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9 Description of the education (the units of study)

This chapter describes the education provided in your degree course in the form of a curriculum overview and description of the units of study, starting with the units of study in the propaedeutic phase, then those of the post-propaedeutic phase, the minors and tracks with a special feature.

Name degree program: Chemie			
CROHO-number: 34396			
Degree format	Full-time		Part-time
Language	Dutch	English	Dutch
Variants and tracks	Abridged English variant (Chemistry)		Abridged

Below is a schematic overview that gives you an overall impression of the degree program. It also gives the units of study in the degree program.

The part-time degree format of chemistry participates in the Flexibilisation Experiment under Article 1.7a WHW. This degree format is not regulated in this EER, but can be found in the EER of part-time Chemistry on https://www.han.nl/werken-en-leren/studiekeuze/bachelor/chemie/programma

Curriculum table propaedeutical phase

A: Overview of Chemie (Dutch) Foundation Year

Term 1	Term 2	Term 3	Term 4
BMC1A, 4 credits	BMC1A, 4 credits	C3K, C3P, C3T 3x5 credits	C4K, C4P, C4T 3x5 credits
BMC1B, 5 credits	BMC1B, 5 credits		
BMC1C, 6 credits	BMC1C, 6 credits		

B: Overview of English variant Chemistry Foundation Year

Term 1	Term 2	Term 3	Term 4
CHLS1A, 4 credits	CHLS1A, 4 credits	CH3K, CH3P, CH3T 3x5 credits	CH4K, CH4P, CH4T 3x5 credits
CHLS1B, 5 credits	CHLS1B, 5 credits		
CHLS1C, 6 credits	CHLS1C, 6 credits		

Curriculum table postpaedeutical phase

A: Overview of Main Phase full-time Chemie (Dutch)

		Term 1	Term 2	Term 3	Term 4
2nd year		C7K, C7T 2x5 credits	C5K, C5T 2x5 credits	C6K, C6T 2x5 credits	C8K, C8T 2x5 credits
		C5-7Pa, C5-7Po 2x5 credits		C6-8Pa, C6-8Po 2x5 credits	
3rd year	Graduation Specialisation Organic chemistry	C9 30 credits		Minor or placement (C13) 30 credits	
	Graduation Specialisation Analytical chemistry	Minor or placement (C13) 30 credits		C11 15 credits	C12 15 credits
4th year		Minor, placement (C13) or graduation project (C14)		Minor or graduation project (C14)	

		30 credits	30 credits

B: Overzicht of Main phase full-time English variant Chemistry

		periode 1	periode 2	periode 3	periode 4
2nd year		CH7K, CH7T 2x5 credits	CH5K, CH5T 2x5 credits	CH6K, CH6T 2x5 credits	CH8K, CH8T 2x5 credits
		CH5-7Pa, CH5-7Po 2x5 credits		CH6-8Pa, CH6-8Po 2x5 credits	
3rd year	Graduation Specialisation Analytical chemistry	Minor or placement (CH13) 30 credits		CH11 15 credits	CH12 15 credits

Safety

If students by exemptions or other measures enter the degree program in the main phase, they are required to take the workshop 'Safety in the laboratory' or take notice of the safetyprotocol to ensure that students can work safely in the laboratories at Laan van Scheut 2.

9.1 Units of study of the propaedeutic phase

The foundation year of the study degree program includes the following eductional units with the associated studyload.

A. Full-time Chemie (Dutch)
   a. Course unit 1A: BMC1A (4 study credits)
   b. Course unit 1B: BMC1B (5 study credits)
   c. Course unit 1C: BMC1C (6 study credits)
   d. Course unit 2A: BMC2A (4 study credits)
   e. Course unit 2B: BMC2B (5 study credits)
   f. Course unit 2C: BMC2C (6 study credits)
   g. Course unit 3K: C3K (5 study credits)
   h. Course unit 3P: C3P (5 study credits)
   i. Course unit 3T: C3T (5 study credits)
   j. Course unit 4K: C4K (5 study credits)
   k. Course unit 4P: C4P (5 study credits)
   l. Course unit 4T: C4T (5 study credits)

B. Full-time Chemistry (English variant)
   a. Course unit 1A: CHLS1A (4 study credits)
   b. Course unit 1B: CHLS1B (5 study credits)
   c. Course unit 1C: CHLS1C (6 study credits)
   d. Course unit 2A: CHLS2A (4 study credits)
   e. Course unit 2B: CHLS2B (5 study credits)
   f. Course unit 2C: CHLS2C (6 study credits)
   g. Course unit 3K: CH3K (5 study credits)
   h. Course unit 3P: CH3P (5 study credits)
   i. Course unit 3T: CH3T (5 study credits)
   j. Course unit 4K: CH4K (5 study credits)

k. Course unit 4P: CH4P (5 study credits)
l. Course unit 4T: CH4T (5 study credits)

This section only contains the Course unit descriptions of the English variant of the study program. The Dutch Course unit descriptions can be found in the Onderwijs en Examenregeling of the study program Chemie.

