FACULTY OF SCIENCE

TEACHING AND EXAMINATION REGULATIONS

PART B

Academic year 2019-2020

MASTER'S PROGRAMME CHEMISTRY

University of Amsterdam
Vrije Universiteit Amsterdam

Joint degree

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's programme.
Research Project	A 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 65012 is offered on a full-time and part-time basis. The language of instruction is English.
2. The programme has a workload of 120 EC.
3. Within the 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. No new applications for this track are accepted since academic year 2017-2018

4. In each research track (see Article 1.2 section 3 for available tracks) the student may choose one out of the following majors or minors (see Article 4.1).
   - Major Science Communication
   - Major Science in Society
   - Major Teaching
   - Minor Tesla
   - Minor Science for Sustainability
   - Minor Teaching
5. The student is to determine the content of the master's programme in consultation with the coordinator of the master's programme or track according to the constraints outlined in Chapter 3. The student will lay down the chosen content in a Personal Education Plan (PEP). The student submits this PEP together with the approval of the coordinator for final approval by the Examinations Board. If the student then 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 will promptly submit 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. These enrolment dates ensure 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, thereby 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 specific area 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 Sciences has obtained the following track-specific qualifications:
   a. a thorough scientific knowledge and understanding of the field of synthesis, catalysis, molecular simulation and/or 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.
5. 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;
6. 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.
7. 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

1. Students who have successfully completed any of 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 Vrije Universiteit Amsterdam (we strongly recommend that students complete the courses *Anorganische Chemie* and *Quantumchemie* of the UvA/VU bachelor's programme Scheikunde before enrolment);
   - 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; the HLO Bachelor's degree Scheikunde (Chemistry), provided that the Admissions Board decides that this degree meets the entry requirements. (Deficiencies must be repaired prior to the start of the master's program).
2. Without prejudice to the provisions of paragraph 1, the Admissions 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 Admissions 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 Admissions Board has decided additional education feasible, the Admissions 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.
4. When the programme commences, the student must have fully completed the bachelor's or pre-master programme allowing admission to this programme.

Article 3.2 - Pre-master's programme (TER)

1. In addition to Article 3.1 section 3 the Admissions Board may draw up a pre-master's programme of maximum 30 EC. This Dutch taught pre-master's programme will be offered in the first semester.
2. The content of the pre-Master's programme is described in paragraph 5a, section B, of the Teaching and Examination Regulations for Bachelor's programme Scheikunde.
3. Proof of a successfully completed pre-Master's programme shall serve as confirmation of admission to the Master's programme, under the conditions specified in the original letter of admission.

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 July in the case of EU/EEA/Swiss students (including Dutch students) and before 1 February in the case of non-EU/EEA/Swiss students. For the programme starting in February, applications must be received before 1 November for EU/EEA/Swiss students (including Dutch students) and before 1 October for non-EU/EEA/Swiss students. Under exceptional circumstances, the Admissions 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 one of the following examinations:
   - IELTS: 6,5, at least 6 on each sub-score (listening/reading/writing/speaking);
   - TOEFL paper-based: 580, paper-delivered at least 22 on each sub-score;
   - TOEFL Internet-based test: 92, at least 22 on each sub-score (listening/reading/writing/speaking);
     The foregoing examination must have been taken within two years before the student's enrolment.
   - C1 Advanced (CAE): minimal result 170 (overall C);
   - C2 Proficiency (CPE): minimal result 170 (overall C)

   Please note that the TOEFL-code for the Faculty of Science of the University of Amsterdam is 9011.
2. An exemption from the English examination, referred to in the first paragraph, shall be granted to students who:
   - had previous education in secondary or tertiary education in one of the following English-speaking countries: Australia, Canada (English), New Zealand, Ireland, the United Kingdom, or the United States of America;
   - hold an English-language 'international baccalaureate' diploma;
   - possessing a Bachelor's degree from a Dutch university satisfy the requirement of sufficient command of the English language;
   - passed the final examination for the subject of English as part of one of the following diplomas: VWO, Belgian ASO (Flemish).

