency in analysing and solving problems in the field of synthesis and catalysis;
 - c. ability to communicate questions and scientific results in the field of synthesis and catalysis.
6. In addition to paragraph 1, the student who has completed the track Molecular Sciences has obtained the following track-specific qualifications:
 - a. a thorough scientific knowledge and understanding of the field of synthesis, catalysis, molecular simulation and spectroscopy;
 - b. a proficiency in analysing and solving scientific problems in the field of molecular simulation, spectroscopy, synthesis and catalysis;
 - c. the ability to communicate with others about questions and problems in the field of molecular simulation, spectroscopy, synthesis and catalysis.
7. In addition to paragraph 1, the student who has completed the track Science for Energy and Sustainability has obtained the following track-specific qualifications:
 - a. a thorough knowledge of the scientific, technological and societal challenges for our future associated with energy and sustainability problems;
 - b. a proficiency in analysing and evaluating the current energy and sustainability problems;
 - c. a proficiency in applying the acquired theoretical and practical insights in day-to-day practice at an institution, company or organization, strongly focused on providing scientific solutions to current and future energy and sustainability problems;
8. The graduate of the regular programme:
 - a. Is able to independently design experiments including the corresponding controls, conducting and evaluating these within a given period of time;
 - b. is able to incorporate the obtained results and conclusions within the framework of the results of other scientists;
 - c. is able to form a view on the development of scientific research in the field of study;
 - d. is able to quantitatively and qualitatively analyse chemical processes, to incorporate data in existing or in new models, and to present the results at various levels of abstraction; has insight in the role of chemistry in a sustainable society.
9. In addition to paragraph 1, the student who has completed the track Science, Business & Innovation has obtained the following track-specific qualifications:
 - a. a thorough knowledge of the specific natural scientific and social scientific aspects of business innovation trajectories in the area of human life and health care (track Life & Health) or in sustainable energy technology (track Energy & Sustainability);
 - b. a proficiency in analysing and solving problems with respect to business innovation

- trajectories in drug development and health diagnostic instruments (track Life & Health) or in sustainable energy technology (track Energy & Sustainability);
- c. a proficiency in applying the acquired theoretical and practical insights in day-to-day practice at an institution, company or organization, strongly focused on providing natural science- and social science-based solutions that enable business innovation trajectories in drug development and health diagnostic instruments (track Life & Health) or in sustainable energy technology (track Energy & Sustainability);

Chapter 3. Admission to the programme

Article 3.1 – Entry requirements (except for the SBI track, entry requirements SBI track in article 3.1a)

1. Students who have successfully completed the following degrees may be admitted:
 - the Bachelor's degree in *Scheikunde* (Chemistry), awarded by a Dutch University;
 - the Bachelor's degree in *Farmaceutische Wetenschappen* (Pharmaceutical Sciences), awarded by the VU University Amsterdam;
 - the Bachelor's Degree in *Bèta-gamma met een Scheikunde major* (Liberal Arts and Sciences with a Chemistry Major), awarded by the University of Amsterdam;
2. the HLO Bachelor's degree *Scheikunde* (Chemistry), provided that the Examinations Board decides that this degree meets the entry requirements. (Deficiencies may be repaired before the start of the master's program or by taking specified courses as part of the elective program of the student. See art. 3.1.4 and 3.2).
3. Without prejudice to the provisions of paragraph 1, the Examinations Board may grant admission to the study programme when concluding, that the previous education of the candidate is equivalent to the bachelor's degree referred to in paragraph 1.
4. Without prejudice to the provisions of paragraphs 1, 2 and 3 the Examinations Board may grant admission to a student whose previous education does not meet aforementioned requirements for admission to the study programme, when concluding that the candidate is able to meet the admission requirements within a reasonable period of time. At the request of a candidate, and when the Examinations Board has decided additional education feasible, the Examinations Board may draw up a pre-master's programme of maximum 30 EC as an admission requirement. After completion of this pre-master's programme a letter of admission will be issued, exclusively for the stated master's programme and track.
5. When the Admission Board decides that the additional required education for a candidate is for not more than 12 EC, direct admission to the master program can be granted. In this case the additional courses to be taken by the candidate will be part of the elective program of the student.
6. When the programme commences, the student must have fully completed the bachelor's or pre-master programme allowing admission to this programme.

Article 3.1a Entry requirements track Science, Business and Innovation (SBI)

1. Students who have successfully completed the following degree may be admitted: Bachelor's degree in SBI from VU University Amsterdam .
2. Without prejudice to the provisions of paragraph 1, the Examination Board may grant admission to the study programme when concluding that the previous education of the candidate is equivalent to the Bachelor's degree referred to in paragraph 1.
3. Without prejudice to the provisions of paragraphs 1 and 2 the Examination Board may grant admission to a student whose previous education does not meet aforementioned requirements for admission to the study programme, when concluding that the candidate is able to meet the admission requirements within a reasonable period of time. At the

request of a candidate, and if the Examination Board has decided additional education feasible, the Examinations Board may draw up a programme of maximum 30 EC as an admission requirement, a so called 'preparatory programme'. After completion of this preparatory programme a letter of admission will be issued, exclusively for the stated Master's programme and track.

4. When the programme commences, the student must have fully completed the Bachelor's programme allowing admission to this programme.