Course unit 1A: CHLS1A (4 study credits)

	CHLS1A
General information	
Target group	Full-time foundation year students Life Science, BML and Chemistry
Name of course unit	CHLS1A: Basic Skills
Study unit code	CHLS1A
Teaching term	1
ECTS credits	4 ECTS
Study load in hours	112 SBU
Study hours (contact hours)	Programmed contact time: average of 7.5 lessons periods per week, 53 lessons per term= 39.75 hours Scheduled time for exams: 3 hours Planned time for self-study: 69.25 hours Total: 112 hours
Unit of study entry requirements	HAVO /VWO diploma with the Nature and Technology or Nature and Health profile, MBO diploma level 4.
Content and organization	
General description	In CHLS1A, subjects introduced are essential to the degree programme. The basic knowledge on lab calculations, mathematics and safety is the central focus of this course unit. Workshops also focus on basic skills that are important when working together at HBO level.
Exit qualifications	- Quality control - Teamwork - Professional development
Professional tasks and products	Carrying out scientific research.
Professional products	
Cohesion	CHLS1A is the first course of the degree programme. In this course, basic knowledge is learned or brought to the required level.
Mandatory participation	Participation in the Professional Skills 1 workshop is mandatory
Maximum number of participants	
Compensation possibilities	
Activities and/or teaching methods	**Support subject: Laboratory calculations** - Concentrations - Dilutions - Average, range, standard deviation, coefficient of variation

	- Mol and molar mass - Molecular and empirical formulas Teaching methods: Combined lectures/tutorials **Supporting subject: Mathematics** Basic calculation rules (including formulae) Isolate various functions, including equations and variables: - Linear - Quadratic functions - Broken functions Teaching methods: Combined lectures/tutorials **Supporting subject: Safety** - Laboratory Rules - Safe handling of materials - Waste categories - Practical rules/accident or incident Teaching methods: Lectures and work discussion in the lab **Supporting subject: PDL Professional Skills 1:** - Exercising basic skills for working together, giving feedback, active listening, summarising, asking questions - Gaining insight into different ways of feedback in an intercultural setting - Gaining insight into one's own strengths and learning points with regard to cooperation and feedback Teaching methods: Workshop
Required literature	The latest edition of: - Heron-reeks Managing safety, health and environmental risks in laboratories V € 37,41 Leven, Iris van 't | Syntax Media bv | Druk: 2 | The following e-books: - Mathematics Fundamentals (https://bookboon.com/en/mathematics-fundamentals-ebook) - Precalculus (https://openstax.org/subjects/math)
Required software/materials	
Recommended literature	Verkerk G. et al. BINAS book VWO HAVO Groningen: Noordhoff Uitgeverij.
Examination	
	CHLS1A-Lab
Name of examination or modular examination	Lab calculations
Examination or modular examination code	CHLS1A-Lab
Assessment types(s):	Individual written open questions

Result	Grade
Passing grade	5.5
Weight factor of modular exams	2
Exam opportunities	In case of physical lessons: Modular exams during term 1. Resit end of term 1 and 3 In case of online lessons: CHLS1A-Lab: Term 1, term 3. Resit mid-term 2.
Permitted resources	Non-graphic calculator, periodic table
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the assessment period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is held during a lesson of Lab calculations BMC2A. The discussion of exams taken in a resit period is scheduled at the end of the education period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 examiners for the construction and the evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	
Assessment dimensions	Knowledge of lab calculations: Systematically work out problems in lab work using elementary calculation rules and the several core relationships.
Assessment criteria	The student is able to: Calculate volume and mass using density of a solution; Perform calculations with percentages and fractions; Apply descriptive statistics and display answers in scientific notation and correct significance; Calculate atomic mass, molecular mass and formula mass of a substance; Calculate with mole and molar mass; Calculate molecular and empirical formulas of a substance; Calculate the concentration of a substance after dilution.
Exam matrix	Modular exams: 1. Concentrations 1 + Dilutions 1 30% 2. Average & dispersion + Mol & Molar mass 30% 3. Molecular and empirical formulas + Concentrations & Dilutions 2 40%

	CHLS1A-Wis
Name of examination or modular examination	Mathematics
Examination or modular examination code	CHLS1A-Wis
Assessment types(s):	Individual, written, open questions
Result	Grade
Passing grade	5.5
Weight factor of modular exams	2
Exam opportunities	CHLS1A-Wis: term 1, term 3. Resits during term 2.
Permitted resources	Non-graphic calculator
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the assessment period or the resits. The period is published in the SABC annual schedule on Insite-Timetables
Discussion and review	• The SABC annual schedule indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is held during a Mathematics lesson of BMC2A.The discussion of exams taken in a resit period is scheduled at the end of the education period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 examiners for the construction and the evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	
Assessment dimensions	Knowledge of mathematics
Assessment criteria	The student masters the following basic math skills: Calculation sequence and calculations with fractions Manipulating formulas with powers (with whole, negative and broken exponents), scientific notation Factor analysis and removing brackets; Defining fraction formulas and solving equations with fractions, isolating variables, inverse functions Finding a straight line, solving first-degree equations Solve equations of quadratic functions and broken functions, power functions Isolate variables at linear, quadratic functions and broken functions
Exam matrix	1 question covering each of the following subjects: where each of the 10 questions is worth 10% of the CHLS1A-Wis grade.

