Assessment plan for the curriculum of the Bachelor's degree programme in Chemistry, 2024-2025

Programme director : W.R. Browne

Date advice Board of Examiners : 16-7-2024

Date approval Faculty Board :

1. Vision on assessment

1. The use of formative and summative assessment should be appropriate to the course unit but overall a blend of assessment tools should be used over the course of the program; including but not limited to written examinations, oral examinations, oral and poster presentations, essays, practical reports, practical work (e.g., a program). MCQ based exams should not be used.
2. Formative assessment is used in practical courses to enable students to learn from mistakes and successes in their work. The outcome of formative assessment should not as a rule contribute to summative grades for a course unit.
3. Formative assessment stimulates students to write independently and respond to critical feedback towards improvement.
4. Summative assessment is used to ascertain that the student has been able to demonstrate sufficient competence in regard to the learning objectives of individual course units. Summative assessment will be in line with the preparation of the students made during the course unit.
5. Summative assessment will be transparent and should stimulate students to reflect on their performance in a course unit.
6. By definition, successful completion of a degree programme requires individual success in all stages, a key skill in research is the ability to accept apparent failure - not every experiment will work as expected. Hence, assessment of practical work is focused on process and reflection primarily.

2. Assessment guidelines

1. Summative assessment should comprise of at least 2 distinct activities after the 1st year and preferably also in the first year.
2. Summative assessment is performed onsite
3. Oral examinations should be conducted in accordance with FSE policy
4. Formative assessment can be performed onsite, online, as well as take home and collaborative work.
5. Formative assessment should not be used towards passing a course but can contribute to a final course grade where the summative component is sufficient.

6. Resits may differ from the original assessment method as long as the result of the resit remains valid and reliably assesses the students' mastery of the LOs
7. Grading should use valid and reliable grading tools, as described in the test matrix/grading scheme.
8. Students should be given the opportunity to view their work and the test matrix used. Clarification of how their grade was decided on should be provided when requested.
9. Individual grades must be provided in group assignments and determined using assessment of work done by the individual student.
10. In group presentations the assessor determines which student presents which part of the presentation during the presentation
11. For practical reports a maximum of two feedback rounds (one on parts, one on the first draft) are organized, if a third round of feedback is needed to guide students to sufficient quality, the maximum grade is a 7.
12. For research reports formative assessment through the project should be provided before the report writing stage.
13. In assignments in which students generate written reports or programs, the scope to which AI tools can be used and should be documented should be defined for all stages of the writing process.

3. Learning outcomes of the bachelor's degree programme Chemistry

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 I 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 Appendix 1.2

Degree programme-specific learning outcomes – Basic Knowledge

The Bachelor's graduate in Chemistry has:
1.1 knowledge of the most important fields of Chemistry: Inorganic, Organic, Analytical, Physical, Macromolecular Chemistry and Biochemistry, furthermore general knowledge of more specific fields such as Theoretical Chemistry, Materials Chemistry, etc.,
1.2 knowledge of at least one multidisciplinary field: 'Chemistry of Life', 'Smart Materials' and 'Sustainable Energy and Chemistry',
1.3 a broad general knowledge of subjects within their own discipline or of subjects within a different discipline,
1.4 necessary background knowledge of Mathematics and Physics,
1.5 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:
a. The important aspects of chemical terminology, nomenclature and conventions.
b. Numerical and computational skills, including error analysis, understanding of the proper order of magnitude and correct use of units.
c. The most important types of chemical reactions and their characteristics.
d. The principles and procedures that are used in the analysis and in the characterization of chemical compounds.
e. The fundamental techniques of structural analysis, including spectroscopy.
f. The properties of various states of matter and the common theories to describe them.
g. The principles of Quantum Mechanics and its applications in the description of structure and properties of atoms and molecules.
h. The principles of Thermodynamics and its applications in Chemistry.
i. The kinetics of chemical processes, catalysis and mechanical interpretation of chemical reactions.
j. The typical properties of elements and their compounds, including group relationships and trends in the periodic table.
k. The structural properties of chemical elements and their compounds.
l. The typical properties of aliphatic, aromatic, heterocyclic and organometallic compounds.
m. The nature and behavior of functional groups in molecules.
n. Important synthetic routes of organic/inorganic chemistry.
o. The relationship between bulk properties of matter and properties of individual atoms and molecules, including macromolecules (both natural and synthetic).
p. The structure and reactivity of important types of biomolecules and the chemistry of important biological processes.

q. The design of processes (also on industrial scale), taking into account flow and transfer of matter and energy.
r. Properties of chemicals and the involved environmental and safety aspects.