Article 3.2 – Pre-master's programme (except for the SBI track, for a pre-master for the SBI track see article 3.2a)

1. In addition to Article 3.1.3 the Examinations Board may draw up a pre-master's programme of maximum 30 EC. The pre-master's programme will be offered in the first semester.
2. The pre-master's programme consists of a selection of the following components:
 - Structure and properties of organic molecules Premaster Course (6 EC)
 - Thermodynamics Premaster Course (6 EC)
 - Mathematics Premaster Course (6 EC)
 - Organic Chemistry Premaster Course (3 EC)
 - Chemical Bonding Premaster Course (3 EC)
 - Inorganic Chemistry Premaster Course (3 EC)
 - Literature Study Premaster Program (3-6 EC)
 - English Academic Course/ Scientific Writing (3 EC)

Article 3.2a Pre-master for the SBI track

Pre-master candidates have to apply via the Examinations Board.

Article 3.3 – Restrictions on the number of students admitted to the Master's programme

No restrictions

Article 3.4 – Intake dates

A request for admission to the master's programme starting in September must be received before 1 May in the case of EU students (including Dutch students) and before 1 February in the case of non-EU students. For the programme starting in February, applications must be received before 1 November for EU students (including Dutch students) and before 1 October for non-EU students. Under exceptional circumstances, the Examinations Board may consider a request submitted after this closing date.

Article 3.5 – English Language Requirements

1. The proficiency requirement in English as the language of instruction can be met by the successful completion of the following examinations or an equivalent:
 - IELTS: 6.5 at least 6 on each sub-score (listening/reading/writing/speaking)
 - TOEFL paper based test: 580
 - TOEFL internet based test: 92
 - TOEFL computer based test: 237
- Cambridge Certificate in Advanced English (CAE): A,B
- Cambridge Certificate of Proficiency in English (CPE): A, B, C
2. Students possessing a bachelor's degree from a Dutch university satisfy the requirement of sufficient command of the English language.
3. Exemption is granted from the examination in English referred to in the first paragraph to students who:
 - had previous education in secondary or tertiary education in an English-speaking

- country as listed on the website, or;
- have an English language ‘international BSc’ diploma.

Article 3.6 – Free curriculum

1. The student may compile a curriculum of his/her own choice, which has to be approved by the Examinations Board.
2. At least one half of the proposed curriculum, excluding the Research Project, has to consist of components of the regular programme. Furthermore the Research Project has to be done.

Chapter 4. Content and organisation of the programme

Article 4.1 – Organisation of the programme

1. The curriculum comprises the following:

Components	Regular programme	Major	Minor
Compulsory courses	12-24 EC	12-18 EC	12-24 EC
Elective courses ¹ for which applies:	42-48 EC	0-6 EC	12-24 EC
-extension final research project	max 18 EC		
-choice of free elective courses	max 12 EC		
-choice of academic skills courses	max 6 EC		
-choice of minor research project	max 24 EC		
Literature review	12 EC	6 EC	12 EC
Research projects ² /Final research project	42 EC	36 EC	42 EC
Major		60 EC	-
Minor	-	-	30 EC
Total study load	120 EC	120 EC	120 EC

¹Regarding the elective and compulsory programme further requirements may have to be met, depending on the track chosen within the Chemistry master's programme. ²The research projects are limited to 2 projects. In case of 2 projects one project must comprise at least 42 EC. This project is deemed to be the final project.

Components track AtoSim	Programme
Compulsory components	48 EC
Elective components discipline	30 EC
Orientation project/seminar/literature study	12 EC
Research project	30 EC
Total study load	120 EC

A complete list of courses provided by the master's programme can be found in Appendix 1. Every component will be tested. Within the master's programme different types of testing and different types of teaching methods are used. These are described per component in the course catalogue.

2. The student can choose between the regular programme and a programme containing one of three majors or three minors. The majors and minors are:
 - a. Major Science in Society;
 - b. Major Science Communication;
 - c. Major Teaching;
 - d. Minor Tesla;
 - e. Minor Science for Sustainability;

- f. Minor Teaching.
3. Regarding the majors:
A major consists of 60 EC. It has to be combined with a research programme, comprising at least 60 EC (courses, research project and literature review), and with the general compulsory components in order to meet the general requirements of the programme. Students have to go through a separate intake procedure for admission to the majors. Students first have to finish the obligatory research part of the programme before starting one of the majors. The exit qualifications of the majors can be found in appendix 2.
 4. Regarding the major Teaching:
Students who have completed an Educative Minor of 30 EC during their bachelor's programme may submit a non-standard study programme for approval to the Examinations Board of the *Interfacultaire Lerarenopleidingen*, after discussing this non-standard study programme with the coordinator of the major Teaching and the coordinator of the master's programme.
 5. Regarding the minor Tesla:
The minor Tesla consists of 30 EC. It must be combined with a research programme, comprising at least 90 EC. The minor consist of a course component and a project-based component. This project-based component has to be supervised by a Faculty of Science examiner and is subject to prior approval of the Examinations Board. An examiner from the research programme has to be appointed as a second assessor. The learning objectives of this minor can be found in appendix 2.
 6. Regarding the minor Science for Sustainability:
The minor Science for Sustainability consists of 30 EC. It must be combined with a research programme, comprising at least 90 EC. The learning objectives of this minor can be found in appendix 2.