	Addition/subtraction + simplification of fraction formulas Multiplying/dividing fractional formulas + simplifying power formula simplify (writing without fractional and/or negative exponent) Removal of parentheses Isolation of fraction equations Equation through two points or by drawing a graph Determination of the intersection between 2 functions or solving systems of equations Solving second degree equations by factorizing or abc formula Solve broken equation Asymptote broken function
	CHLS1A-Kvei
Name of examination or modular examination	Theory exam: Safety
Examination or modular examination code	CHLS1A-Kvei
Assessment types(s):	Individual, Written, Multiple choice questions
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 1, resit end term 1. Term 3, resit end term 3
Permitted resources	
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the assessment period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam will be scheduled before the resit. The discussion of the resit is scheduled in the following teaching period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 examiners for the construction and the evaluation. 1 Examiner for the assessment (Safety lecturer).
Possibilities for compensation	
Assessment dimensions	Knowledge of safety in the lab.
Assessment criteria	The student: Can apply general and specific laboratory rules; Is familiar with safety equipment available and how they should be used; Recognize the safety symbols, GHS pictograms dangerous substances and knows how to act appropriately; Know the short- and long-term effects of harmful substances on

	the human body and the environment; Knows and can apply the definitions of the safety concepts: limit value, LD50 value, H and P statements; Can estimate fire and explosion risk based on physical fire related concepts; Can look up safety information on substances in MSDS sheets and chemistry charts; Knows and recognises the biological agents Knows the rules on “safe microbiological techniques”; Knows the rules on processing lab waste (chemicals and biological agents); Can indicate how first aid should be applied in lab situations;
Exam matrix	10% Laboratory rules 50% Safe handling of materials 15% Categories of waste 25% Practical rules/accident or incident
	CHLS1A-PS1
Name of examination or modular examination	Professional Skills 1
Examination or modular examination code	CHLS1A-PS1
Assessment types(s):	Oral, Individual
Result	Satisfactory / Not Satisfactory
Passing grade	Satisfactory
Weight factor of modular exams	0
Exam opportunities	There is only one opportunity for the workshop (EER 8.5) See the class roster.
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in CHLS1A counts as registration for CHLS1A-PS1.
Discussion and review	For questions about the assessment, please contact the examiner.
Number of examiners	One examiner for the assessment (workshop lecturer).
Possibilities for compensation	
Assessment dimensions	Competence 8: Cooperation / communication / internationalization 8.1.1. Adheres to rules. 8.1.2. Makes a valuable contribution to the group. 8.1.6. Maintains eye contact with conversation partner 8.1.7. Gives others opportunity to speak. 8.1.8. Verbally expresses their opinion/message. 8.1.9. Is active in conflict resolution. 8.1.12. Is aware of the international character of the professional community. Competence 11: Professional development

	11.1.3. Reflects critically on their actions and learning process; learns from mistakes.
Assessment criteria	An active participation in the Professional Skills 1 workshop is required for a satisfactory assessment. At the end of the academic year a team discussion takes place in which the student has to demonstrate their professional skills.

Course unit 1B: CHLS1B (5 study credits)

	CHLS1B
General information	
Target group	Full-time students Common Foundation Year - Life Sciences, Biology and Medical Laboratory Research, Chemistry
Name of course unit	CHLS1B: Basic practical skills Chemistry, Biology & Medical (Basispraktijkvaardigheden Chemie, Biologie & Medisch CHLS1B)
Study unit code	CHLS1B
Teaching term	1
ECTS credits	5 study credits
Study load in hours	140 SBU
Study hours (contact hours)	Biology and Medical Practical/ Chemistry Practical/ Tutorial/ Workshops Programmed contact hours: Avg. 11.7 periods (lesson periods) per week= 82 periods in term 2 = 61.5 clock hours per term Planned time for self-study: 78.5 hours per term Total: 140 hours
Unit of study entry requirements	HAVO (higher general continued education)/VWO (pre-university) diploma with the Nature and Technology or Nature and Health profile, MBO diploma level 4.
Content and organisation	
General description	Based on the themes of basic techniques, spectrophotometry and separation techniques, both the biological and chemical aspects are highlighted. In addition, professional attitude is developed in the tutorial through development assignments.
Exit qualifications	Design of experimental plan Experimenting Results Analysis Quality control Management and administration Reporting and presenting Methodology Professional development
Professional tasks and products	Carrying out scientific research.
Professional products	Lab journal, IPS
Cohesion	CHLS1B is related to CHLS1A and CHLS1C.

Mandatory participation	CHLS1B-P: In case of unsatisfactory attendance of practice and workshops (knockout) practical assessment is 0.0 (assessment form will not be filled in further). CHLS1B-IPV: In case of unsatisfactory participation, IPS assessment is unsatisfactory.
Maximum number of participants	
Compensation possibilities	
Activities and/or teaching methods	**Practical Biology & Medical:** Histology staining, Cytology, Microbiology, Molecular techniques, Microscopy, Biochemical techniques. *Teaching methods: Lab practicals* **Practical Chemistry:** Weighing, Pipetting, Titration, Dilution, Spectrophotometry, Synthesis, Refractive index, IR spectrometry, TLC *Teaching methods: Lab practicals* **Tutorial** What are tutorials? Cell structure Spectro techniques Basic Excel *Teaching methods: project group meetings* **Workshops** Scientific writing: Lab journal Excel: data analysis in Excel *Teaching methods: interactive workshops*
Required literature	The latest version of: Campbell N, Reece J, *Biology*, Pearson Education Inc Nivaldo J Tro; *Principles of chemistry,* Pearson Dean, J.R. *et al*.: *Practical skills in Chemistry/Biomolecular sciences*, Prentice Hall, Harlow
Required software/materials	LabArchives, Microsoft Office
Recommended literature	

