Appendices to the Course and Examination Regulations Master's Programmes Faculty of Science

valid from 1 September 2026

Index

MSc Astronomy

CROHO-NUMBER 60200

1. Description of the programme (Course and Examination Regulations chapter 2)

1.1 Objectives of the programme (Course and Examination Regulations art. 2.1)

The aim of the Leiden Observatory MSc programme Astronomy is to provide students with the proficiency, experience and skills to pursue a successful career in science, or in companies, industry or society in general with a strong background in scientific thinking and understanding.

1.2 Specialisations (Course and Examination Regulations art. 2.2)

The programme offers eight specialisations, each comprising two years (120 EC): five research-oriented specialisations, and three combined specialisations.

The five research-oriented specialisations focus on major research themes including the evolution of the universe, the formation and evolution of galaxies, the birth and death of stars, the formation, occurrence, and characterisation of planets around other stars, astronomical instrumentation, the analysis of very large and complex data sets, and high technology innovation. They allow the student to choose from either a broad research profile (“Astronomy Research” specialisation), or a profile that is more focused in a particular direction. The research-oriented specialisations offered (and described in detail in the Prospectus) are:

- “Astronomy Research”;
- “Astronomy and Cosmology”;
- “Astronomy and Data Science”;
- “Astronomy and Instrumentation;”
- “Astronomy and High Tech Innovation”.

In addition to the research-oriented specialisations, three other specialisations are offered, which combine the main elements of the research curriculum with topics in Business Studies (BS), Science Communication and Society (SCS), and Education (EDU), and which are described separately.

Upon successful completion of the programme, students receive the degree Master of Science in Astronomy, with specification of the chosen specialisation.

All specialisations have the same Director, the same Programme Committee, the same Board of Examiners, and the same Board of Admissions. Exceptions to this are formed by the specialisations BS, SCS, EDU, and High Tech Innovation which for the specialisation-specific part each have their own specialisation coordinator, Programme Committee and, if applicable, a Board of Examiners, as described in the specialisation sections of this Appendix.

1.3 Learning outcomes (Course and Examination Regulations art. 2.3)

The international standards for astronomy MSc programs are defined in the Domain Specific Reference Frame (DSRF). The DSRF is based on the "Tuning Physics" document, developed at the European level following the Bologna Agreements, which specifies how the general qualifications are translated into the program itself. The DSRF explicitly links to the five Dublin Descriptors and translates these into a number of specific competences, with corresponding achievement levels. The comparison between the learning outcomes of the program and the DSRF (and hence the Dublin Descriptors) is presented below, which shows a detailed match between the learning outcomes of the program and the DSRF and Dublin Descriptors.

(A) KNOWLEDGE AND UNDERSTANDING

On completion of the programme, the student should:

A1 have a good understanding of the important physical theories (logical and mathematical structure, experimental support, physical phenomena described).
A2 be familiar with the most important areas of physics and with the common approaches, which span many areas in physics.
A3 have a good knowledge of the state of the art in (at least) one of the presently active topics in physics research.

(B) APPLYING KNOWLEDGE AND UNDERSTANDING

On completion of the programme, the student should:

B1 be able to frame, analyse and break down a problem in phases defining a suitable algorithmic procedure; be able to evaluate clearly the orders of magnitude in situations which are physically different, but show analogies, thus allowing the use of known solutions in new problems.
B2 be able to identify the essentials of a process/situation and to set up a working model of the same; be able to perform the required approximations; i.e. critically think about how to construct physical models.
B3 be able to understand and master the use of the most commonly used mathematical and numerical methods.
B4 have become familiar with most important experimental methods and be able to perform experiments independently, as well as to describe, analyse and critically evaluate experimental data; and to be able to scientifically report the findings.
B5 be able to use appropriate software, programming language, computational tools and methods in physical and mathematical investigations.
B6 acquire an understanding of the nature and ways of physics research and of how physics research is applicable to many fields other than physics, e.g. engineering; be able to design experimental and/or theoretical procedures for: (i) solving current problems in academic or industrial research; (ii) improving the existing results.

(C) JUDGEMENT

On completion of the programme, the student should:

C1 be able to develop a personal sense of responsibility; be able to gain professional flexibility through the wide spectrum of scientific techniques offered in the curriculum; be able to organize the personal learning process, evaluate personal work, consult experts for information (e.g. about career opportunities) and support when appropriate; have had the opportunity to take courses that prepare for teaching physics at secondary school, as well as the opportunity to gain in-depth interdisciplinary skills.

C2 have become familiar with highly regarded research in the field, thus developing an awareness of the highest standards.

C3 be able to understand the socially related problems related to the profession, and to comprehend the ethical characteristics of research and of the professional activity in physics and its responsibility to society; be able to conduct processes of decision making and inspect the consequences of actions taking into account principles, norms, values and standards both from a personal and a professional standpoint.

C4 be able to work with a high degree of autonomy, even accepting responsibility in (project) planning, and in the managing of structures.

(D) COMMUNICATION

On completion of the programme, the student should:

D1 be able to listen carefully and to present difficult ideas and complex information in a clear and concise manner to a professional as well as to lay audiences; be able to work in a multidisciplinary or in an interdisciplinary team.

D2 be able to read, speak, and write in technical English.

(E) LEARNING SKILLS

On completion of the programme, the student should:

E1 be able to search for and use physical and other technical literature, as well as any other sources of information relevant to research work and technical project development.

E2 be able to enter new fields through independent study; have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy (lifelong learning).

E2 enjoy the facility to remain informed of new developments and methods, and be able to provide professional advice on their possible impact or range of applications.

The aforementioned qualifications, which are derived from the international domain-specific reference framework for Physics, apply to all specialisations of the MSc Astronomy. For the 4 research-oriented specialisations they are complete. The three society-oriented specialisations have the following additional qualifications:

Business Studies
BS1- Insight in managerial issues related to knowledge-intensive businesses and basic theoretical skills in business disciplines most relevant to working in these businesses; BS2- The ability to make a plan for a new business or an innovation project;

BS3- Experience with performing business activities in an existing company or organization or directed towards technology-based business creation.
Science Communication and Society
SCS1- Knowledge about theories and frameworks in science communication & society; SCS2- Knowledge about science communication research methods; SCS3- Insight about the field of science communication & society; SCS4- Applying theoretical knowledge and insights towards evidence-based development of products and projects related to science communication and society; SCS5- Applying theoretical knowledge and insights towards conducting research about science communication and society; SCS6- Being able to work in interdisciplinary and transdisciplinary contexts; SCS7- Becoming a professional taking into account social, cultural, environmental and ethical considerations in their work related to science communication and society; SCS8- Contributing to innovation and improvement of the field of science communication & society; SCS9- Skills in oral, written and visual communication about science towards different target audiences; SCS10- Developing innovative communication strategies including dialogue and participation with experts and non-experts; SCS11- Inter- and intrapersonal skills; SCS12- Becoming a creative, innovative, analytical, reflective professional in the field of science communication and society; SCS13- Being able to build and use a network of stakeholders in science communication and society; SCS14- Having an overview of career paths in science communication and society and their own possible role within the field science communication and society.
Education
EDU1- all qualifications necessary for teaching all years of secondary education and technical and vocational training (students from 12 to 18 years old).

The general qualifications of Faculty of Science are linked to the final learning outcomes of the programme as depicted below:

Final qualifications of Faculty of Science	Final learning outcomes MSc Astronomy
A. Knowledge and understanding	
A graduate has: * the ability to interrelate and integrate various areas of the discipline;	A1, A2, and A3
B. Applying knowledge and understanding	
* theoretical and/or practical skills in more than one specialist area of the discipline such that they can carry out research under overall supervision; * the ability to make an independent analysis of scientific problems, analysis of relevant specialist literature, formulate verifiable hypotheses, and set up and carry out research and critical reflection on one's own research and that of others;	B1, B2, B3, B4, B5, and B6
C. Judgement	
* sufficient understanding of the social role of the natural sciences to be able to reflect upon them and in part consequently to come to an ethically sound attitude and corresponding execution of one's professional duties;	C1, C2, C3, and C4
D. Communication	

* the ability to present clearly, verbally as well as in writing, one's own research results, and the ability to communicate with colleagues and to present their research results as a contribution to a congress or as (part of) a scientific publication;	D1 and D2
E. Learning (Skills)	
* the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.	E1, E2, and E3

1.4 Start of the programme (Course and Examination Regulations art. 2.6)

Students can start their programme in September or February.

2. Curriculum (Course and Examination Regulations chapter 3)

The duration of the programme is two years (120 EC). For all specialisations, the selection of course work and research projects requires prior approval by the MSc Study Advisor. In individual cases a course from a different programme or field of study may be elected, but only after prior written approval from the Board of Examiners. In this case, the student should first discuss the course of choice with the MSc Study Advisor and obtain agreement to proceed. Subsequently the chair of the Board of Examiners should be contacted to seek the required official approval. At the start of the Master's Programme, the student and the MSc Study Advisor together draw up a complete list of planned courses and projects (the Master Study Plan). Changes in the Master Study Plan during the programme are possible at any time but always require prior approval by the Study Advisor.

2.1 Types of courses and research

A variety of courses is taught each year. Specifics for all courses can be found in the Prospectus. Courses are taught at different intervals: once per year, once per 18 months, once per two years, or at irregular intervals. Students must therefore always consult the long-term teaching schedule (which is published in the Prospectus and specifies the course schedule for the current and next year) when making their Master Study Plan. Courses are classified as follows (see the Prospectus for more information):

Astronomy Core Courses: these are offered at regular intervals.

General Astronomy Courses: these vary with time and are offered at regular or sometimes irregular intervals. Examples include: Simulation and Modeling in Astrophysics (AMUSE) and Active Galactic Nuclei (AGN's).

Instrumentation-related Astronomy Courses: these vary with time and are offered at regular or irregular intervals. Examples include: Astronomical Adaptive Optics, Astronomical Telescopes and Instruments, Detection of Light a, Detection of Light b, High Contrast Imaging, Radio Astronomy, and Planetary Physics: Science and Instrumentation.

Specialist Astronomy Courses: these vary with time and are offered at regular or irregular intervals. Examples include: Astronomical Spectroscopy, Exo-planets A: Interiors and Atmospheres, Exo-planets B: Space Physics, Gravitational Lensing, Modern Astrostatistics, Numerical Recipes in Astrophysics a, and Observational Molecular Astronomy in Galaxies.

Non-Astronomy Courses: these must be selected from the courses offered by the Leiden MSc programmes in Physics, Mathematics, or Computer Science.

Astronomy Research Projects. Students in the specialisations "Astronomy Research", "Astronomy and Cosmology", "Astronomy and Data Science", and "Astronomy and Instrumentation" carry out two astronomy research projects: the First Research Project and the Master's Research Project. Students in the BS, SCS, EDU, or High Tech Innovation specialisations carry out only the Master's Research Project. All research projects have a total credit of 30 EC. For the First and Master's Research Project, the total credit includes 25 EC Research and 5 EC Thesis[T1].

All research projects are carried out under the supervision of a member of the scientific staff. The First and Master's Research Projects must be on different topics and different research groups. Only in exceptional cases, and with prior approval from the Board of Examiners following a motivated request from the student and supervisor(s), the First and Master's Research Project can be conducted under the same supervision. In such cases, both First and Master's Research Project must have resulted in a separate thesis.

The Master's Research Project can be started only after successful completion of the First Research Project (if that forms part of the programme). The maximum duration in calendar time of any Research Project is 9 months, unless otherwise specified below.
For students who started their programme in September, the submission deadline is extended to 15 July of the following year, provided that the First Research Project is started before November 1 of the first year. For students who started the programme in February, the submission deadline is extended to 7 January of the following year, provided that the First Research Project is started before April 1 of the first year.

In the specialisations Astronomy Research, Astronomy and Cosmology, Astronomy and Data Science, and Astronomy and Instrumentation, it is possible to carry out (part of) the Master's Research project at a university abroad. This requires explicit permission from both the Study Advisor and Board of Examiners, and a Master Study Plan that allows for an extended stay abroad without causing delays to the study programme. Furthermore, it requires 2 supervisors: 1 in Leiden and 1 at the institute abroad. This option is only open to students who have no delays in their programme.

Every student should deliver a Student Colloquium at Leiden Observatory, as listed in the programmes specified in the Prospectus. For all eight specialisations, the colloquium describes the Master's Research Project.

3. Specialisation Astronomy Research

3.1 Description (Course and Examination Regulations chapter 2)

This 2-year programme consists of advanced Astronomy courses, two research projects in Astronomy, and courses on science topics related to the field of Astronomy. It allows the broadest programme, including a significant component from adjacent fields (Physics, Mathematics, and Computer Science). As such it prepares the student as much for a career in research as for a career outside academia.

3.2 Programme (Course and Examination Regulations chapter 3)

The structure for the programme (120 EC) is as follows (for more details, please consult the Prospectus):

	Level	EC
Choice of Astronomy core courses, at least	500	18
Choice of Instrument-related courses, at least	400-500	6
Choice of Astronomy courses of any type	400-500	12
Choice of Non-Astronomy courses	400-500	24
First Astronomy research project	500	25
First Astronomy Research Project – thesis	500	5
Master's Astronomy research project	600	25
Master's Astronomy research project – thesis	600	5
Student Colloquium	600	-

The following remarks apply:

- The First Research Project has to be done in the 1st year of the programme, while the Master's Research Project has to be done in the 2nd year.
- One of the courses "Science and the Public: Contemporary and Historical Perspectives" (4603SPCH6Y), "Science and Human Impact on Earth: Anthropocene" (4603SHIEAY) and "Science Methodology" (4603SCMT5), if offered, may also be chosen as a non-Astronomy course.
- The programme may be adapted for Master's students who have not followed the Leiden Astronomy Bachelor programme. Upon recommendation by the MSc Study Advisor and written approval by the Board of Examiners, the First Research Project can be reduced to a weight not smaller than 21 EC with a simultaneous increase in the number of courses in Astronomy. These additional courses can be selected from the normal courses in the Master's curriculum, and the BSc course Radiative Processes (4072RAP63Y). These students may also add Astronomy courses at the cost of the non-Astronomy courses, in consultation with the MSc Study Advisor and approval by the Board of Examiners.
- Students who have not followed the Leiden Bachelor programme and therefore not the BSc course "Radiative Processes" (4072RAP63Y) or an equivalent course, may take this course in the MSc programme, as a general or specialised astronomy course. This requires consultation with, and approval from, the Study Advisor.

4. Specialisation Astronomy and Data Science

4.1 Description (Course and Examination Regulations chapter 2)

The 2-year programme Astronomy and Data Science offers the student the option to follow a Research Master in Astronomy with a particular focus on the big data and computation aspects of both astronomy (as a data-rich science) and computer science. It prepares as much for a career in astronomy as in computational science, and for careers in research as well as outside research, in academia or elsewhere in society. It consists of advanced Astronomy courses, two research projects in Astronomy, and selected courses from the Computer Science MSc programme. This specialisation

is offered by Leiden Observatory in collaboration with the Leiden Institute of Advanced Computer Science (LIACS) of Leiden University.

4.2 Programme (Course and Examination Regulations chapter 3)

The structure for the programme (120 EC) is as follows (for more details, please consult the Prospectus):

	Level	EC
Mandatory courses		
Modern Astrostatistics	500	3
Choice of Astronomy core courses	500	18
Choice of Instrument-related courses	400-500	3-6
Choice of Astronomy courses of any type	400-500	9-12
Choice of four of the following six courses (24 EC total)		
Simulation and Modeling in Astrophysics (AMUSE)	500	6
Numerical Recipes in Astrophysics a	500	6
Advances in Data Mining (Computer Science)	500	6
Introduction to Deep Learning (Computer Science)	500	6
Seminar Advances in Deep Learning (Computer Science)	500	6
Reinforcement Learning (Computer Science)	500	6
First Astronomy research project	500	25
First Astronomy Research Project - thesis	500	5
Master's Astronomy research project	600	25
Master's Astronomy Research Project - thesis	600	5
Student Colloquium	600	-

The following remarks apply:

- In the programme listed in the Prospectus, the courses labelled "Computer Science" are offered by the Leiden Institute for Advanced Computer Science.
- The First Research Project has to be done in the 1st year of the programme, while the Master's Research Project has to be done in the 2nd year. The Master's Research Project must involve data manipulation (which may be simulated data) and/or data-related computational or statistical aspects.
- One of the courses "Science and the Public: Contemporary and Historical Perspectives" (4603SPCH6Y), "Science and Human Impact on Earth: Anthropocene" (4603SHIEAY) and "Science Methodology" (4603SCMT5), if offered, may also be chosen as a general/specialist/instrumentation Astronomy course.
- The programme may be adapted for Master's students who have not followed the Leiden Astronomy Bachelor programme. Upon recommendation by the MSc Study Advisor and written approval by the Board of Examiners, the First Research Project can be reduced to a weight not smaller than 21 EC with a simultaneous increase in the number of courses in Astronomy. These

additional courses can be selected from the normal courses in the Master's curriculum, and the BSc course Radiative Processes.
- Students who have not followed the Leiden Bachelor programme and therefore not the BSc course “Radiative Processes” (4072RAP63Y) or an equivalent course, may take this course in the MSc programme, as a general or specialised astronomy course. This requires consultation with, and approval from, the Study Advisor.

5. Specialisation Astronomy and Instrumentation

5.1 Description (Course and Examination Regulations chapter 2)

The specialisation “Astronomy and Instrumentation” offers the student the option to conduct a Research Master in Astronomy with a particular focus on advanced astronomical instrumentation, techniques, and instrument development. It prepares the student as much for a career in research as for a career outside academia.

5.2 Programme (Course and Examination Regulations chapter 3)

The structure for the programme (120 EC) is as follows (for more details, please consult the Prospectus):

	Level	**EC**
Mandatory Courses:		
Astronomical Telescopes and Instruments	500	6
Detection of Light a+b	500	6
Choice of Astronomy core courses, at least	500	6
Choice of core/general/specialist Astronomy courses	400-500	24-30
Choice of instrumentation-related Astronomy courses	400-500	12-18
First Research Project in Instrumental or General Astronomy	500	25
First Research Project - thesis	500	5
Master’s Astronomy Research Project in Instrumental Astronomy	600	25
Master’s Astronomy Research Project - thesis	600	5
Student Colloquium	600	-

The following remarks apply:

- Students who have not followed the Leiden Bachelor programme and therefore not the BSc course “Radiative Processes” (4072RAP63Y) or an equivalent course, may take this course in the MSc programme, as a general or specialised astronomy course. This requires consultation with, and approval from, the Study Advisor.
- The following courses offered by Delft University of Technology (TU Delft) may, if offered, be included as instrumentation-related courses in the above programme:
    - Space Instrumentation (AE4896; 4 EC)
    - Space Systems Engineering (AE4S12; 4 EC)
    - Geometrical Optics (AP3391; 6 EC)
    - Advanced Optical Imaging (AP3122; 6 EC)
    - Control for High Resolution Imaging (SC42030; 3 EC)[1]

- Adaptive Optics Design Project[2] (SC42065; 3 EC)

[1] Students are not permitted to take both the Leiden "Astronomical Adaptive Optics" course and the TU Delft course "Control for High-Resolution Imaging", as these courses have significant overlap.

[2] The course "Adaptive Optics Design Project" (SC42065) is open only to students who have successfully completed "Control for High Resolution Imaging" (SC42030) or are currently enrolled in it.

- Up to 12 EC of the general/specialist Astronomy courses may be replaced by non-astronomy courses, to be taken from the MSc programmes in Mathematics, Physics, or Computer Science. Among these 12 EC the student may choose, if offered, one of the courses "Science and the Public: Contemporary and Historical Perspectives" (4603SPCH6Y), "Science and Human Impact on Earth: Anthropocene" (4603SHIEAY) and "Science Methodology" (4603SCMT5).
- The Physics course "Optics and Instruments" (4403OPIN6Y -- previously named "Advanced Optics") may be chosen as an Instrumentation-related course.
- The Master's Research Project must be an Astronomy Instrumentation project and may involve designing, building or testing an instrument or instrument system, or any combination of these activities. It may be carried out in any of the Leiden Astronomy or Delft Technical Physics labs, or at external organisations directly involved in astronomical instrumentation.

6. Specialisation Astronomy and Cosmology

6.1 Description (Course and Examination Regulations chapter 2)

The specialisation "Astronomy and Cosmology" offers the student the possibility to conduct a Research Master in Astronomy with a particular focus on modern observational and theoretical cosmology. This specialisation is offered by Leiden Observatory in collaboration with the Institute Lorentz for Theoretical Physics in the Department of Physics at Leiden University (LION).

6.2 Programme (Course and Examination Regulations chapter 3)

The structure for the programme (120 EC) is as follows (for more details, please consult the Prospectus):

	Level	**EC**
Mandatory Astronomy Courses:		
Origin and Evolution of the Universe	500	6
Large Scale Structure and Galaxy Formation	500	6
Choice of:		
Astronomy core courses	500	6
Astronomy courses of any type	400-500	18
Mandatory Physics Courses:		

Particle Physics and Early Universe	500	3
Origin and Structure of the Standard Model	400	3
Theory of General Relativity	400	6
Choice of:		
Related Science courses	400-500	12
First Research Project in Cosmology *or* General Astronomy	500	25
First Research Project - thesis	500	5
Master's Astronomy Research Project in Cosmology	600	25
Master's Astronomy Research Project - thesis	600	5
Student Colloquium	600	-

The following remarks apply:

- Students who have not followed the Leiden Bachelor programme and therefore not the BSc course "Radiative Processes" (4072RAP63Y) or an equivalent course, may take this course in the MSc programme, as a general or specialised astronomy course. This requires consultation with, and approval from, the Study Advisor.
- The Physics course "Black Holes and Gravitational Waves" (4403BHGW3Y) may be counted towards the 'Astronomy courses of any type' requirement.
- *Related Science courses* are specified in the Prospectus.

7. Specialisation Business Studies

7.1 Description (Course and Examination Regulations chapter 2)

The specialisation Astronomy and Business Studies (BS) offers students the possibility to combine astronomy with knowledge, insights and skills in the area of Management, Business, New Technology Ventures, and Entrepreneurship. Students are encouraged to broaden their horizons, to form an opinion on and prepare for a career in industry and to enhance competences for pursuing entrepreneurial business opportunities created in science and research.

Students who complete the specialisation Astronomy and Business Studies can be accepted into a PhD programme in Astronomy.

7.2 Programme (Course and Examination Regulations chapter 3)

The Astronomy and Business Studies (BS) programme consists of:

- A Master's Research Project (25 EC and 5EC thesis) supervised by a member of the Leiden Observatory scientific staff.
- 30 EC of courses to be selected in correspondence with the research topic; these should at least include:
    - two Astronomy core courses; and
    - 6-12 EC of Astronomy courses related to the research topic; and

    - 6-12 EC of non-Astronomy courses, to be taken from the programmes of Physics, Mathematics or Computer Science.
- Students who have not followed the Leiden Bachelor programme and therefore not the BSc course “Radiative Processes” (4072RAP63Y) or an equivalent course, may take this course in the MSc programme, as a general or specialised astronomy course. This requires consultation with, and approval from, the Study Advisor.
- A maximum of 20 EC of electives within either Astronomy or the BS component.
- A minimum of 40 EC and a maximum of 50 EC of BS specialisation courses and internship is required to complete the BS specialisation. A more comprehensive description, exemptions and more information on the complete programme can be found in the Prospectus.
- A Student Colloquium at Leiden Observatory on the Master’s Research Project.

A more comprehensive description, exemptions and more information on the complete programme can be found in the Prospectus.

8. Specialisation Science Communication and Society

8.1 Description (Course and Examination Regulations chapter 2)

The specialisation Astronomy and Science Communication and Society (SCS) offers students the possibility to combine astronomy and science communication. Students are prepared for a career in the area of science communication or for a career as a scientist with a communicating mind-set.

Students who complete the specialisation Astronomy and Science Communication and Society can be accepted into a PhD programme in astronomy or in science communication.

8.2 Programme (Course and Examination Regulations chapter 3)

The Astronomy and Science Communication and Society (SCS) programme consists of:

- A Master’s Research Project (25 EC and 5EC thesis) supervised by a member of the Leiden Observatory scientific staff.
- 30 EC of courses to be selected in correspondence with the research topic; these should at least include:
    - two Astronomy core courses; and
    - 6-12 EC of Astronomy courses related to the research topic; and
    - 6-12 EC of non-Astronomy courses, to be taken from the programmes of Physics, Mathematics or Computer Science.
- Students who have not followed the Leiden Bachelor programme and therefore not the BSc course “Radiative Processes” (4072RAP63Y) or an equivalent course, may take this course in the MSc programme, as a general or specialised astronomy course. This requires consultation with, and approval from, the Study Advisor.
- A Student Colloquium at Leiden Observatory on the Master’s Research Project.
- A maximum of 20 EC of electives within either Astronomy or the SCS component.

- A minimum of 40 EC and a maximum of 60 EC of SCS specialisation courses is required to complete the SCS specialisation. A more comprehensive description, exemptions and more information on the complete programme can be found in the Prospectus.

The Science Communication and Society programme consists of the parts specified in the Prospectus.

The following remarks apply:

- **SCS courses** Informal Science Education, Policy & Development in Science and Society, Research in Science Communication, Science Journalism (ENG), Wetenschapsjournalistiek (NL), and Science in Society are available as elective courses for students who do not follow the SCS specialisation.
- Students need to take either "**Science Journalism"** (ENG) or "**Wetenschapsjournalistiek"** (NL) and cannot do both.
- The course **Science Communication Product Development** is only admissible for students who have completed all other SCS courses.

9. Specialisation Education

9.1 Description (Course and Examination Regulations chapter 2)

The specialisation Astronomy and Education (EDU) prepares students for a career as physics (natuurkunde) teacher qualified to teach in Dutch secondary education.

Students who complete the specialisation Astronomy and Education can be accepted into a PhD programme in Astronomy.

9.2 Programme (Course and Examination Regulations chapter 3)

The Astronomy and Education (EDU) programme consists of:

- A Master's Research Project (25 EC and 5 EC thesis) supervised by a member of the Leiden Observatory scientific staff.
- 30 EC of courses to be selected in correspondence with the research topic; these should at least include:
    - two Astronomy core courses; and
    - 6-12 EC of Astronomy courses related to the research topic; and
    - 6-12 EC of non-Astronomy courses, to be taken from the programmes of Physics, Mathematics or Computer Science.
- Students who have not followed the Leiden Bachelor programme and therefore not the BSc course "Radiative Processes" (4072RAP63Y) or an equivalent course, may take this course in the MSc programme, as a general or specialised astronomy course. This requires consultation with, and approval from, the Study Advisor.
- A Student Colloquium at Leiden Observatory on the Master's Research Project.
- The Education component as described in the Prospectus.

- The Astronomy component of the programme will be followed during the first year of study, the Education component will be followed during the second year.

When the student has passed the minor Education (30 EC) during the BSc programme, the compulsory Education component is reduced by 30 EC. The remaining 30 EC can be used for either the Astronomy or the Education component of the MSc programme.

A more comprehensive description, qualifications for admission, exemptions and more information on the complete programme can be found in the Prospectus.

10. Astronomy and High Tech Innovation

10.1 Description (Course and Examination Regulations chapter 2)

The Astronomy High-Tech Innovation (HTI) specialisation prepares students for careers in high technology industries, where they develop the skills needed to drive innovation in interdisciplinary and knowledge-intensive sectors of the high-tech market.

Students who complete the specialisation Astronomy and High Tech Innovation can be accepted into a PhD programme in Astronomy.

10.2 Programme (Course and Examination Regulations chapter 3)

The Astronomy and High Tech Innovation (HTI) programme consists of:

- A Master's Research Project (25 EC and 5 EC thesis) supervised by a member of the Leiden Observatory scientific staff.
- 30 EC of courses to be selected in correspondence with the research topic; these should at least include:
    - two Astronomy Core courses; and
    - 6 EC Instrumentation-related Astronomy courses*; and
    - 6-12 EC of Astronomy courses related to the research topic; and
    - 0-6 EC of non-Astronomy courses, to be taken from the programmes of Physics, Mathematics or Computer Science.
- Students who have not followed the Leiden Bachelor programme and therefore not the BSc course "Radiative Processes" (4072RAP63Y) or an equivalent course, may take this course in the MSc programme, as a general or specialised astronomy course. This requires consultation with, and approval from, the Study Advisor.
- A Student Colloquium at Leiden Observatory on the Master's Research Project.
- The HTI component as described on the Prospectus.

* The 6 EC of instrumentation-related Astronomy courses cannot be counted as part of the HTI component of core electives.

The Astronomy component of the programme will be followed mostly during the first year of study, the HTI component will be the focus of the majority of the second year.

A more comprehensive description, qualifications for admission, exemptions and more information on the complete programme can be found in the Prospectus.

11. Additional and transitional arrangements

Transitional rule T1: Students who started their **First** or **Master's Research Project** in the academic year 2023-2024 or earlier received 27 EC for their Research component and 3 EC for their Thesis component. This 27 EC + 3 EC combination is considered equivalent to the current 25 EC Research and 5 EC Thesis requirement for the **First** or **Master's Research Project**.

Transitional rule T2: For students who successfully completed the 6 EC course "Numerical Recipes in Astrophysics" (4303NRAPHY) in 2023-2024 or earlier, this is considered to be equivalent to the combination of the 6 EC course "Numerical Recipes in Astrophysics a" (4303NRASAY) and the 3 EC course Numerical Recipes in Astrophysics b" (4303NRASBY).

Transitional rule T3 (*only for the Astronomy and Instrumentation specialisation*): Students who have successfully completed the Delft University of Technology course "Advanced photonics" (AP3382; 6 EC) in 2024-2025 or earlier, may count this course as an instrumentation-related course.

Transitional rule T4 (***only for the Astronomy and Science Communication and Society specialisation***): Students who have successfully completed the course "Scientific Narration and Visualization" (4603SCNV3Y) during the academic year 2023-2024 or earlier, and students who have taken the course Innovative Methods in Science Communication and Society (4603SCIM3Y) during the academic year 2024-2025 can use that course as a substitute for the requirement of "Science in Society".