Article 4.2 – Compulsory components

The programme includes compulsory components with a study load of 24 EC (18 in the Science in Society major and the Science and Communication major). The contents and format of the compulsory components of the various tracks are further described in the Course Catalogue, stating the necessary entry requirements for successful participation in the component.

Article 4.3 – Practical components

1. In addition to, or instead of, classes in the form of lectures, the elements of the master's programme can include a practical component as defined in article 1.2 of part A. The Course Catalogue contains information on the types of classes in each part of the programme. Attendance during practical components is mandatory .
2. When performing practical components, students must adhere to the Faculty's safety regulations.
3. The programme consists of research-related components with a study load of at least 42 EC (36 in the Science in Society major and the Science and Communication major). The research-related components always include the compulsory components:
 - a research assignment with a study load of at least 36 EC (30 in the Science in Society major and the Science and Communication major);
 - a final report and a scientific presentation with a study load of 6 EC.

Article 4.4 – Elective components

1. Students choose components in the field of the discipline according to the rules stated in the Course Catalogue.
2. Students may make a choice out of components in the field of the discipline included in the Course Catalogue, and out of components offered by another Dutch or foreign university,

- that are according to the Examinations Board of a comparable level.
3. Course components successfully completed elsewhere or that are not included in appendix 1 during the programme may supplement the student's examination programme, subject to prior permission from the Examinations Board.
 - a. The courses have to be followed at an accredited university or institute
 - b. The course has to be relevant to the master chosen.
 4. In exceptional cases students may choose bachelor's level free elective components as part of their programme. The Examinations Board will determine whether a free elective component at the bachelor's level will be seen as part of the programme and the number of credits that will be allocated to the elective component.
 5. In terms of content, elective components must not show too much similarity to other components of the student's curriculum. The acceptable degree of similarity will be decided by the Examinations Board.
 6. A free elective component will only be seen as part of the programme if the Examinations Board has given its prior approval.

Article 4.5 – Sequence and admission requirements

1. Participation in a course may be restricted to students that have completed certain other programme components. Details of such restrictions will be published in the Course Catalogue.
2. A student can start the final research project only after having completed the compulsory theoretical components of the programme. The coordinator of the student's track can grant exemption of this rule.
3. In exceptional cases, the Examinations Board may, at the student's reasoned request, deviate from the order mentioned in paragraph 1 of this article, with or without stipulating conditions.
4. In cases where the result of a component has not been determined within the time periods mentioned in Article 4.4 of part A, this component may not be required as prior knowledge for the subsequent component.

Article 4.6 – Participation practical training and tutorials Not applicable

Article 4.7 – Exemption

1. At the written request of the student, the Examinations Board may exempt the student from taking one or more examination components, if the student:
 - a. Has passed a component of an academic or higher professional education programme that is equivalent in both content and level;
 - b. Has demonstrated through his/her work and/or professional experience that he/she has sufficient knowledge and skills with regard to the relevant component.
2. This exemption does not apply to the master's thesis.
3. Exemptions from examinations (or parts thereof), if granted, will be valid for the same period as indicated in article 4.8.
4. A maximum of 60 EC can be accumulated in the programme through granted exemptions.

Article 4.8 – Degree

A student who passes the final examination of a programme is awarded a Master of Science degree. The degree awarded is stated on the diploma.

Article 4.9 – Double Master's programme (two-year programmes)

In order to be awarded two master's degrees or to have stated on the master's diploma that two master's programmes have been completed within the discipline, the following requirements must be met:

1. The total programme of the candidate should amount to at least 180 EC credits.
2. The candidate's work for the programme (lectures, research work, etc.) must be of such a standard that all the compulsory requirements of each of the two programmes have been met.
3. The candidate must have conducted separate research work for both Master's degrees. This may consist of two separate research projects with supervisors from the respective study programmes. In the case of an integrated research project, this must be supervised by two staff members appointed from the two study programmes. Both staff members must assess the work as a pass.
4. The Examinations Boards of both study programmes must approve the student's double master's programme before the student commences on the double master's programme.

Article 4.10 – Participation in courses and rules for priority admission

1. Every student must enrol for every course component. To participate in courses, the student must enrol within the period indicated in the Course Catalogue and according to procedures mentioned there. The student may be refused the opportunity to participate if he/she does not enrol or fails to enrol in time.
2. Admission to courses with limited capacity takes place based on previously established and published admission criteria and rules for priority admission, on the understanding that students enrolled in the programme are given priority over others when enrolling for courses in the compulsory part of their programme.

Article 4.11 – Final research project, final report and literature thesis

1. It is mandatory that the student fills out an online research training contract, together with the supervisor, before the student starts the research training. The track coordinator and the supervisor evaluate this proposal, and upon approval the student can start the research training. The supervisor is a permanent staff member of the VU and UvA Faculty of Science, appointed as an examiner by the Examinations Board.
2. At the end of the final research project and after handing in the final report the supervisor checks on the basis of the assessment form, if the student has sufficiently achieved the set exit qualifications.
3. For the assessment of the final research project and the final report the advice of a second examiner is always obtained.
4. Students, proficient in the Dutch language write a short non-specialist summary in Dutch; students who do not have a sufficient command of the Dutch Language write this summary in English.
5. Article 4.11 number 1 – 3 also applies to the literature thesis.