Examination	
	CHLS1B-P
Name of examination or modular examination	Practical
Examination or modular examination code	CHLS1B-P
Assessment types(s):	Individual, Practice, Written
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 1: There is only one opportunity per year for the modular exam CHLS1B-P (EER art. 8.5)
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in CHLS1B is considered as registration for CHLS1B-P.
Discussion and review	The filled-in assessment form with any feedback is considered the discussion and review of this modular assessment.
Number of examiners	Assessment by one examiner on the basis of assessment forms (practical lecturer).
Possibilities for compensation	
Assessment dimensions	Competence 1: Design 1.1.4. Forms a hypothesis based on the research question. Competence 2: Experimenting 2.1.1. Reads and understand the practical guide; understands the theoretical background of the main steps of the methods. 2.1.2. Performs calculations prior to beginning lab work. 2.1.3. Ensures that all requirements are present before beginning the experiment. 2.1.4. Carries out experiments accurately according to the protocol. 2.1.5 Carries out the experiment within the given time frame. Competence 3: Results Analysis 3.1.1. Carries out results analysis according to the prescribed methods; performs error analysis in the correct manner (if applicable). 3.1.2. Evaluates the obtained results based on their accuracy and reliability. 3.1.3. Makes conclusions relating to the initial research question (if possible). 3.1.4. Discusses the execution of the experiment and results. Competence 4: Quality control 4.1.1. Is aware of the health and safety rules and works according to these rules. 4.1.2. Uses materials and equipment correctly.

	Competence 5: Management and administration 5.1.1. Encodes chemicals and samples; stores these in the prescribed manner. 5.1.2. Leaves the workplace tidy and clean. 5.1.3. Manages and archives data in lab journal (aim, experiment description, alterations, results, conclusion) and if relevant, other ways of storing data. Competence 6: Reporting and presenting 6.1.1. Reports their research according to the product criteria for lab journal and reports; Level 1: 6.1.3 Is familiar with the international conventions of scientific and academic writing. Competence 7: Methodology 7.1.3. Works according to the previously described plan. Competence 11: Professional development 11.1.5. Has study skills required by higher professional education; is motivated and determined.
Assessment criteria	See assessment form on #OnderwijsOnline under General Information. Practical assessment: Lab journals and the practical impression throughout the course will be assessed as a whole using the assessment form.
Exam matrix	See assessment form on #OnderwijsOnline under General Information. Practical assessment: 12.5% Lab journal: General 25% Preparation 40% Practical Performance 22.5% Analysis
	CHLS1B-IPV
Name of examination or modular examination	IPS
Examination or modular examination code	CHLS1B-IPV
Assessment types(s):	Individual, Oral, Written
Result	Satisfactory/ Unsatisfactory
Passing grade	Satisfactory
Weight factor of modular exams	1
Exam opportunities	Term 1: There is only one opportunity per academic year for the modular exam CHLS1B-IPV (EER art. 8.5)

Permitted resources	
Method of enrolment for exam/enrolment period	Participation in CHLS1B is considered as registration for CHLS1B-IPV.
Discussion and review	For questions about assessment, contact the examiner.
Number of examiners	One examiner (tutor) for the assessment based on participation and effort.
Possibilities for compensation	
Assessment dimensions	Competence 7: Planning and project-based working Works according to the previously described plan. Competence 8: Team work 8.1.1. Adheres to rules. 8.1.2. Makes a valuable contribution to the group. Communicates his task to fellow students and lecturer according to the basic rules of communication; if needed, supervised by the lecturer. 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.1.8. Verbally expresses their opinion/message. Competence 11: Professional development 11.1.5. Has study skills required by higher professional education; is motivated and determined.
Assessment criteria	The student: - Has prepared for the meeting by completing the assignment to be discussed, and also completed the required reading for the following assignment to be discussed; - Is able to show weekly assignments to the tutor (according to agreement, in writing or as a presentation); all required aspects are complete in all assignments; - Adheres to the rules agreed upon; - Asks questions and shares knowledge regarding the assignment during tutorials; verbalizes these clearly and audibly, maintains eye contact; - Gives others opportunity to speak; - The student offers feedback to group and class members and is open to receiving feedback; - Is satisfactorily present during the tutor lessons (missed a maximum of 1 lesson for a good reason); - Submits a reflection report on the professional attitude to the tutor.

Course unit 1C: CHLS1C (6 study credits)

	CHLS1C
General information	
Target group	Full-time students common foundation year - Life Sciences, Biology and Medical Laboratory Research, Chemistry

Name of course unit	CHLS1C: Basic theory Biology&Medical and Chemistry 1 (Basistheorie Biologie&Medisch en Chemie 1 CHLS1C)
Study unit code	CHLS1C
Teaching term	1
ECTS credits	6 study credits
Study load in hours	168 SBU
Study hours (contact hours)	Programmed contact hours: 6 lesson periods/week, 42 lesson periods/term = 31.5 hours Scheduled time for exams: 4 lesson periods per term =3 hours Planned time for self-study: 133.5 hours Total: 168 hours
Unit of study entry requirements	HAVO (higher general continued education)/VWO (pre-university) diploma with the Nature and Technology or Nature and Health profile, MBO diploma level 4.
Content and organisation	
General description	Students work from different angles on basic biological, medical and chemical knowledge.
Exit qualifications	Design Experimenting Results Analysis Quality control
Professional tasks and products	Carrying out scientific research.
Professional products	
Cohesion	CHLS1C is related to CHLS1A and CHLS1B
Mandatory participation	
Maximum number of participants	
Compensation possibilities	Final grade CHLS1C = (CHLS1C-Tbm + CHLS1C-Tc) /2 ≥ 5.5 CHLS1C-Tbm en CHLS1C-Tc may be compensated from ≥ 4.5.
Activities and/or teaching methods	**Support subject: Biology&Medical:** Biological macromolecules Cell structure and function Prokaryotic versus eukaryotic Cell respiration Mitosis *Teaching methods: Combined lectures/tutorials* **Supporting subjects: *Theory of the Life Science/ Biology & Medical lab practicals*** Theoretical background to lab practical *Teaching methods: Combined lectures/tutorials* **Supporting subjects: Chemistry** Atoms and elements Nomenclature of molecules and salts Spectrophotometry