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:

2.1 able to demonstrate and use their knowledge and understanding of essential facts, concepts, principles and theories related to the topics, as defined in Appendix I, in various situations,
2.2 able to apply knowledge and understanding to solve basic qualitative and quantitative problems,
2.3 skilled in evaluating, interpreting and combining chemical information and data,
2.4 able to recognize and implement 'good laboratory practice',
2.5 familiar with project work,
2.6 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:

2.7 skilled in the use of standard laboratory procedures and in the use of equipment for synthetic and analytical work,
2.8 able to verify chemical properties, to observe and measure events or changes, and to systematically archive and document data,
2.9 able to interpret data, obtained from observations and measurements, and relate it to the right theories,
2.10 able to assess the risks of laboratory procedures and the use of chemicals,
2.11 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,
2.12 able to use IT skills appropriate to the chosen specialization.

4. Overview of assessment methods, test moments for course units, and examiners

(WE: Written Exam, MC: Multiple Choice, OE: Oral Exam, R: Report, P: Practica Work, AST: Assignment)

Year	Period	Course Code	Course Name	EC	Assessment*	Formatief Function?	First examiner	Second examiner
1	1a	WBCH004-05	Molecules: Structure, Reactivity, and Function	5	WE,PR		C. Mayer	E. Otten
1	1a	WBCH048-05	Maths for Chemistry and Engineering	5	WE		W.R. Browne	A.H. de Vries
1	1a	WBCH063-05	Concepts of Chemistry	5	R,PR,AST	Yes	N.N.H.M. Eisink	N.H. Katsonis
1	1b	WBCE023-05	Transport Phenomena	5	WE,AST		F. Picchioni	G. Maglia
1	1b	WBCH013-05	Organic Chemistry 1	5	WE		M.D. Witte	J.G.Roelfes
1	1b	WBCH016-05	Practical Course: Synthesis and Analysis	5	R,PR		A.J. Minnaard	T. R. Canrinus
1	2a	WBCH064-05	Biochemistry	5	WE	Yes	M.J.L.J. Fürst	D J. Scheffer
1	2a	WBCH065-05	Biochemistry practical and programming	5			K.M. Tych	W.R.Browne
1	2a	WBCH066-05	Physical Chemistry	5	WE,PR		K.M. Tych	W.R. Browne
1	2b	WBCH011-05	Linear Algebra & Multivariable Calculus for Chemistry	5	WE		P. Lamprou	TBA
1	2b	WBCH039-05	Inorganic Chemistry	5	WE		E. Otten	J.E.M.N. Klein
1	2b	WBCH044-05	Spectroscopy	5	WE		W.R. Browne	M. Tromp
2	1a	WBCH005-05	Organic Chemistry 2	5	WE,AST		S. Harutyunyan	W.R. Browne
2	1a	WBCH006-05	Physical Properties of Materials 1	5	WE,MC,AST		G.R. Blake	B. Noheda Pinuaga
2	1a	WBCH008-05	Synthesis 2 Lab Course	5	R,PR		M.T.C. Walvoort	T. R. Canrinus
2	1b	WBCH009-05	Bioenergy, Metabolism and Bioresources	5	WE		D.J. Slotboom	M.Heinemann
2	1b	WBCH015-05	Physical Chemistry 2	5	WE		A.H. de Vries	W.R. Browne
2	1b	WBCH017-05	Soft Molecular Materials	5	WE	Yes	S. Otto	N.H. Katsonis
2	2a	WBCH023-05	Macromolecular Chemistry	5	WE,P		D. Maniar	K.U. Loos
2	2a	WBCH029-05	Quantum Chemistry	5	WE,PR		R.W.A. Havenith	J.E.M.N. Klein
2	2a	WBCH061-05	Biomacromolecular Chemistry and Analysis	5	R,PR		W.R. Browne	T. R. Canrinus
2	2b	WBCH036-05	Chemical Biology	5	WE		G. Maglia	C. Mayer
2	2b	WBCH037-05	Electrochemistry and Energy	5	WE,R,PR		W.R. Browne	M. Tromp
2	2b	WBCH040-05	Molecular Design	5	WE,PR,AST	Yes	R. Pollice	A.H. de Vries

