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Appendices for the Master's degree programme Chemical Engineering

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Appendix I. Learning outcomes of the degree programme (art. 3.1)

Appendix I Learning outcomes of the degree programme (art. 3.1)

The objectives of the master's degree programme Chemical Engineering are:

- to prepare students for an independent professional career; in this context this means being able to carry out fundamental or applied scientific research, as well as applying state of the art scientific variety of new practical situations,
- to make students develop skills, knowledge and insight in a specialization area of the field of study, with a focus on insight in and approach to scientific problems,
- to make students develop the ability to clearly and concisely communicate the acquired knowledge to others.

The objectives of the programme result in the following learning outcomes

A. General academic skills for the master's degree programme Chemical Engineering

The graduate

A1. is able to keep up with and make use of professional literature in relevant subfields,
A2. is able to make themselves familiar with a subfield of the own discipline within a reasonable time span,
A3. is able to formulate a research plan based on a global problem description in a subfield of the own discipline,
A4. is able to analyze, interpret using state of the art information, and draw conclusions from research results,
A5. is able to operate effectively in a position in which knowledge and research skills within the field of the own discipline are required,
A6. is able to perform in a multidisciplinary team, transfer knowledge to others, give oral presentations, write a report or internationally accessible scientific article, and take part in a scientific discussion,
A7. is able to design, conduct and evaluate experiments and the necessary checks and balances independently,
A8. is able to relate their own results and conclusions to results already available in the literature,
A9. has sufficient understanding of the role of the own discipline in society to come to a well-considered choice and practice of profession,
A10. has an understanding of the role of their own discipline in a sustainable society.

B. Specific academic knowledge and skills for the master's degree programme Chemical Engineering.

Engineering knowledge and skills: the graduate has acquired specific knowledge and skills in the area of fundamental and applied engineering sciences. More specifically, the graduate:

B1. is able to design a realistic process including specifying the sub-steps, like drawing flow charts, describing equipment and process flows, and calculating the behavior of process equipment; as well as to provide alternatives for these separate steps,

B2. has an understanding of: (i) process-product relations, (ii) ways to minimize byproduct and waste streams, (iii) manufacturing routes for classes of molecules and products.

Academic knowledge and skills in the product and process technology: the graduate is able to design chemical products and the related process based on a multidisciplinary approach (chemical and technological aspects). More specifically, the graduate:

B3. has knowledge on product formulation, specifications, catalytic systems, analytical methods, interactions between components and relevant physical and mechanical methods for the manufacture of chemical or biotechnological products within one of the 'product sectors' industrial catalysis, polymeric products or renewable energy.

B4. is able to design a realistic product and associated process, either focussing on the product within one of the 'product sectors' industrial catalysis, polymeric products or renewable energy, or focussing on the process through advanced process technology. This includes an analysis and design of all sub-steps, including specification of product properties, product flow diagrams, a description of the process and processing equipment, as well as providing alternatives for these steps.

B5. (Science, business and policy track) is prepared for a professional career in business and policy.

Appendix II. Tracks/specializations (art. 3.6)

The degree programme has the following tracks:

- Research track
- Science, Business and Policy

Appendix III. Content of the degree programme (art. 3.8)

Research Track

Practicals are defined as lab practicals

Course unit	Course code	ECTS	Practical	Entry requirements
Research project	WMCE901-45	45	x	Passed 25 ECTS of the compulsory courses of the Master's degree programme of Chemical Engineering, completion of Scientific Integrity and Safety, submitting study programme
Internship	WMCE014-20	20*	x	Passed 25 ECTS of the compulsory courses of the Master's degree programme of Chemical Engineering, completion of Scientific Integrity and Safety, submitting study programme
Scientific Integrity and Safety	WMCE020-00	-		
Processes and Products for a Sustainable Carbon Cycle	WMCE021-05	5		
Catalysis for Engineers	WMCE002-05	5		
Interfacial Engineering	WMCE003-05	5		
Electrochemical Systems and Engineering (ME)	WMME029-05	5		
Polymer Products	WMCE005-05	5		
Advanced Product Engineering	WMCE007-05	5		
Electives**		25		

*The Internship is 20 ECTS and can be extended, before the start of the project, to 25 or 30 ECTS (at the expense of one or two elective courses).
** A minimum of 15 ECTS to be chosen from the courses from the list in Appendix IV Table 1. With the additional requirement that a minimum of 5 ECTS should come from choice group 1 and 5 ECTS from choice group 2.

