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

Programme director : R.K. Bose

Date advice Board of Examiners : 16-7-2024

Date approval Faculty Board :

1. Vision on assessment

1. The programme assesses the students' knowledge, skills and understanding in the field of chemical engineering to design technological processes and products.
2. The programme uses formative and summative assessments and a variety of assessment methods such as written exams, open book exams, oral exams, presentations, and practical work including report writing.
3. The programme assesses the students on their critical thinking and scientific communication.
4. The programme assesses retention and synthesis of knowledge obtained in various courses, thus setting the foundation for lifelong learning.

2. Assessment guidelines

1. The chosen assessment methods should be aligned with the learning objectives and class activities.
2. Grading should be reliable and transparent (e.g. use of rubrics).
3. Individual grades from group assignments should be determined using peer assessment methods or by oral presentation/exam or by assessing the individual contributions to the work.
4. Summative assessment is performed onsite.
5. Formative assessment should be used in courses where possible.
6. Exam viewing sessions and feedback on assignments will be provided.
7. Clear guidelines on the use of AI tools will be provided for each course unit as applicable.

3. Learning outcomes of the degree programme

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 Chemical Engineering has:
1.1. 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.
1.2. Necessary background knowledge of Mathematics and Physics.
1.3. 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:
a. 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 chemical analysis and in the characterization of chemical compounds.
e. The design of industrial processes, taking into account flow and transfer of matter and energy.
f. The principles of Thermodynamics and phase diagrams.
g. Kinetics of various chemical reactions.
h. Dimensional analysis and its application in various (technological) problems.
i. Basic knowledge of fluid dynamics and heat and mass transfer and their application in various parts of process technology.
j. Knowledge of equipment that is used in many chemical processes.
k. The principles of separation methods and their application in industry.
l. Basic knowledge of industrial chemistry and reactor engineering.
m. Materials Science with emphasis on structure-property relationships and their application in various areas of Product Technology (production, analysis, etc.).
n. The principles of production, structure and properties of polymers and the use of these in various types of chemical products.
o. Basic knowledge of Product Technology.
p. Thinking in systems that are relevant for industrial chemistry and technology.
q. The properties of chemicals and the environmental and safety aspects of using them.

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:
2.1 able to demonstrate and use his/her knowledge and understanding of essential facts, concepts, principles and theories related to the topics, as defined in Appendix I, for the (re)design new chemical processes/products.
2.2 able to apply knowledge and understanding to solve basic qualitative and quantitative problems,
2.3 skilled in evaluating, interpreting and combining chemical and process/product technological 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.
2.7 able to work at different levels of abstraction and detail, including system design level,
2.8 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:
2.9 skilled in the use of standard laboratory procedures and in the use of equipment for synthetic and analytical work,
2.10 able to verify chemical properties, to observe and measure events or changes, and to systematically archive and document data,
2.11 able to interpret data, obtained from observations and measurements, and relate it to the right theories,
2.12 able to assess the risks of laboratory procedures and the use of chemicals,

2.13 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,

2.14 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	WBCE034-05	Concepts of Chemical Engineering	5	WE		H.J. Heeres	R.K. Bose
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	1b	WBCE023-05	Transport Phenomena	5	WE,AST		F. Picchioni	D. Parisi
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	WBCE024-05	Sustainability Projects	5	R,P,AST		P. Karka	P.J. Deuss
1	2a	WBCE035-05	Biochemical Technology	5	WE,R,PR		E. Jurak	P.J. Deuss
1	2a	WBCH066-05	Physical Chemistry	5	WE,PR		K.M. Tych	W.R. Browne
1	2b	WBCH011-05	Linear Algebra & Multivariable Calculus for CH	5	WE		P. Lamprou	P.M.J. Tibboel
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	WBCE003-05	Industrial Organic Chemistry and Catalysis	5	WE,AST	Yes	P. Raffa	P. J. Deuss
2	1a	WBCE006-05	Single-Phase Reactors	5	WE,AST	Yes	J. Xie	H.J. Heeres
2	1a	WBCE014-05	Technical Thermodynamics	5	WE	Yes	V. Kyriakou	J.G.M. Winkelman
2	1b	WBCE011-05	Physical Transport Phenomena 2	5	WE		J. Yue	F. Picchioni
2	1b	WBCE032-05	Numerical Analysis for Chemical Engineers	5	WE,P,PR,AST	Yes	P.D. Druetta	D. Parisi
2	1b	WBCE033-05	Chemical Engineering Practical	5	R,PR	Yes	P. Raffa	N.N H.M. Eisink
2	2a	WBCE020-05	Separation Processes	5	WE		D.M. Morales Hernández	P.P. Pescarmona
2	2a	WBCE028-05	Polymer Analysis and Engineering Prac.	5	R,PR		F. Picchioni	D. Parisi
2	2a	WBCH023-05	Macromolecular Chemistry	5	See assessment plan CH			
2	2b	WBCE002-05	General Process Equipment	5	R,P,AST		P. Karka	F. Picchioni
2	2b	WBCE019-05	Product Technology	5	WE,AST	Yes	R.K. Bose	F. Picchioni