Chapter 4. Content and organisation of the programme

Article 4.1 - Organisation of the programme

1. All programme variants comprise a total of 120 EC; the curriculum is built up as follows:
   a. Regular programme

	Compulsory	Constrained Choice	Research Project(s) (*)	Literature Thesis	Free Choice
Track AS	24 EC	12 EC	≥ 42 EC	12 EC	≤ 30 EC
Track MS	-	30 EC	≥ 42 EC	12 EC	≤ 36 EC
Track SfES	12 EC	24 EC	≥ 42 EC	12 EC	≤ 30 EC
Track ATOSIM	48 EC	-	30 EC	12 EC	≤ 30 EC

(*) the research project may be extended to max 60 EC. The 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.

   b. Programme including a 60 EC major

	Compulsory	Constrained Choice	Research Project	Literature Thesis	Free Choice
Track AS	18 EC	-	36 EC	6 EC	-
Track MS	-	18 EC	36 EC	6 EC	-
Track SfES	12 EC	6 EC	36 EC	6 EC	-
Track ATOSIM	*The track ATOSIM is not compatible with a major programme*				

   c. Programme including a 30 EC minor

	Compulsory	Constrained Choice	Research Project	Literature Thesis	Free Choice
Track AS	24 EC	12 EC	42 EC	12 EC	-
Track MS	-	24 EC	42 - 54 EC	12 EC	≤ 12 EC
Track SfES	12 EC	24 EC	42 EC	12 EC	-
Track ATOSIM	*The track ATOSIM is not compatible with a minor programme*				

   d. Elective courses have to adhere to the following restrictions:
      - Free-choice electives outside the master's chemistry programme: max 12 EC
      - Academic skills courses: max 6 EC
      - Minor research project: max 24 EC
   e. A complete list of courses provided by the master's programme is included in Appendix 1. A form of assessment is part of every component. Within the master's programme different forms of assessment and 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 one of 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 48 EC of the obligatory research part of the programme before starting one of the majors. The exit qualifications of the majors are included in Appendix 2.

4. Regarding the major Teaching:
   Students who have completed an Educational 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 has to be combined with a research programme, comprising at least 90 EC. The minor consists of a course component and a project-based component. The project-based component must be supervised by a Faculty of Science examiner and is subject to prior approval of the Examinations Board. The second assessor must also be an appointed examiner of the master's programme chemistry. The learning objectives of this minor are included in Appendix 3.
6. Regarding the minor Science for Sustainability:
   The minor Science for Sustainability consists of 30 EC. It has to be combined with a research programme, comprising at least 90 EC. The learning objectives of this minor are included in Appendix 3.

Article 4.2 - Compulsory components

The programme includes compulsory components with a study load up to 48 EC (Article 4.1. 1.a, 1.b, 1.c). The contents and format of the compulsory components of the various tracks are described in Appendix 1. Entry requirements for said components are published online in the Course Catalogue.

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 may 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 programmes comprising a major). The research-related components always include the following compulsory components:
   - a research assignment with a study load of at least 36 EC (30 in programmes comprising a major);
   - a final report and scientific presentation with a study load of 6 EC.

Article 4.4 - Elective components

1. Students choose components in their field or discipline according to the constraints imposed by the programme and chosen track as listed in Appendix 1.
2. Students may choose components offered by other Dutch or foreign universities. Courses which are not part of the regular master's chemistry programme must be deemed of a suitably high level by the Examinations Board.
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. The following constraints apply:
   a. The course has to be followed at an accredited university or institute
   b. The course has to be relevant to the chosen programme and track.

4. In exceptional cases students may choose bachelor's level free-choice elective components as part of their programme. The Examinations Board will determine whether a free-choice 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. Chosen elective components should exhibit limited overlap in content within the student's curriculum. The acceptable degree of overlap is to be decided by the Examinations Board.
6. A free-choice elective component will only be seen as part of the programme if the Examinations Board has given its prior approval.

Article 4.5 – Free curriculum
1. Subject to certain conditions, students have the option to compile a curriculum of their own choice, which deviates from the curricula stipulated by the degree programme.
2. The composition of this curriculum must first be approved by the most relevant Examinations Board.
3. The free curriculum is assembled by the student and consists of units of study offered by the University of Amsterdam or Vrije Universiteit. It must at least have the size, breadth and depth of a regular Master's programme and must be in line with the learning outcomes of the master's programme in Chemistry.
4. At least one half of the proposed curriculum, excluding the Research Project, has to consist of components of the regular programme. Furthermore, inclusion of the Research Project in the proposal is compulsory.