Chapter 5. Transitional and final provisions

Article 5.1 – Amendments

1. The dean shall establish amendments to the part B of these Regulations by independent decision – having heard the Board of Studies and with due regard for the authority of the relevant advisory bodies.
2. Amendments to these regulations take place following a recommendation by the Board of Studies relating to the regulations in their entirety, and with the endorsement of a joint meeting of those sections which do not relate to the subject of Article 7.13 paragraphs 2a to g, and paragraph 3 of the Act and the admission requirements for master's programmes.
3. Amendments to the part B of these Regulations do not apply to the current academic year unless they can be reasonably assumed not to damage the student's interest.

Article 5.2 – Cancelled programme components

Not applicable

Article 5.3 - Publication

1. The dean shall ensure a fitting publication of part A and B of these Regulations and the rules and guideline referred to in the Act.
2. These regulations can be accessed at the website of the Faculty.

Article 5.4 – Effective date

These Regulations enter into force with effect from 1 September, 2016.

Thus drawn up by the Dean of the Faculty of Science on 18 July 2016 and by the Faculty board (VU) on 14 July 2016.

Appendix 1 Description of the content and study load of the components.

This list comprises the curriculum components of the Chemistry master's programme tracks in the academic year 2016-2017. The contents of the components are described in the Course Catalogue.

Analytical Sciences:

Format: L: lectures; T: tutorials; CP: computer practicum.; Lit: literature study; As: assignment; P: presentation; Exp: experimental work / practicum

Assessment: W: written exam; O: oral exam; P: presentation; R: report

Compulsory components	Code	EC	Period	Format	Assessment
(Bio) Molecular Spectroscopy	52548BMS6Y	6	5	L/T	W
Fundamentals of Analytical Sciences	5254FUAS6Y	6	4	L/T, CP	W, P
Mass Spectrometry	5254MASP6Y	6	2	L/T	W
Separation Sciences	52548SES6Y	6	1	L/T, Lit	W, P

Elective components	Code	EC	Period	Format	Assessment
Advanced Separation Sciences	5254ADSS6Y	6	3	L/T	W
Advanced Spectroscopy	52548ADS6Y	6	6	L/T	W
Advanced Statistics for Analytical Chemistry	5254ASFA6Y	6	5	L/T, CP, As	W, P
Bio-Analysis and Clinical Diagnostics	52548BAC6Y	6	1	L/T, As	W, R
Chemical Analysis for Forensic Evidence	5254CAFE6Y	6	2	L/T	W
Environmental Chemistry	5254ENCH6Y	6	1	L/T	W
Environmental Measuring Techniques	5264ENMT6Y	6	4	Exp, Lit	P, R
High-Throughput Screening	52548HTS6Y	6	2	L/T, As	O, P, R
Nuclear Magnetic Resonance	5254NUMR6Y	6	4	L/T	W
Protein Analysis	52548PAN6Y	6	5	L/T, As	W, P
The Analytical Chemist in Industry	5254ANCI6Y	6	4	L/T, As	P, R

ATOSIM

Format: L: lectures; T: tutorials; CP: computer practicum.; Lit: literature study; As: assignment; Exp: experimental work / practicum

Assessment: W: written exam; O: oral exam; P: presentation; R: report

Compulsory components	Code	EC	Period	Format	Assessment
Quantum Theory of Molecules and Matter	5254QTMM6Y	6	1	L/T, As	W
Scientific Computing and Programming	52548SCP6Y	6	2	L, CP	R
Statistical Theory of Complex Molecular Systems	5254STTC6Y	6	1	L/T	W
Understanding Molecular Simulation	5254UNMS6Y	6	3	L, CP, As	W,R
Understanding Quantum Chemistry	52548UQC6Y	6	2	L, CP	W

Elective components	Code	EC	Period	Format	Assessment
Applied Theoretical Chemistry	52548ATC6Y	6	4	CP	R
Density Functional Theory for Chemists	5254DFTF6Y	6	1-6	Lit	O
Relativistic Molecular Quantum Chemistry*	52548RMQ6Y	6	4		
Scientific Computing	52548SCCO6Y	6	5	L, CP	R
Transport Phenomena	5254TRPH6Y	6	4,5	L	O

* This course is not available in 2016/2017

Molecular Sciences

Format: L: lectures; T: tutorials; CP: computer practicum.; Lit: literature study; As: assignment; Exp: experimental work / practicum

Assessment: W: written exam; O: oral exam; P: presentation; R: report

Constrained choice components	Code	EC	Period	Format	Assessment
Bio Organic Chemistry	52548BIO6Y	6	2	L	W
Coordination and Organometallic Chemistry	5254COOC6Y	6	2	L	W
Heterogeneous Catalysis	5254HECA6Y	6	3	L,T,P	W
Homogeneous Catalysis	5254HOCA6Y	6	5	L	W
Molecular Computational Chemistry	52548MOC6Y	6	5	L,CP,P	W
Nuclear Magnetic Resonance	5254NUMR6Y	6	4	L,T	W
Physical Organic Chemistry	52548POC6Y	6	1	L,T	W
Supramolecular Chemistry and Nanomaterials	5254SUCN6Y	6	1	L	W
Synthetic Organic Chemistry	5254SYOC6Y	6	4	L,T,P	W
Quantum Optics	53548LSM6Y	6	1	L/T, As	W
Statistical Theory of Complex Molecular Systems	5254STTC6Y	6	1	L/T	W
Quantum Theory of Molecules and Matter	5254QTMM6Y	6	1	L/T, As	W
Advanced Experimental Techniques	52548AET6Y	6	6	L, As	W
Ultrafast Laser Physics	53548ULL6Y	6	4		
Understanding Molecular Simulation	5254UNMS6Y	6	3	L,CP,As	W,R
Understanding Quantum Chemistry	52548UQC6Y	6	2	L, CP	W