MSc Biology

CROHO-number 66860

1. Description of the programme (Course and Examination Regulations chapter 2)

The MSc Biology programme is coordinated by the Institute of Biology Leiden (IBL) and builds on its strong research-driven educational foundation. The programme is enriched through close collaboration with strategic partners, including the Institute of Environmental Sciences (CML) and the Naturalis Biodiversity Center (Naturalis).

The range of courses and research projects is further broadened through the embedding of the programme within the Faculty of Science and through connections with the Leiden University Medical Center (LUMC), the Netherlands Institute of Ecology (NIOO), and bioscience-based companies located at the Leiden BioScience Park.

1.1 Specialisations (Course and Examination Regulations art. 2.2)

The MSc programme Biology offers seven specialisations:

- Biodiversity and Sustainability (B&S)
- Evolutionary Biology (EB)
- Molecular, Cellular, and Organismal Biology (MCOB)
- Molecular Genetics and Biotechnology (MGBT)
- Biology and Business Studies (BS)
- Biology and Education (EDU)
- Biology and Science Communication & Society (SCS)

The duration of each specialisation is two years (120 EC); a general overview of the distribution of study load over the components in the seven specialisations is given in Table 1. Students who complete the programme receive the degree Master of Science in Biology, with specification of the specialisation.

The degree provides graduates with the academic training and research skills required to pursue a scientific or science-related career. All specialisations have the same Director of Education, Education Committee and Board of Examiners. A Board of Admissions advises on admissions.

Table 1: Overview of the programmes of the seven MSc Biology specialisations (weights in EC)

Specialisation	**B&S**	**EB**	**MCOB**	**MGBT**	**EDU**	**SCS**	**BS**
Compulsory courses	24	24	12	15	6	6	6
Compulsory choice courses	6	-	9-12	9-12	6	6	6
Research Project(s) Biology	60-90	60-90	60-90	60-90	36-66	36-56	36-56
Electives	0-30	6-36	9-39	6-36	12-42	12-32	12-32
EDU/SCS/BS components	-	-	-	-	30-60*	40-60**	40-60**
Total EC	**120**	**120**	**120**	**120**	**120**	**120**	**120**

***** Students who have successfully completed the minor Educational Specialisation at the bachelor level (30 EC) have a right to request an exemption for the courses which overlap (see Article 3.6 Education Specialisation).

****** The SCS/BS component or the research component can be extended with 20 EC (courses or extension of the research project).

Double specialisations

After approval of the study advisor, students are allowed to follow a double specialisation comprising of the full programme (120 EC) of one specialisation (i.e. the main specialisation) plus the specialisation-specific components of the second specialisation. The second specialisation can be recorded on the Master's diploma only if the student complies with the requirements of said specialisation and has obtained a minimum of 160 EC (curriculum main specialisation plus an additional 40 EC extra-curricular), with the main specialisation completed within the 120 EC curriculum.

The main specialisation should be chosen in the following order: Research above Education above Business/Communication

It is not permitted to include more ECs for the Biology Research Projects than the maximum allowed for the main specialisation.

The number of credits for double specialisations thus must be at least:

- 160 EC (Research+ Research; Research + BS; Research + SCS; EDU + BS, EDU + SCS, BS + SCS; SCS+ BS); or
- 180 EC (Research + EDU-60).

1.2 Start of the programme (Course and Examination Regulations art. 2.6)

Students can start their programme in September or February. However, they are strongly advised to start in September when a general introduction to the master programme and most of the compulsory theoretical courses are scheduled. The nominal study duration of the programme is two years.

1.3 Learning outcomes (Course and Examination Regulations art. 2.3)

Each variant within the Master's programme has the same final level when it comes to general academic qualifications. All variants also give access to the promotion. However, they differ from each other due to a number of specific final objectives and competences.

Dublin descriptor Knowledge and Insight
Student has in-depth/specialised knowledge and understanding that exceeds the bachelor level and which forms a basis for making an original contribution to the development and/or application of ideas often in a research context.

The Master of Science in Biology - research specialisation:

1) Has in-depth knowledge of and insight into the fundamental principles of biology and extensive/in-depth knowledge of concepts and working methods in a chosen specialization or research field of biology.
2) Is aware of important international scientific developments in the research field of their specialization.
3) Has insight into the relationship between the field of specialization and adjacent scientific fields.

Dublin descriptor Applying Knowledge and Insight
The student is able to apply knowledge and insight and problem-solving abilities in new or unfamiliar circumstances within a broader (or multidisciplinary) context related to the field of study; is able to integrate knowledge and deal with complex material.

The Master of Science in Biology - research specialisation:

4) Has insight of how concepts and working methods in an important sub-area of biology and insight can be applied to increase knowledge.
5) Is able to make use of the conceptual framework of the discipline in which he/she has specialized in order to explain the state of the art of developing theories and to identify the most important research issues and can develop, apply and optimize research techniques in biological research under supervision.
6) Can independently formulate, initiate and execute a biological research project and analyse and interpret the results that could lead to the solution of such problems.
7) Is able to contribute to knowledge increase in the field by means of original (fundamental or application-oriented) research based on knowledge and insight in the field and problem-solving ability.
8) Is able to function in a (mono- or multidisciplinary composed) scientific team and can contribute from her/his own specialization to the realization of the objectives of the team.

Dublin descriptor Judgement
Student is able to formulate judgements on the basis of incomplete or limited information, taking into account societal and ethical responsibilities.

The Master of Science in Biology - research specialisation:

9) Is able to summarise and critically reflect on scientific literature.
10) Has insight into the social and ethical discussions surrounding his/her field, is able to critically evaluate own and other people's research results and can involve social and ethical aspects and responsibilities in the assessment of research and professional practice.
11) Is aware of the societal needs regarding biology and capable of contributing to discussions.

Dublin descriptor Communication
Student is able to communicate conclusions, as well as the knowledge, motivation and considerations underlying them, clearly and unambiguously to an audience of specialists and non-specialists.

The Master of Science in Biology - research specialisation:

12) Can present her/his own research results clearly:
    - in writing and orally on the field of study for a specialist and a general audience;
    - is able to write a scientific article for an international journal and contribute to a scientific meeting by means of a lecture or poster, and;
    - is able to transfer oral and written knowledge in his/her own field to specialists and non-specialists and to contribute to scientific and social discussions in the field.
13) Can communicate effectively within the chosen field of specialization.
14) Can collaborate in multidisciplinary teams and can manage projects.

Dublin descriptor Learning Skills
Student possesses the learning skills that will enable him/her to follow a PhD track or to enter the labour market in the field of his or her specialisation.

The Master of Science in Biology - research specialisation:

15) Has the necessary skills to embark upon a PhD track and has a good idea of the professional opportunities and practice in the field of the specialisation
16) Is able to embark on a follow-up study with a largely self-directed or autonomous character/ to follow a “Lifelong Learning” trajectory.

With due observance of a shorter research program (at least 60 EC), these final objectives and competences also apply to the master variants "Biology and Business Studies", "Biology and Science Communication and Society" and "Biology and Education". Additional qualifications or competences that only apply to these specialisations are formulated in the relevant specialisation appendices 4-9.

3. Entry requirements for courses, examinations and practicals (Course and Examination Regulations chapters 3 & 4)

3.1 Students are expected to purchase the required reading for a given course, as set out in the course description in the Prospectus and/or on Brightspace. A student who is not in possession of the required literature may be excluded from participating in the course in question.

3.2 The entry requirements or additional conditions for participating in specific elective courses can be found in the appendix to the OER (the degree programme) and/or the Prospectus.

3.3 For all components of the Master programme, the lecturer may decide to make lecture attendance compulsory.

3.4 The costs of following elective courses are borne fully by the student.

3.5 The scope for electives in the Master's programme may not comprise more than 15 EC of courses that do not contain any biological component.

4. Specialisation Biodiversity and Sustainability

4.1 Description (Course and Examination Regulations chapter 2)

This research-oriented master specialisation offers students in-depth knowledge on relationships between biodiversity and society. The critical importance of biodiversity and the services provided by nature for our society is increasingly endorsed by national and international conventions. However, to implement the right policy measures for creating a sustainable society, a much better understanding of the biological processes involved is essential. This master specialisation aims to discuss and answer societal relevant biological questions for instance on the amount of biodiversity we need to ensure that nature functions well and how we can optimize ecosystem functioning and biodiversity for a sustainable society. By using 'sustainability' as a guiding principle, the programme provides students with an academic attitude by stimulating reflective, independent, and creative thinking to support, conserve and manage biodiversity and sustainable ecosystem services. This master specialisation prepares students for a PhD programme and/or for research positions at universities or research institutes and for positions at governmental organisations and consultancy agencies.

The programme (120 EC) consists of:

- a theoretical part: compulsory and elective courses (30-60 EC); and
- a practical part: one or more research projects (60-90 EC).

Compulsory components

The compulsory part of the programme provides students with the theoretical knowledge needed to successfully complete the subsequent research project.

Optional components

The elective part of the programme can consist of elective courses or of an extension of the duration of a research project.

Research Projects

Research projects are an important part of the Biology Master programmes. During a research project, students will learn to independently design, plan, and conduct scientific research and are an integral part of the host research group.

Students should spend at least 60 EC on (a) research project(s), and the total may not exceed 90 EC. Students are allowed to do two research projects. At least one project must be within the research specialization for at least 36 EC. A second project may be within or outside the chosen specialization, for at least 30 EC.

The course *Fish species in animal experimentation* or *Bird species in animal experimentation* is obligatory in case of a research project that involves handling or experimental use of fish species or birds species.

4.2 Programme (Course and Examination Regulations chapter 3)

The Prospectus further specifies the actual structure of the programme, the study load, level,[1] content, method of examination, and structure of the components of the curriculum.

5. Specialisation Evolutionary Biology

5.1 Description (Course and Examination Regulations chapter 2)

This research-oriented master specialisation provides students with in-depth knowledge about Evolutionary Sciences. Students learn about evolutionary changes over time and study the origin and maintenance of biological variation all over the tree of life. The mechanisms that drive the adaptation of organisms and their features are investigated at all biological levels. Thus, the specialisation includes genomics, functional developmental genetics, paleobiology, behavioural biology and evolutionary ecology. With this master specialisation completed, students are well equipped to start a career in evolutionary research or to take responsibility for projects in an industrial or institutional research environment.

The programme (120 EC) consists of:

- a theoretical part: compulsory and elective courses (30-60 EC); and
- a practical part: one or more research projects (60-90 EC).

Compulsory components
The compulsory part of the programme provides students with the theoretical knowledge needed to successfully complete the subsequent research project.

Optional components

The elective part of the programme can consist of elective courses or of an extension of the duration of a research project.

Research Projects

Research projects are an important part of the Biology Master programmes. During a research project, students will learn to independently design, plan, and conduct scientific research and are an integral part of the host research group.

[1] In accordance with the 'abstract structure', as described in the Framework Document of the Leiden University Register of Study Programmes.

Students should spend at least 60 EC on (a) research project(s), and the total may not exceed 90 EC. Students are allowed to do two research projects. At least one project must be within the research specialization for at least 36 EC. A second project may be within or outside the chosen specialization, for at least 30 EC.

The course *Fish species in animal experimentation* or *Bird species in animal experimentation* is obligatory in case of a research project that involves handling or experimental use of fish species or birds species.

5.2 Programme (Course and Examination Regulations chapter 3)

The Prospectus further specifies the actual structure of the programme, the study load, level,[2] content, method of examination, and structure of the components of the curriculum.

6. Molecular, Cellular, and Organismal Biology

6.1 Description (Course and Examination Regulations chapter 2)

This research-oriented master specialisation offers students the unique possibility to integrate molecular, cellular, and organismal levels of research, and also provides the possibility to specialize in one of these levels. It equips students with advanced knowledge ranging from the functioning of individual cells to the communication between cells, and the development, physiology, and behaviour of multicellular organisms. An important aspect of this specialisation is to understand the molecular mechanisms underlying health and disease and how cells and organisms adapt to environmental factors ranging from light, stress, and pathogens to ecological and social conditions. Model organisms include bacteria, fungi, plants, and animals (invertebrates and vertebrates). The subject areas covered encompass functional genomics, signal transduction, cellular differentiation, development, host-microbe interactions, and animal behaviour.

This master specialisation is suited as a basis for starting a research career at a university or research institute and for a position in a bioscience-based company.

The programme (120 EC) consists of:

- a theoretical part: compulsory and elective courses (30-60 EC); and
- a practical part: one or more research projects (60-90 EC).

Compulsory components

The compulsory part of the programme provides students with the theoretical knowledge needed to successfully complete the subsequent research project.

Optional components

[2] In accordance with the 'abstract structure', as described in the Framework Document of the Leiden University Register of Study Programmes.

The elective part of the programme can consist of elective courses or of an extension of the duration of a research project.

Research Projects

Research projects are an important part of the Biology Master programmes. During a research project, students will learn to independently design, plan, and conduct scientific research and are an integral part of the host research group.

Students should spend at least 60 EC on (a) research project(s), and the total may not exceed 90 EC. Students are allowed to do two research projects. At least one project must be within the research specialization for at least 36 EC. A second project may be within or outside the chosen specialization, for at least 30 EC.

The course *Fish species in animal experimentation* or *Bird species in animal experimentation* is obligatory in case of a research project that involves handling or experimental use of fish species or birds species.

6.2 Programme (Course and Examination Regulations chapter 3)

The Prospectus further specifies the actual structure of the programme, the study load, level,[3] content, method of examination, and structure of the components of the curriculum.

7. Specialisation Molecular Genetics and Biotechnology

7.1 Description (Course and Examination Regulations chapter 2)

The master specialisation *Molecular Genetics and Biotechnology* focusses on genetics, molecular biology, genomics and biotechnology of animal, plant, and microbial systems. Through courses and research projects, students are trained by experts in the areas of molecular biology, microbiology, plant genetics, cellular imaging, animal disease models, and various –omics technologies and the corresponding bioinformatics. Attention is paid to the application of these techniques to biotechnology, i.e., how studies on model organisms can be translated to improve crops or human health. Students graduating in this master specialisation are well trained to start a research career in biological and medical sciences or lead projects in industrial or institutional research environments.

This master specialisation is suited as a basis for starting a research career at a university or research institute and for a position in a bioscience-based company.

The programme (120 EC) consists of:

- a theoretical part: compulsory and elective courses (30-60 EC); and
- a practical part: one or more research projects (60-90 EC).

Compulsory components

[3] In accordance with the 'abstract structure', as described in the Framework Document of the Leiden University Register of Study Programmes.

The compulsory part of the programme provides students with the theoretical knowledge needed to successfully complete the subsequent research project.

Optional components

The elective part of the programme can consist of elective courses or of an extension of the duration of a research project.

Research Projects

Research projects are an important part of the Biology Master programmes. During a research project, students will learn to independently design, plan, and conduct scientific research and are an integral part of the host research group.

Students should spend at least 60 EC on (a) research project(s), and the total may not exceed 90 EC. Students are allowed to do two research projects. At least one project must be within the research specialization for at least 36 EC. A second project may be within or outside the chosen specialization, for at least 30 EC.

The course *Fish species in animal experimentation* or *Bird species in animal experimentation* is obligatory in case of a research project that involves handling or experimental use of fish species or birds species.

7.2 Programme (Course and Examination Regulations chapter 3)

The Prospectus further specifies the actual structure of the programme, the study load, level,[4] content, method of examination, and structure of the components of the curriculum.

8. Specialisation Business Studies

8.1 Description (Course and Examination Regulations chapter 2)

The specialisation Biology and Business Studies offers students the possibility to combine biology with knowledge, insights and skills in the area of Management, Business and Entrepreneurship.

Students are encouraged to broaden their horizon, to form an opinion on and prepare for a career in industry and to enhance competences for pursuing entrepreneurial business opportunities created in science and research.

Students who complete the specialisation Biology and Business Studies are admissible to a PhD programme.

8.2 Programme (Course and Examination Regulations chapter 3)

The Biology and Business Studies programme consists of:

- 24 EC of advanced theory;

[4] In accordance with the 'abstract structure', as described in the Framework Document of the Leiden University Register of Study Programmes.

- a research project of 36 EC; the course *Fish species in animal experimentation* (3 EC) or *Bird species in animal experimentation* (3 EC) is obligatory in case of a research project that involves handling or experimental use of fish or birds;
- 40-60 EC Business studies component, as described here.
- a maximum of 20 EC of electives within either Biology or the Business Studies component; and

The theoretical part of the Biology research component is described in the Prospectus.

The Biology component can be extended with an additional 20 EC (courses or extension of the research project)).

Theoretical components should be minimally at level 400. The individual study programme consisting of choices of courses and the research project must have prior approval by the Board of Examiners through approval of the individual study plan of a student and approval of the research agreement.

A more comprehensive description, exemptions and more information on the complete programme can be found here.

9. Specialisation Education

9.1 Description (Course and Examination Regulations chapter 2)

The specialisation Biology and Education (EDU) prepares students for a career as biology (biologie) teacher qualified to teach in Dutch secondary education.

Students who complete the specialisation Biology and Education are admissible to a PhD programme.

9.2 Programme (Course and Examination Regulations chapter 3)

The Biology and Education (EDU) programme consists of:

- 24 EC of advanced theory;
- a research project of 36 EC; the course *Fish species in animal experimentation* (3 EC) or *Bird species in animal experimentation* (3 EC) is obligatory in case of a research project that involves handling or experimental use of fish or birds;
- 60 EC Education component as described here.

The theoretical part of the Biology research component is described in the Prospectus.:

The research project has to take place in one of the research groups of the IBL, CML or Naturalis, other Institutes of the Faculty of Sciences or LUMC.
Theoretical components should be minimally at level 400. The individual study programme consisting of choices of courses and the research project must have prior approval by the Board of Examiners through approval of the individual study plan of a student and approval of the research agreement.
A more comprehensive description, exemptions and more information on the complete programme can be found here.

10. Specialisation Science Communication and Society

10.1 Description (Course and Examination Regulations chapter 2)

The specialisation Biology and Science Communication and Society (SCS) offers students the possibility to combine Biology and science communication.

The specialisation Science Communication and Society concerns science communication in a broad sense. The program focuses on the link between science and society and covers knowledge and skills in the field of science communication. The programme prepares students for a career in the area of science communication, for example, as a science communicator, a science policymaker or a public relations or health communication officer, or for a career as a scientist with a communicator's mind-set. Students with an MSc specialisation Science Communication and Society are admissible to a PhD programme in their MSc research field or in Science Communication.

10.2 Programme (Course and Examination Regulations chapter 3)

The Biology Science Communication and Society (SCS) programme consists of:

- 24 EC of advanced Biology theory;
- a Biology research project of 36 EC; the course *Fish species in animal experimentation* (3 EC) or *Bird species in animal experimentation* (3 EC) is obligatory in case of a research project that involves handling or experimental use of fish or birds;
- 40-60 EC Science Communication & Society component.
- a maximum of 20 EC of electives within either Biology or the SCS component

The theoretical part of the Biology research component as described in the Prospectus.

The Biology component can be extended with an additional 20 EC (courses or extension of the research project).

The Science Communication and Society component consists of the parts specified in the Prospectus.:

- a maximum of 20 EC of electives within either Biology or the SCS component

Theoretical components should be minimally at level 400. The individual study programme consisting of choices of courses and the research project must have prior approval by the Board of Examiners through approval of the individual study plan of a student and approval of the research agreement.

A more comprehensive description, exemptions and more information on the complete programme can be found here.

11. Transitional Agreements

1. After a change in the course objectives and/or study load, or the cancellation of a course, students will be given one more opportunity in the following academic year to take the examination for that course, if necessary using partial examinations and/or replacement assignments.

2. If a student does not use the opportunity mentioned under 1 or does not complete it with a sufficient grade, the student is expected to obtain the credits of the cancelled courses in the form of the replacement course as specified in the Prospectus.

Transitional agreements specialisation Biodiversity and Sustainability

Compulsory courses

Students who started in 2019-2020 or earlier and have yet to complete the previously taught course *Methods in Biodiversity Analysis*, should as of 2020-2021 complete *Systematics and Biodiversity* instead.

Students who started in 2024-2025 or earlier and have yet to complete the previously taught course *Genomic Architecture*, should as of 2025-2026 complete *Skills for Scientists* instead. They may take the new version of *Genomic Architecture* as an elective course.

Students who started in 2025-2026 or earlier and have yet to complete the previously taught course *Systematics and Biodiversity*, should as of 2026-2027 complete *Biodiversity Across Space and Time* instead.

Restricted choice

Students who started in 2024-2025 or earlier and have yet to complete (parts of) the previously taught course *Advanced Cell Biology (4EC)*, should as of 2025-2026 complete *Advanced Cell Biology (3EC)* instead.

Students who started in 2025-2026 or earlier and have yet to complete the previously taught course *Development and Evolution*, should as of 2026-2027 complete *Evolution and Development* instead.

Transitional agreements specialisation Evolutionary Biology

Compulsory courses

Students who started in 2019-2020 or earlier and have yet to complete the previously taught course *Integrative Taxonomy*, should as of 2020-2021 complete *Systematics and Biodiversity* instead.

Students who started in 2024-2025 or earlier and have yet to complete the previously taught course *Genomic Architecture*, should as of 2025-2026 complete *Skills for Scientists*. They may take the new version of *Genomic Architecture* as an elective course.

Students who started in 2025-2026 or earlier and have yet to complete the previously taught course *Development and Evolution*, should as of 2026-2027 complete *Evolution and Development* instead.

Students who started in 2025-2026 or earlier and have yet to complete the previously taught course *Systematics and Biodiversity*, should as of 2026-2027 complete *Biodiversity Across Space and Time* instead.

Elective courses

Students who started in 2024-2025 or earlier and have yet to complete (parts of) the previously taught course *Advanced Cell Biology (4EC)*, should as of 2025-2026 complete *Advanced Cell Biology (3EC)* instead.

Transitional agreements specialisation Molecular, Cellular and Organismal Biology

Compulsory courses

Students who started in 2021-2022 or earlier and have yet to complete *Orientation on From Cells to Organisms,* should as of 2022-2023 complete *Orientation on Molecular, Cellular, and Organismal Biology* instead.

Students who started in 2024-2025 or earlier and have yet to complete the previously taught course *Genomic Architecture*, should as of 2025-2026 complete *Skills for Scientists*. They may take the new version of *Genomic Architecture* as an elective course.

Restricted choice

As of 2020-2021 *Animal Personality* is no longer offered, *Animal Cognition* may be used to meet this requirement instead.

Students who started in 2023-2024 or earlier may as of 2024-2025 also choose *Systems Microbiology* in the compulsory elective space.

Students who started in 2024-2025 or earlier and have yet to complete (parts of) the previously taught course *Advanced Cell Biology (4EC)*, should as of 2025-2026 complete *Advanced Cell Biology (3EC)* instead.

Students who started in 2025-2026 or earlier and have yet to complete the previously taught course *Development and Evolution*, should as of 2026-2027 complete *Evolution and Development* instead.

Elective courses

Students who started in 2025-2026 or earlier and have yet to complete the previously taught course *Systematics and Biodiversity*, should as of 2026-2027 complete *Biodiversity Across Space and Time* instead.

Transitional agreements specialisation Molecular Genetics and Biotechnology

Compulsory courses

Students who started in 2024-2025 or earlier and have yet to complete the previously taught course *Genomic Architecture*, should as of 2025-2026 complete *Skills for Scientists*. They may take the new version of *Genomic Architecture* as an elective course.

Restricted choice

Students who started in 2023-2024 or earlier may as of 2024-2025 also choose *Systems Microbiology* in the compulsory elective space.

Students who started in 2024-2025 or earlier have to choose at least one of the available compulsory electives. Students who started in 2025-2026 and later have to choose at least two.

Students who started in 2024-2025 or earlier and have yet to complete (parts of) the previously taught course *Advanced Cell Biology (4EC)*, should as of 2025-2026 complete *Advanced Cell Biology (3EC)* instead.

Elective courses

Students who started in 2025-2026 or earlier and have yet to complete the previously taught course *Development and Evolution*, should as of 2026-2027 complete *Evolution and Development* instead.

Students who started in 2025-2026 or earlier and have yet to complete the previously taught course *Systematics and Biodiversity*, should as of 2026-2027 complete *Biodiversity Across Space and Time* instead.

MSc Bio-Pharmaceutical Sciences

CROHO-number 60207

1. Description of the programme (Course and Examination Regulations (OER), chapter 2)

The MSc programme Bio-Pharmaceutical Sciences (BPS) is taught in Leiden by the Leiden Academic Centre for Drug Research (LACDR).

The duration of the programme is two years (120 EC), independent of the specialisation.

Students who complete the programme receive the degree Master of Science in Bio-Pharmaceutical Sciences, with specification of the specialisation. Details are provided below.

All specialisations have the same Programme Director, the same Board of Examiners, and the same Programme Committee. A Board of Admissions will advise on admissions.

The specialisation-specific parts of Business Studies (BS), Science Communication and Society (SCS), and Education (EDU) have their own Programme Coordinator and Board of Examiners which is mandated by the Board of Examiners of Bio-Pharmaceutical Sciences. The Board of Examiners of BS and SCS is appointed by the Faculty of Science. The Board of Examiners of EDU (ICLON) is appointed by a composed board of multiple faculties.

Students who complete any of the specialisations in Bio-Pharmaceutical Sciences are admissible to a PhD programme in Bio-Pharmaceutical Sciences or other science disciplines.

1.1 Objectives of the programme (Course and Examination Regulations art. 2.1)

The aim of the MSc programme BPS, organised by the Leiden Academic Centre for Drug Research (LACDR) of Leiden University, is to train students for a research career in drug research and development, not for a career as a (public) pharmacist. The general objective of the MSc programme BPS is to teach the master's student sufficient knowledge, insight, and skills to work independently at an academic level as a drug researcher, to contribute in an original manner to recognizing, introducing and solving questions in a specific knowledge area related to drug research, to discuss this contribution with experts in the field, to inform non-specialists about their ideas, goals and the public impact of their research.

1.2 Specialisations (Course and Examination Regulations art. 2.2)

The MSc programme BPS offers five specialisations. The 'Research in Bio-Pharmaceutical Sciences' specialisation focusses on research corresponding to major research themes at the LACDR. The remaining four specialisations combine Bio-Pharmaceutical research with training in Business Studies (BS), Science Communication and Society (SCS), Education (EDU), or Industrial Pharmacy (IP).

1.3 Learning outcomes (Course and Examination Regulations art. 2.3)

Graduates of the MSc programme BPS have reached the following general achievement levels, ranked according to the Dublin descriptors:

1. Theoretical and practical skills in a specialist area of drug research such that the graduate can carry out research under overall supervision. Specifically, the graduate has knowledge and understanding of

- the core concepts and principles and recent developments in a specialist area of drug research
- in the commonly used skills and state-of-the art practical and/or computational research methods in a specialised area of drug research
- the principles of responsible scientific conduct and the regulations in relation to the graduate's specialist drug research area.

2. The ability to make an independent analysis of scientific problems, analysis of relevant specialist literature, formulate verifiable hypotheses, and set up and carry out research and critical reflection on one's own research and that of others. Specifically, the graduate is able to
   - apply knowledge, insights and skills to work independently as a drug researcher at an academic level
   - contribute, in an original manner, to define and solve questions in a specific drug research knowledge area
   - draw up a research plan in which the research questions, the hypothesis and the experimental design are related to relevant literature and relevant previous research and is able to present and defend the plan against the opinion of professional colleagues
   - process, critically analyse, and interpret experimental and/or computational data.

3. The ability to interrelate and integrate various areas of drug research. Specifically, the graduate is able to
   - interrelate and integrate various areas of drug research and reflect on one's own research and that of others.

4. The ability to present clearly, verbally as well as in writing, one's own research results, and the ability to communicate with colleagues and to present research results as a contribution to a congress or as (part of) a scientific publication. Specifically, the graduate is able to

   - co-operate in a multi-disciplinary team on (bio)pharmaceutical-oriented research questions
   - participate in scientific discussions on drug research-related topics with scientific peers
   - provide a clear, structured oral presentation on the background, hypothesis, purpose of the research, experimental design, and on the obtained results, interpretation and conclusions, that is adjusted to the level of the target audience
   - communicate in writing on the background, hypothesis, purpose of the research, experimental design, and on the obtained results, interpretation and conclusions in the form of a scientific article according to the standards of an international peer-reviewed journal in the field.

5. Sufficient understanding of the social roles of drug research to be able to reflect upon them and in part consequently to come to an ethically sound attitude and corresponding execution of one's professional duties. Specifically, the graduate is able to

   - critically assess the significance for society and the applicability of one's own research results and that of scientific literature
   - judge any conflicts of interest and other factors that may influence the trustworthiness of one's research and/or the presentation of the research

- judge and critically reflect on the scientific, ethical, societal and economic consequences of drug research.

6. Learning skills to allow the graduate to continue to study in a manner that may be largely self-directed or autonomous. Specifically, the graduate

- is able to study in a manner that is largely self-directed or autonomous and is able to make conscious choices for one's own professional development
- has the academic competences for employment as a drug researcher at an academic institution or in (bio)pharmaceutical/life science industry
- is aware of the necessity to keep up-to-date on recent developments for one's own research.

1.4 Start of the programme (Course and Examination Regulations art. 2.6)

While students can technically start with the MSc programme BPS in September or February, the introduction course is only scheduled in September. Therefore, a start in February is strongly discouraged and will likely lead to study delays.

2. Examinations, Final Examination (Course and Examination Regulations chapter 4)

2.1 Obligatory sequence (Course and Examination Regulations art. 4.2)

2.1.1 Students may only take the following courses and sit their attendant examinations once they have passed the examinations for one or more other components:

Programme component	Follow course and sit its attendant examination after having passed
Research project 1 and 2	Introduction course for all students. Additionally, for research projects involving animal experimentation "Introduction to animal experimentation" is obligatory, supplemented with the course "Fish species in animal experimentation" (2 EC, level 400) in case research projects involve experimental use of fish species.
Specialisation components of year 2	Research project 1
Internship Quality Control/Quality Assurance	GMP for Middle Management in the Pharmaceutical Industry Module 2 – Quality Management in Drug Development Module 3 – Quality Management in Sterile Manufacturing Module 4 – Quality Management in Manufacturing of Biopharmaceuticals Essay Quality Control/Quality Assurance
Module 1 – The Role of the Qualified Person	GMP for Middle Management in the Pharmaceutical Industry
Module 2 – Quality Management in Drug Development	GMP for Middle Management in the Pharmaceutical Industry
Module 3 – Quality Management in Sterile Manufacturing	GMP for Middle Management in the Pharmaceutical Industry

Module 4 – Quality Management in Manufacturing of Biopharmaceuticals	GMP for Middle Management in the Pharmaceutical Industry

2.1.2 For the components and their attendant examinations which must be completed in a given sequence, the Board of Examiners may in special cases, and following a substantiated written request by the student, agree to an alternative sequence.