	Redox reaction *Teaching methods: Combined lectures/tutorials* **Supporting subjects: Theory of the chemistry practicals** Theoretical background to lab practical *Teaching methods: Combined lectures/tutorials*
Required literature	Latest version of Campbell and Reece, Biology, a Global Approach, Pearson Education Latest version of Nivaldo J Tro, Chemistry, A Molecular Approach, Pearson Education
Required software/required materials	LabArchives
Recommended literature	Life Science: Latest version of Reed and Weyers, Practical Skills in Biomolecular Science, Pearson Education. Chemistry Students: Latest version of Reed and Weyers, Practical skills in Chemistry, Pearson Education.
Examination	
	CHLS1C-Tbm
Name of examination or modular examination	Basic Theory Biology & Medical
Examination or modular examination code	CHLS1C-Tbm
Assessment types(s):	Individual written open questions and/or multiple choice questions
Result	Grade
Passing grade	4.5
Weight factor of modular exams	1
Exam opportunities	Term 1, resit Term 2 Participation in CHLS1C-Tbm is only possible twice per academic year.
Permitted resources	Ordinary calculator
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration term is several weeks prior to the exam period or the resit period. The period is stated in the SABC annual schedule on Insite - Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place.

	• Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key.
Possibilities for compensation	CHLS1C-Tbm may be compensated from ≥ 4.5.
Assessment dimensions	Competence 1: Design 1.1.4. Forms a hypothesis based on the research question. 1.1.5. Integrates information into a simple research plan. 1.1.6. Understands and applies simple English literature relevant to the given context. Competence 2: Experimenting 2.1.1. Reads and understand the practical guide; understands the theoretical background of the main steps of the methods. 2.1.2. Performs calculations prior to beginning lab work. Competence 3: Results Analysis 3.1.1. Carries out results analysis according to the prescribed methods; performs error analysis in the correct manner (if applicable). 3.1.3. Makes conclusions relating to the initial research question (if possible). Competence 4: Quality control 4.1.1. Is aware of the health and safety rules and works according to these rules.
Assessment criteria	The student has knowledge of the following subjects and is able to apply them: Biology & Medical Theory - The structure and function of different parts of the animal and plant cells; - The differences between the prokaryotic and eukaryotic cell; - The structure and function of biological macromolecules; - Cellular respiration - Mitosis Background theory of experiments and analysis: - Microscope use; - Mitosis - diluting, plating and reading; - Spectrophotometry - isolation of DNA; - agarose gel electrophoresis; - Lab safety
Exam matrix	65 (±5)% Biology & Medical theory 35 (± 5)% Lab Practical theory and analysis
	CHLS1C-Tc

Name of examination or modular examination	Chemistry Theory
Examination or modular examination code	CHLS1C-Tc
Assessment types(s):	Individual, Written Open Questions
Result	Grade
Passing grade	4.5
Weight factor of modular exams	1
Exam opportunities	Term 1, resit Term 2 Participation in CHLS1C-Tc is only possible twice per academic year.
Permitted resources	Ordinary calculator
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration term is several weeks prior to the exam period or the resit period. The period is stated in the SABC annual schedule on Insite - Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	CHLS1C-Tc may be compensated from ≥ 4.5.
Assessment dimensions	Competence 1: Design 1.1.4. Forms a hypothesis based on the research question. 1.1.5. Integrates information into a simple research plan. 1.1.6. Understands and applies simple English literature relevant to the given context. Competence 2: Experimenting 2.1.1. Reads and understand the practical guide; understands the theoretical background of the main steps of the methods. 2.1.2. Performs calculations prior to beginning lab work. Competence 3: Results Analysis 3.1.1. Carries out results analysis according to the prescribed methods; performs error analysis in the correct manner (if applicable).

	3.1.3. Makes conclusions relating to the initial research question (if possible). Competence 4: Quality control 4.1.1. Is aware of the health and safety rules and works according to these rules.
Assessment criteria	The student has knowledge of the following subjects and can apply this knowledge: Chemistry Basic Theory: *Basic chemistry:* - Describe how an atom or simple ion is structured; - Draw ratio formulas of ion and molecule formulas of molecules; - Name cations, anions, ion compounds and Inorganic compounds or vice versa; - Calculate using the formulas c= n/V and m=n*Mm - Predict the possible reaction between 2 substances and balance the reaction equation; - Calculating and working with precipitation reactions (balancing equations, calculate hvh, predict precipitate) *Redox:* - Identifying an oxidizer and a reducing agent of the oxidation and reduction reaction by the determination of the oxidation numbers of the elements in a compound; - Make balanced redox reactions on the basis of half-reactions. *Spectrophotometry:* - Knows the relationship between wavelength and energy; - Calculate using the Lambert-Beer Law; - Convert extinction to transmission and vice versa. - Calculating with the relation between the energy of light/photon and the frequency of light Background theory of experiments and analysis: - Quantitative transfer - Dilution - Titration - Spectrophotometry - TLC analysis - Lab safety
Exam matrix	65 (±5) % Chemistry theory 35 (± 5)% Lab Practical theory and analysis

Course unit 2A: CHLS2A (4 study credits)

	CHLS2A
General information	
Target group	Full-time foundation year students Life Science, BML and Chemistry
Name of course unit	CHLS2A General Skills / CHLS2A Basic Skills
Study unit code	CHLS2A
Teaching term	Term 2
ECTS credits	4 ECTS