Article 4.6 - 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 may grant exemption to 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 deemed as a required prior knowledge for the subsequent component.

Article 4.7 – Participation practical training and tutorials
Not applicable

Article 4.8 – Further conditions for Exemption
1. A maximum of 60 EC can be accumulated in the programme through granted exemptions.

Article 4.9 - 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 4.10 – Double Master's programme (two-year programmes)
In case a student combines two master's programmes and their components, the following requirements must at least be met in order to be awarded two master's degrees:
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 programmes. 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 with the double master's programme.

Article 4.11 – 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.
3. Students may enrol for a maximum of 18 EC worth of courses of the master's programme Chemistry per period. If students are enrolled in more than 3 courses, they will be notified of this fact automatically by email. Students are asked to unenrol from courses until the limit is no longer exceeded. Students who exceed the limit 4 weeks prior to the start of the period will be automatically unenrolled from all courses within that period. Requests for exception to this rule must be made to the study advisor.

Article 4.12 – Final research project, final report and literature thesis

1. It is mandatory for the student to fill an online research proposal, in consultation with the supervisor, before the student starts the research project. The track coordinator and supervisor evaluate this proposal, and upon approval the student may start the research project. The supervisor has to be a staff member of the VU department of Chemistry and Farmaceutical Sicience or UvA HIMS institute and officially 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 if the student has achieved the set exit qualifications at a sufficient level, based on a standardized assessment form provided by the master's programme.
3. For the assessment of the final research project and the final report, the advice of a second examiner is required.
4. The dates of examination are defined as the date when the thesis has been uploaded and the date when the defence has taken place. The examination date for the project as a whole is defined as the latter of the two for the purpose of marking, as defined in TER A article 4.4.1.
5. Students are required to write a short non-specialist summary in English.
6. Article 4.12 sections 1, 2, 3 and 4 also apply to the literature thesis.

Article 4.13 - Academic student counselling

The academic student counselling for this programme consists of:

- a dedicated study advisor for all students of the master's programme Chemistry

Article 4.14 - Teaching evaluation

Teaching evaluation shall take place as follows:

- Course evaluations of all courses
- Evaluation of the Research Project
- Curriculum evaluation

All evaluation reports are discussed within the Programme Committee, and subsequently made available to students of the programme via Canvas.

Chapter 5. Transitional and final provisions

Article 5.1– Amendments

1. Any amendment to the Teaching and Examination Regulations will be adopted by the dean after taking advice, and if necessary, approval by the relevant Programme Committee. A copy of the advice will be sent to the authorised representative advisory body.
2. Any amendment to the Teaching and Examination Regulations requires the approval of the authorised representative advisory body as stated in the WHW.
3. An amendment to the Teaching and Examination Regulations is only permitted to concern an academic year already in progress if this demonstrably does not damage the interests of students.

Article 5.2– Cancelled programme components

By way of departure from the Teaching and Examination Regulations currently in force, the following transitional provisions apply for students who started the programme under a previous set of Teaching and Examination Regulations:

Old component	Replacement	Effective starting
Chemical Bonding Premaster Course (5252CBPC3Y, 3 EC)	Chemical Bonding Premaster Course (5252CBPC6Y, 6 EC)	September 2017
Nuclear Magnetic Resonance (5254NUMR6Y, 6 EC) for the track Analytical Sciences	Any other elective course within the Analytical Sciences track.	September 2017
Advanced Experimental Techniques (52548AET6Y, 6 EC)	Advanced Spectroscopic Techniques (5254ADST6Y, 6 EC)	September 2019
Quantum Optics (5354QUOP6Y, 6 EC) in constrained choice of track Molecular Sciences	Any other course of the Molecular Sciences track's constrained choice courses	September 2019
Ultrafast Laser Physics (53548ULL6Y, 6 EC) in constrained choice of track Molecular Sciences	Any other course of the Molecular Sciences track's constrained choice courses	September 2019
Science in Perspective (5254SCIP6Y , 6 EC)	Science in Perspective (5354SCIP6Y, 6 EC)	September 2019

Students who have started the master's programme prior to 1 September 2019 with a number of deficiency courses must have succesfuly finished these courses prior to graduation. As of 1 September 2019 it is no longer possible to start this master's programme with deficiency courses.