3. Programmes of the specialisations (Course and Examination Regulations chapter 3)

3.1 General programme 'Bio-Pharmaceutical Sciences'

3.1.1 Compulsory components (Course and Examination Regulations 3.1)

The first year programme of all specialisations is identical and consists of 60 ECTS credits of compulsory courses as described in the prospectus under "Programme first year". These compulsory components include the set components from which students are obliged to choose. During the second year, students are required to follow their specialisation-specific programme, as outlined below, worth a total study load of 60 ECTS credits.

3.1.2 Optional components (Course and Examination Regulations 3.2)

The Prospectus specifies the actual structure of the programme, the study load, level,[5] content, method of examination, and structure of the components of the curriculum. The format requirements and guidelines for supervision and assessment of individual programme components are published in the online module "Master Bio-Pharmaceutical Sciences" in the learning management system. Every student, daily supervisor, and responsible examiner is instructed to study these guidelines before the start of the programme component. [6]
Below the programmes of the individual specialisations are described.

3.2. Specialisation 'Research in Bio-Pharmaceutical Sciences'

The MSc specialisation 'Research in Bio-Pharmaceutical Sciences' offers research-orientated education into the discovery of new drugs and development of state-of-the-art therapies. Research topics within the LACDR are clustered in four research divisions and one research centre:

- **BioTherapeutics**: The research within this division is aimed at a smoother and speedier transition from preclinical research to pharmacological interventions, and the delivery of drugs in the human body by use of small molecules and biologics.
- **Cell Systems and Drug Safety**: The research within this division is focused on novel therapeutic modalities and novel concepts in early drug discovery, in order to develop more effective and safer therapeutic strategies.
- **Medicinal Chemistry**: The mission in this division is to design and synthesize novel and better ligands for drug targets using a combination of chemical, biochemical and computational methods.

[5] In accordance with the 'abstract structure', as described in the Framework Document of the Leiden University Register of Study Programmes.
[6] In accordance with Article 7.3j of the WHW ('free curriculum in higher education').

- **Systems Pharmacology and Pharmacy**: This Division aims to develop precision medicine approaches to characterize and predict variation in treatment response and enhance translational drug development strategies.
- **Metabolomics and Analytics Centre**: The ambition of this Centre is to develop innovative analytical strategies for metabolomics-driven health monitoring and systems biology studies.

Students who complete the specialisation 'Research in Bio-Pharmaceutical Sciences' are admissible to a PhD programme in bio-pharmaceutical sciences or related science disciplines.

3.1.1 Learning outcomes (Course and Examination Regulations art. 2.3)

In addition to the general achievements (see 1.3), graduates of the MSc programme BPS with the specialisation 'Research in Bio-Pharmaceutical Sciences'

1. have obtained in-depth knowledge of a specific subject related to the discovery of new drugs and development of state-of-the-art therapies.
2. have obtained theoretical and practical skills in a second specialist area of drug research.
3. have deepened and extended learning outcomes art. 1.3, achievements 1-4 by performing a second research project.
4. are able to independently acquire in-depth expert understanding in an unfamiliar drug research subject area by critical review of scientific literature.

3.1.2 Programme (Course and Examination Regulations chapter 3)

The 'Research in Bio-Pharmaceutical Sciences' programme consists of the general BPS components (60 EC), deepening research specialisation components (42 EC), and elective (18 EC) programme components as specified in the prospectus.

3.4 Specialisation 'Bio-Pharmaceutical Sciences and Industrial Pharmacy'

3.4.1 Description (Course and Examination Regulations chapter 2)

The MSc specialisation 'Bio-Pharmaceutical Sciences and Industrial Pharmacy' trains students in safety and quality control in the production of medicinal products, and prepares students for a career in Quality Assurance and Quality Control in the biotechnological and pharmaceutical industry.

Students who complete the specialisation Industrial Pharmacy are admissible to a PhD programme in bio-pharmaceutical sciences or in related life science disciplines.

3.4.2 Learning outcomes (Course and Examination Regulations art. 2.3)

In addition to general achievements, graduates of the MSc programme BPS with the specialisation Industrial Pharmacy have reached the following specific achievement levels:

1. Industrial pharmaceutical knowledge and understanding of prerequisites for production, quality and safety management, and batch release;
2. Experience with industrial pharmaceutical quality documentation systems;
3. Knowledge of industrial pharmaceutical regulatory affairs and ethical issues.

3.4.3 Programme (Course and Examination Regulations chapter 3)

The 'Bio-Pharmaceutical Sciences and Industrial Pharmacy' (IP) programme consists of the general BPS components (60 EC) and Industrial Pharmacy specialisation components (60 EC) as specified in the prospectus.

3.5 Specialisation BPS and Business Studies

3.5.1 Description (Course and Examination Regulations chapter 2)

The specialisation Bio-Pharmaceutical Sciences and Business Studies (BS) offers students the possibility to combine bio-pharmaceutical sciences research training with knowledge, insights, and skills in the area of Management, Business, and Entrepreneurship.

Students are encouraged to broaden their horizon, to form an opinion on and prepare for a career in industry and to enhance competences for pursuing entrepreneurial business opportunities created in science and research.

Students who complete the specialisation Bio-Pharmaceutical Sciences and Business Studies are admissible to a PhD programme in bio-pharmaceutical sciences or related science disciplines.

3.5.2 Learning outcomes (Course and Examination Regulations art. 2.3)

In addition to general achievements, graduates of the MSc programme BPS with the specialisation Business Studies have reached the following specific achievement levels:

1. insight in managerial issues related to knowledge-intensive businesses and basic theoretical skills in business disciplines most relevant to working in these businesses;
2. the ability to make a plan for a new business or an innovation project;
3. experience with performing business activities in an existing company or organisation or directed towards technology-based business creation.

3.5.3 Programme (Course and Examination Regulations chapter 3)

The BPS and Business Studies (BS) programme consists of the general BPS components (60 EC), Business Studies specialisation components (40-60 EC), and electives (0-20 EC) as specified in the prospectus.

3.6. Specialisation BPS and Science Communication and Society

3.6.1 Description (Course and Examination Regulations chapter 2)

The specialisation Bio-Pharmaceutical Sciences and Science Communication and Society (SCS) offers students the possibility to combine bio-pharmaceutical sciences research training with knowledge, insights, and skills in the area of science communication.

Students are prepared for a career in the area of science communication or for a career as a scientist with a communicating mind-set.

Students who complete the specialisation Bio-Pharmaceutical Sciences and Science Communication and Society are admissible to a PhD programme in bio-pharmaceutical sciences or in science communication.

3.6.2 Learning outcomes (Course and Examination Regulations art. 2.3)

In addition to general achievements, graduates of the MSc programme BPS with the specialisation Science Communication and Society have reached the following specific achievement levels:

1. Knowledge about theories and frameworks in science communication & society.
2. Knowledge about science communication research methods.
3. Insight about the field of science communication & society.
4. Applying theoretical knowledge and insights towards evidence-based development of products and projects related to science communication and society.
5. Applying theoretical knowledge and insights towards conducting research about science communication and society.
6. Being able to work in interdisciplinary and transdisciplinary contexts.
7. Becoming a professional taking into account social, cultural, environmental and ethical considerations in their work related to science communication and society.
8. Contributing to innovation and improvement of the field of science communication & society.
9. Skills in oral, written and visual communication about science towards different target audiences.
10. Developing innovative communication strategies including dialogue and participation with experts and non-experts.
11. Inter- and intrapersonal skills.
12. Becoming a creative, innovative, analytical, reflective professional in the field of science communication and society.
13. Being able to build and use a network of stakeholders in science communication and society.
14. Having an overview of career paths in science communication and society and their own possible role within the field science communication and society.

3.6.3 Programme (Course and Examination Regulations chapter 3)

The BPS and Science Communication and Society (SCS) programme consists of the general BPS components (60 EC), SCS specialisation components (40-60 EC), and electives (0-20 EC) as specified in the prospectus.

3.7. Specialisation BPS and Education

3.7.1 Description (Course and Examinations Regulations chapter 2)

The specialisation Bio-Pharmaceutical Sciences and Education (EDU) prepares students for a career as biology (biologie)[7] or chemistry (scheikunde)[8] teacher qualified to teach in Dutch secondary education (the so-called “eerstegraads-lesbevoegdheid”).

Students who complete the specialisation Bio-Pharmaceutical Sciences and Education are admissible to a PhD programme in bio-pharmaceutical sciences or related science disciplines.

3.7.2 Learning outcomes (Course and Examination Regulations art. 2.3)

In addition to general achievements, graduates of the MSc programme BPS with the specialisation Education have reached the following specific achievement level:

[7] BPS Master’s Students wishing to qualify for the school subject “Biology”, need to remedy their deficiencies in concert with the teacher educator Biology of the ICLON.

[8] BPS Master’s students wishing to qualify for the school subject “Chemistry”, need to remedy the deficiencies in concert with the teacher educator Chemistry of the ICLON.

1. All qualifications necessary for teaching all years of secondary education and technical and vocational training.

3.7.3 Programme (Course and Examination Regulations chapter 3)

The BPS and Education (EDU) programme consists of the general BPS components (60 EC) and EDU specialisation components (30-60 EC), and electives (0-30) as specified in the prospectus.

4 Transitional arrangements

Substitution rule for the Introduction Course:

Students who started before September 2022 are committed to another study programme (see the OER of the specific year for the study programme). Due to changes in the Introduction course, the substitution rules below are in place.

Code study programme 2026-2027	Name component	Codes study programme 2026-20267replace these codes study programme 2021-2022	Name component	Codes study programme 2021-2022 replacethese codes study programmes 2018-2021	Name component
4323ICBPSO	Proposal	4323ICORVO	Proposal	4323INBPSO	Proposal
4323ICBPST	Lab Safety exam	4323ICORVT	Lab Safety exam	-	-
4323ICBPSR	Division assignment	4323ICORVR	Division assignment	4323INBPST	Division exam

Board of Examiners may mandate the approval for specific components to examiners, the programme director, or the study advisor. In case of a mandate this will be communicated via the online module “Master Bio-Pharmaceutical Sciences” in the learning management system.

MSc Chemistry

CROHO-number 66857

1. Description of the programme (Course and Examination Regulations chapter 2)

The Leiden Institute of Chemistry (LIC) forms the basis for research and collaborations of the Leiden chemistry and life sciences groups. The LIC offers two MSc programmes, namely the MSc Chemistry and the MSc Life Science and Technology. Chemistry research in the LIC is centred on the two research themes *Chemistry for Health* and *Chemistry for Sustainability,* which are leading for the courses and research training projects offered in the MSc programme Chemistry.

Chemistry for Health research at the Leiden Institute of Chemistry is aimed at understanding biological processes at the molecular level to strengthen the knowledge base of human health and disease. The approach to achieve this goal is a fundamental chemical one; biological systems are interrogated with the aid of chemical probes. Our chemical biology research is conducted with the aim to acquire knowledge and develop tools and techniques for the design and synthesis of human medicine. The ultimate goal is to contribute to human health through conceptually new chemical methods for diagnosis, drug development and new therapies for diseases.

Chemistry for Sustainability research is focused on a fundamental level on chemical reactions that are of importance to the sustainable and efficient production and storage of energy, as well as efficient subsequent usage of stored energy. The researchers apply advanced spectroscopic techniques, nano-imaging, inorganic synthesis, homogeneous, heterogeneous, photochemical or electrochemical catalysis and theoretical methods to elucidate the molecular processes that are at the basis of the conversion of solar energy to chemical energy.

1.1 Specialisations (Course and Examination Regulations art. 2.2)

The MSc programme Chemistry offers five specialisations, each with a focus on one of these two major research themes. The five specialisations are:

- Research in Chemistry (CHEM),
- Chemistry and High-Tech Innovation (HTI),
- Chemistry and Business Studies (BS),
- Chemistry and Science Communication and Society (SCS), and
- Chemistry and Education (EDU).

The duration of each specialisation is two years (120 EC); a general overview of the distribution of study load over the components in the five specialisations is given in Table 1. Students who complete the programme receive the degree Master of Science in Chemistry, with specification of the specialisation.

Table 1: Overview of the programmes of the five MSc Chemistry specialisations (weights in EC)

Specialisation	CHE	HTI	EDU[#]	SCS	BS
Research-training project*	60	30	30	30	30
Academic and Professional Skills	10	10	10	10	10
Core courses in research theme	20	20	20[##]	20[##]	20
Free electives**	30	0	0 / 30	20	20
HTI/EDU/SCS/BS components	-	60	60 /	40	40
Total EC	**120**	**120**	**120**	**120**	**120**

* The research-training project is the final assignment of the programme, as mentioned in article 4.12 of the Course and Examination Regulation Master's Programmes.
** The choice in the free electives is restricted to the boundaries specified in this document. A maximum of 20 EC can be used for extension of the Chemistry research-training project. In case of a single SCS/BS specialisation, a maximum of 20 EC may be used as an extension of the SCS/BS component. In case of a double specialisation, the free electives of the first specialisation cannot be used for compulsory courses or extension of the internship of the second specialisation.
# If the student has taken a minor in Education ("tweedegraadsbevoegdheid") of 30 EC in the BSc programme, only 30 EC are necessary in the MSc programme to obtain the "eerstegraadsbevoegdheid". Then either 30 EC are added to the electives of the programme of the MSc Chemistry or the student may request 30 EC of exemptions (art. 3.6 FWN faculty OER).
Students in the SCS or EDU specialisation are allowed and advised to choose from both research themes to obtain a broader knowledge of chemistry.

1.2 Learning outcomes (Course and Examination Regulations art. 2.3)

Graduates of the programme have achieved the below learning outcomes, ranked according to the Dublin descriptors:
Dublin descriptor Knowledge and Insight

- Graduates demonstrate a solid understanding of key theoretical concepts in Chemistry, based on textbooks and primary scientific literature, relevant to the research themes *Chemistry for Health* or *Chemistry for Sustainability*.

Dublin descriptor Applying Knowledge and Insight

- Graduates are able to design and plan chemical research, carry out experiments within a realistic timeframe, and collect, store, and organise data clearly and systematically so that it is accessible to others (good data management practice).
- Graduates are able to independently analyse scientific problems, critically read and interpret relevant specialist literature, and formulate testable scientific hypotheses.

Dublin descriptor Judgement

- Graduates show a critical scientific attitude by analysing their own experimental results and evaluating scientific literature for reliability, accuracy, and limitations.
- Graduates demonstrate awareness of the social and ethical responsibilities associated with academic research in chemistry.

Dublin descriptor Communication

- Graduates are able to clearly communicate research progress and results in chemistry to peers, supervisors, and subject-matter experts.
- Graduates are able to independently write a well-structured, clear, and accurate report describing chemical research they have carried out.

Dublin descriptor Learning Skills

- Graduates possess the learning skills needed to continue their education in a follow-up study, working largely independently and taking responsibility for their own learning.

1.3 Start of the programme (Course and Examination Regulations art. 2.6)

Students can start their programme in September or February; the nominal study duration of the programme is two years.

1.4 Programme organisation

All MSc Chemistry specialisations have the same Programme Director, same Board of Admissions, same Programme Committee, and same Board of Examiners. The Programme Committee for the MSc programme Chemistry is combined with the one for the MSc programme Life Science and Technology and is responsible for the Research specialisation as well as the programme-specific components of the other specialisations. The Board of Examiners of the MSc programme Chemistry is also combined with the one of the MSc programme Life Science and Technology.

Programme organisation of specialisation-specific components for HTI, BS, SCS and EDU is described in the specialisation sections of this Appendix

2. Programme (Course and Examination Regulations chapter 3)

The programme includes compulsory (Course and Examination Regulations art. 3.1), elective (Course and Examination Regulations art. 3.2) and specialisation-specific components as shown in Table 1 and specified in the Prospectus. Students compose their own study programme, with a choice in core courses, electives and research-training project. The choice in elective courses in the MSc programme may be limited by the need to adapt the programme to the present knowledge of the candidate. The programme may be adjusted during the MSc study.

Specialisation-specific components of the specialisations Chemistry and High-Tech Innovation, Chemistry and Business Studies, Chemistry and Science Communication and Society, and Chemistry and Education are described separately in this Appendix and the Prospectus. Students are allowed to do a double specialisation, comprising the full programme of one specialisation (i.e. the main specialisation) plus the specialisation-specific components of a second specialisation. The main specialisation should be chosen in the following order: Research above Education above Business/Communication. The number of credits for double specialisations thus must be at least 150 EC (Research + EDU-30), 160 EC (Research + BS; Research + SCS; EDU + BS, EDU + SCS, BS + SCS) or 180 EC (Research + EDU-60). The specialisation HTI cannot be combined with another specialisation.

Requirements for and boundaries of the various components in the specialisations are provided in the following chapters.

3. Specialisation Research in Chemistry (CHEM)

3.1 Description (Course and Examination Regulations chapter 2)

The research specialisation offers the student the opportunity to spend two full years on training and specialisation not only to become an independent and creative researcher, but also someone who can use their analytical skills to resolve challenges in their career in science or in

society. Many students with an MSc in Research in Chemistry continue their career in a PhD position.

3.2 Programme (Course and Examination Regulations chapter 3)

The Research in Chemistry programme (CHEM) consists of the parts specified in Table 2.

Table 2: Overview of the programme of the MSc Chemistry Research specialisation

Component	Study load	Level
Research-training project:	60-80 EC*	600
Major research project	40-60 EC	600
Minor research project (optional)	20-40 EC	600
Academic and Professional Skills	10 EC	400
Core courses (in research theme)	20 EC	400-500
Electives	10-30 EC	400-600

* The total weight of research-training projects may not exceed 80 EC; if the research training projects exceed 60 credits, the additional credits are subtracted from the electives.

3.3 Research-training Project ('Final assignment', Course and Examination Regulations art. 3.3.2)

3.3.1 Scope and study load: The research-training project may be split into a major and one or two minor projects. The major research project is limited to a minimum of 40 EC and a maximum of 60 EC, and is carried out in a LIC research group in the chosen research theme (*Chemistry for Health* or *Chemistry for Sustainability*). An optional minor research project must comprise at least 20 EC, and may be carried out within the LIC, in another institute (within the Netherlands or abroad), or in a company. A minor research project cannot be carried out under supervision of the supervisor of the major research project. All external research projects need prior approval from the Board of Examiners.

3.3.2 Supervision and evaluation: Each research-training project must be supervised by a scientific staff member (main supervisor). The major research project is evaluated and graded by the main supervisor, with input from the daily supervisor, a second reviewer, and a Thesis Talk juror. The second reviewer is a staff member in the same research field as the main supervisor; the Thesis Talk juror is a staff member who was not directly involved in the research project. The second reviewer and Thesis Talk juror decide the final grade together with the main supervisor based on the quality of the research report, the quality of the Thesis Talk presentation, and the scientific level of the student.

Minor research projects carried out within the LIC are evaluated and graded by two LIC scientific staff members who were not the student's main supervisor for the major research project. External research projects are supported, evaluated and graded by a scientific staff member of the LIC (the internal supervisor), who is not the main supervisor for any of the student's other research-training projects and a staff member from the host institute or host company (the external supervisor).

For all research-training projects the internal supervisor has the final responsibility for creating the research-project agreement, grading the research-project report and signing and submitting the project-evaluation form.

3.3.3 Written report: All research-training projects are concluded with a written report; for the major research project this is the MSc thesis. The requirements for the written report can be

found in the Prospectus. The final version of the report should be handed in within 3 months after the last day of practical work.

3.3.4 Thesis Talk: The major research project is concluded with an oral presentation for the main supervisor, the second reviewer, the Thesis Talk juror, and an audience of interested students and staff members of the LIC (i.e. Thesis Talk). Students must attend at least 7 Thesis Talks as part of their major research project before they present their own Thesis Talk.

3.3.5 Obligatory sequence (Course and Examination Regulations art. 4.2): Students can only start with an optional minor research project (within or outside the LIC) when the major research project has been successfully concluded with a grade (including a Thesis Talk). Exceptions can only be granted by the Board of Examiners following article 4.2.2 of the Faculty OER.

3.4 Theoretical compulsory components (Course and Examination Regulations art. 3.1)

The compulsory theoretical component comprises a selection of four core courses and the courses Academic and Professional Skills 1, 2 and WORK.

3.5 Electives (Course and Examination Regulations art. 3.2)

The electives can comprise either theoretical or practical courses or an extension of the duration of a research project with a maximum of 20 EC and within the limitations described in section 3.3. Elective courses can be chosen from the core courses within or outside the chosen research theme, additional MSc courses offered by the LIC, and MSc courses of the Leiden University Faculty of Science published in the Prospectus.
Students may include MSc courses offered in a Science Faculty of any Dutch or foreign university of level 400 or higher, level 400 courses from the BSc MST or LST programmes, or other relevant courses in their final examination, but prior approval must have been obtained of the Board of Examiners (Course and Examination Regulations 3.2). Elective courses are restricted to courses that were not part of the student's earlier studies and do not overlap in content with other courses already taken as part of the MSc curriculum.

Students can verify the suitability of their programme with the Board of Examiners when they have doubts about a combination of courses. Students must gain approval from the Board of Examiners prior to taking any components at universities other than Leiden University.

4. Specialisation Chemistry and High-Tech Innovation

4.1 Description (Course and Examination Regulations chapter 2)

The specialisation Chemistry and High-Tech Innovation (HTI) offers students the possibility to broaden their chemistry programme with courses in Physics, Astronomy, Mathematics and/or Computer Science in order to develop interdisciplinary knowledge necessary to make important contributions to high-tech industries.

Students combine high quality research in Chemistry with experience in a scientific business environment comprising development from idea, to prototype, to application.

4.2 Programme (Course and Examination Regulations chapter 3)

The Chemistry and High-Tech Innovation (HTI) programme consists of the parts specified in Table 3. A more comprehensive description, exemptions and more information on the complete programme can be found in the section “Specialisation High-Tech Innovation”.

Table 3. Overview of the programme of the specialisation Chemistry and High-Tech Innovation

	Component	Study load	Level
Chemistry			
	Research-training project	30 EC	600
	Academic and Professional Skills	10 EC	400
	Core courses (in research theme)	20 EC	400-500
High-Tech Innovation			
	Orientation HTI	3 EC	400
	HTI courses	27 EC	400-500
	HTI research project	30 EC	600

4.3 Research-training Project ('Final assignment', Course and Examination Regulations art. 3.3.2)

4.3.1 General The research-training project in Chemistry must be carried out in one of the research groups of the Leiden Institute of Chemistry. The requirements for the research-training project are as specified in section 3.3 with the exception that the minimum length of the major research training project is 30 EC.

4.3.2 Obligatory sequence (Course and Examination Regulations art. 4.2): Students can only start with their HTI research project when the research-training project has been successfully concluded with a grade (including a Thesis Talk). Exceptions can only be granted by the Board of Examiners following article 4.2.2 of the Faculty OER.

4.4 Theoretical compulsory components (Course and Examination Regulations art. 3.1)

The compulsory theoretical component comprises a selection of four core courses and the course Academic and Professional Skills as described in section 3.4.

4.5 HTI components

Within the HTI specialisation 60 EC is required to complete this specialisation. The HTI components are specified in the section "Specialisation High-Tech Innovation".

5. Specialisation Chemistry and Business Studies

5.1 Description (Course and Examination Regulations chapter 2)

The specialisation Chemistry and Business Studies (BS) offers students the possibility to combine chemistry with knowledge, insights and skills in the area of Management, Business and Entrepreneurship.

Students are encouraged to broaden their horizon, to form an opinion on and prepare for a career in industry and to enhance competences for pursuing entrepreneurial business opportunities created in science and research.

5.2 Programme (Course and Examination Regulations chapter 3)

The Chemistry and Business Studies (BS) programme consists of the parts specified in Table 4. A more comprehensive description, exemptions and more information on the complete programme can be found in the section "Specialisation Business Studies".

Table 4. Overview of the programme of the specialisation Chemistry and Business Studies

	Component	Study load	Level
Chemistry			
	Research-training project	30 EC	600

	Academic and Professional Skills	10 EC	400
	Core courses (in research theme)	20 EC	400-500
	Electives	0-20 EC	400-600
Business Studies			
	BS courses	20 EC	500
	BS internship	20 or 30 EC	600
	BS electives	0-20 EC	400-500

5.3 Research-training Project ('Final assignment', Course and Examination Regulations art. 3.3.2)

5.3.1 General The research-training project in Chemistry must be carried out in one of the research groups of the Leiden Institute of Chemistry. The requirements for the research training are as specified in section 3.3 with the exception that the minimum length of the major research training project is 30 EC.

5.3.2 Obligatory sequence (Course and Examination Regulations art. 4.2): Students can only start with their Business internship when the research-training project has been successfully concluded with a grade (including a Thesis Talk). Exceptions can only be granted by the Board of Examiners following article 4.2.2 of the Faculty OER.

5.4 Theoretical compulsory components (Course and Examination Regulations art. 3.1)

The compulsory theoretical component comprises a selection of four core courses and the courses Academic and Professional Skills as described in section 3.4.

5.5 Electives (Course and Examination Regulations art. 3.2)

Elective components may consist of additional courses within or outside the chosen research theme, an extension of the research project, additional BS courses or an extension of the Business Internship. Furthermore, the restrictions and conditions specified for electives in section 3.5 apply.

5.6 BS components

A minimum of 40 EC and a maximum of 60 EC within the BS component is required to complete the BS specialisation. A specification of the BS specialisation is described in the section "Specialisation Business Studies".

6. Specialisation Chemistry and Science Communication and Society

6.1 Description (Course and Examination Regulations chapter 2)

The specialisation Chemistry and Science Communication and Society (SCS) offers students the possibility to combine chemistry and science communication. Students are prepared for a career in science communication or for a career as a scientist with a communicating mind-set.

Students who complete the specialisation Chemistry and Science Communication and Society are admissible to a PhD programme in Chemistry or in Science Communication.

6.2 Programme (Course and Examination Regulations chapter 3)

The Chemistry and Science Communication and Society (SCS) programme consists of the parts specified in Table 5. A more comprehensive description, exemptions and more information on the complete programme can be found in the section "Science Communication and Society".

Table 5: Overview of the programme of the specialisation Chemistry and Science Communication and Society

	Component	Study load	Level
Chemistry			
	Research-training project	30 EC	600
	Academic and Professional Skills	10 EC	400
	Core courses	20 EC	400-500
	Electives	0-20 EC	400-600
SCS components			
	SCS courses	23 EC	400-600
	Internship		
	SCS Project Proposal	3 EC	600
	SCS Internship(s)	14-34 EC	600
	Additional elective		
	SCS Elective	1-10 EC	400-500

6.3 Research-Training Project ('Final assignment', Course and Examination Regulations art. 3.3.2)

The research-training project in Chemistry must be carried out in one of the research groups of the Leiden Institute of Chemistry. The requirements for the research training are as specified in section 3.3 with the exception that the minimum length of the major research training project is 30 EC.

6.4 Theoretical compulsory components (Course and Examination Regulations art. 3.1)

The compulsory theoretical component comprises a selection of four core courses and the course Academic and Professional Skills as described in section 3.4.

6.5 Elective components (Course and Examination Regulations art. 3.2)

Elective components may consist of additional courses within or outside the chosen research theme, an extension of the research project, additional SCS courses or an extension of or additional SCS internships. Furthermore, the restrictions and conditions specified for electives in section 3.5 apply.

6.6 SCS components

A minimum of 40 EC and a maximum of 60 EC within the SCS component is required to complete the SCS specialisation. A more comprehensive description, exemptions and more information on the complete programme can be found in the section "Science Communication and Society".

7. Specialisation Chemistry and Education (NL)

7.1 Description (Course and Examination Regulations chapter 2)

The specialisation Chemistry and Education (EDU) prepares students for a career as teacher of chemistry (scheikunde) qualified to teach in Dutch secondary education.

7.2 Programme (Course and Examination Regulations chapter 3)

The Chemistry and Education (EDU) programme consists of the parts specified in Table 6. All programme-specific components must be finished before the specialisation-specific Education components can be started. Exceptions to this obligatory sequence can only be granted by the

Board of Examiners of the MSc programme Chemistry. A more comprehensive description, qualifications for admission, exemptions and more information on the complete programme can be found in the section “Specialisation Education”.

Table 6: Overview of the programme of the specialisation Chemistry and Education

	Component	Study load	Level
60 EC EDU programme			
Chemistry			
	Research-training project	30 EC	600
	Academic and Professional Skills	10 EC	400
	Core courses	20 EC	400-500
EDU components			
	EDU theoretical courses	28 EC	300-600
	EDU teaching practice	32 EC	
30 EC EDU programme			
Chemistry			
	Research-training project	30 EC	600
	Academic and Professional Skills	10 EC	400-500
	Core courses	20 EC	400-500
	Electives	30 EC	400-600
EDU components (‘eerstegraads’ only, see section 7.6)			
	EDU theoretical courses	15 EC	400-600
	EDU teaching practice	15 EC	

7.3 Research-Training Project (‘Final assignment’, Course and Examination Regulations art. 3.3.2)

The research-training project in Chemistry must be carried out in one of the research groups of the Leiden Institute of Chemistry. The requirements for the research training are as specified in section 3.3 with the exception that the minimum length of the major research training project is 30 EC.

7.4 Theoretical compulsory components (Course and Examination Regulations art. 3.1)

The compulsory theoretical component comprises a selection of four core courses and the course Academic and Professional Skills as described in section 3.4.

7.5 Elective components (Course and Examination Regulations art. 3.2)

When the student has passed the minor Education (30 EC) during their BSc programme, the compulsory Education component is reduced with 30 EC. The remaining 30 EC either are added to the Chemistry programme as electives or students may request 30 EC of exemptions (art. 3.6 FWN faculty OER). Elective components may consist of additional elective courses or extension of the research project. Furthermore, the restrictions and conditions specified for electives in section 3.5 apply.

