Appendices Bachelor's degree programme Chemical Engineering

Appendix I Learning outcomes of the 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 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 Chemical Engineering has:

C1. knowledge of the most important fields of i) process technology: physical transport phenomena, chemical reactor engineering, separation methods, and process design, ii) product technology: materials science, design methodology, and processing, and iii) basic aspects of chemistry: inorganic, organic, analytical, physical, and polymer chemistry and biochemistry.
C2. skilled in the use of standard laboratory procedures and in the use of equipment for synthetic and analytical work, necessary background knowledge of Mathematics and Physics,
C3. 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 Chemical Engineering:

C4. Important aspects of chemical terminology, nomenclature and conventions.
C5. Numerical and computational skills, including error analysis, understanding of the proper order of magnitude and correct use of units.

C6. The most important types of chemical reactions and their characteristics.
C7. The principles and procedures that are used in the chemical analysis and in the characterization of chemical compounds.
C8. The design of industrial processes, taking into account flow and transfer of matter and energy.
C9. The principles of Thermodynamics and phase diagrams.
C10. Kinetics of various chemical reactions.
C11. Dimensional analysis and its application in various (technological) problems.
C12. Basic knowledge of fluid dynamics and heat and mass transfer and their application in various part of process technology.
C13. Knowledge of equipment that is used in many chemical processes.
C14. The principles of separation methods and their application in industry.
C15. Basic knowledge of industrial chemistry and reactor engineering.
C16. Materials Science with emphasis on structure-property relationships and their application in various areas of Product Technology (production, analysis, etc.).
C17. The principles of production, structure and properties of polymers and the use of these in various types of chemical products.
C18. Basic knowledge of Product Technology.
C19. Thinking in systems that are relevant for industrial chemistry and technology.
C20. The properties of chemicals and the environmental and safety aspects of using them.

D. Degree programme-specific learning outcomes- Skills

The Bachelor's graduate in Chemical Engineering has developed the skills and competences mentioned below.

Chemical Engineering-related cognitive skills and competences

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 B, for the (re)design new chemical processes/products.
D2. able to apply knowledge and understanding to solve basic qualitative and quantitative problems,
D3. skilled in evaluating, interpreting and combining chemical and process/product technological 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.
D7. able to work at different levels of abstraction and detail, including system design level,
D8. able to see, where necessary, the importance of other disciplines (interdisciplinarity) and their contribution in the design process.

Chemical Engineering-related practical skills

The Bachelor's graduate is:

D9. skilled in the use of standard laboratory procedures and in the use of equipment for synthetic and analytical work,
D10. able to erify chemical properties, to observe and measure events or changes, and to systematically archive and document data,
D11. able to interpret data, obtained from observations and measurements, and relate it to the right theories,
D12. able to assess the risks of laboratory procedures and the use of chemicals,
D13. 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,
D14. able to use IT skills appropriate to the chosen specialization.

Appendix II Majors and Minors in 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 degree programme has the following Minor(s):
A minor of 20 ECTS in the third year is defined, see table for course units. Students can choose to fill this in with electives or with research project (10≤ ECTS ≤ 15).

Appendix III Course units in the propaedeutic phase

- **List of course units; Article 3.1.1**
- **Course units with one or more practicals; Article 3.2**
- **Compulsory order of examinations; Article 8.2**

Practicals are defined as labpracticals

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 Practicum	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**
- **Course units with one or more practicals; Article 6.2.1**
- **Compulsory order of examinations; Article 8.2**

Course unit	**ECTS**	**Practical**	**Entry requirements**
Technical Thermodynamics	5		
Organic Chemistry 2	5		
Practical Synthesis 2	5	x	Practical Synthesis and Analysis 1
Introduction to Programming and Numerical Methods	5		
Single-Phase Reactors	5		
Linear Algebra for Chemistry and Chemical Engineering	5		
Product Technology	5		
Separation Processes	5		
Science, Ethics, Technology, and Society	5		

Physical Transport Phenomena 1	5		
Macromolecular Chemistry	5		
Practicum Macromolecular Chemistry	5	x	Having obtained a minimum grade of "5" for the course Macromolecular Chemistry (CHMMC-11)
General Process Equipment	5	x	
Multiphase Reactors	5		
Physical Transport Phenomena 2	5		
Control Engineering	5		
Special Process Equipment	5		
Electives, courses from Bachelor's programmes in which are to be individually approved by the BoE.	20		See programme-specific appendices of the Teaching and Examination Regulations.
Bachelor Project	15	x	Passed 150 ECTS of the Bachelor's degree programme of Chemistry

Elective offered by Chemical Engineering

Course unit	**ECTS**	**Practical**	**Entry requirements**
Minor Research Project	10 or 15	x	
Control Engineering	5		
General Process Equipment	5	x	
Medicinal Chemistry I	5		
Physical Properties of Materials 1	5		
RC-C++1 Programming in C/C++ (part I)	5		
Statistics	5		
Structural probes for solid materials	5	x	
Multiphase Reactors	5		
Bioenergy and Bioresources	5		
Bioenergy and Metabolism	5		
Geo-Energy	5		
Medicinal chemistry II	5		
Molecular Biophysics	5		
Onderwijs en Communicatie	5		
Organic and Molecular Electronics	5		
Programming in C/C++ (part II)	5		
Soft molecular Materials	5		
Solar Cells	5		
Physical Transport Phenomena 2	5		
(Bio)catalysis	5		
Cellular Chemistry	5	x	
Electrochemistry and Energy	5	x	
Marketing for E&BE	5		
Materials Design: Theoretical	5		

Methods			
Modelling and analysis of complex networks			
Outlining and implementing innovation strategy			
Physical Organic and Photo-chemistry			
Physical Properties of Materials 2			
Recombinant DNA and Biotechnology			
Trends in Polymer Science			

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	Yes
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 Faculty Committee for Special Admissions 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 Faculty Committee for Special Admissions 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 Faculty Committee for Special Admissions 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 Faculty Committee for Special Admissions 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 Faculty Committee for Special Admissions 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 Faculty Committee for Special Admissions 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	B Applied Mathematics
56965	B Applied Mathematics	56980	B Mathematics
50206	B Physics	56962 50205	B Applied Physics B Astronomy
56962	B Applied Physics	50206 50205	B Physics B Astronomy
50205	B Astronomy	56962 50206	B Applied Physics B Physics
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:
Holders of a propaedeutic certificate of the degree programmes in Chemistry or Chemical Engineering

Appendix VIII Contact hours propaedeutic phase Article 2.4

Degree programme year 1	
Structure contact hours	**Number of 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:
   - Neuroscience (15 ECTS)
   - Behavioural Neuroscience (15 ECTS)

   People, Planet, Profit Minor:
   - 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:
   - The Evolving Universe (5 ECTS)
   - Cosmic Origins (5 ECTS)
   - Astrobiology (5 ECTS)

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.

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.

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