Study load in hours	112 SBU
Study hours (contact hours)	Programmed contact time: average of 7 lessons per week, 51 lessons periods per term = 38.25 hours Scheduled time for exams: 2 hours Planned time for self-study: 71.75 hours Total: 112 hours
Unit of study entry requirements	HAVO (higher general continued education)/VWO (pre-university) diploma with the Nature and Technology or Nature and Health profile, MBO diploma level 4. Course unit CHLS1A must be followed.
Content and organisation	
General description	In CHLS2A, subjects introduced are essential to the degree programme. The basic knowledge on lab calculations and mathematics are the central focus of this course unit. Workshops also focus on conflict management.
Exit qualifications	- Quality control - Teamwork - Professional development
Professional tasks and products	Carrying out life science research
Professional products	
Cohesion	CHLS2A follows on from CHLS1A.
Mandatory participation	Participation in the Professional Skills 2 workshops is mandatory.
Maximum number of participants	
Compensation possibilities	
Activities and/or teaching methods	**Support subject: Laboratory calculations** - Dilutions - Stoichiometry - Gases and the ideal gas law - Calculations with reactions - Mixing Teaching methods: Combined lectures/tutorials Supporting subject: Mathematics - Power functions - Logarithmic and exponential functions - Trigonometry - Differentiation Teaching methods: Combined lectures/tutorials **Supporting subject:** PDL Professional Skills 2 - Recognize your own style of conflict behavior - Practicing escalating and de-escalating behavior - Gaining insight into Hofstede's intercultural dimensions of cooperation

	- Gaining insight into one's own strengths and learning points with regard to conflict management *Method: Workshop*
Required literature	The latest edition of: - Leven, I. van 't Veiligheid en milieu in laboratoria. Utrecht: Syntax Media. The following e-books: - Mathematics Fundamentals (https://bookboon.com/en/mathematics-fundamentals-ebook), - Precalculus (https://openstax.org/subjects/math) - Calculus Volume 1 (https://openstax.org/subjects/math)
Required software/materials	
Recommended literature	Verkerk G. et al. BINAS book VWO HAVO Groningen: Noordhoff Uitgeverij.
Examination	
	CHLS2A-Lab
Name of examination or modular examination	Lab calculations
Examination or modular examination code	CHLS2A-Lab
Assessment types(s):	Individual written open questions
Result	Grade
Passing grade	5.5
Weight factor of modular exams	2
Exam opportunities	In case of physical lessons: Modular exams during term 2. Resit end of term 2 and 4 In case of online lessons: CHLS2A-Lab: Term 2, term 4. Resit in Term 3.
Permitted resources	Non-graphic calculator, periodic table
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the assessment period or the resits. The period is published in the SABC academic calendar on Insite-Timetables
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period. At the end of term 4, the discussion will be held before the start of the resit period of term 4. • Indicate for an exam made in a resit period to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not

	take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 examiners for the construction and the evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	
Assessment dimensions	Knowledge of lab calculations: Systematically work out problems in lab work using elementary calculation rules and the several core relationships. Systematically work out problems with chemical reactions using several core relationships.
Assessment criteria	The student is able to: Reverse calculation of concentrations after dilution; Calculate the concentration of a substance after mixing; Calculate with reactions and apply stoichiometry on reactions; Apply the ideal gas law.
Exam matrix	Modular exams: 1. 30% Dilutions recalculation + stoichiometry 2. 30% Gases and the ideal gas law + calculate with reactions 3. 40% Mixing 1 + Mixing 2
	CHLS2A-Wis
Name of examination or modular examination	Mathematics
Examination or modular examination code	CHLS2A-Wis
Assessment types(s):	Individual, written, open questions
Result	Grade
Passing grade	5.5
Weight factor of modular exams	2
Exam opportunities	CHLS2A-Wis: Term 2, term 4. Resit in term 3
Permitted resources	Non-graphic calculator
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the assessment period or the resits. The period is published in the SABC academic calendar on Insite-Timetables

Discussion and review	- The exam and resit periods, and review of exam results are indicated in the SABC academic calendar. Review takes place in the presence of a supervisor. - The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period. At the end of term 4, the post-exam discussion will be held before the start of the resit period of term 4. - Contact the examiner/course coordinator (for exams taken during a resit period) if you would like to discuss the exam. Upon request, the post-exam discussion will be scheduled. - Participation in the post-exam discussion is only allowed if you have taken the exam.
Number of examiners	2 examiners for the construction and the evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	
Assessment dimensions	Knowledge of mathematics
Assessment criteria	Masters the following basic math skills: Solving equations with power functions, logarithms and exponential functions Isolate variables in power functions, logarithms and exponential functions Trigonometry in right angled triangles Converting degrees to radians and vice versa Knowing the relationship between graphical waveform and trigonometric function Apply sine rule and cosine rule in arbitrary triangles Differentiation with standard rules, sum rule, product rule, chain rule
Exam matrix	10 questions covering each of the following subjects: where each of the 1 questions is worth 10% of the CHLS2A-Wis grade. Solving equations with roots Isolation with different types of equations Solving equations with exponential functions Solving equations with logarithms or applying logarithmic calculation rules Applying trigonometry in a right angle triangle and/or calculations with radials Applying sine and cosine rules Determination of amplitude, period, equilibrium position and phase shift in trigonometric function Differentiation with standard rules Differentiation with product rules Differentiation with chain rules
	CHLS2A-PS2
Name of examination or modular examination	Professional Skills 2
Examination or modular examination code	CHLS2A-PS2

