Appendix for the Bachelor degree programme in Chemistry

Appendix I Learning outcomes of the Bachelor's degree programme (Article 3.1.1)

A. Generic learning outcomes – Knowledge

A1. Bachelor's graduates have general knowledge of the foundations and history of mathematics, natural sciences and technology, in particular those of their own discipline.
A2. Bachelor's graduates have mastered the basic concepts of their own discipline (see Appendix 1 for further specification) to a certain extent and are familiar with the interrelationships of these concepts within their own discipline as well as with other disciplines.
A3. Bachelor's graduates have in-depth knowledge of several current topics within their own discipline.
A4. Bachelor's graduates are familiar with the quantitative character of the fields of mathematics and natural sciences and have an understanding of the methods used in these fields, and particularly within their own discipline, including computer-aided methods.
A5. Bachelor's graduates have sufficient knowledge and understanding of mathematics and natural sciences to successfully complete a follow-up Master's degree programme in their own discipline.
A6. Bachelor's graduates are aware of the societal, ethical and social aspects involved in the fields of mathematics and natural sciences.

B. Generic learning outcomes – Skills

B1. (Research) Bachelor's graduates are able to draw up a research question, design, plan and conduct research and report on it independently with a certain degree of supervision. Bachelor's graduates are able to evaluate the value and limitations of their research and assess its applicability outside their own field.
B2. (Designing) Bachelor's graduates are able to translate a problem, in particular a design problem, into a plan of approach and – taking into account the requirements of the client and/or technical preconditions – find a solution.
B3. (Gathering information) Bachelor's graduates are able to gather relevant information using modern means of communication and to critically interpret this information.
B4. (Collaborating) Bachelor's graduates are able to collaborate in teams (including multidisciplinary teams) on technical-scientific problems.
B5. (Communicating) Bachelor's graduates are able to communicate orally and in writing in academic and professional contexts, with both colleagues and others. They are familiar with the relevant means of communication.
B6. (Reflecting) Bachelor's graduates are able to assess their own actions and those of others in a natural sciences context, bearing in mind the social/societal and ethical aspects.
B7. (Learning skills) Bachelor's graduates are able to apply learning skills that enable them to pursue a follow-up degree and acquire knowledge in new fields with a high level of autonomy.
B8. Additional subject-specific skills are listed in D.

C. Degree programme-specific learning outcomes – Basic Knowledge

The Bachelor's graduate in Chemistry has:

C1. knowledge of the most important fields of Chemistry: Inorganic, Organic, Analytical, Physical, Polymer Chemistry and Biochemistry, furthermore general knowledge of more specific field such as Theoretical Chemistry, Materials Chemistry, etc.,
C2. some knowledge of at least one multidisciplinary field: 'Chemistry of Life', 'Smart Materials' and 'Sustainable Energy and Chemistry',
C3. a broad general knowledge of subjects within their own discipline or of subjects within a different discipline,
C4. necessary background knowledge of Mathematics and Physics,
C5. understanding of the position and role of the discipline within science and society, and also in the international character of the discipline.

The Bachelor's graduate has become familiar with the following key elements of Chemistry:

C6. The important aspects of chemical terminology, nomenclature and conventions.

C7. Numerical and computational skills, including error analysis, understanding of the proper order of magnitude and correct use of units.
C8. The most important types of chemical reactions and their characteristics.
C9. The principles and procedures that are used in the chemical analysis and in the characterization of chemical compounds.
C10. The fundamental techniques of structural analysis, including spectroscopy.
C11. The properties of various states of matter and the common theories to describe them.
C12. The principles of Quantum Mechanics and its applications in the description of structure and properties of atoms and molecules.
C13. The principles of Thermodynamics and its applications in Chemistry.
C14. The kinetics of chemical processes, catalysis and mechanical interpretation of chemical reactions.
C15. The typical properties of elements and their compounds, including group relationships and trends in the periodic table.
C16. The structural properties of chemical elements and their compounds.
C17. The typical properties of aliphatic, aromatic, heterocyclic and organometallic compounds.
C18. The nature and behavior of functional groups in molecules.
C19. Important synthetic routes of organic/inorganic chemistry.
C20. The relationship between bulk properties of matter and properties of individual atoms and molecules, including macromolecules (both natural and synthetic).
C21. The structure and reactivity of important types of biomolecules and the chemistry of important biological processes.
C22. The design of processes (also on industrial scale), taking into account flow and transfer of matter and energy.
C23. Properties of chemicals and the involved environmental and safety aspects.

D. Degree programme-specific learning outcomes - Skills

The Bachelor's graduate in Chemistry has developed the skills and competencies mentioned below.

Chemistry-related cognitive skills and competencies

The Bachelor's graduate is:

D1. able to demonstrate and use their knowledge and understanding of essential facts, concepts, principles and theories related to the topics, as defined in A, in various situations,
D2. able to apply knowledge and understanding to solve basic qualitative and quantitative problems,
D3. skilled in evaluating, interpreting and combining chemical information and data,
D4. able to recognize and implement 'good laboratory practice',
D5. familiar with project work,
D6. able to adopt a professional attitude regarding environmental and safety aspects and possible ethical implications in the context of research, education and industry.

Chemistry-related practical skills

The Bachelor's graduate is:

D7. skilled in the use of standard laboratory procedures and in the use of equipment for synthetic and analytical work,
D8. able to verify chemical properties, to observe and measure events or changes, and to systematically archive and document data,
D9. able to interpret data, obtained from observations and measurements, and relate it to the right theories,
D10. able to assess the risks of laboratory procedures and the use of chemicals,
D11. skilled in the safe handling of chemicals, taking into account physical and chemical properties, including the various specific risks of use, and is also able to act adequately in emergency situations in the laboratory,
D12. able to use IT skills appropriate to the chosen specialization.