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 2019.

Thus drawn up by the Dean of the Faculty of Science on 27 August 2019.

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 2018-2019. 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
Analytical NMR spectroscopy	5254ANNS6Y	6	4	L/T	W
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
Human and Environmental Toxicology	5254HUET6Y	6	6	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	2	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
Advanced Computational Chemistry	52548ATC6Y	6	4	CP	R
Relativistic Quantum Chemistry	5254REQC6Y	6	4	L	W
Chemical Bonding in Kohn-Sham DFT	5254DFTF6Y	6	4	Lit	O
Scientific Computing	52548SCCO6Y	6	5	L, CP	R
Transport Phenomena	5254TRPH6Y	6	4,5	L	O

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
Advanced Spectroscopic Techniques	5254ADST6Y	6	6	L,As	W
Advanced Computational Chemistry	52548ATC6Y	6	4	CP	R
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
Nuclear Magnetic Resonance	5254NUMR6Y	6	4	L,T	W
Physical Organic Chemistry	52548POC6Y	6	1	L,T	W
Quantum Theory of Molecules and Matter	5254QTMM6Y	6	1	L/T, As	W
Statistical Theory of Complex Molecular Systems	5254STTC6Y	6	2	L/T	W
Supramolecular Chemistry and Nanomaterials	5254SUCN6Y	6	1	L	W
Synthetic Organic Chemistry	5254SYOC6Y	6	4	L,T,P	W
Synthetic Strategies	5254SYST6Y	6	5	L, As	P, R
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
Advanced Molecular Orbital Theory	5254AMOT6Y	6	3	Lit	O
Biomolecular Simulations	5254BISI6Y	6	5	L, CP	W, R
Concepts in Chemical Biology	52548CIC6Y	6	5	L	W
Molecular Computational Chemistry	52548MOC6Y	6	5	L,CP,P	W
Molecular Photochemistry	5254MOPH6Y	6	5	L,T	W,P
Numerical Techniques	5254NUTE6Y	6	4	L, CP, As	R
Scientific Computing and Programming	52548SCP6Y	6	2	L, CP	R
Second Quantization Techniques in Quantum Chemistry	5254SQTI6Y	6	5	L	W
Relativistic Quantum Chemistry	5254REQC6Y	6	4	L	W

Science, Business & Innovation

See TER master SBI of the Vrije Universiteit Amsterdam

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

Restricted-choice components	Code	EC	Period	Format	Assessment
BioSolar Cells	52548BIC6Y	6	1	L, Lit	R, P
Catalysis for Sustainable Energy	5254CFSE6Y	6	4	L	W
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

Elective components	Code	EC	Period	Format	Assessment
Human and Environmental Toxicology	5254HUET6Y	6	6	L,P	W
Concepts in Chemical Biology	52548CIC6Y	6	5	L	W

Pre-Master programme

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)
Science for Energy and Sustainability (SfES)

Elective components	EC	Period	Format	Assessment	Track
Structure and Properties of Organic Molecules Premaster Course	6	1-2	L, W	W	AS
Thermodynamics Premaster Course	6	2-3	L, W	W	AS, MS, SfES
Mathematics Premaster Course	6	1-2	L, W	W	AS, MS, SfES
Organic Chemistry Premaster Course	3	1	L, W	W	MS, SfES
Chemical Bonding Premaster Course	6	1	L	W	AS, MS, SfES
Inorganic Chemistry Premaster Course	3	2	L, W	W	MS, SfES
Literature Study Premaster Course	3	1-3	As	P	AS, MS, SfES
Academic English Premaster Course/ Scientific Writing	3	1-2	W, As	P, R	AS, MS, SfES

Appendix 2 Final attainment levels of the major Science in Society (SS), the major Science Communication (SC) and Major Teaching

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:
   - important concepts and theories in the field of policy science, management studies, and entrepreneurship;
   - 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).