2	2b	WBCH041-05	Physical Properties of Materials 2	5	WE,P		G.R. Blake	J. Even
2	2b	WBCH042-05	Recombinant DNA and Biotechnology	5	WE,PR,AST		F. Bianchi	A. Belyy
2	2b	WBCH045-05	Chemistry & Society: Ethical and Professional Aspects	5	WE,MC,R		M.J. van den Nieuwenhof-Schilstra	J. Zevenberg
2	2b	WBCH050-05	Green Chemistry and Photochemistry	5	WE,P		J.E.M.N. Klein	R. Hage
3	1a	WBCE006-05	Single-Phase Reactors	5	See assessment plan CE			
3	1a	WBCE021-05	Electrochemical Technology	5	See assessment plan CE			
3	1a	WBCE029-05	Biochemical Engineering	5	See assessment plan CE			
3	1a	WBCE030-05	Polymer Engineering	5	See assessment plan CE			
3	1a	WBCE031-05	Research Trends in Sustainable CE	5	See assessment plan CE			
3	1a	WBCH051-05	Organic Synthesis	5	WE,P		A.J. Minnaard	S. Harutyunyan
3	1a	WBCH052-05	Nuclear and Radiochemistry	5	WE,P		J. Even	P.H. Elsinga
3	1a	WBCH060-05	AI and Machine Learning in Chemistry	5	WE,R,PR	Yes	R. Pollice	W.R. Browne
3	1a	WBPH010-05	Nuclear Energy	5	See assessment plan PH			
3	1a	WBPH023-05	Molecular Biophysics	5	See assessment plan PH			
3	1b	WBCH010-05	Carbohydrates	5	WE		M.T.C. Walvoort	M.D. Witte
3	1b	WBCH018-05	Solar Cells	5	WE,R,P		L.J.A. Koster	G. Portale
3	1b	WBCH062-05	Coordination Chemistry: From Molecules to Materials	5	WE,AST		L. Protesescu	E. Otten
3	1b	WBEC001-05	Introduction to Science Communication	5	See assessment plan EC			
3	1b	WBEC002-05	Introduction to Science Education	5	See assessment plan EC			
3	2a	WBCH019-05	(Bio)catalysis	5	WE		J.G. Roelfes	M.W. Fraaije
3	2a	WBCH021-05	Cellular Chemistry	5	WE,P		F. Bianchi	J.L. Kamenz
3	2a	WBCH024-05	Materials Design: Theoretical Methods	5	WE,R		A. Borschevsky	R.W.H. Havenith
3	2a	WBCH027-05	Physical Organic and Photo- chemistry	5	WE		J.E.M.N. Klein	W.R.Browne
3	2a	WBCH034-05	Trends in Polymer Science	5	WE		G. Portale	K.U. Loos
3	2a	WBCH054-05	Research Practical: Chemical Biology	5	R,P,PR		G. Maglia	M.W. Fraaije
3	2a	WBCH056-05	Research Practical: Polymer Chemistry	5	OE,R,PR		K.U. Loos	D. Maniar
3	2a	WBCH057-05	Research Practical: Materials Design	5	R,PR	Yes	B. Noheda Pinuaga	G.R. Blake
3	2a	WBCH058-05	Research Practical: OMIC	5	R,P,PR		T. Kudernác	J.G. Roelfes
3	2b	WBCH901-15	Bachelor Research Project	15	R,P,PR		Individual Supervisor	Individual Supervisor

Examiners for individual projects

Bianchi, F.
Blake, G.R.
Borschevsky, A *
Broos, J. (BSc)
Browne, W.R.
Canrinus, T.R.
Eisink, N.N.H.M.
Even, J.
Feringa, B.L.
Fraaije, M.W.
Fürst, M.J.L.J.
Guskov, A. (BSc)
Hage, R. *
Harutyunyan, S.
Havenith, R.W.A.
Heinemann, M.
Incarnato, D. *
Kamperman, M.M.G.
Katsonis, N.H.
Klei, I.J. van der (BSc)
Klein, J.E.M.N.
Kortholt, A. (BSc)
Kudernac, T.
Lerch, M.M. *
Loos, K.U.
Maglia, G.
Marrink, S.J.
Mayer, C.
Maniar, D.
Milias Argeitis, A. *(BSc)
Minnaard, A.J.
Noheda Pinuaga, B.
Otten, E.
Otto, S.
Pollice, R.
Poolman, B.
Portale, G.
Protesescu, L. *
Rijn, P. van
Roelfes, J.G.
Roos, W.H.
Slotboom, D.J.
Szymanski, W.C.
Thunnissen, A.M.W.H.
Tromp, M.
Tych, K.M.
Vries, A.H. de
Walvoort, M.T.C.
Witte, M.D.

* Examiners without UTQ, should be accompanied by a certified examiner.

An examiner from the Chemical Engineering Bachelor can act as a second supervisor for a Chemistry Bachelor Research Project.

5. Relationship between course units and details of the learning outcomes

(X : the learning outcome is explicitly assessed in the course.)