Assessment types(s):	Oral, Individual
Result	Satisfactory / Not Satisfactory
Passing grade	Satisfactory
Weight factor of modular exams	0
Exam opportunities	There is only one opportunity for the workshop (EER 8.5) See the class roster.
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in CHLS2A is considered as registration for CHLS2A-PS2.
Discussion and review	For questions about the assessment, please contact the examiner.
Number of examiners	One examiner for the assessment (workshop lecturer).
Possibilities for compensation	
Assessment dimensions	Competence 8: Cooperation / communication / internationalization 8.1.1. Adheres to rules. 8.1.2. Makes a valuable contribution to the group. 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.1.8. Verbally expresses their opinion/message. 8.1.9. Is active in conflict resolution. 8.1.12. Is aware of the international character of the professional community. Competence 11: Professional development 11.1.3. Reflects critically on their actions and learning process; learns from mistakes.
Assessment criteria	An active participation in the Professional Skills 2 workshop is necessary for a satisfactory assessment. At the end of the academic year a team discussion takes place in which the student has to demonstrate their professional skills.

Course unit 2B: CHLS2B (5 study credits)

	CHLS2B
General information	
Target group	Full-time students common Foundation Year - Life Sciences, Biology and Medical Laboratory Research, Chemistry
Name of course unit	CHLS2B: Basic practical skills Chemistry, Biology & Medical (Basispraktijkvaardigheden Chemie, Biologie & Medisch / CHLS2B)
Study unit code	CHLS2B
Teaching term	Term 2
ECTS credits	5 study credits
Study load in hours	140 SBU
Study hours (contact hours)	Biology and Medical Practical/ Chemistry Practical/ Tutorial/ Workshops

	Programmed contact hours: Avg. 11.7 lesson periods per week= 82 lesson periods per term = 61.5 hours per term Planned time for self-study: 78.5 hours per term Total 140 hours
Unit of study entry requirements	HAVO (higher general continued education)/VWO (pre-university) diploma with the Nature and Technology or Nature and Health profile, MBO diploma level 4. CHLS1A, CHLS1B and CHLS1C must be followed.
Content and organisation	
General description	Based on the themes of benzoic acid and nutrition, the basic techniques of Chemistry and Life Science research are applied. At the end, a personal research project will be carried out within a chosen theme in which the design, execution and presentation of research and results will be discussed. In addition, professional attitude is developed in the tutorial through development assignments.
Exit qualifications	Design of experimental plan Experimenting Results Analysis Quality control Management and administration Reporting and presenting Methodology Professional development
Professional tasks and products	Carrying out life science research
Professional products	Lab journals, measurement reports, IPS and final presentation
Cohesion	CHLS2B is related to CHLS2A and CHLS2C.
Mandatory participation	CHLS2B-P: In case of insatisfactory attendance of practice and workshops (knockout) practical assessment is 0.0 (assessment form will not be filled in further). CHLS2B-IPV: In case of insatisfactory participation, IPS assessment is not satisfactory
Maximum number of participants	
Compensation possibilities	
Activities and/or teaching methods	**Practical Biology & Medical:** Histology staining, Cytology, Microbiology, Molecular techniques, Microscopy, Biochemical techniques. *Teaching methods: Lab practicals* **Practical Chemistry:** Weighing,

	Pipetting, Titration, Dilution, Spectrophotometry, Synthesis, Melting point determination, Refractive index, IR spectrometry, TLC *Teaching methods: Lab practicals* **Tutor:** Calculation and error analysis Benzoic acid background Lab materials and safety Biobased economy Field of work and internationalization *Teaching methods: project group meetings* **Workshops** Scientific writing: Lab journal and data report: discussion and conclusion. *Teaching methods: interactive workshops*
Required literature	The latest version of: Campbell N, Reece J, *Biology*, Pearson Education Inc Nivaldo J Tro; *Principles of chemistry,* Pearson Dean, J.R. *et al*.: *Practical skills in Chemistry/Biomolecular sciences*, Prentice Hall, Harlow
Required software/materials	LabArchives, Microsoft Office
Recommended literature	
Examination	
	CHLS2B-P
Name of examination or modular examination	Practical
Examination or modular examination code	CHLS2B-P
Assessment types(s):	Individual, Practice, Written
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 2. There is only one opportunity per year for the modular exam CHLS2B-P (EER art. 8.5)
Permitted resources	

Method of enrolment for exam/enrolment period	Participation in CHLS2B is considered as registration for CHLS2B-P.
Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this modular assessment.
Number of examiners	Assessment by one examiner on the basis of assessment forms (practical lecturer).
Possibilities for compensation	
Assessment dimensions	Competence 1: Design 1.1.4. Forms a hypothesis based on the research question. Competence 2: Experimenting 2.1.1. Reads and understand the practical guide; understands the theoretical background of the main steps of the methods. 2.1.2. Performs calculations prior to beginning lab work. 2.1.3. Ensures that all requirements are present before beginning the experiment. 2.1.4. Carries out experiments accurately according to the protocol. 2.1.5 Carries out the experiment within the given time frame. Competence 3: Results Analysis 3.1.1. Carries out results analysis according to the prescribed methods; performs error analysis in the correct manner (if applicable). 3.1.2. Evaluates the obtained results based on their accuracy and reliability. 3.1.3. Makes conclusions relating to the initial research question (if possible). 3.1.4. Discusses the execution of the experiment and results. Competence 4: Quality control 4.1.1. Is aware of the health and safety rules and works according to these rules. 4.1.2. Uses materials and equipment correctly. Competence 5: Management and administration 5.1.1. Encodes chemicals and samples; stores these in the prescribed manner. 5.1.2. Leaves the workplace tidy and clean. 5.1.3. Manages and archives data in lab journal (aim, experiment description, alterations, results, conclusion) and if relevant, other ways of storing data. Competence 6: Reporting and presenting 6.1.1. Reports their research according to the product criteria for lab journal and reports; Level 1: 6.1.3 Is familiar with the international conventions of scientific and academic writing.