7.6 EDU components

To complete the EDU specialisation, 60 EC within the EDU programme is required. If a minor EDU was successfully taken in the BSc programme, the EDU programme is limited to 30 EC. A specification of the EDU specialisation is described in the section “Specialisation Education”.

The courses taken must be those listed in the EDU-OER at time of registration, or any updated version thereof.

8. Additional and transitional arrangements

8.1. In addition to the stipulations in the Course and Examination Regulations section 4.9, the following restrictions apply to exemptions in the degree programme of a student:
- the major research project cannot be an exemption,
- the core courses cannot include any exemptions,
- a maximum of 15 EC of exemptions can be included in the programme, except for students enrolled in the specialisation Chemistry and Education, who may request 30 EC of exemptions for the minor Education obtained in their BSc programme (art. 3.6 FWN faculty OER).

8.2. If a student for any reason, is not able to compose a programme conform the requirements, the Board of Examiners can grant an exception and approve an alternative programme. The Board of Examiners judges whether the alternative programme guarantees the student meets the learning outcomes of the programme.

8.3. Students are allowed to compose their set of core courses for the final examination based on the set described in either the current OER or the OER applicable at the time they started their MSc programme, provided they did not interrupt their registration.

8.4. The programme component 'Academic development' is compulsory for students who started with the MSc Chemistry programme between September 2017 and August 2025. Electives for Academic Development can be chosen from the following list:

Course title	Catalogue number	Level	EC
Leading and Managing People	4603BSLMP	500	5
Oriëntatie op Onderwijs*	4082OROND	300	6
Tangible and Playful Research	4383TPRES	500	6
Science and the Public: Contemporary and Historical Perspectives	4603SPCH6	400	6
Science Journalism	4603SCSJ4	500	4
Science Methodology	4603SCMT5	400	5
Science in Society	4603SCSIS	500	3
Wetenschapsjournalistiek*	4603SCSWJ	500	4

* This course is given in Dutch

8.5. The co-curricular component Career Orientation and Competence Reflection (4423WORKV) is compulsory for students who started between September 2019 and August 2025.

8.6. The specialisation-specific component of the research specialisation for students who started before August 2025 is the essay and colloquium (4423ESCOL). The final grade for the colloquium is determined by the colloquium supervisor and the colloquium juror. The colloquium supervisor and juror are LIC staff members and cannot be the main supervisor of the student's major research project. Students must attend at least 7 colloquia as part of their colloquium and essay component before they present their own colloquium. If insufficient colloquium presentations from fellow students are available, the education team will provide alternative options.

8.7. Students who started before September 2025 and have not yet fulfilled their core course requirements can use core courses from the 2025-26 curriculum to complete their core course requirements. Students must complete 4 core courses for a total number of 20-24 EC.

8.8. Students who started before September 2025 and have not yet fulfilled the compulsory course 'Academic Writing' need to fulfil either one of the courses Academic and Professional Skills 1 (4423APSK1 or 4423ACPS1). The 5 EC of 4423APSK1 or the 4 EC of 4423ACPS1will count towards their Academic Development requirement. These students then are not required to complete the course 4423WORKV.

8.9. Molecular Cell Biology (MCB), catalogue number 4423MOLCB, can be used to replace either Molecular Biology (MB, 4423MOLBI) or Cell Biology (CEB, 4423CELBI) as a core course for any student who started before September 2020.

8.10. Surface Science for Heterogeneous Catalysis (4423SUSHC) can be used to replace either Surface Science (4423SURFS) or Heterogeneous Catalysis (4423HETCA) as a core course for any student who started before September 2024.

8.11. A combination of both Academic and Professional Skills 1 (4423ACPS1) and Academic and Professional Skills: WORK (4423APSKW) can be used to replace Academic and Professional Skills 1 (4423APSK1).

8.12. The following courses cannot be included together in the final examination:

Advanced Medicinal Chemistry (4423ADMC6)	and	Medicinal Chemistry and Drug Discovery (4423MCHDD)
Academic and Professional Skills 1 (4423APSK1)	and	Academic and Professional Skills 1 (4423ACPS1)
Career Orientation and Competence Reflection (4423WORKV)	and	Academic and Professional Skills: WORK (4423APSKW)
Quantitative Imaging in Life Sciences (4423QILS4)	and	Quantitative MRI in Disease Diagnosis (4423QMIDD)
Quantitative MRI in Disease Diagnosis (4423QMIDD)	and	Quantitative MRI in Disease Diagnosis (4423QMDD5)
Quantitative Imaging in Life Sciences (4423QILS4)	and	Quantitative MRI in Disease Diagnosis (4423QMDD5)
Heterogeneous Catalysis (4423HETCA) or Surface Science (4423SURFS)	and	Surface Science for Heterogeneous Catalysis (4423SUSHC)
Heterogeneous Catalysis (4423HETCA)	and	Surface Science for Heterogeneous Catalysis (4423SSHC5)
Surface Science for Heterogeneous Catalysis (4423SUSHC)	and	Surface Science for Heterogeneous Catalysis (4423SSHC5)
Surface Science (4423SURFS)	and	Surface Science for Heterogeneous Catalysis (4423SSHC5)
Molecular Biology (4423MOLBI)	and	Molecular Cell Biology (4423MOLCB)
Cell Biology (4423CELBI)	and	Molecular Cell Biology (4423MOLCB)
Molecular Biology (4423MOLBI)	and	Molecular Cell Biology (4423MLCB5)
Cell Biology (4423CELBI)	and	Molecular Cell Biology (4423MLCB5)
Molecular Cell Biology (4423MOLCB)	and	Molecular Cell Biology (4423MLCB5)
Essay & Colloquium (4423ESCOL)	and	Academic and Professional Skills 2 (4423APSK2)

Cross-domain Chromatin Organisation (4423CDC4R)	and	Chromatin Organisation and Function (4423CHORF)
Academic Writing (4423ACWR2)	and	Academic Writing (4423AWR2V)
Academic Writing (4423ACWR2)	and	Academic and Professional Skills 1 (4423APSK1)
Academic Writing (4423AWR2V)	and	Academic and Professional Skills 1 (4423APSK1)
Supramolecular Chemistry (4423SUPC6)	and	Supramolecular Biomaterials (4423SUPMB)
Biomaterials (4423BIOMA)	and	Supramolecular Biomaterials (4423SUPMB)
Bionanotechnology (4423BIONT)	and	Bionanotechnology (code 25-26)
Biosynthetic and Pharmaceutical Chemistry (4423BBPHC)	and	Biosynthetic and Pharmaceutical Chemistry (4423BPHC5)
Chemical Immunology (4423CHEIM)	and	Immunotherapy and Technology (4423IMMTE)
Computational Chemistry and Molecular Simulations (4423CCAMS)	and	Computational Chemistry and Molecular Simulations (4423CCMS5)
Cell Membranes and Membrane Transport (4423CMMT4)	and	Cell Membranes and Membrane Transport (4423CMMT5)
Density Functional Theory in Practice (4423DFTP6)	and	Density Functional Theory in Practice (4423DFTP5)
Reactivity in Organic Chemistry (4423RIOCH)	and	Reactivity in Organic Chemistry (4423ROCH5)
Science Methodology (4603SCMT4)	and	Science Methodology (4603SCMT5)
Antibiotics: Synthesis, Mechanisms of Action & Resistance (4423ASMAR)	and	Antibiotics: Synthesis, Mechanisms of Action & Resistance (4423ASMR5)
Chemical Biology (4423CHEMB)	and	Chemical Biology (4423CHEB5)
Electrochemistry (4423ELECH)	and	Electrochemistry (4423ELEC5)
Enzyme Dynamics: NMR Spectroscopy and Kinetics (4423EDNMR)	and	Enzyme Dynamics: NMR Spectroscopy and Kinetics (4423EDNS5)
Modern Organic Chemistry (4423MODOC)	and	Modern Organic Chemistry (4423MOCH5)
Photochemistry (4423PHCH6)	and	Photochemistry (4423PHCH5)
Dynamics of Molecule-Surface Reactions (4423DMSR3)	and	Dynamics of Molecule-Surface Reactions (4423DYMOL)
Dynamics of Molecule-Surface Reactions (4423DYMOL)	and	Dynamics of Molecule-Surface Reactions (4423DMSR5)
Dynamics of Molecule-Surface Reactions (4423DMSR3)	and	Dynamics of Molecule-Surface Reactions (4423DMSR5)
Bio-Inorganic Catalysis (4423BIOIN)	and	Bio-Inorganic Catalysis (4423BICA5)
Computational Techniques for Chemical Biology (4423CTFCB)	and	Computational Techniques for Chemical Biology (4423CTCB5)
In-vivo Biomolecular Interactions Underlying Diseases (4423IVIBR)	and	In-vivo Biomolecular Interactions Underlying Diseases (4423IVBI5)
Metals and Life (4423METL6)	and	Metals and Life (4423METL5)
Molecules of Life (4423MOFL6)	and	Molecules of Life (4423MOFL5)
Medicinal Chemistry & Drug Discovery (4423MCHDD)	and	Medicinal Chemistry & Drug Discovery (4423MCDD5)

Photosynthesis and Bioenergy (4423PBE06)	and	Photosynthesis and Bioenergy (4423PBE05)
Spectroscopy on Chemical Reactions and Environments (4423SCRE6)	and	Spectroscopy for Chemistry and Materials Science (4423SCRE5)
Chemistry and Physics of Solids (4423CHPHS)	and	Solid State Chemistry and Physics (4423SSCPH)
Anthropocene: The Era of Man (4042MAEM5) in a BSc programme	and	Science and Human Impact on Earth: Anthropocene (4603SHIEA)
Both Chromatin Organisation and Function (4423CHORF) and Molecular Aspects of RNA Viruses (4423MAORV)*	and	Advanced Gene Regulation (4423ADVGR)
Students are allowed a maximum of one of the following courses as part of their degree: - Protein Folding, Misfolding and Design (4423PFMAD) - Protein Folding, Misfolding and Disease (4423PFMFD) - Protein Folding, Misfolding and Design (4423PFMD5) - Protein Folding, Disease and Therapeutics (4423PFDT5)		

* Students who have taken *either* Chromatin Organisation and Function (4423CHORF) *or* Molecular Aspects of RNA Viruses (4423MAORV) are allowed to take Advanced Gene Regulation (4423ADVGR)

MSc Computer Science

CROHO-number 60300

1. Description of the programme (Course and Examination Regulations art. 2)

The MSc programme Computer Science is taught in Leiden by the Leiden Institute of Advanced Computer Science (LIACS).

1.1 Objectives of the programme (Course and Examination Regulations art. 2.1)

The general objective of the MSc programme Computer Science is to teach master's students sufficient knowledge, insight, and skills to work independently at an academic level as computer scientists, and to contribute in an original manner to recognizing, defining, and solving problems in specific knowledge areas of computer science, to discuss this contribution with experts in the field, and to inform non-specialists in a clear and unambiguous manner on their own ideas, goals and the public impact of their research, and to follow a PhD programme within the field of Computer Science and its adjacent areas.

1.2 Specialisations (Course and Examination Regulations art. 2.2)

The MSc programme Computer Science offers eight specialisations in total, of which four can be characterised as core computer science specialisations: '*Advanced Computing and Systems* (ACS)', *'Artificial Intelligence* (AI)*'*, '*Data Science: Computer Science* (DS), and *'Foundations of Computing* (FoC)*'*. The other four specialisations combine research in computer science with *Business Studies* (BS), *Education* (EDU), *High-Tech Innovation* (HTI), and *Science Communication and Society* (SCS). The duration of each specialisation is two years (120 EC).

From 1 September 2026, the specialisation '*Bioinformatics* (BI)' is no longer available to new students in the MSc Computer Science programme. Students who started the *Bioinformatics* specialisation before 1 September 2026 will have the opportunity to complete the specialisation.

All specialisations have the same Programme Director, the same Board of Examiners, and the same Programme Committee. Exceptions to this are formed by the specialisations BS, EDU, HTI, and SCS, which for the specialisation-specific part each have their own specialisation coordinator and a Board of Examiners appointed by the Faculty of Science. A Board of Admissions will advise on admissions.

1.3 Learning outcomes (Course and Examination Regulations art. 2.3) [Consent OC]

Graduates of the programme have achieved the following learning outcomes, ranked according to the Dublin descriptors:

a. theoretical and practical skills in more than one specialist area of computer science such that they can carry out research under overall supervision;
b. the ability to make an independent analysis of scientific problems, analysis of relevant specialist literature, formulate verifiable hypotheses, and set up and carry out research and critical reflection on one's own research and that of others;
c. the ability to interrelate and integrate various areas of computer science;

d. the ability to present clearly, verbally as well as in writing, one's own research results, and the ability to communicate with colleagues and to present their research results as a contribution to a congress or as (part of) a scientific publication;
e. sufficient understanding of the social and societal role of computer science to be able to reflect upon it and in part consequently to come to an ethically sound attitude and corresponding execution of one's professional duties;
f. have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.

1.4 Programme duration and completion (Course and Examination Regulations art. 2.5)

The duration of the *MSc programme Computer Science* is two years (120 EC). Students who complete the programme receive the degree Master of Science in Computer Science, with a description of the specialisation. Students who complete any of the specialisations in Computer Science are admissible to a PhD programme in Computer Science or related fields.

1.5 Start of the programme (Course and Examination Regulations art. 2.6)

Students can start their programme in September or February.

1.6 Language of the programme (Course and Examination Regulations art. 2.8)

The programme is taught in English, except for a few courses in the Education specialisation.

2. Programme (Course and Examination Regulations art. 3)

The programme is 120 EC in extent and, depending on the specialisation, consists of a combination of compulsory core courses, elective courses and seminars, a master's thesis research project in computer science, and for four specialisations a separate, faculty-wide specialisation component. The programme's specialisations are described further in Articles 3-11 and specified in full detail in the Prospectus.

3. Specialisation Advanced Computing and Systems

3.1 Description (Course and Examination Regulations art. 2)

The master's specialisation *Advanced Computing and Systems* offers future-oriented topics in computer science with a focus on high performance computing, embedded systems, and cloud and distributed computing. This specialisation focuses on the computer systems of tomorrow. These include the driver of the internet of things, such as high-performance computers capable of simultaneously processing huge volumes of data, large database systems satisfying today's demands on data analysis, and embedded systems in which sensors and processors are integrated, making them 'smart' and sensitive to the change of the environment.

The main focus is on computing systems, which represents the unique expertise of one of the research groups of Leiden University. The strength of the programme is the individual possibility for each student to study other future-oriented topics in Foundations of Computing, Artificial Intelligence, and Data Science. This specialisation of the MSc programme Computer Science provides

students with a thorough computer science background that will allow them to pursue careers in research or industrial environments.

3.2 Learning outcomes (Course and Examination Regulations art. 2.3)

In addition to the general achievements, graduates of the MSc programme Computer Science with the specialisation *Advanced Computing and Systems* have obtained in-depth knowledge in programming high performance computers and embedded systems, and building multimedia systems.

3.3 Programme (Course and Examination Regulations art. 3)

The programme is 120 EC in extent and consists of 1) six compulsory courses in the *Core component Computer Science Advanced Computing and Systems* (36 EC in total); 2) elective courses and seminars in Computer Science (42 EC in total); and 3) a *Master's Thesis Research Project* in computer science (42 EC, to be done in the second year). The choice of the elective courses may be limited by the need to adapt the programme to the prior knowledge of the candidate and the schedules of the elective courses.

4. Specialisation Artificial Intelligence

4.1 Description (Course and Examination Regulations art. 2)

The master's specialisation *Artificial Intelligence* offers future-oriented topics in computer science with a focus on machine learning, optimization algorithms, and decision support techniques. Artificial intelligence techniques are capable of making incredibly accurate predictions on the basis of data they themselves have gathered. In other words, computers can learn without intervention once they have been pre-programmed by humans. In this specialisation we explore the borders of what a revolutionary new generation of artificial intelligent algorithms can achieve. The specialisation also deals with optimisation, which offers theory and methods for efficiently searching for the best configuration of a hard problem, e.g., to optimise some production process.

The main focus is on Machine Learning and Optimisation, which represent the unique expertise of several research groups of Leiden University. The strength of the programme is the individual possibility for each student to study other future-oriented topics in Advanced Computing and Systems, Foundations of Computing, and Data Science. This specialisation of the MSc programme Computer Science provides students with a thorough computer science background that will allow them to pursue careers in research or industrial environments.

4.2 Learning outcomes (Course and Examination Regulations art. 2.3)

In addition to the general achievements, graduates of the MSc programme Computer Science with the specialisation *Artificial Intelligence* have obtained in-depth knowledge on deep and reinforcement learning methods, understanding the principles of evolutionary computation and its application for optimisation algorithms.

4.3 Programme (Course and Examination Regulations art. 3)

The programme is 120 EC in extent and consists of 1) six courses in the *Core component Computer Science Artificial Intelligence* (36 EC in total); 2) elective courses and seminars in Computer Science and/or Artificial Intelligence (42 EC in total); and 3) a *Master's Thesis Research Project* in computer

science (42 EC, to be done in the second year). The *Core component Computer Science Artificial Intelligence* consists of four compulsory courses (24EC) and one additional block of two core courses (either *Core courses Algorithmic Artificial Intelligence* or *Core courses Human-Centred Artificial Intelligence*, both 12EC). The choice of the elective courses may be limited by the need to adapt the programme to the prior knowledge of the candidate and the schedules of the elective courses.

5. Specialisation Bioinformatics

5.1 Description (Course and Examination Regulations chapter 2)

The focus of this programme is on data analysis and modelling of biological processes, which represents the unique expertise of the Bioinformatics research group at LIACS. This expertise is used to address issues like data acquisition, data warehousing, data analysis, data mining, and data modelling, which all have become major challenges in the field of bioinformatics due to the tremendous complexity and abundance of quantitative data in biology and medicine. On the other hand, bioinformatics heavily contributes to the identification of new fundamental computer science principles and the development of new informatics tools. Bioinformatics offers a unique new synthetic approach for formulating hypotheses and solving problems in (molecular-) biology versus the classical reductionist approach.

5.2 Learning outcomes (Course and Examination Regulations art. 2.3)

In addition to the general achievements, graduates of the MSc programme Computer Science with the specialisation Bioinformatics have obtained in-depth knowledge of the core concepts of bioinformatics, including methods in computational biology, the design and mining of bio databases, the process and analysis of images, and the construction of mathematical models of biological systems.

5.3 Programme (Course and Examination Regulations chapter 3)

The programme is 120 EC in extent and consists of 1) six compulsory courses in the *Core component Computer Science Bioinformatics* (36 EC in total); 2) elective courses and seminars in Computer Science Bioinformatics (42 EC in total); and 3) a *Master's Thesis Research Project* in computer science (42 EC, to be done in the second year). The choice of the elective courses may be limited by the need to adapt the programme to the prior knowledge of the candidate and the schedules of the elective courses.

6. Specialisation Data Science: Computer Science

6.1 Description (Course and Examination Regulations art. 2)

The focus of the *Data Science* master's specialisation is on state-of-the-art knowledge on the foundations and algorithmic aspects of data mining, machine learning, and statistical data analysis. Data science is an interdisciplinary discipline at the intersection of statistical science and computer science aiming at discovering knowledge from typically large sets of structured or unstructured data. To achieve this goal, data scientists combine statistical methods and machine learning with exploration and optimization algorithms from computer science.

The specialisation *Data Science: Computer Science* equips students interested in data analysis with state-of-the-art knowledge in advanced statistical techniques, machine learning, and algorithmic

aspects of data analysis. The strength of the programme is the individual possibility for each student to study other future-oriented topics in Advanced Computing and Systems, Foundations of Computing, and Artificial Intelligence.

6.2 Learning outcomes (Course and Examination Regulations art. 2.3)

In addition to the general achievements, graduates of the MSc programme Computer Science with the specialisation Data Science: Computer Science have obtained in-depth knowledge of data management, have a thorough understanding of algorithmic analysis of data and are able to develop new data models and techniques and execute data analysis.

6.3 Programme (Course and Examination Regulations art. 3)

The programme is 120 EC in extent and consists of 1) six courses in the *Core component Computer Science Data Science* (36 EC in total); 2) elective courses and seminars in Computer Science and/or Data Science (42 EC in total); and 3) a *Master's Thesis Research Project* in computer science (42 EC, to be done in the second year). The choice of the elective courses may be limited by the need to adapt the programme to the prior knowledge of the candidate and the schedules of the elective courses.

7. Specialisation Foundations of Computing

7.1 Description (Course and Examination Regulations art. 2)

The master's specialisation *Foundations of Computing* focuses on the core concepts of computing, their applications in AI, quantum computing, parallel computing, and in verification and testing to ensure correctness of digital systems. By focusing on core concepts that transcend the boundaries of various Computer Science fields, the Foundations specialisation prepares you for an inter-disciplinary future. In particular, students will learn to model complex software systems and apply automated proof techniques to verify their correctness, thereby increasing trust in digital systems. Using the power of symbolic computation, the specialisation tackles hard computational problems and lays the basis to realise reasoning for artificial intelligence. It also equips students with knowledge of concurrency required to analyse parallel systems, but also with knowledge about non-deterministic, probabilistic and quantum computational models, all with the goal of solving problems more efficiently than with classical techniques.

The Foundations of Computing specialisation offers a unique blend of state-of-the-art topics in Computer Science reflecting the unique expertise of one of the research groups of Leiden University. The strength of the programme is the individual possibility for each student to study other future-oriented topics in Advanced Computing and Systems, Artificial Intelligence, and Data Science. The programme provides students with a thorough computer science background that will allow them to pursue careers in research or industrial environments, and will give them the ability to handle future technologies and to work across disciplines.

7.2 Learning outcomes (Course and Examination Regulations art. 2.3)

In addition to the general achievements, graduates of the MSc programme Computer Science with the specialisation *Foundations of Computing* have obtained in-depth knowledge of verification methods and modelling techniques, and understanding of advanced data structures and algorithms.

7.3 Programme (Course and Examination Regulations art. 3)

The programme is 120 EC in extent and consists of 1) six compulsory courses in the *Core component Computer Science Foundations of Computing* (36 EC in total); 2) elective courses and seminars in Computer Science (42 EC in total); and 3) a *Master's Thesis Research Project* in computer science (42 EC, to be done in the second year). The choice of the elective courses may be limited by the need to adapt the programme to the prior knowledge of the candidate and the schedules of the elective courses.

8. Specialisation Computer Science and Business Studies

8.1 Description (Course and Examination Regulations art. 2)

The master's specialisation *Business Studies* combines high-quality research in Computer Science with training in management and entrepreneurship. Rapid developments in computer science and AI have created major challenges and opportunities for all kinds of organisations, industries, and individuals. The strength and emphasis of the Business Studies specialisation is on combining research with the management and application of information technology in an organisational context. This prepares students well for a career in industry and government, or as entrepreneurs.

The Computer Science covers important topics such as software development, product management, enterprise architectures, and systems engineering, while the Business Studies component entails strategy, marketing, operations, and finance. In addition, the specialisation allows students to choose additional electives in computer science and business to specialise in a direction of their preference.

8.2 Learning outcomes (Course and Examination Regulations art. 2.3)

In addition to the general achievements, graduates of the MSc programme Computer Science with the specialisation *Business Studies* have attained the learning outcomes as described in the OER appendix for the faculty-wide *Business Studies* specialisation.

8.3 Programme (Course and Examination Regulations art. 3)

The programme is 120 EC in extent and consists of a Computer Science component of 60-80EC, and a Business Studies component of 40-60EC. The Business Studies component is described in detail in the OER appendix of the faculty-wide *Business Studies* specialisation, with the restriction that only the 20EC variant of the Business Internship is available; the reason for this is that the Business Internship is linked to the Master's Thesis Research Project (this is described in more detail in the prospectus). Note that the Business Studies component has its own elective space, with elective courses as listed in the Prospectus.

The Computer Science component consists of 1) five compulsory *Core courses Computer Science & Business Studies* (22 EC in total); 2) elective courses and seminars (16-36 EC in total), to be chosen from *Elective courses and seminars Computer Science* and/or *Elective courses Computer Science & Business Studies*; and 3) a *Master's Thesis Research Project* in computer science (second year; 22 EC; to be combined with an 20EC Business Internship in the Business Studies component, as described in the prospectus). The choice of the elective courses may be limited by the need to adapt the programme to the prior knowledge of the candidate and the schedules of the elective courses.

9. Specialisation Computer Science and Education

9.1 Description (Course and Examination Regulations chapter 2)

The specialisation *Computer Science and Education* (EDU) is offered as a joint programme with the Leiden University Graduate School of Teaching (ICLON). It prepares students for a career as computer science (in Dutch: 'informatica') teacher. This programme leads up to the so-called "eerstegraads onderwijsbevoegdheid", qualifying the student to teach in Dutch upper secondary education.

9.2 Learning outcomes (Course and Examination Regulations art. 2.3)

In addition to general achievements, graduates of the MSc programme Computer Science with the specialisation Education have all qualifications necessary for teaching all years of secondary education and technical and vocational training (for 12–18 year-olds).

9.3 Programme (Course and Examination Regulations chapter 3)

The *Computer Science and Education* programme consists of:

- 30 EC of elective courses and seminars chosen from *Elective courses and seminars Computer Science*, to be selected in correspondence with the Master's thesis research topic;
- a *Master's Thesis Research Project* in computer science of 30 EC; and
- the *Education component* as described in the Prospectus.

The *Computer Science component* of the programme will be followed during the first year of study, the Education component will be followed during the second year.
When the student has passed the *minor Education* (30 EC) during the BSc programme, the compulsory Education component is reduced by 30 EC. The remaining 30 EC can be used for both the Computer Science and/or Education component of the Master's programme.

A more comprehensive description, qualifications for admission, exemptions and more information on the complete programme can be found here.

10. Specialisation Computer Science and High-Tech Innovation

10.1 Description (Course and Examination Regulations art. 2)

The master's specialisation *High-Tech Innovation*, you are trained to do high-quality research in Computer Science for real-world technological applications in high-tech industry. This specialization explores how cutting-edge technologies from computer science and artificial intelligence drive innovation in the high-tech industry. You will expand your knowledge on optimisation, machine learning, and other advanced topics.

Beyond deepening your expertise in computer science and AI, you will gain interdisciplinary knowledge and skills from astronomy, chemistry, mathematics, and physics, making this a unique specialisation that enables you to contribute to the development of, i.e., novel high-tech instruments or integrated software and hardware solutions.

10.2 Learning outcomes (Course and Examination Regulations art. 2.3)

In addition to the general achievements, graduates of the MSc programme Computer Science with the specialisation *High-Tech Innovation* have attained the learning outcomes as described in the OER appendix for the faculty-wide *High-Tech Innovation* specialisation.

10.3 Programme (Course and Examination Regulations art. 3)

The programme is 120 EC in extent and consists of a Computer Science component of 60EC, and a High-Tech Innovation component of 40-60EC. The Business Studies component is described in detail in the OER appendix of the faculty-wide *High-Tech Innovation* specialization.

The Computer Science component consists of 1) three compulsory *Core courses Computer Science and High-Tech Innovation* (18 EC in total); 2) elective courses and seminars in Computer Science (12 EC in total); and 3) a *Master's Thesis Research Project* in computer science (30 EC). The choice of the elective courses may be limited by the need to adapt the programme to the prior knowledge of the candidate and the schedules of the elective courses.

11. Specialisation Computer Science and Science Communication and Society

11.1 Description (Course and Examination Regulations chapter 2)

The specialisation *Computer Science and Science Communication and Society* (SCS) offers students the possibility to combine computer science and science communication. Students are prepared for a career in the area of science communication or for a career as a scientist with a communication mind-set.

Students who complete the specialisation *Computer Science and Science Communication and Society* are admissible to a PhD programme in computer science or in science communication.

11.2 Learning outcomes (Course and Examination Regulations art. 2.3)

In addition to the general achievements, graduates of the *MSc programme Computer Science* with the specialisation *Science Communication and Society* have reached the following specific achievement levels:

15. Knowledge about theories and frameworks in science communication & society;
16. Knowledge about science communication research methods;
17. Insight about the field of science communication & society;
18. Applying theoretical knowledge and insights towards evidence-based development of products and projects related to science communication and society;
19. Applying theoretical knowledge and insights towards conducting research about science communication and society;
20. Being able to work in interdisciplinary and transdisciplinary contexts;

21. Becoming a professional taking into account social, cultural, environmental and ethical considerations in their work related to science communication and society;
22. Contributing to innovation and improvement of the field of science communication & society;
23. Skills in oral, written and visual communication about science towards different target audiences;
24. Developing innovative communication strategies including dialogue and participation with experts and non-experts (if applicable);
25. Inter- and intrapersonal skills;
26. Becoming a creative, innovative, analytical, reflective professional in the field of science communication and society;
27. Being able to build and use a network of stakeholders in science communication and society;
28. Having an overview of career paths in science communication and society and their own possible role within the field science communication and society.

11.3 Programme (Course and Examination Regulations chapter 3)

The *Computer Science and Science Communication and Society* (SCS) programme consists of:

- a minimum of 40 EC and a maximum of 60 EC of courses chosen from the *SCS component;*
- at least 30 EC of elective courses and seminars chosen from *Elective courses and seminars Computer Science*, to be selected in correspondence with the Master's thesis research topic;
- a *Master's Thesis Research Project* in computer science of 30 EC.

A more comprehensive description, qualifications for admission, exemptions and more information on the complete programme can be found in the Prospectus.

12. Transitional Agreements

12.1 Specialisations (Course and Examination Regulations art. 2.2)

From 1 September 2020, the specialisation *Computer Science and Advanced Data Analytics* is no longer available to new students in the MSc Computer Science programme. Students who started this specialisation on 1 September 2019 or 1 February 2020 change specialisation based on the core component they chose: *Advanced Computing and Systems*, *Artificial Intelligence*, and *Foundations of Computing* change to the specialisation with the same name, while *Advanced Data Analytics* changes to *Data Science: Computer Science*. For students who started before 1 September 2019, the programme consists of elective courses and seminars Computer Science (78 EC in total, from the list in Article 3), and a *Master's Thesis Research Project* (second year; 42 EC).

