Appendices for the Bachelor's degree programme in Chemistry

Appendix I Learning outcomes of the Bachelor's degree programme (art 3.1)

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. 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 (art. 3.7)

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 first year of the degree programme

- **List of course units (art. 4.1.1)**
- **Compulsory order of examinations; (art. 9.3)**

Practicals are defined as laboratory practicals

Course unit name	**Code**	**EC**	**Practical**	**Entry requirements**
Maths for Chemistry and Engineering	WBCH048-05	5		
Molecules: Structure, Reactivity, and Function	WBCH004-05	5	x	
Concepts of Chemistry	WBCH063-05	5	x	
Transport Phenomena	WBCE023-05	5		
Organic Chemistry 1	WBCH013-05	5		
Practical Synthesis and Analysis 1	WBCH016-05	5	x	Molecules: Structure, Reactivity, and Function and Organic chemistry 1
Biochemistry	WBCH064-05	5		
Biochemistry practical and programming	WBCH065-05		x	
Physical Chemistry	WBCH066-05	5		
Inorganic Chemistry	WBCH039-05	5		
Spectroscopy	WBCH044-05	5		
Linear Algebra & Multivariable Calculus for Chemistry	WBCH011-05	5		

Appendix IV Course units in the second and third year of the degree programme

- **List of course units (art. 7.1.1)**
- **Compulsory order of examinations (art. 9.3)**

Course unit name	**Code**	**EC**	**Prac.**	**Entry requirements**
Physical Properties of Materials 1	WBCH006-05	5		
Organic Chemistry 2	WBCH005-05	5		Organic Chemistry 1 or Organic Chemistry for Life Science 1
Synthesis Lab Course 2	WBCH008-05	5	x	Practical Course: Synthesis and Analysis or Practical Skills in Organic Chemistry (for LST) (WBLT019-05)
Physical Chemistry 2	WBCH015-05	5		
Bioenergy, Metabolism and Bioresources	WBCH009-05	5		
Soft Molecular Materials	WBCH017-05	5		
Quantum chemistry	WBCH029-05	5		
Chemistry & Society: Ethical and Professional Aspects	WBCH045-05	5		
Macromolecular Chemistry	WBCH023-05	5		
Biomacromolecular Chemistry and Analysis	WBCH061-05	5	x	Biochemistry and biotechnology
Specialization: ● Smart Materials ● Sustainable Chemistry and Energy ● Chemistry of Life		20		See individual table
Research skills practical choice: ● Organic &Molecular Inorganic Chemistry ● Chemical Biology ● Polymer Chemistry ● Materials Design: experiment	 WBCH058-05 WBCH054-05 WBCH056-05 WBCH057-05	5	x	Practical Course: Synthesis and Analysis, or Practical Skills in Organic Chemistry (for LST) (WBLT019-05) and Biomacromolecular Chemistry and analysis
Bachelor's Research Project	WBCH901-15	15	x	To participate in the Bachelor Research Project the student must have: (1) successfully completed the propaedeutic phase of the degree programme. (2) achieved a minimum of 130 ECTS in the curriculum after period 1b. (If the Project is done in period 1a the student should have achieved 130 ECTS in the curriculum after period 2a of the previous year) (3) applied for their diploma (by sending a study programme for approval to the Board of Examiners) one month before the start of the project.

				(4) apply to the course coordinator before starting in 2b or the study advisor before starting outside of block 2b.
Minor		30		Students must have successfully completed the first year of the degree programme to be admitted to the Minor. (BSc TER Article 6.1.4)

Chemistry of Life

Course unit name	Code	ECTS	Prac.	Entry requirements
Recombinant DNA and Biotechnology	WBCH042-05	5		
Chemical Biology	WBCH036-05	5		Organic Chemistry 1 and 2 or Organic Chemistry for Life Science 2 (WBLT018-05)
(Bio)-catalysis	WBCH019-05	5		
Cellular Chemistry	WBCH021-05	5		