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

Final attainment levels of the major Teaching

1. De bekwaamheidseisen Leraar Voorbereidend Hoger Onderwijs zijn, naast de voor alle wo-masteropleidingen geldende Dublin-descriptoren en algemene wettelijke eisen, richtinggevend voor de doelstellingen en eindtermen van de lerarenopleidingen Voorbereidend Hoger Onderwijs. Deze bekwaamheidseisen zijn vastgelegd in de Wet op het voortgezet onderwijs (artikel 36 e.v.) en het Besluit bekwaamheidseisen onderwijspersoneel (zie 'Besluit bekwaamheidseisen onderwijspersoneel' (http://wetten.overheid.nl/BWBR0018692/2017-08-01) en 'Besluit van 16 maart 2017 tot wijziging van het Besluit bekwaamheidseisen onderwijspersoneel en het Besluit bekwaamheidseisen onderwijspersoneel BES in verband met de herijking van de bekwaamheidseisen voor leraren en docenten' (https://zoek.officielebekendmakingen.nl/stb-2017-148.html)).

De eindtermen zijn geordend in twee categorieën:

- Eindtermen die rechtstreeks te maken hebben met de kern van het beroep: het onderwijsleerproces en het leren van leerlingen, te weten de vakinhoudelijke, vakdidactische en pedagogische bekwaamheid (eindterm 1 t/m 3).
- Eindtermen die betrekking hebben op meer algemene aspecten van professioneel handelen ten dienste van die kern van het beroep: te weten samenwerking met collega's en de omgeving van de school en met reflectie en persoonlijke en professionele ontwikkeling (eindterm 4 t/m 5).

De opleiding draagt er zorg voor dat de afgestudeerde Leraar VHO in ieder geval:

1. aantoonbaar beschikt over vakinhoudelijke kennis en vaardigheden die het wo-bachelorniveau overstijgen dan wel verdiepen. Dat wil zeggen dat de afgestudeerde Leraar VHO:
   a. de inhoud van vak beheerst / boven de leerstof staat;
   b. daardoor de leerstof, voor het schooltype waarin de leraar werkzaam is, zo kan samenstellen, kiezen of bewerken dat de leerlingen die kunnen leren;
   c. vanuit vakinhoudelijke expertise verbanden kan leggen met het dagelijks leven, met werk en met wetenschap en het onderwijs betekenisvol kan maken voor de leerlingen;
   d. daarmee kan bijdragen aan de algemene vorming van de leerlingen.
2. aantoonbaar beschikt over vakdidactische kennis en vaardigheden. Dat wil zeggen dat de afgestudeerde Leraar VHO:
   a. de vakinhoud weet te vertalen in leerplannen of leertrajecten en dat doet op een professionele, ontwikkelingsgerichte werkwijze;
   b. de vakinhoud leerbaar maakt voor en afstemt op het niveau en kenmerken van de leerlingen, daarbij doelmatig gebruikmakend van (digitale) beschikbare leermiddelen;
   c. het onderwijs kan ontwikkelen en evalueren;
   d. het onderwijs doelmatig kan uitvoeren en het leren van leerlingen kan organiseren;
   e. de vak inhoud/didactiek afstemt met de collega's op school en laat aansluiten bij de visie en missie van de school.
3. aantoonbaar beschikt over pedagogische kennis en vaardigheden. Dat wil zeggen dat de afgestudeerde Leraar VHO:
   a. de ontwikkeling van leerlingen volgt in hun leren en gedrag en daarop het handelen afstemt;
   b. bijdraagt aan de sociaal-emotionele en morele ontwikkeling van de leerlingen;
   c. bijdraagt aan de burgerschapsvorming en de ontwikkeling van de leerling tot een zelfstandige en verantwoordelijke volwassene;

d. met een professionele, ontwikkelingsgerichte werkwijze en in samenwerking met collega's een veilig, ondersteunend en stimulerend leerklimaat voor leerlingen kan realiseren;
e. in staat is om oordelen te formuleren, rekening houdend met de sociaal-maatschappelijke en ethische verantwoordelijkheden die horen bij het beroep.