From 1 September 2026, the specialisation '*Bioinformatics* (BI)' is no longer available to new students in the MSc Computer Science programme. Students who started the *Bioinformatics* specialisation before 1 September 2026 will have the opportunity to complete the specialisation.

12.2 Programme (Course and Examination Regulations chapter 3)

General changes

Students who started before 1 September 2020 may choose to replace the *Introductory Research Project* (4343IRPRJ) with 18 EC of elective courses and seminars.

Core course changes

As of 1 September 2026 the *Capstone Case* course code changed from 4343BSCC4 to 4343BSCAC.

Students *Bioinformatics* who have not yet passed *Image Analysis with Applications in Microscopy* (4343MMAV6) should consult their study advisor for a suitable replacement.

Students *Foundations of Computing* who started before 1 September 2026 may choose to replace *Modern Game AI Algorithms* (4343MGAIX) with *Formal Methods for AI* (4343FMFAI).

Students *Advanced Computing and Systems* who started before 1 September 2025 may choose to replace *Cryptographic Engineering* (4343CRYPE) with *Distributed Systems* (4343DISYX).

Students *Advanced Computing and Systems* who started before 1 September 2023 may choose to replace *Distributed Data Processing Systems* (4343DISDP) with *System and Software Security* (4343SYSSS).

Students *Advanced Computing and Systems* who started before 1 September 2022 may choose to replace *High Performance Computing II* (4343HPC2X) with *Cryptographic Engineering* (4343CRYPE).

Students *Data Science: Computer Science* who started before 1 September 2021 are allowed to replace the *Core courses Data Science* with any six courses worth 36 EC from (1) the current core courses (as listed in the prospectus), and (2) *Computational Statistics* (4433COMST), *Information Theoretic Data Mining* (4343ITDM6), *Information Retrieval* (4343INFRX), *Introduction to Deep Learning* (4343INDLX), *Linear & Generalized Linear Models and Linear Algebra* (4433LGMO6), and *Statistical Learning* (4433STATL).

Students *Foundations of Computing* who started before 1 September 2024 may choose to replace *Seminar Combinatorial Algorithms* (4343SCOMA) with *Proof Formalisation* (4343PROFX) or the new *Seminar Combinatorial Algorithms* (4343SECAL).

Elective courses and seminars

Any courses and seminars that were listed in a specialisation's list of elective courses and seminars in the OER of any of the academic years in which a student was enrolled, may be used to satisfy the requirements for that student's elective space.

Course name changes

Below is a list of course list name changes, per academic year. In all cases, the course with the new name is considered equivalent to the old one.

As of 1 September 2026, the following course name changes came into effect:

- *ICT Enabled Process Innovation* (4343BSICT) was renamed to *Integrated and Digital Organizational Development* (4343BSIDO)
- *Role of IT in Public Administration* (4343BSRPA) was renamed to *Managing Digital Transformation in Society* (4343BSMDT).

As of 1 September 2024, the following course name change came into effect:

- *High Performance Computing I* (4343HPCI6) was renamed to *High Performance Computing* (4343HIPX6).

As of 1 September 2023, the following course name changes came into effect:

- *Advanced Statistical Computing* (4433ADSTC) was renamed to *Computational Statistics* (4433COMST);
-

As of 1 September 2022, the following course name changes came into effect:

- *Advances in Deep Learning* (4343ADL6X) was renamed to *Seminar Advances in Deep Learning* (4343SADL6); and
- *Computational Molecular Biology* (4343COMOB) was renamed to *Biological and Biomedical Informatics* (4343BIBII).

As of 1 September 2021, the following course name changes came into effect:

- *Information Retrieval and Text Analytics* (4343IRTA6) was renamed to *Information Retrieval* (4343INFRX).

As of 1 September 2020, the following course name changes came into effect:

- *Advances in Model Checking* (4343ADVMC) was renamed to *Software Verification* (4343SWVRX);
- *Deep Learning and Neural Networks* (4343DLNN6) was renamed to *Introduction to Deep Learning* (4343INDLX);
- *Introduction to Data Science for Computer Scientists* (4343IDAS6) was renamed to *Data Science in Practice* (4343DASPR).

MSc Creative Intelligence & Technology

CROHO-number 60206

1. Description of the programme (Course and Examination Regulations chapter 2)

The Master Creative Intelligence & Technology is an interdisciplinary programme that questions intelligence and technology in a fundamental, creative, and playful way. It educates independent and societally engaged makers, thinkers, and researchers who are able to use and investigate state-of-the-art technology from computer science, artificial intelligence (AI), and related fields. It is offered by LIACS, the Leiden Institute of Advanced Computer Science, which is part of the Faculty of Science.

The programme has a broad take on cognition and intelligence and looks at the human and non-human aspects and effects of technology, including the societal and ecosystemic. It encourages creative thinking and research while questioning creativity itself. The programme regards students as researchers who are aware of, and reflect on, their own role in relation to what they research.

The programme takes a practical, interdisciplinary research approach based on speculating, making, and experimenting. It addresses questions such as "What does a certain technology enable (and disable)?", "What is and isn't possible with AI?", "Can technology be creative?", "How can/do technology and AI impact society?". The programme does not focus on inventing new algorithms, but on new insights and knowledge regarding intelligence and technology in a broader context.

1.1 Objectives of the programme (Course and Examination Regulations art. 2.1)

The programme's goals are to stimulate innovation and creativity in scientific research by the innovative application of intelligent technology, and to enable society to deal with and reflect on new intelligent technologies. Creative Intelligence & Technology students are trained as autonomous scientists, preparing students for a future career involving creative and critical thinking, in scientific research or elsewhere in society.

1.2 Learning outcomes (Course and Examination Regulations art. 2.3)

Graduates of the MSc in Creative Intelligence & Technology have attained the following general learning outcomes:

g. theoretical and practical skills in more than one specialist area (including computer science/artificial intelligence, creative and performative arts, and relevant aspects of philosophy, cognitive science, and linguistics), such that they can carry out research under overall supervision;
h. the ability to make an independent analysis of scientific problems, analysis of relevant specialist literature, formulate verifiable hypotheses, and set up and carry out research and critical reflection on one’s own research and that of others;
i. the ability to interrelate and integrate various areas of computer science, artificial intelligence, creative and performative arts with relevant aspects of philosophy, cognitive science, and linguistics;
j. the ability to present clearly, verbally as well as in writing, one’s own research results. This includes the presentation of their research results as a contribution to a congress or as (part of) a scientific publication and the ability to communicate with colleagues;

k. sufficient understanding of the social and societal role of academia, especially computer science/artificial intelligence and the creative and performative arts, to be able to critically reflect upon it and in part consequently to come to an ethically sound attitude and corresponding execution of one's professional duties;
l. have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.

In addition to the above general achievements, graduates of the MSc in Creative Intelligence & Technology have formed an understanding of the fundamental principles and organisation of academia, and of the importance of creativity and playfulness in academic research. They have knowledge and skills in computer programming and in the use of various media and technologies within virtual and physical environments. They have the ability to communicate with colleagues/peers in science (via e.g. a conference contribution or scientific publication) as well as with a wider audience (via e.g. an exhibition, performance, public event, or in popular-scientific writing). They have the ability to act as independent researchers and thinkers with a critical attitude.

1.3 Programme duration and completion (Course and Examination Regulations art. 2.5)

The duration of the programme is two years (120 EC). Students who complete the programme receive the degree 'Master of Science in Creative Intelligence & Technology'.

1.4 Start of the programme (Course and Examination Regulations art. 2.6)

Students can start their programme in September or February.

1.5 Language of the programme (Course and Examination Regulations art. 2.8)

The programme is taught entirely in English.

2. Programme (Course and Examination Regulations chapter 3)

The programme is 120 EC in extent and consists of a combination of compulsory core courses, accent and elective courses, and a graduation project. The exact composition of the programme is detailed in the Prospectus.

2.1 Substitution for Core Courses

Students can qualify for substitution of certain core courses (especially, but not exclusively, Creative Computation) within their curriculum, when they can prove already having current knowledge of the topics dealt with. Substitution can be granted by the Board of Examiners, who consult the study advisor and course lecturer. As a guideline, the student must participate in the first lecture and present some form of proof that the knowledge was already obtained elsewhere. The study advisor and/or lecturer may advise the Board of Examiners to honour or turn down requests for substitution, based on the material provided by the student and the evaluation of such.

In case the request for substitution is honoured, the student must obtain the required number of ECs through other ways, i.e., for every granted substitution a student must follow another (elective) replacement course with the same number of credits or more. The contents of this replacement course must preferably be a logical extension to the course for which substitution was granted, and must be of at least the same level.

2.2 Acceptance of Elective Courses

Elective courses can be followed throughout Leiden University's various faculties, and at any accredited institute of higher education in the Netherlands or abroad. For curricular acceptance of elective courses, permission must be obtained from the LIACS Board of Examiners. The decision to accept and approve an elective course is based on course level, course load, course content, and the student's personal statement of motivation. Furthermore, the Creative Intelligence & Technology prospectus contains a list of pre-approved elective courses that don't require additional acceptance for the corresponding year of study. Practical guidelines for students and procedures to apply for curricular acceptance of elective courses are communicated via the programme's website. In addition, an annual "electives kick-off meeting" is organised in which students are informed about the possibilities and procedures.

2.3 Option for exchange and studying abroad

Students can apply for permission from the LIACS Board of Examiners to participate in an exchange (typically taking place in the student's 3rd semester). If this permission is granted, the study results obtained within the exchange replace the Accent Courses and elective space. In consultation with the study advisor, the Board of Examiners takes the following criteria into consideration:

- the exchange must take place at a qualified institution and programme in The Netherlands or abroad;
- the exchange should consist of a coherent "package" of courses, all taken at one institution, and cover (at least) 28 EC;
- the exchange should take place at MSc level or equivalent;
- the student has a strong and content-driven motivation to participate in the exchange, reflected in the application submitted to the Board of Examiners, as well as in the will and capacity to pro-actively organise the exchange in all its facets (courses, timeline, costs, housing, etc.).

Independent from this 28 EC exchange option, students can always apply for taking elective courses abroad. For this, the normal procedure for the acceptance of elective courses, as described above, applies.

2.4 Transitional arrangements

The following transitional arrangements are in effect:

- *Human Computer Interaction and Information Visualisation* is replaced by *Collaborative and Multimodal Interaction* (4383COMUI). Students who have completed the former cannot take the latter; students who have not yet completed the former should take the latter instead.
- *Research Fundamentals* (3EC) is no longer offered. Students who started before September 2026 and have not completed the course expand their elective space by 3EC instead.
- *Hardware and Physical Computing* (3EC) is replaced by *Physical Computing and Prototyping* (4383PHCPR). Students who completed the former cannot take the latter.
- *Playful & Creative Science* (2024 – 202*5)* is replaced by *Tangible & Playful Research*. Students who have completed the former cannot take the latter; students who have not yet completed the former should take the latter instead.
- *Non-Human Cognition* (6EC 2024-2025) and *From Human Intelligence to Cognition in Nature and Machines* (6EC 2025-2026) are replaced by *Modes of Cognition* (4383MODCO . Students who completed the former cannot take the latter.

- The *Media Technology Field Trip* (2024-2025) has become an elective course in the 2025-2026 curriculum. For students who started before September 2025 the new elective course *Field Trip (Creative Intelligence & Technology MSc)* (4383FTRIP) can be used as substitute for the previous course.
- *Artificial Creatures* (4EC 2024-2025) is replaced by *Artificial Creatures* (3EC). Students who completed the former cannot take the latter.
- Research Seminar Artificial Intelligence (6EC 2024-2025) is replaced by *Foundations of AI* (6EC 2025-2026). Students who completed the former cannot take the latter.
- *Sound, Space & Interaction* (2024-2025) is replaced by *Generative and Interactive Sound and Music*. Students who started before September 2025 and have not yet completed the former should replace it by the latter or by *AI in Society*.
- *Portfolio (Media Technology MSc)* is replaced by *Portfolio (Creative Intelligence & Technology MSc)*. Students who have completed the former cannot take the latter; students who have not yet completed the former should take the latter instead.
- *Meta Media* (2EC) is no longer offered. Students who started before September 2025 and have not completed the course expand their elective space by 2EC instead.

MSc Governance of Sustainability

CROHO-number 60965

1. Description of the programme (Course and Examination Regulations chapter 2)

The MSc programme is instituted in the Faculty of Science of Leiden University, herein referred to as the Faculty, and taught in The Hague by the Institute of Public Administration, Faculty of Governance and Global Affairs, and by the Institute of Environmental Sciences, Faculty of Science.

The duration of the programme is two years (120 ECTS). Students who complete the programme receive the degree Master of Science in Governance of Sustainability.

The goal of the master programme Governance of Sustainability is to provide students with a thorough basis in natural sciences and in governance needed to handle the grand challenges regarding sustainability. Students learn how to analyse these complex issues from both perspectives and how to integrate these perspectives in order to develop and improve the quality of governance solutions needed to converge to a sustainable society. In addition, students will acquire a variety of skills required to cope with sustainability problems and to develop oneself into a future 'change agent'.

1.1 Learning outcomes (Course and Examination Regulations art. 2.3)

Graduates of the programme have achieved the below learning outcomes, ranked according to the Dublin descriptors:

Knowledge and understanding

The student has a thorough knowledge of:

1. The technical and scientific aspects of the key sustainability issues. These issues refer to themes of, among others, materials and circular economy, biodiversity and ecosystems, climate and energy and toxicity and water.
2. The key concepts and theories that are relevant to understanding governance processes. These concepts and theories include among others institutions and policy cycles, decision making and governance networks, global governance and multi-level analysis and policy framing.

The student is able to:

3. Recognize normative and culture positions of all actors involved in the governance of sustainability – both academics and practitioners.
4. Select and apply a variety of social science and natural science methods to evaluate sustainability issues, such as Environmental Input-Output Analyses, Spatial analyses, Network, Stakeholder and Multi-level analyses.
5. Explain why sustainability issues are complex problems, starting from an integrated analysis of both the natural and the social sciences.
6. Understand how sustainability issues are constrained and enabled by multilevel and multi-stakeholder governance settings and policy processes.
7. Explain which theories, concepts, and data from the natural sciences are -or could be- applied in transnational, national and local governance processes.
8. Analyse a complex sustainability issue and combine knowledge and methods from various disciplines to come to an integrated proposal for governance solution for the issue at hand.

9. Formulate integrated and innovative solutions and implementation pathways regarding sustainability issues.

Skills

The student is able to:

10. Operate within a transdisciplinary and diverse international context.
11. Design and carry out in-depth research on sustainability issues, starting from a set of concepts, theories and research methods based on either the natural or the social sciences, or from a combined approach.
12. Execute integrative scientific research projects (design, organize, execute, analyse and report).
13. Convincingly communicate results from scientific research about sustainability issues to both specialist and non-specialist audiences.
14. Argue a well-considered stance on the governance of sustainability issues, making use of the relevant disciplines.
15. Recognise, respect and use individual and cultural differences within a team.

Judgement

A student is able to:

16. Make an integral and critical assessment of available scientific knowledge and knowledge about governance processes to make judgements about sustainability issues.
17. Compare different transnational, national and local governance settings, policy approaches and institutions to address sustainability issues and apply the most suitable approach.
18. Critically reflect on ethical and normative dimensions regarding the governance of sustainability issues and the associated questions of complexity and uncertainty.
19. Act according to the different normative and culture positions of all actors involved in the governance of sustainability.

Learning skills

A student:

20. Has a positive attitude and openness towards self-directed and life-long learning.
21. Is able to design and plan their own learning processes by virtue of continuous reflection on personal knowledge, skills, attitudes and performance.
22. Is able to study independently and explore new areas of interest regarding the governance of sustainability issues.

2. Programme (Course and Examination Regulations chapter 3)

Article 2.1 Overview of the programme

Component	Level	Study load
Thematic courses	500	48 EC
Research and professional skills	500	20 EC
Governance of Sustainability Project	600	10 EC

Electives*	Master	12 EC
Research project	600	30 EC

*optional component as referred to under Article 3.2 in the Course and Examination Regulations.

Article 2.2 Requirements second year

• To participate in the Sustainability Challenge and Quantitative Research Skills course, students need to have completed at least 48 ECTS of the first year courses of the Governance of Sustainability programme.
• To participate in the Thesis Research Project, students need to meet all of the following requirements:

- completed at least 48 ECTS of the first year courses of the Governance of Sustainability programme
- participated in the Qualitative Research Skills course
- sufficiently completed at least one of the assignments within the Quantitative Research Skills course

Article 2.3 Optional components (electives)

Students have to complete at least 12 ECTS of optional components. The optional components have to be approved by the Board of Examiners before the start of the study components and must meet the following criteria:

1. The optional component should be on Master level (similar to a Master level at a Dutch research university);
2. The optional component should not show a (considerable) overlap with or replace compulsory components or other chosen optional components;
3. The optional component should:
    a. Deepen the understanding in governance, or;
    b. Deepen the understanding in natural science aspects of sustainability, or;
    c. Improve non-transferable or transferable skills needed to become a knowledge broker or change agent, or;
    d. Gather topical knowledge on the masters' thesis research.
    e. An optional component cannot be more than 12 ECTS. The total EC of optional components may, however, exceed 12 ECTS. If this is the case, exceeding credits will be noted as extra-curricular.

Article 2.4 Compulsory and optional components

- If a large difference exists between the expected and actual enrolment of students in a compulsory component, the programme management can decide to change the format of teaching methods and assessment.
- If a large difference exists between the expected and actual enrolment of students in a non-compulsory, optional component, the institute's board that offers this optional component may decide not to offer this component or to offer it in a different form; in this case, students will be informed before the start of the component and will be offered an alternative.

Article 2.5 Transitional arrangements

Course credits changes

2.5.1 As of September 2024, the number of EC for Quantitative Research Skills (QUAN) and Sustainability Challenge (SUSCH) has changed, see below:

Second year	Course code	Level	EC		Second year	Course code	Level	EC
Quantitative Research Skills	4443QUANR	500	6	→	Quantitative Research Skills	4443QRSK8	500	8
Sustainability Challenge	4443SUSCH	600	12	→	Sustainability Challenge	4443GSUCH	600	10

2.5.2 Students who have completed QUAN before September 2024 (6 EC), but follow SUSCH in or after 2024-2025 (10 EC) will miss 2 EC. These can be obtained via a compensatory assignment for SUSCH in consultation with the course coordinator, or by extending the elective space (14 EC instead of 12 EC).

Article 2.6 Exemptions from examinations and/or practicals

Article 4.9 of the Faculty of Science Course and Examinations Regulations for Master's Programmes describes the possibility to grant a student an exemption from an examination of practical.
An exemption will not be granted for:

a. the four thematic courses
    1. Thematic course 1: Materials & Circular Economy
    2. Thematic course 2: Biodiversity & Ecosystems
    3. Thematic course 3: Climate Change & Energy Transition
    4. Thematic course 4: Water & Toxicity
b. the Thesis Research Project

Based on demonstrated and relevant work or professional experience, an exemption will also not be granted for:

a. the Sustainability Challenge

Article 2.7 Capita Selecta

A Capita Selecta introduces a new topic that is not treated elsewhere within the MSc Governance of Sustainability curriculum. It is an additional piece of work which is not covered by any other (optional component) courses or part of the programme, and may allow students to broaden or deepen their knowledge and skills. A capita selecta can be proposed by a student, or by a scientific staff member, and can be conducted individually (by one student), or by a group of students. Within Governance of Sustainability a capita selecta can have the value of 2, 3, 4, 5 or 6 ECTS. All capita selecta's need to be approved by the Board of Examiners and supervised and assessed by a Governance of Sustainability core examiner. If approved by the Board of Examiners, a capita selecta can be used as optional component .

The Capita Selecta is bound to a number of criteria:

1. It should contain specific and realistic learning objectives (to be approved by the Board of Examiners). Within these, it should be clear through the learning objectives why the capita

selecta is worth 2, 3, 4, 5 or 6 ECTS (workload). Furthermore, the final product(s) should be specified.
2. Specific and realistic assessment methods and assessment criteria should be defined (to be approved by the BoE), coupled to the learning objectives and allowing evaluation by the BoE.
3. Similar to other optional components, a Capita Selecta should allow a student of Governance of Sustainability to broaden or deepen the knowledge and skills taught in the curriculum. This will be evaluated through the formulation of learning objectives, contents (teaching method/final product) and assessment methods and criteria.

Article 2.8 Validity of grades for constituent examinations (course and examination regulations art 4.7)

The validity period of grades for constituent examinations [*deeltoetsen*] is limited until the end of the academic year in which the grade for a constituent examination was obtained. If the learning outcomes and assessment method of the component (one of the courses of the programme) have not changed, students can request an exemption to this article from the Board of Examiners. Students need to submit the request to the Board of Examiners latest 40 working days before the start of the component.

MSc ICT in Business and the Public Sector

CROHO-number 60205

1. Description of the programme (Course and Examination Regulations chapter 2)

From September 2025, the MSc *ICT in Business and the Public Sector* programme no longer accepts new students (instead, the *MSc Computer Science & Business Studies* specialisation is available to new students). Current *ICT in Business and the Public Sector* students will have the opportunity to complete the programme until August 31st, 2029; after that date the programme will cease to exist.

1.1 Objectives of the programme (Course and Examination Regulations art 2.1)

The MSc *ICT in Business and the Public Sector* aims at providing a deeper understanding of the issues, challenges and opportunities in this area, with a specific focus on the management and alignment of ICT in a business and/or governmental context. The programme builds on a technical foundation of Computer Science that students bring from their bachelor's education.

1.2 Specialisations (Course and Examination Regulations art. 2.2)

The MSc *ICT in Business and the Public Sector* offers the following two specialisations:

- ICT in Business
- ICT in the Public Sector

The specialisations *Business Studies*, *Science Communication and Society*, *High-Tech Innovation* and *Education* are not available to students of the MSc *ICT in Business and the Public Sector*.

1.3 Learning outcomes (Course and Examination Regulations art. 2.3)

Graduates of the master programme *ICT in Business and the Public Sector* have attained the following general learning outcomes:

a. theoretical knowledge and practical skills in more than one specialist area of business, management and information and communication technology such that they can carry out research under overall supervision;
b. the ability to make an independent analysis of scientific problems, analysis of relevant specialist literature, formulate verifiable hypotheses, and set up and carry out research and critical reflection on one's own research and that of others;
c. the ability to interrelate and integrate various areas of management and information and communication technology;
d. the ability to present clearly, verbally as well as in writing, one's own research results, and the ability to communicate with colleagues and to present their research results as a contribution to a conference or as (part of) a scientific publication;
e. sufficient understanding of the social and societal role of ICT in an organizational context to be able to reflect upon it and in part consequently to come to an ethically sound attitude and corresponding execution of one's professional duties;
f. have the learning skills to allow one to continue to study in a manner that is largely self-directed or autonomous.

Graduates with the specialisation *ICT in Business* have obtained in-depth knowledge on how ICT enables innovations in all business areas including marketing, operations, finance, strategy and IT

itself, and have developed practical skills and experience in applying these concepts in the context of private organisations. Graduates with the specialisation *ICT in the Public Sector* have obtained in-depth knowledge on areas relevant in the public domain such as politico-administrative relations, European procurement, and data-driven policy development, and have developed practical skills and experience in applying these concepts on an administrative and managerial level.

1.4 Programme duration and completion (Course and Examination Regulations art. 2.5)

The duration of the programme, is two years (120 EC). Most courses are organised on campus in Leiden, some courses are organised in The Hague. Students who complete the programme receive the degree Master of Science in ICT in Business and the Public Sector, with a description of the specialisation.

1.5 Start of the programme (Course and Examination Regulations art. 2.6)

The programme does not accept new students.

1.6 Language of the programme (Course and Examination Regulations art. 2.8)

The programme is taught entirely in English.

2. Programme (Course and Examination Regulations Chapter 3)

The programme is 120 EC in extent, with the exact curriculum depending on the student's background. Students with a business background follow the foundation courses on ICT (15 EC total). Students with an ICT background follow the foundation courses on Business (12 EC total). Students with a bachelor degree 'Informatica & Economie' from Leiden University are exempted from the courses in the foundation modules. These students follow additional electives instead for 12 EC. Students who choose for the specialisation ICT in Business need to take all courses from the Module specialisation ICT in Business (12 EC in total), whereas students who choose for the specialisation ICT in the Public Sector take all courses from the Module specialisation ICT in the Public Sector (12 EC in total). Students who choose both specialisations have to take all specialisation courses from both specialisations resulting in a total of 144 ECTS.

3. Transitional arrangements

As of 1 September 2026 the *Capstone Case* course code changed from 4343BSCC4 to 4343BSCAC

As of 1 September 2026 *Machine Learning for Business Analytics* (4343BSMLB) changed semester. Students that started before 1 September 2026 and did not complete Machine Learning for Business Analytics can take it as offered or replace it with an elective.

As of September 1st, 2025, most courses of the *ICT in Business and the Public Sector* programme are offered under new catalogue numbers. The table below provides a mapping from previous to new catalogue numbers. (This concerns catalogue numbers starting with 4353.)

Courses	Level	EC	Old	New

			catalogue nr	catalogue nr
Capstone Cases	500	4	4353CSC4V	4343BSCC4
Cyber Security Management	500	3	4353CYBSM	4343BSCSM
Data-Driven Policy Making	500	6	4353DDPM6	4343BSDPM
Enterprise Architecture	500	6	4353ENTAR	4343BSEA6
Global Business Game	400	0	4353GBGR1	4343BSGBG
ICT-enabled Process Innovation	500	3	4353ICTP3	4343BSICT
Machine Learning for Business Analytics	500	3	4353MLBA3	4343BSMLB
Managing Software Evolution	500	3	4353MNSE3	4343BSMSE
Model-Driven Systems Engineering	500	6	4353MDDSE	4343BSMDS
Regulatory Governance and Data Science	500	6	4353RGDS6	4343BSRGD
Role of IT in Public Administration	500	6	4353RITPA	4343BSRPA
Software Development and Product Management	500	6	4353SWDPM	4343BSSDP

As of September 1st, 2025, Entrepreneurship is replaced by Entrepreneurship and Innovation and is changed from 3 to 6 EC. Students that did not yet complete Entrepreneurship can choose to either 1) take Entrepreneurship and Innovation and reduce their elective space with 3 EC, or 2) not take Entrepreneurship and Innovation and increase their elective space with 3EC. As of September 1st, 2025, the courses Digital Government Citizen Interaction (3 EC) and Applied Research Methodology (4 EC) are no longer offered. Each of these courses that a student has not yet completed can be replaced by electives.

As of September 1st, 2024, the course *Process Modelling* has been removed from the module Foundation ICT and *Accounting* has been removed from the module Foundation Business, and in the core module, the 3 EC course *Systems Development* has been replaced by the 6 EC course *Model-Driven Systems Engineering*. Students that previously completed *Process Modelling* or *Accounting* but not *Systems Development* must now complete *Model-Driven Systems Engineering* and can reduce their elective space with 3EC. Students that started before 2024 and did not complete Process Modelling or Accounting can take an elective instead.

Students who completed *Advances in Datamining* before September 2023 do not need to follow *Cyber Security Management* and *Machine Learning for Business Analytics*.

Students who started before 1 September 2021 and have already successfully completed the previously mandatory courses *Managing Innovation* or *Managing the Digital Business* do not need to follow *Managing Software Evolution or AI for Strategy*.

Course renaming

As of September 1st, 2026, the following course has been renamed: *Managing Digital Transformation in Society* (4343BSMDT) (was *Role of IT in Public Administration* (4343BSRPA). The two courses are considered to be equivalent.

As of September 1st, 2026, the following course has been renamed: *Integrated and Digital Organizational Development* (4343BSIDO) (was *ICT Enabled Process Innovation* (4343BSICT). The two courses are considered to be equivalent.

As of September 1st, 2025, the following course has been renamed: *Business Research Methods* (was *Research Methods*). The two courses are considered to be equivalent.

As of September 1st, 2024, the following course has been renamed: *Enterprise Architecture* (was *ICT Architectures*). The previously completed course is considered to be equivalent.

As of September 1st, 2023, the following course has been renamed: *Cyber Security Management* (was *Cyber Security*). The previously completed course is considered to be equivalent.

As of September 1st, 2022, the following course has been renamed: *Machine Learning for Business Analytics (*was *Business Intelligence), Financing Technology Ventures* (was *Entrepreneurial Finance).* Previously completed courses are considered equivalent to those renamed in September 2022.

As of September 1st, 2021, the following courses have been renamed: *Strategy and Technology* (was *Strategy*), *Marketing Science* (was *Marketing*), *Strategic Financial Management* (was *Financial Management*), and *Operations Management* (was *Technology Operations Management*). Previously completed courses are considered equivalent to those renamed in September 2021.

Course credit changes
As of September 1st, 2025, *Global Business Game* has changed from 1 EC to 0 EC. For students who have not yet completed *Global Business Game*, the elective space is increased by 1 EC (and *Global Business Game* remains mandatory).

From September 2022 *Data-Driven Policy Making* changed to 6 EC instead of 3 in the previous years. Students following Public Sector specialisation who successfully completed the 3 EC version of *Data-Driven Policy Making* before September 2022 will be allowed to follow an elective of 3 EC in order to obtain the 15 EC specialisation credits after consulting the program coordinator.

MSc Life Science and Technology

CROHO-number 66286

1. Description of the programme (Course and Examination Regulations chapter 2)

The Leiden Institute of Chemistry (LIC) forms the basis for research and collaborations of the Leiden chemistry and life sciences groups. The LIC offers two MSc programmes, namely the MSc Life Science and Technology and the MSc Chemistry. The programme Life Science and Technology (LST) concerns the study and manipulation of processes occurring in the living cell. The cell is the building block of life; it is the smallest unit with the characteristics of living systems. Increased knowledge of the mechanisms of processes in the cell can lead to better medicines or new methods for combating diseases. The MSc programme LST fits within the Leiden University research area "BioScience: Science base of Health".