	Course	**Year 1 Compulsory courses**																													
	Learning outcomes	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	B7	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.10	2.11	2.12
1a	Molecules: Structure, Reactivity and Function	x	x			x								x	x					x	x		x	x	x	x	x	x	x	x	
1a	Maths for Chemistry and Engineering	x	x		x	x								x				x			x										
1a	Concepts of Chemistry		x		x	x									x		x	x		x	x	x	x			x	x	x			x
1b	Transport phenomena	x	x		x										x			x			x										
1b	Organic Chemistry 1	x	x			x								x	x					x	x										
1b	Practical Course: Synthesis and Analysis		x			x		x				x			x					x		x	x		x	x	x	x	x	x	x
2a	Biochemistry	x	x		x	x	x	x				x			x	x	x		x												
2a	Biochemistry practical and programming		x		x	x		x	x	x	x	x		x	x	x	x			x	x	x	x		x	x	x	x	x	x	x
2a	Physical Chemistry	x	x		x	x								x	x			x		x	x	x									x
2b	Linear Algebra and multivariable calculus	x	x		x	x								x				x			x										
2b	Inorganic Chemistry	x	x			x								x	x					x	x				x						
2b	Spectroscopy	x	x		x	x								x	x			x		x	x										x
	Course	**Year 2 Compulsory courses**																													
	Learning outcomes	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	B7	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.10	2.11	2.12
1a	Organic Chemistry 2	x	x			x			x					x	x					x	x										
1a	Physical Properties of Materials 1	x	x	x		x								x	x	x				x	x										
1a	Synthesis 2 Lab Course					x		x				x								x		x	x		x	x	x	x	x	x	x
1b	Bioenergy, Metabolism and Bioresources		x	x			x					x	x	x		x			x	x	x				x						
1b	Physical Chemistry 2	x	x		x	x								x	x			x		x	x										x
1b	Soft Molecular Materials		x	x										x		x				x	x										

2a	Macromolecular Chemistry	x	x			x					x	x			x			x		x	x										
2a	Quantum Chemistry	x	x			x								x	x			x		x	x										x
2a	Biomacromolecular Chemistry and Analysis		x			x				x		x			x					x	x	x	x	x	x	x	x	x	x	x	x
2b	Chemistry & Society: Ethical and Professional As.	x	x				x			x	x	x	x						x												
	Course	**Year 2 Specialization courses**																													
	Learning outcomes	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	B7	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.10	2.11	2.12
	Smart Materials																														
2b	Molecular Design		x	x	x					x		x		x		x				x	x	x									x
2b	Physical Properties of Materials 2		x	x										x		x				x	x										
	Chemistry of life																														
2b	Chemical Biology		x	x										x		x				x	x	x									
2b	Recombinant DNA and Biotechnology		x	x										x		x				x	x										
	Sustainable Chemistry and Energy																														
2b	Electrochemistry and Energy		x	x	x				x		x			x		x		x		x	x	x	x		x	x	x	x	x	x	x
2b	Green chemistry and photochemistry		x	x			x						x	x		x			x	x	x										
	Course	**Year 3 Compulsory courses**																													
	Learning outcomes	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	B7	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.10	2.11	2.12
2b	Bachelor Research Project	x	x	x	x	x		x	x	x	x	x	x	x	x			x		x	x	x	x	x	x	x	x	x	x	x	x
	Course	**Year 3 Specialization courses**																													
	Learning outcomes	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	B7	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.10	2.11	2.12
	Smart Materials																														
2a	Materials Design: Theoretical Methods		x	x	x											x					x						x	x			x
2a	Trends in Polymer Science		x	x										x		x				x	x										
	Chemistry of life																														
2a	(Bio-)Catalysis		x	x						x		x		x		x				x	x										
2a	Cellular Chemistry		x	x						x				x		x				x	x										
	Sustainable Chemistry and Energy																														

2a	(Bio-)Catalysis		x	x						x		x		x		x				x	x										
2a	Physical Organic and Photo-Chemistry		x	x	x									x		x		x		x	x	x									
	Course	**Year 3 Electives**																													
Learning outcomes		A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	B7	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.10	2.11	2.12
2a	Research Practical: Chemical Biology	x	x	x			x	x	x	x	x				x				x	x	x	x	x	x	x	x	x	x	x	x	
2a	Research Practical: Polymer Chemistry		x	x	x				x	x	x	x				x				x	x	x	x	x	x	x	x	x	x	x	x
2a	Research Practical: Materials Design Experiments		x	x	x				x	x	x	x				x				x	x	x	x		x	x	x	x	x	x	x
2a	Research Practical: OMIC		x	x	x			x	x	x		x	x			x				x	x	x	x		x	x	x	x	x	x	x