Science, Business and Policy track

Practicals are defined as lab practicals

Course unit	Code	ECTS	Practical	Entry requirements
Research project	WMCE901-45	30	x	Passed 25 ECTS of the compulsory courses of the Master's degree programme of Chemical Engineering, completion of Scientific Integrity and Safety, submitting study programme
Scientific Integrity and Safety	WMCE020-00	-		
Processes and Products for a Sustainable Carbon Cycle	WMCE021-05	5		
Catalysis for Engineers	WMCE002-05	5		
Interfacial Engineering	WMCE003-05	5		
Electrochemical Systems and Engineering (ME)	WMME029-05	5		
Polymer Products	WMCE005-05	5		
Advanced Product Engineering	WMCE007-05	5		
Introduction Science and Business	WMSE001-10	10		
Introduction Science and Policy	WMSE002-10	10		
Work Placement Business and Policy	WMSE902-40	40	x	Intr. to Science and Business, Intr. to Science and Policy

Appendix IV. Electives (art. 3.9.1)

Table 1: electives offered by CE

Course unit	Course code	ECTS	Practical	Entry requirements
Choice Group 1				
Design of Industrial Catalysts	WMCE009-05	5		
Advanced Polymer Processing	WMCE006-05	5		
Compressible Flows	WMCE008-05	5		
CFD for Engineers	WMCE013-05	5		
Choice Group 2				
Advanced Process and Energy Technologies	WMCE012-05	5		
Biocatalysis for Engineers	WMCE015-05	5		
Product Focused Process Design	WMCE011-05	5		
Circular Polymers	WMCE017-05	5		
Other electives				
Advanced LCA for Sustainability (IEM)	WMIE034-05	5		
Food Pharma Products (IEM)	WMIE008-05	5		
Microfluidics (ME)	WMME020-05	5		

Table 2: electives offered outside CE

Course unit	Course code	ECTS	Practical	Entry requirements
Advanced Processing for Complex Materials (ME)	WMME007-05	5		
Bioinspired Designer Materials	WMCH009-05	5		
Properties of Functional Materials	WMPH051-05	5		
Analysis and Control of Smart Systems	WMIE015-05	5		
Characterisation of Materials (PH)	WMPH021-05	5		
Sustainable Energy Supply (FEB)	EBM202A05	5		
Sustainable Industrial Practice (IEM)	WMIE027-05	5		
Electives on individual approval of the Board of Examiners			See course unit	

Appendix V. Entry requirements and compulsory order (art. 4.4)

Entry requirements are mentioned in tables appendices III and IV.

Appendix VI. Admission to the degree programme (art. 2.1A.1 + 2.1B.1)

Holders of the following Bachelor's degrees from the University of Groningen are considered to have sufficient knowledge and skills and will be admitted to the Master's degree programme in Chemical Engineering on that basis:
- BSc Chemical Engineering

Students with a background in Chemical Engineering or related bachelor's degree programme and interested in pursuing a master's degree programme in Chemical Engineering are encouraged to apply through the Admissions Office of the Faculty of Science and Engineering. The Board of Admissions of Chemistry and Chemical Engineering will then assess the application and decides whether the applicant has sufficient background to register for the programme, possibly after following a bridging premaster's programme.