Research topics in ***Life Science and Technology*** within the LIC comprise chemical and biomolecular synthesis and design combined with cell and chemical biology research. Thereby an unprecedented foundation is created for understanding the fundamental cellular processes and mechanisms underlying diseases, as well as knowledge of and skills in the technology to manipulate these systems for therapeutic purposes. At the core of our modern understanding of health and disease are studies on protein-protein interactions, synthesis and manipulation of protein structures, the design and use of novel chemical probes and inhibitors, the study of the effects of these potential drugs in cells and application of biomedical informatics. Our MSc students specifically learn to understand the molecular and structural chemical and biological aspects of disease-related processes and will be able to apply chemical and biotechnological tools to the treatment of diseases. The molecular insight of MSc LST students is highly appreciated by research groups in institutes such as LUMC and ErasmusMC and in research institutes abroad.

A variety of molecularly based, disease-related research training projects can be carried out at the LIC or alternatively at LACDR, IBL, LUMC, the Dutch Cancer Institute (NKI) or ErasmusMC.

1.1. Specialisations (Course and Examination Regulations art. 2.2)

The MSc LST programme offers four specialisations:

- Life Science Research and Development (RESEARCH),
- Life Science and Business Studies (BS),
- Life Science and Science Communication and Society (SCS), and
- Life Science and Education (EDU).

The duration of each specialisation is two years (120 EC); a general programme overview of the distribution of study load over the components in the four specialisations is given in Table 1. Students who complete the programme receive the degree Master of Science in LST, with specification of the specialisation.

Table 1: Overview of the programmes of the four MSc LST specialisations (weights in EC)

Specialisation	RESEARCH	EDU#	SCS	BS
Research-training project*	60	30	30	30
Academic and Professional Skills	10	10	10	10
Core courses	20	20	20	20
Free electives**	30	0 / 30	20	20
EDU/SCS/BS components	-	60 / 30	40	40
Total EC	120	120	120	120

* The research-training project is the final assignment of the programme, as mentioned in article 4.12 of the Course and Examination Regulation Master's Programmes.

** The choice in the free electives is restricted to the boundaries specified in this document. A maximum of 20 EC can be used for extension of the LST research-training project. In case of a single SCS/BS specialisation, a maximum of 20 EC may be used as an extension of the SCS/BS component. In case of a double specialisation, the free electives cannot be used for compulsory courses or extension of the internship of the second specialisation.

If the student has taken a minor in Education ("tweedegraadsbevoegdheid") of 30 EC in the BSc programme, only 30 EC are necessary in the MSc programme to obtain the "eerstegraadsbevoegdheid". Then either 30 EC are added to the electives of the programme of the MSc LST, or the student may request 30 EC of exemptions (art. 3.6 FWN faculty OER).

1.2 Learning outcomes (Course and Examination Regulations art. 2.3)

Graduates of the MSc LST programme will have developed the following, ranked by the Dublin descriptors:

Dublin descriptor Knowledge and Insight

- Graduates demonstrate a solid understanding of key theoretical concepts in Life Sciences, based on textbooks and primary scientific literature..

Dublin descriptor Applying Knowledge and Insight

- Graduates are able to design and plan chemical research, carry out experiments within a realistic timeframe, and collect, store, and organise data clearly and systematically so that it is accessible to others (good data management practice).
- Graduates are able to independently analyse scientific problems, critically read and interpret relevant specialist literature, and formulate testable scientific hypotheses.

Dublin descriptor Judgement

- Graduates show a critical scientific attitude by analysing their own experimental results and evaluating scientific literature for reliability, accuracy, and limitations.Graduates demonstrate awareness of the social and ethical responsibilities associated with academic research in Life Sciences.

Dublin descriptor Communication

- Graduates are able to clearly communicate research progress and results in chemistry to peers, supervisors, and subject-matter experts.
- Graduates are able to independently write a well-structured, clear, and accurate report describing chemical research they have carried out.

Dublin descriptor Learning Skills

- Graduates possess the learning skills needed to continue their education in a follow-up study, working largely independently and taking responsibility for their own learning.

1.3 Start of the programme (Course and Examination Regulations art. 2.6)
Students can start their programme in September or February; the nominal study duration of the programme is two years.

1.4 Programme organisation
All MSc LST specialisations have the same Programme Director, same Board of Admissions, same Programme Committee, and same Board of Examiners. The Programme Committee for the MSc programme LST is combined with the one for the MSc programme Chemistry and is responsible for the Research specialisation as well as the programme-specific components of the other specialisations. The Board of Examiners of the MSc programme LST is also combined with the one of the MSc programme Chemistry.

Programme organisation of specialisation-specific components for BS, SCS and EDU is described in the specialisation sections of this Appendix.

2. Programme (Course and Examination Regulations chapter 3)
The programme includes compulsory (Course and Examination Regulations art. 3.1), elective (Course and Examination Regulations art. 3.2) and specialisation-specific components as shown in Table 1 and specified in the Prospectus. Students compose their own study programme, with a choice in core courses, electives and research-training project. The choice in elective courses in the MSc programme may be limited by the need to adapt the programme to the present knowledge of the candidate. The programme may be adjusted during the MSc study.

Specialisation-specific components of the specialisations Life Science and Business Studies, Life Science and Science Communication and Society, and Life Science and Education are described separately in this Appendix and the Prospectus. Students are allowed to do a double specialisation, comprising the full programme of one specialisation (i.e. the main specialisation) plus the specialisation-specific components of a second specialisation. The main specialisation should be chosen in the following order: Research above Education above Business/Communication. The number of credits for double specialisations thus must be at least 150 EC (Research + EDU-30), 160 EC (Research + BS; Research + SCS; EDU + BS, EDU + SCS, BS + SCS) or 180 EC (Research + EDU-60).

Requirements for and boundaries of the various components in the specialisations are provided in the following chapters.

3. Specialisation Life Science Research and Development (RESEARCH)
3.1 Description (Course and Examination Regulations chapter 2)
The research specialisation offers the student the opportunity to spend two full years on training and specialisation not only to become an independent and creative researcher, but also someone who can use their analytical skills to resolve challenges in their career in science or in society. Many students with an MSc in Research in LST continue their career in a PhD position.

3.2 Programme (Course and Examination Regulations chapter 3)

The Life Science research and development programme (RESEARCH) consists of the parts specified in Table 2.

Table 2: Overview of the programme Life Science research and development

Component	Study load	Level
Research-training project:	60-80 EC*	600
Major research project	40-60 EC	600
Minor research project (optional)	20-40 EC	600
Academic and Professional Skills	10 EC	400-500
Core courses	20 EC	400-500
Electives	30 EC	400-600

* The total weight of research-training projects may not exceed 80 EC; if the research-training projects exceed 60 credits, the additional credits are subtracted from the electives.

3.3 Research-training Project ('Final assignment', Course and Examination Regulations art. 3.3.2)

3.3.1 Scope and study load: The research training may be split into a major and one or two minor research projects. The major research project is limited to a minimum of 40 EC and a maximum of 60 EC, and is carried out within a LIC research group, at the LACDR, or at the IBL. Students may also carry out pre-clinical master research training projects in the LUMC, NKI or ErasmusMC. An optional minor research project must comprise at least 20 EC. A minor research project may be carried out in the LIC, in another institute (within the Netherlands or abroad) or in a company. A minor research project cannot be carried out with the supervisor of the major research project. Prior approval of the Board of Examiners is required for a research-training project outside the LIC, IBL, LACDR, LUMC, NKI, or ErasmusMC.

3.3.2 Supervision and evaluation: Each research-training project must be supervised by a scientific staff member (main or internal supervisor). For research-training projects carried out in the LIC, the major research project is evaluated and graded by the main supervisor, with input from the daily supervisor, a second reviewer and a Thesis Talk juror. The second reviewer is a staff member in the same research field as the main supervisor; the Thesis Talk juror is a staff member who was not directly involved in the research project. The second reviewer and Thesis Talk juror decide the final grade together with the main supervisor based on the quality of the research report, the quality of the Thesis Talk and the scientific level of the student. For research-training projects carried out outside the LIC, the major research project is evaluated by the external supervisor, with input from the daily supervisor. Final grading is the responsibility of the internal supervisor and the Thesis Talk juror, who is a staff member not directly involved in the research-training project. The internal supervisor and Thesis Talk juror decide the final grade together with the external supervisor based on the quality of the research report, the quality of the presentation and the scientific level of the student.

Minor research projects carried out within the LIC are evaluated and graded by two LIC scientific staff members who were not the student's main supervisor for the major research project. External research projects are supported, evaluated and graded by a scientific staff member of the LIC (the internal supervisor) who was not the main supervisor for any of the student's other research-training projects and a staff member from the host institute or host company (the external supervisor).

For all research-training projects the internal supervisor has the final responsibility for creating the research-project agreement, grading the research-project report and signing and submitting the project-evaluation form.

3.3.3 Written report: All research-training projects are concluded with a written report; for the major research project this is the MSc thesis. The requirements for the written report can be found via the Prospectus. The final version of the report should be handed in within 3 months after the last day of practical work.

3.3.4 Thesis Talk: The major research project is concluded with an oral presentation for the main supervisor, the second reviewer, the Thesis Talk juror, and an audience of interested students and staff members of the LIC (i.e. Thesis Talk). Students must attend at least 7 Thesis Talks as part of their major research project before they present their own Thesis Talk.

3.3.5 Obligatory sequence (Course and Examination Regulations art. 4.2): Students can only start with an optional minor research project (within or outside the LIC) when the major research project has been successfully concluded with a grade (including a Thesis Talk). Exceptions can only be granted by the Board of Examiners following article 4.2.2 of the Faculty OER.

3.4 Theoretical compulsory components (Course and Examination Regulations art. 3.1)

The compulsory theoretical component comprises a selection of four core courses and the courses Academic and Professional Skills 1, 2 and WORK.

3.5 Electives (Course and Examination Regulations art. 3.2)

The electives can comprise either theoretical or practical courses or an extension of the duration of a research project with a maximum of 20 EC and within the limitations described in section 3.3. Elective courses can be chosen from the core courses, additional MSc courses offered by the LIC, MSc courses of the Leiden University Faculty of Science published in the Prospectus, and MSc courses offered by the LUMC.
Students may include MSc courses offered in a Science Faculty of any Dutch or foreign university of level 400 or higher, level 400 courses from the BSc MST or LST programmes, or other relevant courses in their final examination, but prior approval must have been obtained of the Board of Examiners(Course and Examination Regulations 3.2). Elective courses are restricted to courses that were not part of the student's earlier studies and do not overlap in content with other courses already taken as part of the MSc curriculum.

Students can verify the suitability of their programme with the Board of Examiners when they have doubts about a combination of courses. Students must gain approval from the Board of Examiners prior to taking any components at universities other than Leiden University, as well as before starting a research project at a university, company or institute other than LIC, IBL, LACDR, LUMC, NKI or ErasmusMC.

4. Specialisation Life Science and Business Studies

4.1 Description (Course and Examination Regulations chapter 2)

The specialisation Life Science and Business Studies (BS) offers students the possibility to combine Life Science with knowledge, insights and skills in the area of Management, Business and Entrepreneurship.

Students are encouraged to broaden their horizon, to form an opinion on and prepare for a career in industry and to enhance competences for pursuing entrepreneurial business opportunities created in science and research.

4.2 Programme (Course and Examination Regulations chapter 3)

The Life Science and Business Studies (BS) programme consists of the parts specified in Table 3. A more comprehensive description, exemptions and more information on the complete programme can be found in the section "Specialisation Business Studies".

Table 3: Overview of the programme of the specialisation Life Science and Business Studies

	Component	Study load	Level
LST			
	Research-training project	30 EC	600
	Academic and Professional Skills	10 EC	400
	Core courses	20 EC	400-500
	Electives	0-20 EC	400-600
Business Studies			
	BS courses	20 EC	500
	BS internship	20 or 30 EC	600
	BS electives	0-20 EC	400-500

4.3 Research-training Project ('Final assignment', Course and Examination Regulations art. 3.3.2)

4.3.1 General The research-training project in LST must be carried out in one of the research groups of the Leiden Institute of Chemistry or other institutes as specified in section 3.3. The requirements for the research training are as specified in section 3.3 with the exception that the minimum length of the major research training project is 30 EC.

4.3.2 Obligatory sequence (Course and Examination Regulations art. 4.2): Students can only start with their Business internship when the research-training project has been successfully concluded with a grade (including a Thesis Talk). Exceptions can only be granted by the Board of Examiners following article 4.2.2 of the Faculty OER.

4.4 Theoretical compulsory components (Course and Examination Regulations art. 3.1)

The compulsory theoretical component comprises a selection of four core courses and the course Academic and Professional Skills as described in section 3.4.

4.5 Elective components (Course and Examination Regulations art. 3.2)

Elective components may consist of additional courses within or outside the chosen research area, an extension of the research project, additional BS courses or an extension of the Business Internship. Furthermore, the restrictions and conditions specified for electives in section 3.5 apply.

4.6 BS components

A minimum of 40 EC and a maximum of 60 EC within the BS component is required to complete the BS specialisation. A specification of the BS specialisation is described in the section "Specialisation Business Studies".

5. Specialisation Life Science and Science Communication and Society

5.1 Description (Course and Examination Regulations chapter 2)

The specialisation Life Science and Science Communication and Society (SCS) offers students the possibility to combine life sciences and science communication. Students are prepared for a career in science communication or for a career as a scientist with a communicating mind-set.

Students who complete the specialisation Life Science and Technology and Science Communication and Society are admissible to a PhD programme in Life Science and Technology or in Science Communication.

5.2 Programme (Course and Examination Regulations chapter 3)

The SCS programme consists of the parts specified in Table 4. A more comprehensive description, exemptions and more information on the complete programme can be found in section “Science Communication and Society”.

Table 4: Overview of the programme of specialisation Life Science and Science Communication and Society

	Component	Study load	Level
LST			
	Research-training project	30 EC	600
	Academic and Professional Skills	10 EC	400
	Core courses	20 EC	400-500
	Electives	0-20 EC	400-600
SCS components			
	SCS courses	23 EC	400-600
	Internship		
	SCS Project Proposal	3 EC	600
	SCS Internship(s)	14-34 EC	600
	Additional elective		
	SCS Elective	1-10 EC	400-500

5.3 Research-training Project (‘Final assignment’, Course and Examination Regulations art. 3.3.2)

The research-training project in LST must be carried out in one of the research groups of the Leiden Institute of Chemistry or other institutes as specified in section 3.3. The requirements for the research training are as specified in section 3.3 with the exception that the minimum length of the major research training project is 30 EC.

5.4 Theoretical compulsory components (Course and Examination Regulations art. 3.1)

The compulsory theoretical component comprises a selection of four core courses and the course Academic and Professional Skills as described in section 3.4.

5.5 Elective components (Course and Examination Regulations art. 3.2)

Elective components may consist of additional theoretical courses within or outside the chosen research area, an extension of the research project, additional SCS courses or an extension of

or additional SCS internships. Furthermore, the restrictions and conditions specified for electives in section 3.5 apply.

5.6 SCS components

A minimum of 40 EC and a maximum of 60 EC within the SCS component is required to complete the SCS specialisation. A more comprehensive description, exemptions and more information on the complete programme can be found in the section “Science Communication and Society”.

6. Specialisation Life Science and Education (NL)

6.1 Description (Course and Examination Regulations chapter 2)

The specialisation Life Science and Education (EDU) prepares students for a career as teacher of chemistry (scheikunde) or biology (biologie), qualified to teach in Dutch secondary education.

6.2 Programme (Course and Examination Regulations chapter 3)

The Life Science and Education (EDU) programme consists of the parts specified in Table 5. All programme-specific components must be finished before the specialisation-specific Education components can be started. Exceptions to this obligatory sequence can only be granted by the Board of Examiners of the MSc programme LST. A more comprehensive description, qualifications for admission, exemptions and more information on the complete programme can be found in the section “Specialisation Education”.

Table 5: Overview of the programme of the specialisation Life Science and Education

	Component	Study load	Level
60 EC EDU programme			
LST			
	Research-training project	30 EC	600
	Core courses	20 EC	400-500
	Academic and Professional Skills	10 EC	400
EDU components			
	EDU theoretical courses	28 EC	300-600
	EDU teaching practice	32 EC	
30 EC EDU programme			
LST			
	Research-training project	30 EC	600
	Core courses	20 EC	400-500
	Academic and Professional Skills	10 EC	400-500
	Electives	30 EC	400-600
EDU components (‘eerstegraads’ only, see 7.6)			
	EDU theoretical courses	15 EC	400-600
	EDU teaching practice	15 EC	

6.3 Research-training Project (‘Final assignment’, Course and Examination Regulations art. 3.3.2)

The research-training project in LST must be carried out in one of the research groups of the Leiden Institute of Chemistry or other institutes as specified in section 3.3. The requirements for the research training are as specified in section 3.3 with the exception that the minimum length of the major research training project is 30 EC.

6.4 Theoretical compulsory components (Course and Examination Regulations art. 3.1)

The compulsory theoretical component comprises a selection of four core courses and the course Academic and Professional Skills as described in section 3.4.

6.5 Elective components (Course and Examination Regulations art. 3.2)

When the student has passed the minor Education (30 EC) during their BSc programme, the compulsory Education component is reduced with 30 EC. The remaining 30 EC either are added to the LST programme as electives or students may request 30 EC of exemptions (art. 3.6 FWN faculty OER). Elective components may consist of additional elective courses or an extension of the research project. Furthermore, the restrictions and conditions specified for electives in section 3.5 apply.

6.6 EDU components

To complete the EDU specialisation, 60 EC within the EDU programme is required. If a minor EDU was successfully taken in the BSc programme, the EDU programme is limited to 30 EC. A specification of the EDU specialisation is described in the section “Specialisation Education”. The courses taken must be those listed in the EDU-OER at time of registration, or any updated version thereof.

7. Additional and transitional arrangements

7.1 In addition to the stipulations in the Course and Examination Regulations section 4.9, the following restrictions apply to exemptions in the degree programme of a student:

- the major research project cannot be an exemption,
- the core courses cannot include any exemptions,
- a maximum of 15 EC of exemptions can be included in the programme, except for students enrolled in the specialisation Life Science and Education, who may request 30 EC of exemptions for the minor Education obtained in their BSc programme (art. 3.6 FWN faculty OER).

7.2 If a student for any reason, is not able to compose a programme conform the requirements, the Board of Examiners can grant an exception and approve an alternative programme. The Board of Examiners judges whether the alternative programme guarantees the student meets the learning outcomes of the programme.

7.3 Students are allowed to compose their set of core courses for the final examination based on the set described in either the current OER or the OER applicable at the time they started their MSc programme, provided they did not interrupt their registration.

7.4 In addition to article 8.3, students who started per February 2019 and base their core courses on the set described in the OER 2018-19 are allowed to take Metals and Life (4423METL6) as a core course in the set ‘Molecular Sciences’.

7.5 The programme component ‘Academic development is compulsory for students who started with the MSc Life Science and Technology between September 2017 and August 2025.

Electives for Academic Development can be chosen from the following list:

Course title	Catalogue number	Level	EC
Leading and Managing People	4603BSLMP	500	5
Oriëntatie op Onderwijs*	4082OROND	300	6
Tangible and Playful Research	4383TPRES	500	6

Science and the Public: Contemporary and Historical Perspectives	4603SPCH6	400	6
Science Journalism	4603SCSJ4	500	4
Science Methodology	4603SCMT5	400	5
Science in Society	4603SCIS	500	3
Wetenschapsjournalistiek*	4603SCSWJ	500	4

* This course is given in Dutch

7.6 The co-curricular component Career Orientation and Competence Reflection (4423WORKV) is compulsory for students who started between September 2019 and August 2025.

7.7 The specialisation-specific component of the research specialisation for students who started before August 2025 is the essay and colloquium (4423ESCOL). The final grade for the colloquium is determined by the colloquium supervisor and the colloquium juror. The colloquium supervisor and juror are LIC staff members and cannot be the main supervisor of the student's major research project. Students must attend at least 7 colloquia as part of their colloquium and essay component before they present their own colloquium. If insufficient colloquium presentations from fellow students are available, the education team will provide alternative options.

7.8 Students who started before September 2025 and have not yet fulfilled their core course requirements can use core courses from the 2025-26 curriculum to complete their core course requirements. Students must complete 4 core courses for a total number of 20-24 EC.

7.9 Students who started before September 2025 and have not yet fulfilled the compulsory course 'Academic Writing' need to fulfil either one of the courses Academic and Professional Skills 1 (4423APSK1 or 4423ACPS1). The 5 EC of 4423APSK1 or the 4 EC of 4423ACPS1 will count towards their Academic Development requirement. These students then are not required to complete the course 4423WORKV.

7.10 A combination of both Academic and Professional Skills 1 (4423ACPS1) and Academic and Professional Skills: WORK (4423APSKW) can be used to replace Academic and Professional Skills 1 (4423APSK1).

7.11 The following courses cannot be included together in the final examination:

Advanced Medicinal Chemistry (4423ADMC6)	and	Medicinal Chemistry and Drug Discovery (4423MCHDD)
Academic and Professional Skills 1 (4423APSK1)	and	Academic and Professional Skills 1 (4423ACPS1)
Career Orientation and Competence Reflection (4423WORKV)	and	Academic and Professional Skills: WORK (4423APSKW)
Quantitative Imaging in Life Sciences (4423QILS4)	and	Quantitative MRI in Disease Diagnosis (4423QMIDD)
Quantitative MRI in Disease Diagnosis (4423QMIDD)	and	Quantitative MRI in Disease Diagnosis (4423QMDD5)
Quantitative Imaging in Life Sciences (4423QILS4)	and	Quantitative MRI in Disease Diagnosis (4423QMDD5)
Heterogeneous Catalysis (4423HETCA) or Surface Science (4423SURFS)	and	Surface Science for Heterogeneous Catalysis (4423SUSHC)

Heterogeneous Catalysis (4423HETCA)	and	Surface Science for Heterogeneous Catalysis (4423SSHC5)
Surface Science for Heterogeneous Catalysis (4423SUSHC)	and	Surface Science for Heterogeneous Catalysis (4423SSHC5)
Surface Science (4423SURFS)	and	Surface Science for Heterogeneous Catalysis (4423SSHC5)
Essay & Colloquium (4423ESCOL)	and	Academic and Professional Skills 2 (4423APSK2)
Cross-domain chromatin organisation (4423CDC4R)	and	Chromatin Organisation and Function (4423CHORF)
Academic Writing (4423ACWR2)	and	Academic Writing (4423AWR2V)
Academic Writing (4423ACWR2)	and	Academic and Professional Skills 1 (4423APSK1)
Academic Writing (4423AWR2V)	and	Academic and Professional Skills 1 (4423APSK1)
Supramolecular Chemistry (4423SUPC6)	and	Supramolecular Biomaterials (4423SUPMB)
Biomaterials (4423BIOMA)	and	Supramolecular Biomaterials (4423SUPMB)
Bionanotechnology (4423BIONT)	and	Bionanotechnology (4423BION5)
Biosynthetic and Pharmaceutical Chemistry (4423BBPHC)	and	Biosynthetic and Pharmaceutical Chemistry (4423BPHC5)
Chemical Immunology (4423CHEIM)	and	Immunotherapy and Technology (4423IMMTE)
Computational Chemistry and Molecular Simulations (4423CCAMS)	and	Computational Chemistry and Molecular Simulations (4423CCMS5)
Cell Membranes and Membrane Transport (4423CMMT4)	and	Cell Membranes and Membrane Transport (4423CMMT5)
Density Functional Theory in Practice (4423DFTP6)	and	Density Functional Theory in Practice (4423DFTP5)
Reactivity in Organic Chemistry (4423RIOCH)	and	Reactivity in Organic Chemistry (4423ROCH5)
Science Methodology (4603SCMT4)	and	Science Methodology (4603SCMT5)
Antibiotics: Synthesis, Mechanisms of Action & Resistance (4423ASMAR)	and	Antibiotics: Synthesis, Mechanisms of Action & Resistance (4423ASMR5)
Chemical Biology (4423CHEMB)	and	Chemical Biology (4423CHEB5)
Electrochemistry (4423ELECH)	and	Electrochemistry (4423ELEC5)
Enzyme Dynamics: NMR Spectroscopy and Kinetics (4423EDNMR)	and	Enzyme Dynamics: NMR Spectroscopy and Kinetics (4423EDNS5)
Modern Organic Chemistry (4423MODOC)	and	Modern Organic Chemistry (4423MOCH5)
Photochemistry (4423PHCH6)	and	Photochemistry (4423PHCH5)
Dynamics of Molecule-Surface Reactions (4423DMSR3)	and	Dynamics of Molecule-Surface Reactions (4423DYMOL)
Dynamics of Molecule-Surface Reactions (4423DYMOL)	and	Dynamics of Molecule-Surface Reactions (4423DMSR5)
Dynamics of Molecule-Surface Reactions (4423DMSR3)	and	Dynamics of Molecule-Surface Reactions (4423DMSR5)
Bio-Inorganic Catalysis (4423BIOIN)	and	Bio-Inorganic Catalysis (4423BICA5)
Computational Techniques for Chemical Biology (4423CTFCB)	and	Computational Techniques for Chemical Biology (4423CTCB5)

In-vivo Biomolecular Interactions Underlying Diseases (4423IVIBR)	and	In-vivo Biomolecular Interactions Underlying Diseases (4423IVBI5)
Metals and Life (4423METL6)	and	Metals and Life (4423METL5)
Molecules of Life (4423MOFL6)	and	Molecules of Life (4423MOFL5)
Medicinal Chemistry & Drug Discovery (4423MCHDD)	and	Medicinal Chemistry & Drug Discovery (4423MCDD5)
Photosynthesis and Bioenergy (4423PBE06)	and	Photosynthesis and Bioenergy (4423PBE05)
Spectroscopy on Chemical Reactions and Environments (4423SCRE6)	and	Spectroscopy for Chemistry and Materials Science (4423SCRE5)
Chemistry and Physics of Solids (4423CHPHS)	and	Solid State Chemistry and Physics (4423SSCPH)
Anthropocene: The Era of Man (4042MAEM5) in a BSc programme	and	Science and Human Impact on Earth: Anthropocene (4603SHIEA)
Both Chromatin Organisation and Function (4423CHORF) and Molecular Aspects of RNA Viruses (4423MAORV)*	and	Advanced Gene Regulation (4423ADVGR)
Students are allowed a maximum of one of the following courses as part of their degree: - Protein Folding, Misfolding and Design (4423PFMAD) - Protein Folding, Misfolding and Disease (4423PFMFD) - Protein Folding, Misfolding and Design (4423PFMD5) - Protein Folding, Disease and Therapeutics (4423PFDT5) -		

* Students who have taken *either* Chromatin Organisation and Function (4423CHORF) *or* Molecular Aspects of RNA Viruses (4423MAORV) are allowed to take Advanced Gene Regulation (4423ADVGR)

MSc Mathematics

CROHO-number 66980

1. Description of the programme (Course and Examination Regulations chapter 2)

The programme is taught in Leiden by the Mathematisch Instituut (MI).

The duration of each programme is two years (120 EC). Students who complete the programme receive the degree Master of Science in Mathematics, with specification of the specialisation, if applicable. Details are provided below. All specialisations have the same Director, the same Board of Examiners, and the same Programme Committee. A Board of Admissions will advise on admissions. Exceptions to this are formed by the specialisations Business Studies (BS), Science Communication and Society (SCS), and Education (EDU) which for the specialisation-specific part each have their own specialisation coordinator, Programme Committee and, if applicable, a Board of Examiners, as specified in the relevant specialisation section of this Appendix.

1.1 Objectives of the programme (Course and Examination Regulations art. 2.1)

The goal of each programme is to train the student as an independent researcher, and to develop the necessary skills and proficiency to advance their career.

1.2 Specialisations (Course and Examination Regulations art. 2.2)

The Universiteit Leiden offers six specialisations of an MSc programme in mathematics. Two of these correspond to research specialisations in the Leiden Mathematisch Instituut. The remaining four specialisations combine research in mathematics with Business Studies, Science Communication and Society, and Education.

1.3 Final qualifications/ final learning outcomes (Course and Examination Regulations art. 2.3)

Generically, for all specialisations, master's graduates reach the below final qualifications, ranked according to the Dublin descriptors.

A Knowledge and Understanding, and their Application

Master's graduates have:

A1 knowledge and understanding of the core concepts and principles of the broad mathematics domain, and have thorough knowledge and understanding of at least one subdomain of mathematics which is related to one of the following topics:
- for the specialisation Algebra, Geometry and Number Theory: algebra, algebraic and analytic number theory, algebraic and differential geometry, topology, cryptology, or combinatorics;
- for the specialisation Applied Mathematics: differential equations, dynamical systems, analysis of problems from industry and the life sciences, measure and integration theory, probability theory, statistics, functional analysis, numerical analysis, or operations research;

A2 proficient skills in applying mathematical theory to concrete mathematical problems;

A3 the ability to recognise the specific mathematical areas relevant to a problem;

A4 the ability, under supervision, to either formulate a research question in a mathematically rigorous way, and to set up and carry out the subsequent analysis of the problem; or, to study a topic of recent research and to provide an original exposition exhibiting deep understanding of the material.

B Making Judgements

Master's graduates are able to:

B1 independently interpret and reflect on mathematical results;

B2 form judgements about mathematical, scientific or societal questions by formulating mathematical problems and gathering appropriate mathematical techniques or data;

B3 act as professional academics with a sound ethical attitude, and are aware of the societal role of a professional mathematician with a corresponding level of integrity and the according behaviour.

C Communication

C1 Master's graduates are able to write a clear and unambiguous scientific report, and to communicate orally with mathematicians and non-specialists.

D Learning Skills

Master's graduates have:

D1 the ability to acquire and integrate new or additional knowledge relevant to a mathematical problem;

D2 sufficient mathematical knowledge and academic and general professional skills to become productive in industry, government, as a high school teacher, or as a PhD student in mathematics.

1.4 Start of the programme (Course and Examination Regulations art. 2.6)

Starting the programme is possible throughout the year, but international students are strongly advised to start in September or February.

2. Programme (Course and Examination Regulations chapter 3)
Specialisation Algebra, Geometry and Number Theory

3.1 Description (Course and Examination Regulations chapter 2)

The MSc programme Algebra, Geometry and Number Theory leads students to a high level of knowledge in this area. It consists of advanced courses from the field and a final research project including a master's thesis and an oral presentation of it. Students with this MSc in Mathematics are admissible to a PhD programme. The programme is suited as preparation for an academic career, in particular via subsequent PhD study, but also for a career as mathematical researcher outside the universities.

