Appendix for the Bachelor degree programme in Chemistry

Appendix I Learning outcomes of the Bachelor's degree programme (Article 1.3.a)

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 C 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 fields such as Theoretical Chemistry, Materials Chemistry, etc.,
C2. 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 his/her 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 his/her 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 2.1.4)

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 tracks:

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 and faculty Minors appendix IX.

Appendix III Course units in the propaedeutic phase

- **List of course units; Article 3.1.1**
- **Compulsory order of examinations; Article 8.2**

Practicals are defined as lab practicals

Course unit name	**ECTS**	**Practical**	**Entry requirements**
Calculus for Chemistry and Chemical Engineering	5		
Molecules: Structure, Reactivity, and Function	5	x	
General Chemistry	5		
Organic Chemistry 1	5		
Practical Synthesis and Analysis 1	5	x	
Physical Chemistry 1	5		
Biochemistry	5		
Biochemistry Practical	5	x	
Spectroscopy	5		
Introduction to Process and Product Technology	5		
Inorganic Chemistry	5		
First Year Symposium	5		

Appendix IV Course units in the post-propaedeutic phase

- **List of course units; Article 6.1.1**
- **Compulsory order of examinations; Article 8.2**

Course unit name	ECTS	Practical	Entry requirements
Physical Properties of Materials 1	5		
Organic Chemistry 2	5		Organic Chemistry 1
Practical Synthesis 2	5	x	
Physical Chemistry 2	5		
Linear Algebra for Chemistry and Chemical Engineering	5		
Quantum chemistry	5		
Science, Ethics, Technology and Society	5		
Macromolecular Chemistry	5		
Practical Macromolecular Chemistry	5	x	Having obtained a minimum grade of "5" for the course Macromolecular Chemistry (CHMMC-11)
Track: • Smart Materials • Sustainable Chemistry and Energy • Chemistry of Life	25	See individual table	See individual table
Track practical choice: • Organic and Molecular Inorganic Chemistry • Chemical Biology • Polymer Chemistry • Materials Design, experiment	5	x	• 'Practical synthesis and analysis 1' or 'Practicum Chemie voor Levenswetenschappen' • - • 'Practical Macromolecular Chemistry' • -
Bachelor's Research Project	15	x	Passed 150 ECTS of the Bachelor's degree programme of Chemistry and completed first year
Minor	30	See minor	See programme-specific appendices of the Teaching and Examination Regulations.

Chemistry of Life

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

Smart Materials

Course unit name	ECTS	Practical	Entry requirements
Soft Molecular Materials	5		
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
Bioenergy and Bioresources	5		
Electrochemistry and Energy	5	x	
Green Chemistry and Technology	5		
(Bio)-catalysis	5		
Physical Organic and Photo-Chemistry	5		

The course units 'Bio-energetics and Metabolism' and 'Bioenergy and Bioresources' have a large overlap, therefore only one of these course units may be included in an individual's programme.

Minor Chemistry 'Science for Scientists'

The Minor comprises 30 ECTS and is a coherent and deepening package of course units.

Course unit name	ECTS	Practical	Entry requirements
Medicinal Chemistry I	5		
Structural Probes for Solid Materials	5	x	
Organic and Molecular Electronics	5		
Solar Cells	5		
General Process Equipment	5	x	
Microbiology	5	x	
Nuclear Energy	5		
Programming in C/C++ (part I)	5		
Receptor pharmacology	5		
Single-Phase Reactors	5		
Bioenergy and Bioresources	5		
Bioenergy and Metabolism	5		
Electronics	5	x	
Geo-Energy	5		
Molecular Biology & Medical Biology	5		
Molecular Biophysics	5		
Multiphase Reactors	5		
Education and Communication	5		
Programming in C/C++ (part II)	5		
Soft molecular Materials	5		
Technical Thermodynamics	5		

Appendix V Entry requirements (Article 10.2.1)

A. HBO (university of applied science) propaedeutic certificate

1. The following requirements apply to the entrance examination as defined in Article 7.28.3 of the Act:

Degree programme	**Subjects at VWO (pre-university) level**	Requirement: Dutch as a Second Language (programme II) for non-native speakers of Dutch
B Biology	wia or wib + na+sk+bio	Yes
B Pharmacy	wia or wib + na+sk	Yes
B Life Science and Technology	wib+na+sk	Yes
B Computing Science	wib	
B Artificial Intelligence	wia or wib	
B Physics	wib+na	
B Chemistry	wib+na+sk	
B Astronomy	wib+na	
B Mathematics	wib	
B Chemical Engineering	wib+na+sk	
B Industrial Engineering and Management Science	wib	
B Applied Physics	wib+na	
B Applied Mathematics	wib	

wia = Mathematics A; wib = Mathematics B; na = Physics; sk = Chemistry; bio = Biology

2. Non-native speakers of Dutch who wish to be admitted to the Bachelor's degree programmes in Biology, Life Science and Technology, or Pharmacy must also have passed the State Examination in Dutch as a Second Language, Programme II (NT2-II).

3. The Admissions Board Bachelor's programmes FST will determine whether deficiencies have been compensated satisfactorily.