Smart Materials

Course unit name	Code	ECTS	Prac.	Entry requirements
Physical Properties of Materials 2	WBCH041-05	5		
Molecular Design	WBCH040-05	5		
Materials Design: Theoretical Methods	WBCH024-05	5		
Trends in Polymer Science	WBCH034-05	5		

Sustainable Chemistry and Energy

Course unit name	Code	ECTS	Prac.	Entry requirements
Electrochemistry and Energy	WBCH037-05	5	x	
Physical Organic and Photo-chemistry	WBCH027-05	5		
(Bio)-catalysis	WBCH019-05	5		
Green Chemistry and Photochemistry	WBCH050-05	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	Code	ECTS	Prac.	Entry requirements
Electrochemical Technology	WBCE021-05	5	x	Cannot be taken in combination with Electrochemistry and Energy but can replace it.
Artificial Intelligence and Machine Learning in Chemistry	WBCH060-05	5		
Nuclear Energy	WBPH010-05	5		
Nuclear and Radiochemistry	WBCH052-05	5		
Single-Phase Reactors	WBCE006-05	5		
Organic synthesis	WBCH051-05	5		
Carbohydrates	WBCH010-05	5		

Molecular Biophysics	WBPH023-05	5		
Coordination chemistry: from molecules to materials	WBCH062-05	5		Inorganic chemistry
Introduction to Science Education (EC)	WBEC002-05	5		
Introduction to Science Communication (EC)	WBEC001-05			
Solar Cells	WBCH018-05	5		
Polymer Engineering	WBCE030-05	5		
Biochemical Engineering	WBCE029-05	5		
Research trends in sustainable chemical engineering	WBCE031-05	5		

Appendix V Admission to the second year

The following candidates will be admitted to the second year:
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 (art. 3.6)

Degree programme year 1	
Structure contact hours	**Contact hours per year**
Lectures	390
Tutorial/ practicals/ pc practicals	285/ 260/ 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 (art. 12.1)

For cohort 2023-2024 and earlier

Course	**May be replaced with**	**Info**
Concepts in Chemistry and Engineering (WBCE022-05)	Concepts in Chemistry (WBCH063-05) or Concepts in Chemical Engineering (WBCE034-05)	Course code change and part change in content
Sustainability Projects (WBCE024-05)	Sustainability Projects (WBCE024-05)	Course is removed from programme, but is still offered
Biochemistry & Biotechnology (WBCH049-05)	Biochemistry (WBCH064-05) or biochemistry practical and programming (WBCH065-05): - Students who have not passed the laboratory	Change in content

	component of Biochemistry & Biotechnology (WBCH049-05) are required to pass the biochemistry practical and programming (WBCH065-05). The resulting grade will be recorded under WBCH049-05. - Students who have not passed the theoretical component of Biochemistry & Biotechnology (WBCH049-05) must pass Biochemistry (WBCH064-05). The resulting grade will be recorded under WBCH049-05. (To calculate the final grade the final mark calculation of grading for Biochemistry & Biotechnology should be applied: Practicum grade is 40% of the final grade. For both parts (exam, practicum) the grade should be minimal 5.5.)	
Physical Chemistry 1 (WBCH026-05)	Physical Chemistry (WBCH066-05) OR biochemistry practical and programming (WBCH065-05): -Students who have not passed the python practical component of Physical Chemistry 1 (WBCH026-05) are required to pass the Python practical component of biochemistry practical and programming (WBCH065-05). The resulting grade will be recorded under WBCH026-05. -Students who have not passed the theoretical component of Physical Chemistry 1 (WBCH026-05) must pass Physical Chemistry (WBCH066-05. The resulting grade will be recorded under WBCH026-05. (To calculate the final grade the final mark calculation of grading for Physical chemistry 1 (WBCH026-05) should be applied: Practicum grade is 10%	Change in content

	of the final grade. For all parts the grade should be minimal 5.5.)	
Structural Probes for Solid Materials	-	Course no longer exists