3.2 Programme (Course and Examination Regulations chapter 3)

The following rules supplement articles 3.1 and 3.2 of the Course and Examination Regulations.

For each student a programme will be tailored individually. It consists of

- a choice of at least 60 EC of advanced courses (at least 30 EC of these must be obtained via courses of Mastermath, the Dutch Master's Programme in Mathematics) from algebra, algebraic and analytic number theory, algebraic and differential geometry, topology, cryptology, combinatorics, or related subjects, if agreed in advance with the study advisor of this specialisation;
- a research project in Mathematics of 40 EC (including a thesis and an oral presentation) in one of the research groups of the Leiden Mathematical Institute;
- a free choice of courses from any field, of maximally 20 EC, with the prior permission of the Board of Examiners. The Board of Examiners will base its decision on the level, relevance and coherence of the proposed courses.

A total of at least 120 EC is required.

4. Specialisation Applied Mathematics

4.1 Description (Course and Examination Regulations chapter 2)

The MSc programme Applied Mathematics leads students to a high level of knowledge in this area. It consists of advanced courses from the field and a final research project including a master's thesis and an oral presentation of it. Students with this MSc in Mathematics are admissible to a PhD programme. The programme is particularly suited as preparation for a career as mathematical researcher in industry, government and other institutions, but also for an academic career, in particular via subsequent PhD study.

4.2 Programme (Course and Examination Regulations chapter 3)

The following rules supplement articles 3.1 and 3.2 of the Course and Examination Regulations.

For each student a programme will be tailored individually. It consists of

- a choice of at least 60 EC of advanced courses (at least 30 EC of these must be obtained via courses of Mastermath, the Dutch Master's Programme in Mathematics) from differential equations, dynamical systems, analysis of industrial problems, measure- and integration theory, probability theory, statistics, functional analysis, numerical analysis, operations research or related subjects, if agreed in advance with the study advisor of this specialisation;
- a research project in Mathematics of 40 EC (including a thesis and an oral presentation) in one of the research groups of the Leiden Mathematical Institute;
- a free choice of courses from any field of maximally 20 EC, with the prior permission of the Board of Examiners. The Board of Examiners will base its decision on the level, relevance and coherence of the proposed courses.

A total of at least 120 EC is required.

5. Specialisation Business Studies

5.1 Description (Course and Examination Regulations chapter 2)

The specialisation Mathematics and Business Studies (BS) offers students the possibility to combine mathematics with knowledge, insights and skills in the area of Management, Business and Entrepreneurship.

Students are encouraged to broaden their horizon, to form an opinion on and prepare for a career in industry and to enhance competences for pursuing entrepreneurial business opportunities created in science and research.

Students who complete the specialisation Mathematics and Business Studies are admissible to a PhD programme.

5.2 Programme (Course and Examination Regulations chapter 3)

The Mathematics and Business Studies programme consists of:

- a research project in Mathematics of 20 EC (including a thesis and an oral presentation) in one of the research groups of the Leiden Mathematical Institute;
- 40 EC of courses to be selected in correspondence with the research topic;
- a maximum of 20 EC of electives within either Mathematics or the Business Studies component.

Completion of the specialisation Business Studies requires a minimum of 40 EC and a maximum of 60 EC within the Business Studies component: for more information see the relevant section of this Appendix. A total of at least 120 EC is required.

A more comprehensive description and more information on the complete programme can be found in the Prospectus.

6. Specialisation Science Communication and Society

6.1 Description (Course and Examination Regulations chapter 2)

The specialisation Mathematics and Science Communication and Society (SCS) offers students the possibility to combine mathematics and science communication.

Students are prepared for a career in popularisation of science or for a career as a scientist with a communicating mindset.

Students who complete the specialisation Mathematics and Science Communication and Society are admissible to a PhD programme in mathematics or in science communication.

6.2 Programme (Course and Examination Regulations chapter 3)

The Mathematics and Science Communication and Society (SCS) programme consists of:

- a research project in Mathematics of minimally 20 EC[9] (including a thesis and an oral presentation) in one of the research groups of the Leiden Mathematical Institute;
- minimally 30 EC of courses within Mathematics to be selected in correspondence with the research topic, summing up to a total of at least 60 EC for these courses and the research project;
- a maximum of 20 EC of electives within either Mathematics or the SCS component.

Completion of the specialisation Science Communication and Society requires a minimum of 40 EC and a maximum of 60 EC within the Science Communication and Society component: for more information see the relevant section of this Appendix. A total of at least 120 EC is required.

A more comprehensive description and more information on the complete programme can be found in the Prospectus.

7. Specialisation Education

7.1 Description (Course and Examination Regulations chapter 2)

The specialisation Mathematics and Education (EDU) prepares students for a career as mathematics (wiskunde) teacher qualified to teach in Dutch secondary education.

Students who complete the specialisation Mathematics and Education are admissible to a PhD programme.

7.2 Programme (Course and Examination Regulations chapter 3)

The Mathematics and Education (EDU) programme consists of:

- a research project in Mathematics of minimally 20 EC[10] (including a thesis and an oral presentation) in one of the research groups of the Leiden Mathematical Institute;
- minimally 30 EC of courses within Mathematics to be selected in correspondence with the research topic, summing up to a total of at least 60 EC for these courses and the research project; and
- the Education component as described in the relevant section of this Appendix.

A total of at least 120 EC is required. If the student has passed the minor Education (30 EC) during the BSc programme, the compulsory Education component is reduced by 30 EC. The remaining 30 EC can be used for either the Mathematics or the Education component of the MSc programme.

A more comprehensive description, qualifications for admission, exemptions and more information on the complete programme can be found in the relevant section of this Appendix and in the Prospectus.

[9] A research project of more than 20 EC must be approved in advance by the Board of Examiners, after discussion with the supervisor.
[10] A research project of more than 20 EC must be approved in advance by the Board of Examiners, after discussion with the supervisor.

8. Specialisation High-Tech Innovation

7.1 Description (Course and Examination Regulations chapter 2)

The specialisation Mathematics and High-Tech Innovation (HTI) prepares students for a career in interdisciplinary technologies and research related to or important for high technology industries, for example the semi-conductor industry or nano-fabrication.

Students who complete the specialisation Mathematics and High-Tech Innovation are admissible to a PhD programme.

7.2 Programme (Course and Examination Regulations chapter 3)

The Mathematics and High-Tech Industry (HTI) programme consists of:

- a research project in Mathematics of 20 EC (including a thesis and an oral presentation) in one of the research groups of the Leiden Mathematical Institute;
- 40 EC of courses within Mathematics to be selected in correspondence with the research topic; and
- the High-Tech Industry component of 60 EC as described in the relevant section of this Appendix.

A total of at least 120 EC is required.

A more comprehensive description and more information on the complete programme can be found in the relevant section of this Appendix and in the Prospectus.

MSc Physics

CROHO-number 60202

1. Description of the programme (Course and Examination Regulations chapter 2)

1.1 Objectives of the programme (Course and Examination Regulations art. 2.1)

Leiden University's MSc programme in physics, anchored in the Leiden Institute of Physics (LION), offers a solid background and a thorough experience at the forefront of physics research in the respective specialisations, including practical training in communication and computational skills. The programme aims at training students as independent researchers and provides them with the necessary skills to advance their career. Upon completion of the degree, the MSc graduate will be well equipped to start a PhD, and/or work in research and development, or in other branches of the public and private sector that require strong analytical, computational, and problem-solving skills.

1.2 Specialisations (Course and Examination Regulations art. 2.2)

The MSc programme in Physics has nine specialisations. Four of the specialisations are research specialisations in the Leiden Institute of Physics (LION); one research specialisation (Cosmology) is in collaboration with the Leiden Observatory, and one research specialisation (High-Tech Innovation) is in collaboration with the Leiden Observatory, the Leiden Institute of Chemistry, the Mathematical Institute and the Leiden Institute of Advanced Computer Science. These are:

- Research in Physics, Theoretical Physics
- Research in Physics, Biological and Soft Matter Physics
- Research in Physics, Quantum Matter and Optics
- Research in Physics, Cosmology
- Research in Physics, Classical/Quantum Information
- Research in Physics, High-Tech Innovation

The full programme of these specialisations is in English. A short description is as follows:

- Theoretical Physics aims to describe and understand a broad range of physical phenomena through a variety of analytical concepts and methods and by encoding them into mathematical language.
- The Biological and Soft Matter specialisation is primarily experimental and is typically performed at the interface of medical, biological, chemical and physical sciences. Its study-focus ranges from the physical processes of biomolecules, the emerging properties that evolve in cells, and the control of cell function by signalling, to the study of the mechanical and geometrical properties of soft media, such as granular matter or foam, and the self-assembly in soft-matter systems.
- The Quantum Matter and Optics specialisation is primarily experimental. Its study-focus ranges from the emergence of material properties from a combination of quantum mechanical confinement, electron-electron interaction, and/or electron spin properties, photon-matter interaction, to the quantum properties of light.
- The Cosmology specialisation is offered in collaboration with the Leiden Observatory. Its study-focus ranges from observations of the universe with state-of-the-art telescopes,

supercomputer simulations of the structure of the universe, to theoretical physics studies of the hot big bang, the expanding universe, and inflation. Research projects in the specialisation provide training in theory, data analysis, and numerical simulations for current research in cosmology.

- The specialisation in Classical/Quantum Information sits on the interface of Physics and Data Science. It covers a variety of topics, from the physical principles underlying machine learning and artificial intelligence, to information-science aspects of Quantum Computing. It offers flexible research possibilities for projects on these topics addressing physics challenges with modern data science tools, or studies of algorithms with relevance to Quantum Computing.
- The specialisation High-Tech Innovation aims to prepare the student for a research career in industry rather than academia. Its basis is similar to either the BSM or QMO specialisation, but to emphasize the cross-discliplinary aspects that are the constrasting characteristic of industrial research compared to academic research the program requires a selection of courses in Chemistry, Astronomy, Mathematics or Computer Science. Moreover, the aim is that the final research project is a company internship.

The remaining three specialisations combine research in physics with Business Studies (BS), with Science Communication & Society (SCS), or with Education (EDU). The Physics part of these MSc programmes is in English, as is the Business and Communication Studies component; the Education component is in Dutch.

1.3 Learning outcomes (Course and Examination Regulations art. 2.3)

Graduates of the programme have achieved the following learning outcomes, ranked according to the Dublin descriptors:

(A) KNOWLEDGE AND UNDERSTANDING

On completion of the programme, the student should:

A1 have a good understanding of the important physical theories (logical and mathematical structure, experimental support, physical phenomena described).

A2 be familiar with the most important areas of physics and with the common approaches, which span many areas in physics.

A3 have a good knowledge of the state of the art in (at least) one of the presently active topics in physics research.

(B) APPLYING KNOWLEDGE AND UNDERSTANDING

On completion of the programme, the student should:

B1 be able to frame, analyse and break down a problem in phases defining a suitable algorithmic procedure; be able to evaluate clearly the orders of magnitude in situations which are physically different, but show analogies, thus allowing the use of known solutions in new problems.

B2 be able to identify the essentials of a process/situation and to set up a working model of the same; be able to perform the required approximations; i.e. critically think about how to construct physical models.

B3 be able to understand and master the use of the most commonly used mathematical and numerical methods.

B4 have become familiar with most important experimental methods and be able to perform experiments independently, as well as to describe, analyse and critically evaluate experimental data; and to be able to scientifically report the findings. (does not apply to students in the theory specialisation)

B5 be able to use appropriate software, programming language, computational tools and methods in physical and mathematical investigations.

B6 acquire an understanding of the nature and ways of physics research and of how physics research is applicable to many fields other than physics, e.g. engineering; be able to design experimental and/or theoretical procedures for: (i) solving current problems in academic or industrial research; (ii) improving the existing results.

(C) JUDGEMENT

On completion of the programme, the student should:

C1 be able to develop a personal sense of responsibility; be able to gain professional flexibility through the wide spectrum of scientific techniques offered in the curriculum; be able to organize the personal learning process, evaluate personal work, consult experts for information (e.g. about career opportunities) and support when appropriate; have had the opportunity to take courses that prepare for teaching physics at secondary school, as well as the opportunity to gain in-depth interdisciplinary skills.

C2 have become familiar with highly regarded research in the field, thus developing an awareness of the highest standards.

C3 be able to understand the socially related problems related to the profession, and to comprehend the ethical characteristics of research and of the professional activity in physics and its responsibility to society; be able to conduct processes of decision making and inspect the consequences of actions taking into account principles, norms, values and standards both from a personal and a professional standpoint.

C4 be able to work with a high degree of autonomy, even accepting responsibility in (project) planning, and in the managing of structures.

(D) COMMUNICATION

On completion of the programme, the student should:

D1 be able to listen carefully and to present difficult ideas and complex information in a clear and concise manner to a professional as well as to lay audiences; be able to work in a multidisciplinary or in an interdisciplinary team.

D2 be able to read, speak, and write in technical English.

(E) LEARNING SKILLS

On completion of the programme, the student should:

E1 be able to search for and use physical and other technical literature, as well as any other sources of information relevant to research work and technical project development.

E2 be able to enter new fields through independent study; have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy (lifelong learning).

E2 enjoy the facility to remain informed of new developments and methods, and be able to provide professional advice on their possible impact or range of applications.

The aforementioned qualifications, which are derived from the international domain-specific reference framework for Physics, apply to all specialisations of the MSc Physics. For the six research-oriented specialisations they are complete. The three society-oriented specialisations have the following additional qualifications:

Business Studies
BS1- Insight in managerial issues related to knowledge-intensive businesses and basic theoretical skills in business disciplines most relevant to working in these businesses; BS2- The ability to make a plan for a new business or an innovation project; BS3- Experience with performing business activities in an existing company or organization or directed towards technology-based business creation.
Science Communication and Society
SCS1- Knowledge about theories and frameworks in science communication & society; SCS2- Knowledge about science communication research methods; SCS3- Insight about the field of science communication & society; SCS4- Applying theoretical knowledge and insights towards evidence-based development of products and projects related to science communication and society; SCS5- Applying theoretical knowledge and insights towards conducting research about science communication and society; SCS6- Being able to work in interdisciplinary and transdisciplinary contexts; SCS7- Becoming a professional taking into account social, cultural, environmental and ethical considerations in their work related to science communication and society; SCS8- Contributing to innovation and improvement of the field of science communication & society; SCS9- Skills in oral, written and visual communication about science towards different target audiences; SCS10- Developing innovative communication strategies including dialogue and participation with experts and non-experts; SCS11- Inter- and intrapersonal skills; SCS12- Becoming a creative, innovative, analytical, reflective professional in the field of science communication and society; SCS13- Being able to build and use a network of stakeholders in science communication and society; SCS14- Having an overview of career paths in science communication and society and their own possible role within the field science communication and society.
Education
EDU1- all qualifications necessary for teaching all years of secondary education and technical and vocational training (students from 12 to 18 years old);

The general qualifications of Faculty of Science are linked to the final learning outcomes of the programme as depicted below:

Final qualifications of Faculty of Science	Final learning outcomes MSc Physics
A. Knowledge and understanding	
A graduate has: * the ability to interrelate and integrate various areas of the discipline;	A1, A2, and A3
B. Applying knowledge and understanding	
* theoretical and/or practical skills in more than one specialist area of the discipline such that they can carry out research under overall supervision; * the ability to make an independent analysis of scientific problems, analysis of relevant specialist literature, formulate verifiable hypotheses, and set up and carry out research and critical reflection on one's own research and that of others;	B1, B2, B3, B4, B5, and B6
C. Judgement	
* sufficient understanding of the social role of the natural sciences to be able to reflect upon them and in part consequently to come to an ethically sound attitude and corresponding execution of one's professional duties;	C1, C2, C3, and C4
D. Communication	
* the ability to present clearly, verbally as well as in writing, one's own research results, and the ability to communicate with colleagues and to present their research results as a contribution to a congress or as (part of) a scientific publication;	D1 and D2
E. Learning (Skills)	
* the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.	E1, E2, and E3

1.4 Programme duration and completion (Course and Examination Regulations art. 2.5)

The duration of the *MSc programme Physics* is two years (120 EC). Students who complete the programme receive the degree Master of Science in Physics, with a description of the specialisation. Students who complete any of the Research specialisations in Physics are admissible to a PhD programme in Physics or related fields.

1.5 Start of the programme (Course and Examination Regulations art. 2.6)

The standard programme starts at the beginning of the academic year in September. Admission in February is possible for those students who are able to show that they are proficient in the required courses for the relevant specialisation, but it is usually not possible to complete the studies in two years when the programme is started in February. The specialisations 'Theory' and 'Cosmology' start in September only.

Specialistation	Theory	BSM	QMO	Cosmo	PCQI	HTI	BS	EDU	SCS
Compulsory Courses (excluding Research Project)	30	15	21	39	42				
Elective Courses	42	45	39	21	18				
Research Training Project 1	48	24	24	30	24	30	24	24	24
Research Training Project 2		36	36	30	36	30	36	36	36
Total EC	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**120**	**120**

TABLE 1: OVERVIEW OF THE PROGRAMMES OF THE NINE MSC PHYSICS SPECIALISATIONS (WEIGHTS IN EC)

1.4 Programme organisation

All specialisations have the same Director, the same Board of Admissions, the same Board of Examiners, and the same Programme Committee. For the specialisation--specific part the specialisations High-Tech Innovation (HTI), Business Studies (BS), Science Communication & Society (SCS), and Education (EDU), each have their own specialisation coordinator, and, if applicable, their own Programme Committee and Board of Examiners, as described in the specialisation sections of this Appendix.

2. Programme (Course and Examination Regulations chapter 3)

2.1 Compulsory components

Each of the specialisations is distinguished by a programme and a curriculum that emphasize the intended perspective and goal of the specialisation. Each programme consists of two components: a set of courses and one or more compulsory research projects. The selection of courses differs per specialisation and always comprises a compulsory part that includes Academic and Professional Skills, and an elective part. An overview of this division per specialisation is provided in Table 1; the specific list of compulsory courses per specialisation is provided in the Prospectus.

The Prospectus further specifies the actual structure of the programme per specialisation, the study load, level,[11] content, method of examination, and structure of the components of the curriculum.

The course programme selected by each individual student is set in a study plan that is discussed and agreed with the Study Advisor at the start of the studies. Approval of the study plan by the Study Advisor expresses the approval by the Board of Examiners. Students are allowed to change their study plan upon approval by the Study Advisor.

In addition to the components taught at this university, and those specified in the Prospectus, students may also select components offered by other Dutch or foreign universities, or components offered by another legal entity offering accredited graduate higher education programmes, subject to the approval of the Board of Examiners.

[11] In accordance with the 'abstract structure', as described in the Framework Document of the Leiden University Register of Study Programmes.

3 Specialisation Research in Physics, Theoretical Physics

3.1 Programme (Course and Examination Regulations chapter 3)

The compulsory part of the Research in Physics, Theoretical Physics MSc specialisation comprises 78 EC and consists of:

	Level	EC
Academic and Professional Skills	400	3
Effective Field Theory	500	3
Quantum Information	400	3
Quantum Theory	400	6
Statistical Physics a	400	6
Statistical Physics b	400	3
Topics in Theoretical Physics	400	6
Physics research project in Theoretical Physics at LION (division: research=36 EC, thesis=8 EC, and presentation=4 EC)	600	48

Each project must be approved by the Study Advisor before the start. All research projects are performed under the responsibility of a LION staff member. The project can be either fully theoretical or theoretical/experimental, but, if so, it must be for the major part (>70%) theoretical. Data analysis may be part of the project, but the essence/main goal must be conceptual in nature.

Electives that are pre-approved by the Board of Examiners are provided in the Prospectus. Most elective courses are offered every year. The rest are usually offered in alternate years. The course offering is subject to change.

Transitional arrangements

For students who started this degree program before academic year ’25/’26: The course *Computational Physics A* (4403CMPHAY) is a renaming of the previous course *Computational Physics (3EC) (4403CMPH3Y)*; the course *Computational Physics B* (4403CMPHBY) is a renaming of the second half of the previous course *Computational Physics (6EC) (4403CMPH6Y)*; the course *Quantum Phenomena in Condensed Matter (4403QPCM6Y)* is a renaming of the previous course *Condensed Matter Physics (4403COPH6Y)*; the course *Physics of Machine Learning (4403PHML3Y)* is a renaming of the previous course *Physics of Classical and Quantum Information (4403PHCQIY)*; the course *Frontiers of Measurement Techniques A (4403PMTA3Y)* is a renaming of the previous course *Frontiers of Measurement Techniques (4403FRMT3Y)*.

Any of the aforementioned courses that have been completed under the old name cannot be retaken under the new name as a new course counting towards the EC necessary for completion of the MSc degree.

4 Specialisation Research in Physics, Biological and Soft Matter Physics

4.1 Programme (Course and Examination Regulations chapter 3)

The compulsory part of the Research in Physics, Biological and Soft Matter Physics MSc specialisation comprises 75 EC and consists of:

	Level	EC
Academic and Professional Skills	400	3
Statistical Physics a	400	6
Soft and Bio-matter Theory	400	6
Research project in Physics 1 (division: research=20 EC, thesis=3 EC, and presentation=1 EC)	600	24
Research project in Physics 2 (division: research=30 EC, thesis=4 EC, and presentation=2 EC)	600	36

Each project must be approved by the Study Advisor before the start. At least one of the two projects has to be carried out in an experimental group. All research projects are performed under the responsibility of a LION staff member. Up to one project can be carried out outside LION.

Electives that are pre-approved by the Board of Examiners are provided in the Prospectus.

The default choice of electives that prepares one for a research bio/soft-matter career inside or outside of academia is:

Fall Year 1: Quantum Information, Statistical Physics a, Statistical Physics b, Biophysics, Theory of Soft- and BioMatter, plus 6EC from Complex Networks, Econophysics, Effective Field Theory, Quantum Phenom in Cond.Matter or other Physics electives.

Spring Year 1: Academic and Professional Skills, Frontiers of Measurement Techniques a, Frontiers of Measurement Techniques b, Topics in Experimental Physics, Mechanical Metamaterials, Computational Physics a, plus 6 EC from Physics of Machine Learning, Computational Physics b, Physics of Finance* or other Physics electives.

Fall Year 2: Research Project 1 (24 EC); start Research Project 2 (36EC)

Spring Year 2: Research Project 2 cont'd (36EC).

Most courses are offered every year. The rest (indicated with *) are offered less frequently, usually in alternate years. The course offering is subject to change.

Transitional arrangement

For students who started this degree program before academic year '25/'26: The course *Computational Physics A* is a renaming of the previous course *Computational Physics (3EC)*; the course *Computational Physics B* is a renaming of the second half of the previous course *Computational Physics (6EC)*; the course *Quantum Phenomena in Condensed Matter* is a renaming of the previous course *Condensed Matter Physics*; the course *Physics of Machine Learning* is a renaming of the previous course *Physics of Classical and Quantum Information*; the course *Frontiers of Measurement Techniques A* is a renaming of the previous course *Frontiers of Measurement Techniques*.

Any of the aforementioned courses that have been completed under the old name cannot be retaken under the new name as a new course counting towards the EC necessary for completion of the MSc degree.

5 Specialisation Research in Physics, Quantum Matter and Optics

5.1 Programme (Course and Examination Regulations chapter 3)

The compulsory part of the Research in Physics, Quantum Matter and Optics MSc specialisation comprises 81 EC and consists of:

	Level	EC
Academic and Professional Skills	400	3
Optics and Instruments	400	6
Quantum Phenomena in Condensed Matter	400	6
Statistical Physics a	400	6
Research project in Physics 1 (division: research=20 EC, thesis=3 EC, and presentation=1 EC)	600	24
Research project in Physics 2 (division: research=30 EC, thesis=4 EC, and presentation=2 EC)	600	36

Each project must be approved by the Study Advisor before the start. At least one of the two research projects has to be carried out in an experimental group. All research projects are performed under the responsibility of a LION staff member. Up to one project can be carried out outside LION.

Electives that are pre-approved by the Board of Examiners are provided in the Prospectus.

The default choice that prepares one for a research quantum matter and optics career inside or outside of academia is:

Fall Year 1: Quantum Information, Statistical Physics a, Statistical Physics b, Advanced Optics and Instrumentation, Quantum Phenomena in Condensed Matter, Quantum Theory

Spring Year 1: Academic and Professional Skills, Frontiers of Measurement Techniques a, Frontiers of Measurement Techniques b, Topics in Experimental Physics, Quantum Optics, Theory of Condensed Matter.

Fall Year 2: Research Project 1 (24 EC); start Research Project 2 (36EC)

Spring Year 2: Research Project 2 continued (36EC).

Most courses (including those that are mandatory) are offered every year. The rest (indicated with *) are offered less frequently, usually in alternate years. The course offering is subject to change.

Transitional arrangement

For students who started this degree program before academic year ’25/’26: The course *Computational Physics A* is a renaming of the previous course *Computational Physics (3EC)*; the course *Computational Physics B* is a renaming of the second half of the previous course *Computational Physics (6EC)*; the course *Quantum Phenomena in Condensed Matter* is a renaming of the previous course *Condensed Matter Physics*; the course *Physics of Machine Learning*

is a renaming of the previous course *Physics of Classical and Quantum Information*; the course *Frontiers of Measurement Techniques a* is a renaming of the previous course *Frontiers of Measurement Techniques*.

Any of the aforementioned courses that have been completed under the old name cannot be retaken under the new name as a new course counting towards the EC necessary for completion of the MSc degree.

6 Specialisation Research in Physics, Cosmology

6.1 Programme (Course and Examination Regulations chapter 3)

The compulsory part of the Research in Physics, Cosmology MSc specialisation comprises 99 EC and consists of:

	Level	EC
Academic and Professional Skills	400	3
Large Scale Structure and Galaxy Formation	500	6
Origin and Evolution of the Universe	500	6
Origin and Structure of the Standard Model	400	3
Particle Physics and the Early Universe	500	3
Quantum Theory	400	6
Theoretical Cosmology	400	6
Theory of General Relativity	400	6
Research project in Cosmology 1 (division: research=26 EC, thesis=3 EC, and presentation=1 EC)	500	30
Research project in Cosmology 2 (Master's project) (division: research=26 EC, thesis=3 EC, and presentation=1 EC)	600	30

Both projects must be in Cosmology and must be pre-approved by the Study Advisor. The combination of the two projects must cover three aspects: theory, numerical modelling and data analysis. Typically, the two projects have different supervisors. At least one project must be done at LION.

Electives that are pre-approved by the Board of Examiners are provided in the Prospectus.

The default choice that prepares one for a research cosmology career inside or outside of academia is:

Fall Year 1: Statistical Physics a (6EC), Effective Field Theory (3EC) Origin and Evolution of the Universe (6EC), Origin and Structure of the Standard Model (3EC), Quantum Theory (6EC), Theory of General Relativity (6EC).

Spring Year 1: Academic and Professional Skills (3EC), Computational Physics A (3EC) (4403CMPHAY), Computational Physics B (3EC) (4403CMPHBY), Large Scale Structure and Galaxy Formation (6EC), Particle Physics in the Early Universe (3EC), Theoretical Cosmology (6EC) (4403THCO6Y) plus 6 EC electives.

Fall Year 2: Research Project 1 (30 EC)

Spring Year 2: Research Project 2 (30EC).

Most courses (including those mandatory) are offered every year. The rest (indicated with *) are offered less frequently, usually in alternate years. The course offering is subject to change.

Transitional arrangement

For students who started this degree program before academic year ’25/’26: The course *Computational Physics A* is a renaming of the previous course *Computational Physics (3EC)*; the course *Computational Physics B* is a renaming of the second half of the previous course *Computational Physics (6EC)*; the course *Quantum Phenomena in Condensed Matter* is a renaming of the previous course *Condensed Matter Physics*; the course *Physics of Machine Learning* is a renaming of the previous course *Physics of Classical and Quantum Information*; the course *Frontiers of Measurement Techniques a* is a renaming of the previous course *Frontiers of Measurement Techniques*.

Any of the aforementioned courses that have been completed under the old name cannot be retaken under the new name as a new course counting towards the EC necessary for completion of the MSc degree.

7 Specialisation Research in Physics, Classical/Quantum Information

7.1 Programme (Course and Examination Regulations chapter 3)

The compulsory part of the Research in Physics, Classical/Quantum Information MSc specialisation comprises 102 EC and consists of:

	Level	EC
Academic and Professional Skills	400	3
Computational Physics A	400	3
Computational Physics B	400	3
Quantum Information	400	3
Statistical Physics a	400	6
Introduction to Machine Learning (Computer Science)	500	6
Physics of Machine Learning	400	6
Choice of 2 courses from list of core courses presented below	400	12
Research project in Physics with Data Science (division 36 EC: research=30 EC, thesis=4 EC, and presentation=2 EC)	600	36
Research project or internship (division 24 EC: research=20 EC, thesis=3 EC, and presentation=1 EC)	600	24

Each project must be approved by the Study Advisor before the start. All research projects are performed under responsibility of a LION staff member.

The course Introduction to Machine Learning (4343INTML) has strong overlap with the BSc course Machine Learning (4032KIMLR), they are mutually exclusive. Students who have passed Machine Learning should replace Introduction to Machine Learning by another course from the list of core courses.

Core courses: choose at least 2 from list (rest can serve as electives)	**Level**	**EC**
Advances in Deep Learning (Computer Science)	500	6
Applied Quantum Algorithms (Physics, Computer Science)	500	6
Introduction to Deep Learning (Computer Science)	500	6
Foundations of Statistics and Machine Learning (Mathematics)	500	6
Reinforcement Learning (Computer Science)	500	6

Transitional arrangement

For students who started this degree program before academic year ’25/’26: The course *Computational Physics A* is a renaming of the previous course *Computational Physics (3EC)*; the course *Computational Physics B* is a renaming of the second half of the previous course *Computational Physics (6EC)*; the course *Quantum Phenomena in Condensed Matter* is a renaming of the previous course *Condensed Matter Physics*; the course *Physics of Machine Learning* is a renaming of the previous course *Physics of Classical and Quantum Information*; the course *Frontiers of Measurement Techniques a* is a renaming of the previous course *Frontiers of Measurement Techniques*.