B. Foreign qualifications (EEA)

1. Any certificate that grants access to a university in a European country will also grant access to Dutch universities.

2. The same requirements that also apply to candidates with an HBO (university of applied science) propaedeutic certificate will apply to these candidates in the entrance examination as defined in Article 7.28.3 of the Act (see A).

3. Non-native speakers of Dutch who wish to be admitted to the Bachelor's degree programmes in Biology, Life Science and Technology, or Pharmacy must also have passed the State Examination in Dutch as a Second Language, Programme II (NT2-II).

4. In addition, candidates are required to be competent in English: an IELTS score of 6.5, a TOEFL score of 580 (paper-based), of 237 (computer-based) or of 92 (internet-based) or equivalent.

5. The Admissions Board Bachelor's programmes FST will determine whether deficiencies have been compensated satisfactorily.

C. Foreign qualifications (German)

1. German candidates must have a Zeugnis der Allgemeinen Hochschulreife ('Abitur').

2. The following requirements apply to the entrance examination as defined in Article 7.28.3 of the Act:

Degree programme	
B Biology	wi (LK or GK) na (LK or GK) sk (LK or GK) bio (LK or GK) (at least one subject at Leistungskurs level)
B Pharmacy B Life Science and Technology B Chemistry B Chemical Engineering	wi (LK or GK) na (LK or GK) sk (LK or GK) (at least one subject at Leistungskurs level)
B Computing Science B Mathematics B Applied Mathematics B Artificial Intelligence	wi (LK)
B Physics B Astronomy B Applied Physics	wi (LK) na (LK or GK)
B Industrial Engineering and Management Science	wi (LK or GK) na (LK or GK) (at least one subject at Leistungskurs level)

wi= Mathematics; na = Physics; sk = Chemistry; bio = Biology
LK = Leistungskurs level; GK = Grundkurs level followed until end of Class 13 or Class 12 (if Gymnasium education lasts 12 years).

3. Non-native speakers of Dutch who wish to be admitted to the Bachelor's degree programmes in Biology, Life Science and Technology, or Pharmacy must also have passed the State Examination in Dutch as a Second Language, Programme II (NT2-II).

4. The Admissions Board Bachelor's programmes FST will determine whether deficiencies have been compensated satisfactorily.

D. Foreign qualifications (International Baccalaureate)

1. The following requirements apply to the entrance examination as defined in Article 7.28.3 of the Act:

Degree programme	**from 2010/2011**
B Biology	Biology (SL or HL) Maths (SL or HL) Physics (SL or HL) Chemistry (SL or HL) two of these subjects at HL
B Pharmacy B Life Science and Technology B Chemistry B Chemical Engineering	Maths (SL or HL) Physics (SL or HL) Chemistry (SL or HL) two of these subjects at HL
B Computing Science B Mathematics B Applied Mathematics	Maths HL
B Artificial Intelligence	Maths SL **or** Maths HL
B Physics B Astronomy B Applied Physics B Industrial Engineering and Management Science	Maths HL Physics HL

SL = Standard Level, HL = Higher Level

2. Non-native speakers of Dutch who wish to be admitted to the Bachelor's degree programmes in Biology, Life Science and Technology, or Pharmacy must also have passed the State Examination in Dutch as a Second Language, Programme II (NT2-II).

3. The Admissions Board Bachelor's programmes FST will determine whether deficiencies have been compensated satisfactorily.

E. Foreign qualifications (non-EEA)

1. A non-European certificate that according to NUFFIC and/or NARIC standards is equivalent to a Dutch VWO certificate will grant access to university in the Netherlands.

2. The same requirements that also apply to candidates with an HBO (university of applied science) propaedeutic certificate will apply to these candidates in the entrance examination as defined in Article 7.28.3 of the Act (see A).

3. Non-native speakers of Dutch who wish to be admitted to the Bachelor's degree programmes in Biology, Life Science and Technology, or Pharmacy must also have passed the State Examination in Dutch as a Second Language, Programme II (NT2-II).

4. In addition, candidates are required to be competent in English: an IELTS score of 6.5, a TOEFL score of 580 (paper-based), of 237 (computer-based) or of 92 (internet-based) or equivalent.

5. The Admissions Board Bachelor's programmes FST will determine whether deficiencies have been compensated satisfactorily.

F. Entrance examination

1. The following requirements apply to the entrance examination as defined in Article 7.29 of the Act:

Degree programme	**Nature and Health VWO level**	**or**	**Nature and Technology VWO level**
B Biology	en, wia or b, sk, bio, na		en, wib, na, sk, bio
B Pharmacy	en, wia or b, sk, bio, na		en, wib, na, sk
B Life Science and Technology	en, wib, sk, bio, na		en, wib, na, sk
B Computing Science	en, wib, sk, bio		en, wib, na, sk
B Artificial Intelligence	en, wia of b, sk, bio		en, wib, na, sk
B Physics	en, wib, sk, bio, na		en, wib, na, sk
B Chemistry	en, wib, sk, bio, na		en, wib, na, sk
B Astronomy	en, wib, sk, bio, na		en, wib, na, sk
B Mathematics	en, wib, sk, bio		en, wib, na, sk
B Chemical Engineering	en, wib, sk, bio, na		en, wib, na, sk
B Industrial Engineering and Management Science	en, wib, sk, bio		en, wib, na, sk
B Applied Physics	en, wib, sk, bio, na		en, wib, na, sk
B Applied Mathematics	en, wib, sk, bio		en, wib, na, sk

en = English; wia = Mathematics A; wib = Mathematics B; na = Physics; sk = Chemistry; bio = Biology

2. Non-native speakers of Dutch who wish to be admitted to the Bachelor's degree programmes in Biology, Life Science and Technology, or Pharmacy must also have passed the State Examination in Dutch as a Second Language, Programme II (NT2-II).