Elective components	Code	EC	Period	Format	Assessment
Ab Initio Molecular Dynamics	5254AIMD6Y	6	5	L, As	R
Applied Theoretical Chemistry	52548ATC6Y	6	4	CP	R
Biomolecular Simulations	5254BISI6Y	6	4	L, CP	W, R
Density Functional Theory for Chemists	5254DFTF6Y	6	1-6	Lit	O
Numerical Techniques	5254NUTE6Y	6	4	L, CP, As	R
Scientific Computing and Programming	52548SCP6Y	6	2	L, CP	R
Soft Condensed Matter and Biological Physics	53548SCM6Y	6	2	L, As	W
Supramolecular Chemistry and Nanomaterials	5254SUCN6Y	6	1	L/T	W, R

Science, Business & Innovation:

Format: L: lectures; T: tutorials; CP: computer practicum.; Lit: literature study; As: assignment; Exp: experimental work/practicum

Assessment: W: written exam; O: oral exam; P: presentation; R: report

Compulsory components	Subject code	EC	Period	Format	Assessment	Level
Management of Sustainable Innovation	X_432739	6	2	L	W, O	400
Networked Organizations and Communication	S_NOOC	6	2	L, T	W, R, P	-
SBI Project & Master Thesis	X_432735	36	1-6	Exp	-	600
SBI Research Methodology	X_432846	6	1-6	-	-	-
Transdisciplinarity and Transition	X_430604	6	2	L	W, R, O	400

Compulsory Choice Science, Business and Innovation (6 EC Compulsory)

Subject code	EC	Period	Format	Assessment	Level
X_432723	6	3	L	W, R, P	500
X_422582	6	3	L,	R, P	500

Compulsory Choice Science Project (24 EC or 12 EC + 12 EC track courses from elective components)

Subject code	EC	Period	Format	Assessment	Level
X_432723	24	1-6	-	-	500
X_432850	12	4,5		V, P	400
X_432850	12	4,5	-	V, P	400
X_400424	24	1-6	-	-	400

Compulsory Choice Science Courses (12 EC compulsory)

Subject code	EC	Period	Format	Assessment	Level
X_430112	6	1	L, T	W, P, O	400
X_428531	6	1	L	P, O	400
X_432538	6	1	L, T	W, P, O	400
X_430557	6	1	L	W, R, O	300
X_430602	6	6	L, T	R, P	500
X_225905	6	2	L, Exp	P	400

Principles of Pharmaceutical Sciences / Pharmacochemistry	X_435675	6	1	L, Exp	W	400
Project Sustainable Future	X_432784	6	6	L, T	W, R, P, O	500
Protein Science	AM_470145	6	1	L, T	W	400

Elective components

Expertise and Coordination in Knowledge Intensive Firms?	X_432738	6	1	-	-	400
Science and Society in Historical Perspective	X_400424	6	5	h	L, R, P	400
Technology and Innovation Processes	E_BA_TIP	6	2	-	-	400

Science for Energy and Sustainability:

Format: L: lectures; T: tutorials; CP: computer practicum.; Lit: literature study; As: assignment; Exp: experimental work / practicum

Assessment: W: written exam; O: oral exam; P: presentation; R: report

Compulsory components	Code	EC	Period	Format	Assessment
Current Sustainable Energy Technologies	52548CSE6Y	6	3	L, T, As	W
Project Sustainable Future	52548PRS6Y	6	6	L, T, As	W, R

Elective components	Code	EC	Period	Format	Assessment
Bio-based Economy	52548BIB6Y	6	2		
BioSolar Cells	52548BIC6Y	6	1	L, Lit	R, P
Catalysis for Sustainable Energy	5254CFSE6Y	6	4	L, Lit, As	W, R
Coordination and Organometallic Chemistry	5254COOC6Y	6	2	L	W
Emergent Energy Materials	5354EMEM6Y	6	1	L/T	R, P
Energy & Climate Change; Science, Policy and Economics	5264ECCS6Y	6	2	L, P	R, P
Environmental Chemistry	5254ENCH6Y	6	1	L/T	W
Green Chemistry	52548GRC6Y	6	1	L,T,As	W, P
Heterogeneous Catalysis	5254HECA6Y	6	3	L/T, P	W
Homogeneous Catalysis	5254HOCA6Y	6	5	L	W
Management of Sustainable Innovation	52548MAS6Y	6	2	L	As, W
Open Innovation in Science and Sustainability	53548OII6Y	6	2	L	P, W, R
Organic Photovoltaics	53548ORP6Y	6	5	L, P	P
Photosynthesis and Energy	53548PHO6Y	6	5	L, Lit, P	R, P
Photovoltaics	5354PHV06Y	6	4	L, T	As, P