Any of the aforementioned courses that have been completed under the old name cannot be retaken under the new name as a new course counting towards the EC necessary for completion of the MSc degree.

8 Specialisation High-Tech Innovation

8.1 Description (Course and Examination Regulations chapter 2)

The specialisation Physics and High-Tech Innovation (HTI) offers students the possibility to broaden their physics programme with courses in Chemistry, Astronomy, Mathematics and/or Computer Science in order to develop interdisciplinary knowledge necessary to make important contributions to high-tech industries.

Students combine high quality research in Physics with experience in a scientific business environment comprising development from idea, to prototype, to application.

8.2 Programme (Course and Examination Regulations chapter 3)

The Physics and High-Tech Innovation (HTI) programme is built either on the QMO MSc specialisation or on the BSM MSc specialisation and consists of the parts specified in Table 3. A more comprehensive description, exemptions and more information on the complete programme can be found in the section “Specialisation High-Tech Innovation”.

Table 3. Overview of the programme of the specialisation Physics and High-Tech Innovation

	Component	**Study load**	**Level**
Physics (BSM base)			
	Research-training project	30 EC	600
	Academic and Professional Skills	3 EC	400
	Statistical Physics a	6 EC	400
	Soft-and Biomatter Theory	6 EC	400

or			
Physics (QMO base)			
	Research-training project	30 EC	600
	Academic and Professional Skills	3 EC	400
	Statistical Physics a	6 EC	400
	Quantum Phenomena in Condensed Matter	6 EC	400
	Optics and Instruments	6 EC	400
High-Tech Innovation			
	Orientation HTI	3 EC	400
	HTI courses	27 EC	400-500
	HTI research project	30 EC	600

8.3 Research-Training Project

Each project must be approved by the Study Advisor before the start. At least one of the two research projects has to be carried out in an experimental group. All research projects are performed under the responsibility of a LION staff member.

8.4 HTI components

Within the HTI specialisation 60 EC is required to complete this specialisation. The HTI components are specified in the section “Specialisation High-Tech Innovation”.

9 Specialisation Business Studies

9.1 Description (Course and Examination Regulations chapter 2)

The specialisation Physics and Business Studies offers students the possibility to combine physics with knowledge, insights, and skills in the area of Management, Business and Entrepreneurship.

Students are encouraged to broaden their horizon in the area of business, to form opinions, to prepare for a career in industry, and to enhance competences in pursuing entrepreneurial business opportunities stemming from research disciplines.

9.2 Programme (Course and Examination Regulations chapter 3)

	Level	**EC**
Academic and Professional Skills 4403ACPRSY	400	3
Quantum Information 4403QINF3Y	400	3
Statistical Physics a 4403STPHAY	400	6
Elective courses related to the research project	400-500	12
Research project in Physics (division: research=30 EC 4403MRP30Y , thesis=4 EC 4403MTRP4Y, and presentation=2 EC 4403MPRP2Y)	600	36
Business Studies component, as described here.		40-60
Electives from either the MSc Physics or Business Studies offerings	400-500	20-0

A more comprehensive description, exemptions and more information on the complete programme can be found here.

10. Specialisation Science Communication and Society

10.1 Description (Course and Examination Regulations chapter 2)

The specialisation Physics and Science Communication and Society (SCS) offers students the possibility to combine physics with science communication.

Students are prepared for a career in the area of science communication or for a career as a scientist with a communication focus.

10.2 Programme (Course and Examination Regulations chapter 3)

	Level	EC
Academic and Professional Skills 4403ACPRSY	400	3
Quantum Information 4403QINF3Y	400	3
Statistical Physics a 4403STPHAY	400	6
Elective courses related to the research project	400-500	12
Research project in Physics Division: research=30 EC 4403MRP30Y, thesis=4 EC 4403MTRP4Y, and presentation=2 EC 4403MPRP2Y	600	36
Science Communication and Society component, as described here.	500-600	40-60
Electives from either MSc Physics or SCS offerings	400-500	0-20

A more comprehensive description, exemptions and more information on the complete programme can be found here.

11. Specialisation Education

11.1 Description (Course and Examination Regulations chapter 2)

The specialisation Physics and Education (EDU) prepares students for a career as a physics (Natuurkunde) teacher qualified to teach at the Dutch secondary education as ‘eerstegraads docent’.

11.2 Programme (Course and Examination Regulations chapter 3)

	Level	EC
Academic and Professional Skills 4403ACPRSY	400	3
Quantum Information 4403QINF3Y	400	3
Statistical Physics a 4403STPHAY	400	6
Elective courses related to the research project	400-500	12
Research project in Physics	600	36

Division: research=30 EC4403MRP30Y , thesis=4 EC 4403MTRP4Y, and presentation=2 EC 4403MPRP2Y Education component, as described here.	60

The Physics component of the programme is followed during the first year of study, the Education component during the second year.

For students who have completed the minor in Education (30 EC) during the BSc programme, the compulsory Education component is reduced by 30 EC. The freed up 30 EC can be filled by courses from either the Physics or Education offerings.

A more comprehensive description, qualifications for admission, exemptions and more information on the complete programme can be found here.

MSc Statistics and Data Science

CROHO-number 60957

1. Description of the programme (Course and Examination Regulations chapter 2)

The inter-faculty MSc programme Statistics and Data Science is taught in Leiden by the following institutes:

- Mathematical Institute;
- Department of Biomedical Data Sciences – Leiden University Medical Center;
- Methodology and Statistics – Institute of Psychology – Faculty of Social and Behavioural Sciences;
- Mathematical & Statistical Methods group (Biometris) – Wageningen UR;

The duration of the programme is two years (120 EC). Students who complete the programme receive the degree Master of Science in Statistics and Data Science.

1.1 Objectives of the programme (Course and Examination Regulations art. 2.1)

The goal of the programme is to provide the student with a broad training in statistics and data science and their role and applications in science and society. The graduate will be able to apply their knowledge and understanding critically, independently, and structurally to model and evaluate complex phenomena arising in a variety of situations. The graduate will be well equipped to pursue a career in science, in industry or in the public sector. Qualification to become a PhD candidate is a definite possibility.

Students will gain a thorough knowledge and understanding of statistical models and techniques, which will allow them to apply and/or develop new statistical and data science methods with application to a broad range of research fields.

Students learn practical skills such as statistical programming, statistical consultation, and written and oral presentation of analysis and research results.

1.2 Learning outcomes(Course and Examination Regulations art. 2.3)

Having completed the programme students will have reached the following learning outcomes, according to the Dublin descriptors:

a. Knowledge and understanding

The graduate has a broad knowledge of statistics and data science and its role in science and society. This includes

a1. a firm grasp of the general concepts of statistical science and data science, with attention for the differences in jargon in different contexts;

a2. an understanding of statistics and data science as a branch of science and not merely a collection of techniques;

a3. knowledge of relevant statistical / data science methods, their strengths, assumptions, and limitations;

a4. deeper knowledge of statistical/ data science methods in specific chosen areas of application;

a5. familiarity with directions of current research in statistics and data science in specific chosen areas of application;

a6. knowledge of planning and design of studies;

a7. knowledge of computing and data management;

a8. knowledge of mathematical tools that are essential for statistics and data science (including basic calculus, linear algebra and probability theory).

b. Application of knowledge and understanding

The graduate has the ability to apply their knowledge and understanding in a critical, independent, and a systematic approach to model and evaluate complex phenomena arising in a variety of situations. This involves

b1. the choice of statistical/ data science methods for data analysis in concrete applications;

b2. working with imperfect data;

b3. the translation from concrete applications to statistical terms and vice versa;

b4. the execution of statistical/data analytic tasks with appropriate methods;

b5. the implementation of methods in computer programs and applying existing methods.

c. Judgement and Evaluation

The graduate

c1. demonstrates the ability for sound statistical judgement both within a scientific and societal context;

c2. is aware of the ethical implications of the use of data science and statistics;

c3. has general insight in statistics and data science, their limitations, and their role in society.

d. Communication

The graduate is able to

d1. explain the role of uncertainty in scientific discourse;

d2. present and discuss, orally and/or in writing, the results of a statistical or data science analysis, both to statisticians/data scientists and non-statisticians/non-data scientists;

d3. engage in a dialogue with an applied researcher in a particular subject area with the purpose to identify and formulate research questions that can be dealt with by statistical and data science analysis;

d4. explain to substantive researchers the potential and limitations of statistical/ data science methods.

e. Learning Skills

The graduate takes responsibility to develop their competence, and therefore, will be able to

e1. recognize gaps in their knowledge and find the resources to fill these gaps;

e2. find and consult appropriate sources in the international relevant scientific literature;

e3. recognize a need for novel statistical and data science methods and contribute to their development or implementation;

e4 plan tasks within a given period of time.

1.3 Specialisations (Course and Examination Regulations art. 2.2)

Not applicable.

1.4 Start of the programme (Course and Examination Regulations art. 2.6)

Students can start their programme in September or February. However, they are strongly encouraged to start in September when a general introduction to the master programme and most of the foundational courses are scheduled.

2. Programme (Course and Examination Regulations chapter 3)

2.1 Programme for those starting in the academic year 2025-2026

The curriculum consists of a core programme (59 EC), including one of the two homologation courses of 3 EC, electives (27 EC), and the thesis project (34 EC). Students may enroll in only one of the two homologation courses; the appropriate choice depends on the type of bachelor's degree (quantitative or substantive).

* Homologation course for students with a quantitative Bachelor’s degree, such as Mathematics, Econometrics, Statistics
** Homologation course for students with a substantive Bachelor’s degree such as bachelor degrees in the life and behavioral sciences.

2.2 Electives

A maximum component of 12 EC may come from other electives than the listed preapproved electives. For electives other than the preapproved electives, approval has to be obtained from the Board of Examiners before the start of the study components, and it must meet the following criteria:

5. The elective course should be on MSc level;
6. The elective course should not show a (considerable) overlap with or replace compulsory courses or any of the other chosen electives;
7. The elective should have objectives that contribute to the final learning outcomes of the programme (see article 1.2), or provide topical knowledge on the masters' thesis research of the student.

2.3 Transitional arrangements

2.3.1 The courses Introduction to Probability (3EC) and Introduction to Statistics (6EC) replace the course Statistics and Probability (9EC).

2.3.2 If a student did not pass the course Statistics and probability (9EC) before September 2026, but passed one of the two partial exams of this course, then the partial grade (if passed) of the probability partial exam, can be transferred to the course "introduction to probability" and the partial grade (if passed) of the statistics partial exam, can be transferred to the course "introduction to statistics".

2.3.3 The course Computational Statistics (3EC replaces the course Advanced Statistical Computing (3EC).

2.3.4 The course Causal Inference I (3EC) replaces the course Missing Data and Causal Inference (3EC).

2.3.5 The course Exploratory Data Analysis (6EC) replaces the course Nonlinear (Mixed) Data Analysis (6EC) and the course Multivariate and Multidimensional Data Analysis (6EC).

2.3.6 The courses Linear & Generalized Linear Models (6 EC;) and Linear Algebra (3 EC) will replace the course Linear & Generalized linear Models and Linear Algebra (9 EC).

2.3.7 Preparation of the thesis project (4 EC) and thesis (30 EC) replace the former thesis project (34 EC).

2.3.8 Preparation of the thesis project (4 EC) and thesis (30 EC) replace the former separate internship (10 EC) and master thesis (24 EC). Students who started before September 2021 are still allowed to plan their thesis and internship as separate projects, provided they did not interrupt their registration.

2.3.9 The course Statistics and Data Science in Practice (3 EC) can be used to replace the course Introduction to the Life and Behavioral Sciences (3 EC) for students who started before September 2021.

2.3.10 The course Essentials for Data Science (6 EC) can be used to replace the course Introduction to Data Science (3 EC) for students who started before September 2021.

2.3.11 The two courses Essentials of Mixed and Longitudinal Modelling (3EC) and Design and analysis of biological experiments (6 EC) can be used to replace the course Mixed and Longitudinal Modelling (6 EC) for students who started before September 2022.

2.3.12 The two courses Bayesian Methods I (3EC) and Bayesian Methods II (3EC) can be used to replace the course Bayesian Statistics (6 EC) for students who started before September 2022.

2.3.13 The course Bayesian Statistics (6 EC) can be used to replace the course Bayesian Methods I(4433BAYM1; 3EC) for students who started before September 1, 2022.

2.3.14 Students who started in the year 2021-2022 are allowed to follow the three courses Bayesian Methods I (3EC) , Essentials of Mixed and Longitudinal Modelling (3EC) and Multivariate and Multidimensional Data Analysis (6 EC) , to replace the requirement to follow at least two of the following courses : Bayesian Statistics(6 EC), Mixed and Longitudinal Modelling (6 EC) or Multivariate and Multidimensional Data Analysis(6 EC).

2.3.15 The course Mixed and Longitudinal Modelling (6 EC) can be used to replace the course Essentials of Mixed and Longitudinal Modelling (3EC) for students who started before September 1, 2022.

2.3.16 After cancellation of a component or major changes to a component, the student is provided with one more option to finish the component in the following academic year, where applicable via partial exams and/or compensatory assignments.

2.4 Examinations, Final Examination (Course and Examination Regulations chapter 4)

2.4.1 Obligatory sequence (Course and Examination Regulations art. 4.2).

Students may only take the following courses and sit their attendant examinations once they have passed the examinations for one or more other components:

Programme component:	*Follow course and sit its attendant examination after having passed:*
EMOS Core Module	Survey Methodology

Programme component:	*Follow course and sit its attendant examination after having obtained:*
Statistical Consulting	45 EC from the programme
EMOS Core Module	42 EC from the programme
Thesis Project	42 EC to follow the preparation of the thesis project, 60 EC from the programme to start conducting the Thesis Project, and 90 EC from the programme to sit its attendant final examination.[12]

For the components and their attendant examinations, which must be completed in a given sequence, the Board of Examiners may in special cases, and following a substantiated written request by the student, agree to an alternative sequence.

[12] Students who started before September 2021 and conduct a separate internship (10 EC) and thesis (24 EC), need 96 EC from the programme to sit its attendant final examination. Students who are following thesis project (4433THES4Y; 34 EC) need 86 EC from the programme to sit its attendant final examination.

Specialisation Business Studies

1. Description of the programme (Course and Examination Regulations art. 2)

The specialisation Business Studies is for MSc students in the sciences and biomedicine who are interested in management, entrepreneurship, and/or a career in industry. The objective of the specialisation is to teach students basic analytical frameworks and skills that enable them 1) to analyse business-related problems, and 2) to contribute to managerial decision making, all within the context of established knowledge-intensive organisations or new technology ventures. This faculty-wide specialisation blends discipline-specific scientific knowledge with business and managerial skills. It is designed to meet the evolving needs of start-ups and companies, where a combination of scientific knowledge and effective management has become increasingly important.

1.1 Objectives of the programme (Course and Examination Regulations art. 2.1)

The specialisation *Business Studies* aims to provide an introduction to general management theory and practice. In addition, students will gain practical experience in applying their business knowledge and skills through working as an intern in a knowledge-intensive organisation.

The specialisation emphasises interactive teaching that connects with management practice. This means opportunities for students to learn through real-life business case discussions, guest speakers, and hands-on business experience in internships.

1.2 Learning outcomes (Course and Examination Regulations art. 2.3)

Graduates of the master programme with specialisation *Business Studies* have become proficient in the use of fundamental conceptual frameworks in business studies, and have attained the following general learning outcomes:

- theoretical knowledge and practical skills in the core areas of business and management;
- the ability to interrelate and integrate various scientific disciplines with business and managerial concepts, enabling a multidisciplinary approach to problem-solving;
- the ability to independently analyse business research problems, critically engage with relevant literature, formulate testable hypotheses, and conduct and critically reflect on research, demonstrating a synthesis of scientific and business perspectives;
- communication skills tailored for the business environment, enabling effective collaboration and engagement with diverse stakeholders;
- practical business skills, encompassing hands-on experience in applying scientific expertise to real-world business challenges, and developing effective business strategies.

2 Qualifications for Admission (Course and Examination Regulations art. 5)

Admissible to the specialisation Business Studies are all students that are admitted to a Master Programme of the Faculty of Science or the Master Programme in Biomedical Sciences of the Faculty of Medicine (LUMC) provided that the rules and regulations of the subject Master Programme do allow so.

3 Programme (Course and Examination Regulations art. 3)

The MSc programme in combination with the Business Studies specialisation consists of two components:

- a component within the chosen MSc programme:
  - *Astronomy;*
  - *Bio-Pharmaceutical Sciences;*
  - *Biology;*
  - *Chemistry*;
  - *Computer Science;*
  - *Life Science and Technology;*
  - *Mathematics;*
  - *Physics; or*
  - *Biomedical Sciences (LUMC).*
- a *Business Studies* component

The *Business Studies* component comprises at least 40 EC, of which 20 EC should consist of mandatory core courses from the Business Studies programme and an internship of 20 or 30 EC. An additional maximum of 20 EC of electives can be chosen from the listed courses and electives, or from the MSc programme of choice. The choice of courses and electives should be made in consultation with a study advisor, mentor, or specialisation coordinator.

3.1 Transitional agreements

As of 1 September 2026, the following courses have been renamed:

- ICT Enabled Process Innovation (4343BSICT) was renamed to Integrated and Digital Organizational Development (4343BSIDO)
- Role of IT in Public Administration (4343BSRPA) was renamed to Managing Digital Transformation in Society (4343BSMDT).

As of September 2025, the following course has been renamed: Business Research Methods (was Research Methods). The renamed course is considered equivalent to the previous course.

As of September 1st, 2024, the 40 EC variant of the Business Internship is no longer offered. Students that started their specialisation before that may be able to complete a 40 EC Business Internship after consultation with the specialisation manager.

As of September 1st, 2022, the following courses have been renamed: *Machine Learning for Business Analytics (*was *Business Intelligence),* Financing Technology Ventures *(*was *Entrepreneurial Finance).* Previously completed courses are considered equivalent to those renamed in September 2022.

3.2 Exemptions

Students with prior education in management, business and entrepreneurship may – depending on the contents and extent of said education – be exempted from following one or more of the courses. These courses need to be substituted such that their master programme contains at least 20 EC of business courses as mentioned in the overview above and an internship of at least 20 EC. Decisions on exemptions and substitutions are taken by the Board of Examiners.

Specialisation Education

The specialisation Education is taught in Leiden by the Leiden University Graduate School of Teaching (ICLON).

1.1 Description (Course and Examination Regulations chapter 2)

The MSc specialisation Education prepares students for a career in teaching in their subject matter specialisation. This programme leads up to the so-called "eerstegraads-lesbevoegdheid", qualifying the student to teach in Dutch lower and upper secondary education in the school subject associated with the MSc programme as indicated in the table below.

Master programme	**Qualifies for school subject**
Mathematics	Wiskunde (Mathematics)
Physics	Natuurkunde (Physics)
Astronomy	Natuurkunde (Physics)
Chemistry	Scheikunde (Chemistry)
Bio-Pharmaceutical Sciences	Scheikunde (Chemistry)[13] *or* Biologie[14] (Biology)
Life Science and Technology	Scheikunde (Chemistry) *or* Biologie[15] (Biology)
Biology	Biologie (Biology)
Computer Science	Informatica (Computer Science)

Students with an MSc specialisation in Education are also admissible to a PhD programme in their MSc programme.

1.2 Qualifications for admission (Course and Examination Regulations chapter 5)

Students should be admitted to an MSc programme within the Faculty of Science. The teacher educator of the subject matter will assess if there are deficiencies in the prior education of the student. When deficiencies are identified, the teacher educator will propose how these can be solved.

For all other (international) candidates, the Board of Admissions will judge the equivalence to this BSc degree of their previous training.

Applicants must provide proof of proficiency in Dutch TUL exam (Toelatingsexamen Universiteit Leiden) – Advanced or a Dutch as a Second Language Certificate (Certificaat Nederlands als Vreemde Taal) at Educatief Startbekwaam.

1.3 Programme (Course and Examination Regulations chapter 3)

The MSc programme in combination with the Education (EDU) specialisation consists of two components:

[13] Students Bio-Pharmaceutical Sciences wishing to qualify for the school subject "Chemistry", need to solve their deficiencies in concert with the *teacher educator Chemistry* of the ICLON.
[14] Students Bio-Pharmaceutical Sciences and Life Science and Technology wishing to qualify for the school subject "Biology", need to solve their deficiencies in concert with the *teacher educator Biology* of the ICLON.
[15] Students Bio-Pharmaceutical Sciences and Life Science and Technology wishing to qualify for the school subject "Biology", need to solve their deficiencies in concert with the *teacher educator Biology* of the ICLON.

- a component within the chosen MSc programme (60 EC):
  - *Astronomy*,
  - *Bio-Pharmaceutical Sciences*,
  - *Biology*,
  - *Chemistry*,
  - *Computer Science*;
  - *Life Science and Technology*,
  - *Mathematics*,
  - *Physics*,
- An Education component (60 EC).

The component within the chosen MSC programme should be followed during the first year of study, the Education component should be followed during the second year.

The Education specialisation is offered as a joint programme of the faculty and the Leiden University Graduate School of Teaching (ICLON) and consists of a curriculum of compulsory components (58 ECTS) and electives (2 ECTS), as specified in the Prospectus.

For students who passed the minor Education (30 EC) during the BSc programme, the programme consists of a curriculum of compulsory components (28 ECTS) and electives (2 ECTS), as specified in the Prospectus.

The remaining 30 EC can be used for both the education specialisation and the research component of the MSc programme. For LST and Chemistry the remaining 30 EC are restricted to the MSc programme.

Specialisation Science Communication and Society

1.1 Description (Course and Examination Regulations chapter 2)

The specialisation Science Communication and Society (SCS) concerns science communication in a broad sense. The programme focuses on the link between science and society and covers knowledge and skills in the field of science communication. The programme prepares students for a career in the area of science communication, for example, as a science communicator, a science policymaker or a public relations or health communication officer, or for a career as a scientist with a communicator's mind-set.

Students with an MSc specialisation Science Communication and Society are admissible to a PhD programme in their MSc research field or in Science Communication.

1.2 Objectives of the programme (Course and Examination Regulations art. 2.1)

The programme has the objective to impart sufficient knowledge, understanding and skills to enable the graduate to:

- Conduct research in the area of science communication and society;
- Develop evidence-based products and projects related to science communication, such as science journalism, visual communication, or in informal science education;
- Integrate science communication into the scientific practice and their work as a scientist.

1.3 Learning outcomes (Course and Examination Regulations art. 2.3)

After completion of this specialisation students will have acquired the following learning outcomes:

A Knowledge and insight

A1 Knowledge about theories and frameworks in science communication & society.

A2 Knowledge about science communication research methods.

A3 Insight about the field of science communication & society.

B Applying knowledge and insight

B1 Applying theoretical knowledge and insights towards evidence-based development of products and projects related to science communication and society.

B2 Applying theoretical knowledge and insights towards conducting research about science communication and society.

B3	Being able to work in interdisciplinary and transdisciplinary contexts.

C Judgement

C1	Becoming a professional considering social, cultural, environmental and ethical considerations in their work related to science communication and society.
C2	Contributing to innovation and improvement of the field of science communication and society.

D Communication

D1	Skills in oral, written and visual communication about science towards different target audiences.
D2	Developing innovative communication strategies including dialogue and participation with experts and non-experts.

E Learning skills

E1	Using inter- and intrapersonal skills by reflecting on the learning process, giving and receiving feedback, and contributing effectively to meetings.
E2	Becoming a creative, innovative, analytical, reflective professional in the field of science communication and society.
E3	Being able to build and use a network of stakeholders in science communication and society.
E4	Having an overview of career paths in science communication and society and their own possible role within the field science communication and society.

1.4 Qualifications for admission (Course and Examination Regulations chapter 5)

Admissible to the specialisation SCS are all students that are admitted to one of the designated Master Programmes of the Faculty of Science (see below) or the Master Programme in Biomedical Sciences of the Faculty of Medicine (LUMC) provided that the rules and regulations of the subject Master Programme do allow so. Preferably, the BSc programme has included some coursework in (science) communication.

1.5 Programme (Course and Examination Regulations chapter

The MSc programme in combination with the Science Communication and Society (SCS) specialisation consists of two components:

- a component within the chosen MSc programme:
  - *Astronomy;*
  - *Bio-Pharmaceutical Sciences;*
  - *Biology;*
  - *Chemistry;*
  - *Computer Science;*
  - *Life Science and Technology;*
  - *Mathematics;*
  - *Physics; or*
  - *Biomedical Sciences (LUMC).*

- a Science Communication and Society component[16].

Preferably, the component within the chosen MSc programme should be followed during the first year of study, the Science Communication and Society component should be followed during the second year.

[1] In accordance with the 'abstract structure', as described in the Framework Document of the Leiden University Register of Study Programmes.

The SCS specialisation programme comprises at least 40 EC. Additionally a maximum of 20 EC can be filled in through the internship period within the SCS specialization, or with elective courses within the MSc programme of choice. The choice of electives should be made in consultation with a study adviser, mentor, or specialisation coordinator.

Transitional arrangement

Students who have successfully completed the course *Scientific Narration and Visualization* (4603SCNV3Y) during the academic year 2023-2024 or before and students who have taken the course *Innovative Methods in Science Communication and Society* (4603SCIM3Y) during the academic year 2024-2025 can use that course as a substitute for the requirement of *Science in Society* (4603SCSISY).

Internship

The internship will be in the field of science communication (e.g. science journalism, museum education, new media, health communication). The total internship period may consist of one internship, or can be divided into two smaller internships. Each internship is assessed by an evaluation of: (1) the internship performance, (2) a written report and (3) an oral presentation. The entire internship period consists of 14-34 EC depending on the amount of credit needed in the specialisation (40-60EC). The total internship period includes a minimum of 10 EC of research in science communication. The Project Proposal is the research proposal that needs to be written during the start of the internship period and provides an additional 3 EC.
The choice of internships should be approved beforehand by the coordinator of the specialisation and if applicable by the MSc programme coordinator.

Additional elective

The *SCS elective* (4603SCSELY) is an elective course in which students can perform, e.g. a book exam, a literature review, or an independent project related to science communication. Students need to write a project proposal before starting the SCS elective including description of the project, significance and planning. The SCS supervisor needs to approve the proposal before the start of the project. Students outside of the Science Communication and Society specialisation need permission from their exam board and the specialisation coordinator to take this course.

[16] Completion of the specialisation Science Communication and Society requires a minimum of 40 EC and a maximum of 60 EC within the SCS component.

Specialisation High-Tech Innovation

1. Description of the programme (Course and Examination Regulations art. 2)

The specialisation *High-Tech Innovation* is for MSc students in Natural Sciences who are interested in interdisciplinary technologies and research related to/important for high technology industries, e.g., the semi-conductor industry or nanofabrication. In addition to their primary field of study, students obtain knowledge and skills that enable them either 1) to design and develop novel semi-conducting nanomaterials, 2) develop instrumentation for high-precision measurements and/or 3) develop software, and hardware for integration and design. In the specialisation *High-Tech Innovation* students combine high quality research in their field of study with experience in a scientific business environment comprising development from idea, to prototype, to application.

1.1 Objectives of the programme (Course and Examination Regulations art. 2.1)

The specialisation *High-Tech Innovation* aims to introduce students to a broader array of exact sciences beyond the primary field of study with an emphasis on innovative technologies. In addition, students will gain practical experience in applying their knowledge and skills through completing a research-training project in collaboration with an industrial partner.

The specialisation emphasises interdisciplinarity across fields of study that connects with industry practices. Students will learn through real-life industrial case studies, lectures by industrial guest speakers, and teamwork in multidisciplinary problem solving.

1.2 Learning outcomes (Course and Examination Regulations art. 2.3)

In addition to the learning goals of their primary field of study, graduates of the master programme with specialisation *High-Tech Innovation* are able to:

- acquire understanding of the nature and ways of scientific research and how this is applicable to fields outside their primary study;
- design experimental, computational and/or theoretical procedures for: (i) solving current problems in high-technology industrial research; (ii) developing new techniques and/or novel materials;
- communicate disciplinary ideas and information in a clear and concise manner within a multidisciplinary or an interdisciplinary team;
- realise the importance of new developments and methods in adjacent fields and integrate these in their own knowledge and, vice versa, to provide professional advice to multidisciplinary teams including their possible impact or range of applications.

1.3 Qualifications for Admission (Course and Examination Regulations art. 5)

Admissible to the specialisation *High-Tech Innovation* are students who are admitted to one of the following Master Programmes of the Faculty of Science: Astronomy, Chemistry, Computer Science, Mathematics or Physics.

1.4 Programme organisation

The High-Tech Innovation specialisation is offered in the MSc programmes in Astronomy, Chemistry, Computer Science, Mathematics, and Physics. These five MSc programmes contribute to the content of the curriculum in mutual coordination. The lead Programme Director for the HTI specialisation is nominated from and by the Programme Directors of these MSc programmes for a four-year term.

The Programme Director and Programme Committee of the lead MSc programme are responsible for the coherence and studyability of the HTI programme.

1.5 Programme (Course and Examination Regulations art. 3)

The MSc programme in combination with the *High-Tech Innovation* specialisation consists of two components:

- A 60 EC component, including a research-training project, within the chosen primary MSc programme:
    - Astronomy
    - Chemistry
    - Computer Science
    - Mathematics
    - Physics
- A 60 EC *High-Tech Innovation* component, comprising
    - The 3 EC course *Orientation HTI*.
    - 27 EC elective courses selected from the HTI core as specified in the Prospectus.
    - the HTI research-training project of 30 EC, preferably in an industrial setting.

The elective courses from HTI core should be chosen such that at most 2-3 courses are from the students' primary MSc programme with a maximum of 12 EC. The choice of courses should be made in consultation with a study advisor, mentor, or specialisation coordinator.

All programme-specific components as well as the HTI core courses must be finished before the HTI research-training project can be started. Exceptions to this obligatory sequence can only be granted by the Board of Examiners of the primary MSc programme.

The HTI-research training project must abide by the same scientific requirements as a research-project performed at Leiden University in the primary discipline of the student.

1.6 Exemptions

None.