3. The Admissions Board Bachelor's programmes FST will determine whether deficiencies have been compensated satisfactorily.

Appendix VI Clustering of Bachelor's degree programmes Article 4.3.4, Article 4.6.1

Degree programme CROHO code	Name of degree programme	Clustered with CROHO code	Name of degree programme
56286	B Life Science and Technology	56860 56157	B Biology B Pharmacy
56860	B Biology	56286 56157	B Life Science and Technology B Pharmacy
56157	B Pharmacy	56860 56286	B Biology B Life Science and Technology
56980	B Mathematics	56965 50206 56962 50205	B Applied Mathematics B Physics B Applied Physics B Astronomy
56965	B Applied Mathematics	56980 50206 56962 50205	B Mathematics B Physics B Applied Physics B Astronomy
50206	B Physics	56962 50205 56965 56980	B Applied Physics B Astronomy B Applied Mathematics B Mathematics
56962	B Applied Physics	50206 50205 56965 56980	B Physics B Astronomy B Applied Mathematics B Mathematics
50205	B Astronomy	56962 56965 50206 56980	B Applied Physics B Applied Mathematics B Physics B Mathematics
56857	B Chemistry	56960	B Chemical Engineering
56960	B Chemical Engineering	56857	B Chemistry

Appendix VII Admission to the post-propaedeutic phase Article 5.1.1

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 degree programmes:
- BSc Chemical Engineering

Appendix VIII Contact hours propaedeutic phase Article 2.3

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 IX University Minors of the faculty of Mathematics and Natural Sciences
Article 7.5.1

1. Neurosciences Minor (taught in English):
   - Neuroscience (15 ECTS)
   - Behavioural Neuroscience (15 ECTS)

   People, Planet, Profit Minor (taught in English):
   - Overview and Coherence People Planet Profit (10 ECTS)
   - Paper People Planet Profit (5 ECTS)
   - Project People, Planet, Profit (15 ECTS)

   Astronomy through Space and Time Minor (taught in English):
   - The Evolving Universe (5 ECTS)
   - Cosmic Origins (5 ECTS)
   - Astrobiology (5 ECTS)

   Physics

2. The Programme Committee for the Bachelor's degree programmes in Biology and Life Science & Technology also has authority in the field of the Neurosciences Minor and/or its course units.

   The Programme Committee for the Master's degree programme in Energy & Environmental Sciences also has authority in the field of the People, Planet, Profit Minor and/or its course units.

   The Programme Committee for the Bachelor's degree programme in Astronomy also has authority in the field of the Astronomy through Space and Time Minor and/or its course units.

   The Programme Committee for the Bachelor's degree programmes in Physics and Applied Physics also has authority in the field of the Physics Minor and/or its course units.

3. The Board of Examiners for the Bachelor's degree programmes in Biology and Life Science & Technology and the Master's degree programmes in Biology, Ecology & Evolution, Marine Biology and Molecular Biology & Biotechnology also has authority in the field of the Neurosciences Minor and/or its course units.

   The Board of Examiners for the Master's degree programme in Energy & Environmental Sciences also has authority in the field of the People, Planet, Profit Minor and/or its course units.

   The Board of Examiners for the Bachelor's degree programme in Astronomy also has authority in the field of the Astronomy through Space and Time Minor and/or its course units.

   The Board of Examiners for the Bachelor's degree programmes in Physics and Applied Physics also has authority in the field of the Physics Minor and/or its course units.

4. These Teaching and Examination Regulations also apply in their entirety to the Minors in Neurosciences, People, Planet, Profit, Astronomy through Space and Time and Physics and/or their course units.

Appendix X <u>Transitional arrangement:</u>

Transitional arrangement for the Bachelor's/Master's in *(programme name)*

Course unit code	*Course unit name*	*ECTS*	*Final exam period*	*Course unit code*	*Course unit name*	*ECTS*	*Explanation*	*Equivalent* Yes/No*
WIOW-10	Introduction to Mathematics	5	2015: period Ia	WPCH16000	General Chemistry	5		Yes
CHBK-10	From Bacteria to Plastic	5	2015: period Ia	WPCH16000	General Chemistry	5		Yes
NANP1-10	Physics Laboratory 1	5	2015: period Ia	WPCH16000	General Chemistry	5		Yes

* It is also possible to substitute equivalent course units in the other direction. This can apply to students with a large backlog who want to fall under the new OER.