4. aantoonbaar reflecteert ten behoeve van persoonlijke en professionele ontwikkeling. Dat wil zeggen dat de afgestudeerde Leraar VHO:
   a. in staat is kritisch te reflecteren op alle aspecten die met zijn/haar persoonlijkheid, motivatie, attitudes, verwachtingen en cognities te maken hebben (die onder meer tot uiting komen in het pedagogisch handelen) en feedback hieromtrent ter harte te nemen
   b. op onderzoeksmatige wijze de (eigen) onderwijspraktijk verbetert en blijft ontwikkelen;
   c. in staat is (vak)kennis en -kunde actueel te houden;
   d. in staat is een eigen positie te bepalen ten aanzien van de missie en visie van de school/instelling en bereid is een constructieve bijdrage te leveren aan de ontwikkeling van het vak/het onderwijs in de school.
5. aantoonbaar samenwerkt en communiceert met collega's en omgeving. Dat wil zeggen dat de afgestudeerde Leraar VHO:
   a. het pedagogisch handelen kan afstemmen met collega's en met anderen die voor de ontwikkeling van de leerling verantwoordelijk zijn;
   b. de ontwikkeling van het vak/curriculum in de school kan afstemmen met collega's en met anderen die voor de ontwikkeling van de leerling verantwoordelijk zijn.

2. Onverminderd het bepaalde in lid 1 heeft de afgestudeerde van afstudeerrichting Biologie een gedegen vakinhoudelijke kennis van en inzicht in het vakgebied en de vakdidactiek van Biologie en kan op basis daarvan aantrekkelijke, effectieve en efficiënte leeractiviteiten ontwerpen, uitvoeren, begeleiden en evalueren voor het schoolvak Biologie in de onderbouw en/of bovenbouw.
3. Onverminderd het bepaalde in lid 1 heeft de afgestudeerde van afstudeerrichting Natuurkunde een gedegen vakinhoudelijke kennis van en inzicht in het vakgebied en de vakdidactiek van Natuurkunde en kan op basis daarvan aantrekkelijke, effectieve en efficiënte leeractiviteiten ontwerpen, uitvoeren, begeleiden en evalueren voor het schoolvak Natuurkunde in de onderbouw en/of bovenbouw.
4. Onverminderd het bepaalde in lid 1 heeft de afgestudeerde van afstudeerrichting Scheikunde een gedegen vakinhoudelijke kennis van en inzicht in het vakgebied en de vakdidactiek van Scheikunde en kan op basis daarvan aantrekkelijke, effectieve en efficiënte leeractiviteiten ontwerpen, uitvoeren, begeleiden en evalueren voor het schoolvak Scheikunde in de onderbouw en/of bovenbouw.
5. Onverminderd het bepaalde in lid 1 heeft de afgestudeerde van afstudeerrichting Wiskunde een gedegen vakinhoudelijke kennis van en inzicht in het vakgebied en de vakdidactiek van Wiskunde en kan op basis daarvan aantrekkelijke, effectieve en efficiënte leeractiviteiten ontwerpen, uitvoeren, begeleiden en evalueren voor het schoolvak Wiskunde in de onderbouw en/of bovenbouw.
6. Onverminderd het bepaalde in lid 1 heeft de afgestudeerde van afstudeerrichting Aardrijkskunde een gedegen vakinhoudelijke kennis van en inzicht in het vakgebied en de vakdidactiek van Aardrijkskunde en kan op basis daarvan aantrekkelijke, effectieve en efficiënte leeractiviteiten ontwerpen, uitvoeren, begeleiden en evalueren voor het schoolvak Aardrijkskunde in de onderbouw en/of bovenbouw.
7. Onverminderd het bepaalde in lid 1 heeft de afgestudeerde van afstudeerrichting Informatica een gedegen vakinhoudelijke kennis van en inzicht in het vakgebied en de vakdidactiek van Informatica en kan op basis daarvan aantrekkelijke, effectieve en efficiënte leeractiviteiten

ontwerpen, uitvoeren, begeleiden en evalueren voor het schoolvak Informatica in de onderbouw en/of bovenbouw.

Appendix 3 Teaching objectives for the minor Tesla and minor science for sustainability

Learning Objectives Tesla

By completing the Tesla Minor the graduate is fit to start a career in demanding environments which require abilities to utilize the disciplinary science background in research, corporate, civil society, governmental and advisory work environments.
All learning objectives fall into at least one of the following categories:

1. Information processing;
2. Teamwork;
3. Project Work;
4. Communication;
5. Self-reflection.

Further information about the minor Tesla can be found in the study guide: http://www.teslaminor.nl

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.

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.

Minor science for sustainability

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.