Pre-Master for tracks Analytical Sciences and/or Molecular Sciences

Format: L: lectures; T: tutorials; CP: computer practicum.; Lit: literature study; As: assignment; Exp: experimental work / practicum

Assessment: W: written exam; O: oral exam; P: presentation; R: report

Analytical Sciences (AS)

Molecular Sciences (MS)

Elective components	EC	Period	Format	Assessment
Structure and properties of organic molecules Premaster Course (track AS)	6	1-2	L, W	W
Thermodynamics Premaster Course (tracks AS, MS)	6	2-3	L, W	W
Mathematics Premaster Course (tracks AS, MS)	6	1-2	L, W	W
Organic Chemistry Premaster Course (track MS)	3	1	L, W	W
Chemical Bonding Premaster Course (tracks AS, MS)	3	1	L	W
Inorganic Chemistry Premaster Course (track MS)	3	2	L, W	W
Literature Study Premaster Program (tracks AS, MS)	3-6	2-3	As	P
English Academic Course/ Scientific Writing (tracks AS, MS)	3	3	W, As	P, R

Academic skills components for all tracks (except for the SBI track):

Elective components	Code	EC	Period	Format	Assessment
Science in Perspective	5524SCPE6Y	6	4,5	L, As	W, R
English Academic Course *	5524ENAC3Y	3	1-2		P, R
Tutoring Students (VU)	X_432625	3	2		
Scientific Writing in English (VU)	X400592	3	2,6		
Business and Innovation in Life Science (VU)	X_432539	3	3		
Ethics and Academic Skills (VU)	X_432517	3	3		
Ethics and Academic Skills (VU)	X_437556	6	3		
Teaching Assistant (VU)	X_432741	3	3		
Ethics and Academic Skills (VU)	X_432742	6	3		

* with less than 20 students, the course is canceled

Appendix 2 Final attainment levels of the major Science in Society (SS), the major Science Communication (SC) and Major Teaching, and learning objectives minor TESLA, the minor Teaching and the minor Science & Sustainability

A. Final attainment levels of the major Science in Society (SS)

The final attainment levels of the major with regard to the Dublin descriptors are given below.

Dublin descriptor 1: Knowledge and understanding

The graduate has theoretical and practical knowledge of management, policy analysis and entrepreneurship

The graduate:

- a. has insight into the various relevant disciplines in the social and behavioural sciences. More specifically, the student acquires insight into:
 - o important concepts and theories in the field of policy science, management studies, and entrepreneurship;
 - o the relation of these gamma sciences to the beta sciences;
- b. has insight into concepts and the latest theories, research methodologies, analytical models and important research questions related to interdisciplinary research for addressing societal problems;
- c. has knowledge of, and insight into, relevant concepts and theories for effective communication and collaboration;

Dublin descriptor 2: Applying knowledge and understanding

The graduate is experienced in carrying out interdisciplinary research, in applying techniques specific to the subject area and in applying scientific knowledge to societal problems.

The graduate:

- a. has the ability to integrate knowledge from the beta and gamma sciences, as well as from science and practice;
- b. can apply scientific knowledge to formulate solutions to societal problems and assess them for appropriateness and societal relevance;
- c. adopts an appropriate attitude towards the correct and unbiased use and presentation of data.

Dublin descriptor 3: Making judgements

The graduate is able to independently and critically judge information.

The graduate is able to:

- a. independently acquire information in relevant scientific areas through a literature review and by conducting empirical research, as well as evaluate such information critically;
- b. select and order information, distinguish essentials from trivialities, and recognize connections;
- c. formulate personal learning objectives and critically evaluate own performance, both introspectively and in discussion with others.

Dublin descriptor 4: Communication

The graduate is able to transfer knowledge and skills related to his/her subject area to other people and to adequately reply to questions and problems posed within society.

The graduate:

- a. has acquired skills to report orally and in writing on research results in English;
- b. has the ability to communicate research conclusions, and the knowledge and rationale underpinning them, to specialist audiences and non-specialist audiences clearly and unambiguously;
- c. can collaborate with researchers from various scientific disciplines;
- d. can make essential contributions to scientific discussions about plans, results and consequences of research.

Dublin descriptor 5: Learning skills

The graduate has developed learning skills that enable him/her to continue with self-education and development within the subject area.

The graduate:

- a. has acquired skills to develop a research plan, giving details of the problem statement, objectives, research questions, research approach, research methods, and planning;
- b. is familiar with the general scientific journals, such as Nature and Science, and with journals in the specialisation, such as Research Policy, Health Policy, Science, Technology & Human Values, Social Science & Medicine, and International Journal on Technology Management;
- c. has the learning skills to allow him/her to continue to study in a manner that may be largely self-directed or autonomous (life-long learning).