2	2b	WBCE026-05	Green Chemistry: TSEA	5	WE,P		M.J. van den Nieuwenhof-Schilstra	P.P. Pescarmona
3	1a	WBCE021-05	Electrochemical Technology	5	WE,R,PR	Yes	W.R. Browne	M. Tromp
3	1a	WBCE029-05	Biochemical Engineering	5	R,PR,AST		E. Jurak	P.J. Deuss
3	1a	WBCE030-05	Polymer Engineering	5	WE,R	Yes	R.K. Bose	D. Parisi
3	1a	WBCE031-05	Research Trends in Sustainable CE	5	R,P,AST	Yes	P.J. Deuss	E. Jurak
3	1a	WBCH006-05	Physical Properties of Materials 1	5	See assessment plan CH			
3	1b	WBCE005-05	Process Control & Dynamics	5	WE,AST		J.G.M. Winkelman	F. Picchioni
3	1b	WBCE007-05	Chemical Process Development and Design	5	R		A. Hommes	J. Xie
3	1b	WBCE012-05	Special Process Equipment	5	WE		Xiaohua Li	J.G.M. Winkelman
3	2a	WBCE016-05	Multiphase Reactors	5	WE		A. Hommes	H.J. Heeres
3	2a	WBCE018-10	Process Design	10	R,P,AST		J.G.M. Winkelman	F. Picchioni
3	2b	WBCE901-15	Bachelor Research Project	15	R,P,PR		Individual Supervisor	Individual Supervisor

Examiners for individual projects

Acuautla Meneses, M.I.
Bose, R.K.
Deuss, P.J.
Duchateau, R.*
Druetta, P.D.
Euverink, G.J.W.
Heeres, H.J.
Jurak, E.
Kamperman, M.M.G.
Karka, P.
Kottapalli, A.G.P
Kyriakou, V
Morales Hernández, D.M.
Parisi, D.
Pescarmona, P.P.
Picchioni, F.
Protesescu, L.*
Raffa, P.
Winkelman, J.G.M.
Xie, J.
Yue, J.

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

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

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	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.10	2.11	2.12	2.13	2.14
1a	Concepts of Chemical Engineering	x	x			x									x	x	x	x	x	x	x										
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												
1b	Transport phenomena	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	Sustainability Projects		x	x				x		x	x	x		x			x	x				x									x
2a	Biochemical Technology	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 for CH	x	x		x	x								x				x			x										
2b	Inorganic Chemistry	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	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.10	2.11	2.12	2.13	2.14
1a	Industrial organic chemistry and catalysis	x	x			x			x					x	x			x	x												
1a	Single-Phase Reactors	x	x		x	x								x	x	x		x	x												
1a	Technical Thermodynamics		x			x									x	x				x											
1b	Physical Transport Phenomena 2		x			x									x	x				x											
1b	Numerical Analysis for Chemical Engineers		x		x	x									x	x	x														
1b	Chemical Engineering Practical					x		x	x			x						x	x	x	x	x	x			x	x	x	x	x	x
2a	Separation Processes		x			x									x	x		x	x	x											

2a	Polymer analysis and engineering practical		x			x				x		x			x	x			x	x	x	x	x	x			x	x	x	x	x
2a	Macromolecular Chemistry	x	x			x					x	x			x	x	x		x	x												
2a	General Process Equipment	x	x		x	x									x	x				x	x			x		x						
2b	Product Technology	x	x	x		x			x	x					x	x		x	x	x	x		x									
2b	Green Chemistry: TS&E aspects	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	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.10	2.11	2.12	2.13	2.14		
1b	Process Control & Dynamics		x		x	x									x				x												x		
1b	Chemical Process Development and Design		x		x				x	x	x	x				x			x		x			x	x	x							
1b	Special Process Equipment	x	x	x	x	x			x	x	x	x			x	x			x	x	x		x	x		x							
2a	Multiphase Reactors		x			x									x	x				x													
2a	Process Design	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		
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 Electives**																															
Learning outcomes		A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	B7	1.1	1.2	1.3	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.10	2.11	2.12	2.13	2.14		
1a	Electrochemical Technology	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		
1a	Biochemical Engineering	x	x	x	x			x	x		x	x	x	x	x			x	x	x	x												
1a	Polymer Engineering	x	x	x	x		x		x	x	x	x	x		x			x	x	x													
1a	Research trends in sustainable CE	x	x	x			x	x		x		x	x	x			x			x													