Appendix VII. Pre-master programmes

1. FSE offers Pre-Master's programmes of *60 EC, 40 EC or 30 EC*, for access to the MSc Chemical Engineering and individually determined Pre-Master's programmes. The overview below shows which programmes grant access to the MSc Chemical Engineering:
   - which NVAO-accredited HBO diploma(option a);
   - which Fast track option (option b)
   - which WO Bachelors (option c and d)
   - The content and student workload for these fixed programmes.

   a. Bachelor Chemische Technologie (Hanze/NHL) (34275)

   Pre-master

Semester	Course Title	Course Code	ECTS
1a	Industrial Organic Chemistry and Catalysis	WBCE003-05	5
1b	Chemical Engineering Practical	WBCE033-05	5
1b	Physical Transport Phenomena 2	WBCE011-05	5
2a	Multiphase Reactors	WBCE016-05	5
2b	Green Chemistry: Technological, Societal and Ethical Aspects	WBCE026-05	5
2b	Product Technology	WBCE019-05	5
Total			**30**

   - Starting date(s): 1 September

   b. **Fast-track**
   This programme is intended to be taken in the minor space of the HBO Bachelor Chemische Technologie or equivalent.

Semester	Course Title	Course Code	ECTS
1a	Industrial Organic Chemistry and Catalysis	WBCE003-05	5
1a	Polymer Engineering	WBCE030-05	5
1a	Biochemical Engineering or Electrochemical Technology or Research Trends in Sustainable CE	WBCE029-05 or WBCE021-05 or WBCE031-05	5
1b	Chemical Engineering Practical	WBCE033-05	5
1b	Physical Transport Phenomena 2	WBCE011-05	5
1b	Process Control & Dynamics	WBCE005-05	5
Total			**30**

   - Starting date(s): 1 September

c. **Bachelor Chemistry (RUG)** (56857)

Semester	Course Title	Course Code	ECTS
1a	Polymer Engineering	WBCE030-05	5
1a	Single-Phase Reactors	WBCE006-05	5
1a	Biochemical Engineering or Electrochemical Technology or Research Trends in Sustainable CE	WBCE029-05 or WBCE021-05 or WBCE031-05	5
1b	Chemical Engineering Practical	WBCE033-05	5
1b	Special Process Equipment	WBCE012-05	5
1b	Process Control & Dynamics	WBCE005-05	5
2a	Process Design	WBCE018-10	10
2a	Separation Processes	WBCE020-05	5
2b	Product Technology	WBCE019-05	5
2b	Applied Transport Phenomena for Sustainable Processes (IEM)	WBIE058-05	5
2b	Gas-Liquid Mass Transfer (IEM)	WBIE036-05	5
Total			**60**

- Starting date(s): 1 September

d. **Bachelor IEM (RUG)** (56994)

Semester	Course Title	Course Code	ECTS
1a	Industrial Organic Chemistry and Catalysis	WBCE003-05	5
1a	Biochemical Engineering	WBCE029-05	5
1a	Polymer Engineering	WBCE030-05	5
1b	Chemical Engineering Practical	WBCE033-05	5
2a	Separation Processes	WBCE020-05	5
2a	Polymer Chemistry	WBCE037-05	5
2a	Polymer analysis and engineering practical	WBCE028-05	5
2b	Green Chemistry: Technological, Societal and Ethical Aspects	WBCE026-05	5
Total			**40**

- Starting date(s) 1 September

Appendix VIII. Transitional provisions (art. 7.1)

For cohort 2024-2025 and earlier

Course	May be replaced with	Info
Homogeneous Catalysis (WMCE010-05)	-	Course no longer exists
Engineered Nanomaterials for Industry (WMCE016-05)	-	Course no longer exists

Appendix IX. Additional Requirements Open degree Programmes (art. 3.10)

Students intending to pursue an open program must submit their program for approval, ensuring it demonstrates coherence and sufficiently covers the Learning Outcomes of the Masters Chemical Engineering program.

Additionally, students must contact the Programme Director within the first six months of their MSc registration to seek advice and prepare an application, which will then be submitted to the Board of Examiners for review and approval.

The Board of Examiners will approve the open degree program if the proposed program:

- adequately covers the Learning Outcomes of the Masters Chemical Engineering
- demonstrates clear overall coherence