Appendix II Majors and Minors of the degree programme (Article 3.7.4)

The degree programme has the following Major(s):
A propaedeutic phase (appendix III) and a post propaedeutic phase (appendix IV).

The elective part within the Major is chosen from the following three Specializations:

a) Chemistry of Life
b) Smart Materials
c) Sustainable Chemistry and Energy

The degree programme has the following Minor(s):

The Minor may either be the Minor Chemistry 'Science for Scientists' or may be chosen from the collection of university Minors (FSE BSc TER, Article 8.5).

Appendix III Course units in the propaedeutic phase

- **List of course units; Article 4.1.1**
- **Compulsory order of examinations; Article 9.3**

Practicals are defined as lab practicals

Course unit name	**ECTS**	**Practical**	**Entry requirements**
Maths for Chemistry and Engineering	5		
Molecules: Structure, Reactivity, and Function	5	x	
Concepts of Chemistry and Engineering	5	x	
Transport Phenomena	5		
Organic Chemistry 1	5		
Practical Synthesis and Analysis 1	5	x	
Biochemistry & Biotechnology	5	x	
Sustainability Projects	5		
Physical Chemistry 1	5		
Inorganic Chemistry	5		
Spectroscopy	5		
Linear Algebra & Multivariable Calculus for Chemistry	5		

Appendix IV Course units in the post-propaedeutic phase

- **List of course units; Article 7.1.1**
- **Compulsory order of examinations; Article 9.3**

Course unit name	ECTS	Practical	Entry requirements
Physical Properties of Materials 1	5		
Organic Chemistry 2	5		Organic Chemistry 1
Synthesis Lab Course 2	5	x	'Practical synthesis and analysis 1' or 'Practicum Chemie voor Levenswetenschappen'
Physical Chemistry 2	5		
Bioenergy, Metabolism and Bioresources	5		
Soft Molecular Materials	5		
Quantum chemistry	5		
Chemistry & Society: Ethical and Professional Aspects	5		
Macromolecular Chemistry	5		
Practical Macromolecular Chemistry	5	x	.
Specialization: ● Smart Materials ● Sustainable Chemistry and Energy ● Chemistry of Life	20	See individual table	See individual table
Research skills practical choice: ● Organic &Molecular Inorganic Chemistry ● Chemical Biology ● Polymer Chemistry ● Materials Design: experiment	5	x	'Practical synthesis and analysis 1' or 'Practicum Chemie voor Levenswetenschappen', and 'Practical Macromolecular Chemistry'
Bachelor's Research Project	15	x	After period 1b: passed 130 ECTS of the Bachelor's degree programme of Chemistry (If the Project is done in period 1a the student should have passed 130 ECTS of the Bachelor's degree programme of Chemistry after period 2a of the previous year) The student must submit a study program one month before starting the project.
Minor	30	See minor (Science for Scientists) Table below	Students must have successfully completed the propaedeutic phase of the degree programme to be admitted to the Minor. (BSc TER Article 6.1.4)

Chemistry of Life

Course unit name	ECTS	Practical	Entry requirements
Recombinant DNA and Biotechnology	5		
Chemical Biology	5		Organic Chemistry 1 and 2
(Bio)-catalysis	5		
Cellular Chemistry	5	x	

Smart Materials

Course unit name	ECTS	Practical	Entry requirements
Physical Properties of Materials 2	5		
Molecular Design	5		
Materials Design: Theoretical Methods	5		
Trends in Polymer Science	5		

Sustainable Chemistry and Energy

Course unit name	ECTS	Practical	Entry requirements
Electrochemistry and Energy	5	x	
Physical Organic and Photo-chemistry			
(Bio)-catalysis	5		
Green Chemistry and Photochemistry	5		

Minor Chemistry 'Science for Scientists'

The Minor comprises 30 ECTS and is a coherent and deepening package of course units chosen from the following list

Course unit name	ECTS	Practical	Entry requirements
Electrochemical Technology	5	x	Cannot be taken in combination with Electrochemistry and Energy but can replace it.
Medicinal Chemistry I	5		
Nuclear Energy	5		
Nuclear and Radiochemistry	5		
Single-Phase Reactors	5		
Structural Probes for Solid Materials	5	x	
Organic synthesis	5		
Carbohydrates	5		
Introduction to Science Communication	5		
Molecular Biophysics	5		
Coordination chemistry	5		Inorganic chemistry
Oriëntatie op Onderwijs in de Bètawet.	5		
Solar Cells	5		

Appendix V Admission to the post-propaedeutic phase Article 6.1.1

The following candidates will be admitted to the post-propaedeutic phase:

Students who have been issued a positive study advice from the degree programme in question
Students who have been issued a positive study advice from one of the following degree programmes:
- BSc Chemical Engineering

Appendix VI Contact hours propaedeutic and post-propaedeutic phase (Article 3.6)

Degree programme year 1	
Structure contact hours	**Contact hours per year**
Lectures	264
Tutorial/ practicals/ pc practicals	188/ 330/ 90
Tutoring	8
Supervision during an internship	-
Examinations	52

Appendix VII Additional Requirements Open degree Programmes (Art. 7.3)

In exceptional circumstances students wishing to pursue an open degree programme may file a request with the Board of Examiners of Chemistry. The Board of Examiners will evaluate whether the proposed curriculum meets the learning outcomes of the degree programme.

Appendix VIII Transitional provisions (article 12.1)

For cohort 2021-2022 and earlier

Course	**May be replaced with**	**Reason**
Inorganic and Photochemistry	Green Chemistry and Photochemistry	The name change is made to reflect better the content of the course