B. Final attainment levels of the major Science Communication (SC)

The MSc graduate possesses an academic attitude, skills and competences to operate at the interface of science and society aiming to contribute to a fruitful science-society dialogue. This means that Master's graduates have the following focus:

- Understanding the dynamic relationship between science and society
- Translating information from the natural sciences to society and vice versa
- Shaping the dialogue between science and society

Knowledge

- Knowledge of and insight into the relevant concepts and theories in the field of science communication, sociology, communication science, philosophy and science & technology studies in relation to the natural sciences
- Familiarity with scientific journals in the field of science communication and science & technology studies, as well as familiarity with a variety of popular-scientific media
- Insight into the nature and course of interpersonal and group communication processes relevant to the formal and informal dialogue between science and society
- Insight into relevant concepts and theories for effective communication and collaboration in relation to diverse science-society interactions
- Insight into the popularization of the natural sciences in various media
- Insight into the roles and responsibilities of museums in science communication

Skills

- Independently acquire, analyse and evaluate relevant information in a variety of scientific disciplines, by conducting literature study and empirical research
- Communicate and collaborate effectively with diverse professionals of scientific and non-scientific disciplines as well as lay citizens
- Design and facilitate interactive processes in relation to the science-society dialogue

- Translate information from various natural science disciplines into more generally accessible language and formats

- Produce popular-scientific media output concerning developments in the natural sciences, aimed at a variety of publics
- Contribute to the design of museum exhibitions from the perspective of scientific content management and science communication theory
- Make an intrinsic contribution to the societal discussion of developments in science and technology

C. Final attainment levels of the major Teaching

Aan het eind van de opleiding moet de student beschikken over de kwaliteiten ofwel competenties op het gebied van geïntegreerde kennis, inzicht en vaardigheden behorend bij het beroep van leraar in het eerstegraads gebied van het voortgezet onderwijs. De competenties hebben betrekking op de taakgebieden waarvoor wordt opgeleid: onderwijzen, begeleiden, organiseren, ontwikkelen en onderzoeken, en professionaliseren. De competenties zijn de volgende.

- *Interpersoonlijk competent*

Je bent interpersoonlijk competent als je in het contact met leerlingen (en ook met anderen) kunt leiden, begeleiden, bemiddelen, stimuleren en confronteren. Daarmee bereik je een klimaat met open communicatie en een sfeer van samenwerking en wederzijds vertrouwen.

- *Pedagogisch competent*

Je bent pedagogisch competent als je benaderingen kunt ontwerpen, uitvoeren en evalueren om het welbevinden van leerlingen te bevorderen, om ontwikkelings- en gedragsproblemen te signaleren en om groepen en individuen te begeleiden. Daarmee bereik je een veilige leeromgeving waarin leerlingen zich kunnen ontwikkelen tot zelfstandige en verantwoordelijke personen.

- *Vakinhoudelijk en didactisch competent*

Je bent vakinhoudelijk en vakdidactisch competent als je je eigen vak gedegen beheerst, op basis daarvan aantrekkelijke, effectieve en efficiënte leeractiviteiten kunt ontwerpen, uitvoeren, begeleiden en evalueren. Daarmee bereik je een krachtige leeromgeving voor leerlingen.

- *Organisatorisch competent*

Je bent organisatorisch competent als je concrete en functionele procedures en afspraken kunt hanteren en als je de leeromgeving en het leren van leerlingen kunt organiseren en faciliteren en de planning kunt bewaken en bijstellen. Daarmee bereik je een overzichtelijke, ordelijke en taakgerichte leeromgeving.

- *Competent in het samenwerken met collega's*

Je bent competent in het samenwerken met collega's als je informatie deelt, actief bijdraagt aan overleg en samenwerkingsverbanden en deelneemt aan collegiale consultatie. Daarmee bevordert je een collegiale en harmonieuze werksfeer.

- *Competent in het samenwerken met de omgeving*

Je bent competent in het samenwerken met de omgeving als je doelmatige contacten onderhoudt met ouders (verzorgers), maar ook met andere mensen en instanties die te maken hebben met de zorg voor en de opleiding van leerlingen. Daarmee bereik je dat de ontwikkeling van leerlingen op een realistische en constructieve manier wordt ondersteund en dat eventuele problemen tijdig worden onderkend en opgelost.

- *Competent in reflectie en onderzoek ten dienste van ontwikkeling*

Je bent competent in reflectie als je je handelen planmatig kunt bijstellen op grond van ervaringen in beroepssituaties. Daarmee bereik je professioneel leren en ontwikkeling van jezelf. Je bent competent in onderzoek als je de beroepspraktijk in het algemeen en je eigen beroepspraktijk in het bijzonder kunt analyseren met distantie en met onderzoeksmatige deskundigheid. Daarmee bereik je ontwikkeling van je school, van de didactiek van je vak en/of van jezelf.

D. Learning Objectives Tesla

Main Objective

To offer ambitious science students with a demonstrated excellent academic and non-academic track record the opportunity to engage in a final challenge before finishing their research master programme.

On completing the Tesla programme the graduate has acquired the qualities to bridge Science, Society and Business within complex research and project challenges related to the own scientific background. The graduate is fit to start a career in demanding environments which require abilities to utilize the disciplinary science background (as described in OER B) in work environments within or outside of science.

These qualities will be developed while 1) working on an interdisciplinary project related to the scientific background of the graduate and 2) undergoing intensive training on a range of skills.

General Objectives

The graduate has:

1. The analysing, problem-solving, analytical and synthesizing skills in order to be able to function at the required academic level
2. The abilities to utilize his or her specific scientific background (as specified in the OER B of the master programme in which the student is enrolled) in settings on the interface of science, business and society
3. A series of practical professional, academic and personal skills which result in the ability to
 - a. independently set up, manage and execute an interdisciplinary projects at the interface of science, business and society. Thereby utilizing scientific knowledge in contributing to a real demand of a knowledge intensive organization
 - b. get acquainted with a field of study in a short period of time by self-study, to form one's own opinion and to communicate critically and effectively with different audiences on the topic
 - c. deal with complex challenges and gather and structure information on different levels to enable professional action in different fields and especially the ability to utilize his/her own scientific background in a non-Academic environment
 - d. Communicate effectively with different stakeholders (e.g. business professionals, policymakers) while using appropriate means (e.g. business plans, policy advice).
 - e. operate effectively in interdisciplinary teams.
4. An attitude that enables the student to critically reflect on his/her own actions

In doing so the graduate should have acquired the following qualities in the fields of 'Professional Knowledge & Insight' and 'Professional Skills':

Professional Knowledge and Insight

Students should develop professional knowledge and insight regarding bringing “science to value in practice”, especially in relation to their scientific background. More specifically, students should:

- a. Obtain understanding of different business practices, discourses and settings with regard to bringing scientific knowledge to value.
- b. Develop knowledge on scientific developments in relevant disciplines related to dealing with the societal challenges of 21st century.
- c. Obtain understanding of different non-profit practices and settings with regard to bringing scientific knowledge to value
- d. Obtain understanding of different governmental practices and settings with regard to bringing scientific knowledge to value.
- e. Increase knowledge and insight of possible career paths and possible roles in bringing scientific knowledge to value.

Professional Skills

Students should develop professional business skills to operate effectively in organizations and groups. More specifically, students should:

- f. Develop professional cooperation skills.
 - i. Develop presentation skills: the abilities necessary to communicate complex information and deliver professional presentations in different environments.
 - ii. Develop feedback skills
 - iii. Develop meeting skills: the abilities necessary to host and guide meetings in which complex information, different opinions and positions need to be structured to effectively facilitate collection work.
 - iv. Develop teamwork and leadership skills.
 - v. Develop interview techniques: abilities necessary to successfully obtain information by means of an interview in different settings.
 - vi. Develop reasoning and related skills to structure information: develop the abilities to test arguments and bring propositions towards implementation by convincing others.
 - vii. Develop communication and influencing skills.
- g. Develop project management skills.
 - i. Be able to effectively manage projects on the interface of Science and Practice, including becoming familiar with:
 1. Taking Initiative
 2. Managing the workflow
 - a. Preparing a project planning
 - b. Use of KPIs in Planning
 - c. Prioritizing & adjustment (time management, etc.)
 3. Practical Tools
 - a. Effective use of communication technology
 - b. Budget management
 4. Team Management
 - a. Engaging your interdisciplinary team
 - b. Divide and take Responsibility

- c. Solving problems
 - ii. Get acquainted with consultancy analytics and tools to structure complex challenges & information.
 1. Utilizing consultancy models to structure complex challenges and transform them into workable solutions.

Develop visual thinking skills: the qualities to use visual tools to structure meetings, complex information and group processes.

E. Minor teaching na een bachelor zonder educatieve minor

De student volgt het eerste semester van de master leraar Voorbereidend Hoger Onderwijs (VHO) die de Interfacultaire Lerarenopleidingen (ILO) aanbiedt.

De opleiding leidt niet tot een bevoegdheid.

De eindtermen komen grotendeels overeen met die van de educatieve minor die de ILO aanbiedt.

De student is op basis van voldoende theoretisch inzicht, een professionele houding en voldoende vaardigheid in staat om:

1. een goede samenwerking met en tussen leerlingen tot stand te brengen;
2. voor groepen en voor individuele leerlingen een veilige leeromgeving te creëren;
3. voor groepen en voor individuele leerlingen een krachtige leeromgeving in te richten waarin leerlingen zich op een goede manier leerinhouden van het vakgebied eigen maken;
4. in groepen en in andere contacten met leerlingen een overzichtelijk, ordelijk en taakgericht leer- en werkklimaat tot stand te brengen;
5. relevante informatie uit te wisselen met collega's in de school en uitkomsten daarvan te benutten;
6. relevante informatie uit te wisselen met verzorgers van leerlingen buiten school en daarin te zorgen voor afstemming;
7. eigen opvattingen over het leraarschap en de eigen bekwaamheden als leraar, te expliciteren, kritisch te onderzoeken en verder te ontwikkelen op basis van theoretische inzichten en empirische gegevens.

F. minor teaching na een bachelor met een educatieve minor

De student volgt het tweede semester van de master leraar VHO die de ILO aanbiedt. De eindtermen komen overeen met die van de major teaching, zie onder C.

G. After conclusion of the *minor Science for Sustainability*, students:

- Are aware of the interdependence of the global natural system, the social system and the human system as well as of the importance of the coherence that is required between them to produce effective, science-based sustainable solutions.
- Have developed a view on complex sustainability issues while maintaining a clear focus on one specific disciplinary domain, in which they develop further scientific knowledge and expertise.
- Have learned how sustainable solutions can be realized via system innovations and transition management.
- Have become acquainted with an interdisciplinary approach in developing sustainable, science-based solutions for urgent societal challenges, including the economic and policy aspects related to these issues.
- Have learnt to work collaboratively in an interdisciplinary student project.