	Competence 7: Methodology 7.1.3. Works according to the previously described plan. Competence 11: Professional development 11.1.5. Has study skills required by higher professional education; is motivated and determined.
Assessment criteria	See assessment form on #OnderwijsOnline under General Information. Practical assessment: Lab journals and the practical impression throughout the course will be assessed as a whole using the assessment form.
Exam matrix	See assessment form on #OnderwijsOnline under General Information. Practical assessment: 12.5% Lab journal: General 25% Preparation 40% Practical Performance 22.5% Analysis
	CHLS2B-IPV:
Name of examination or modular examination	IPS
Examination or modular examination code	CHLS2B-IPV:
Assessment types(s):	Individual, oral, written
Result	Satisfactory/ Unsatisfactory
Passing grade	Satisfactory
Weight factor of modular exams	1
Exam opportunities	Term 2. There is only one opportunity per academic year for the modular exam CHLS2B-IPV (EER art. 8.5)
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in CHLS2B is considered as registration for CHLS2B-IPV.
Discussion and review	For questions about assessment, contact the examiner.
Number of examiners	Assessment by one examiner (tutor) for the assessment based on participation and effort.
Possibilities for compensation	
Assessment dimensions	Competence 7: Planning and project-based working Works according to the previously described plan. Competence 8: Teamwork Functioning in a group

	8.1.1. Adheres to rules. 8.1.2. Makes a valuable contribution to the group. Communication Is able to communicate about their assignment with peers and lecturers applying basic rules of communication, if necessary under supervision of the lecturer: 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.1.8. Verbally expresses their opinion/message. Competence 11: Professional development 11.1.5. Has study skills required by higher professional education; is motivated and determined.
Assessment criteria	The student: - Has prepared for the meeting by completing the assignment to be discussed, and also completed the required reading for the following assignment to be discussed; - Is able to show weekly assignments to the tutor (according to agreement, in writing or as a presentation); all required aspects are complete in all assignments; - Adheres to the rules agreed upon; - Asks questions and shares knowledge regarding the assignment during tutor meetings; verbalizes these clearly and audibly, maintains eye contact; - Gives others opportunity to speak; - The student offers feedback to group and class members and is open to receiving feedback; - Is satisfactoryly present during the tutor lessons (missed a maximum of 1 lesson for a good reason); - Submits a reflection report on the professional attitude to the tutor.
	CHLS2B-Pr
Name of examination or modular examination	Presentation
Examination or modular examination code	CHLS2B-Pr
Assessment types(s):	Oral, in pairs
Result	Individual grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 2, resit in consultation with lecturer.
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in CHLS2B is considered as registration for CHLS2B-Pr

Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this modular assessment.
Number of examiners	Two examiners for the assessment based on the assessment form (subject expert)
Possibilities for compensation	
Assessment dimensions	Competence 1: Design 1.1.1. Independently identifies relevant background information required to answer the research question. 1.1.2. Knows the criteria defining reliable sources of information in scientific research. 1.1.5. Integrates information into a simple research plan. Competence 3: Results Analysis 3.1.3. Makes conclusions relating to the initial research question (if possible). 3.1.4. Discusses the execution of the experiment and results. Competence 6: Reporting and presenting 6.1.3. Is familiar with the international conventions of scientific and academic writing. 6.1.5. Presents research to a target audience with similar knowledge background, applies general presentation techniques and answers questions: uses correct spelling and grammar; Describes results so the reader can understand; Uses clearly labelled figures and tables; there is structure in the presentation (introduction-body-conclusion); speaks clearly and coherently; has upright posture and hands are freely used; makes eye contact with the audience; makes organised and clear slides or other visual products. Competence 8: Teamwork Is able to communicate about their assignment with peers and lecturers applying basic rules of communication, if necessary under supervision of the lecturer: 8.1.2. Makes a valuable contribution to the group. 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.1.8. Verbally expresses their opinion/message.
Assessment criteria	*See assessment form "Presentation Course 2 CHLS2B" on OnderwijsOnline under General Information.*
Exam matrix	Content: 30% Presentation: 45% Questions: 25%

Course unit 2C: CHLS2C (6 study credits)

	CHLS2C

General information	
Target group	Full-time students common foundation year - Life Sciences, Biology and Medical Laboratory Research, Chemistry
Name of course unit	CHLS2C: Basic Theory Biology & Medical and Chemistry 2 / ECU CHLS2C: Basic theory Life Science, Biology, Medical and Chemistry 2
Study unit code	CHLS2C
Teaching term	Term 2
ECTS credits	6 study credits
Study load in hours	168 SBU
Study hours (contact hours)	Programmed contact hours: 6 lesson periods/week, 42 lesson periods/term = 5.75 hours Scheduled time for exams: 4 lesson periods per term =3 hours Planned time for self-study: 133.5 hours Total: 168 hours
Unit of study entry requirements	HAVO (higher general continued education)/VWO (pre-university) diploma with the Nature and Technology or Nature and Health profile, MBO diploma level 4. CHLS1C must be followed
Content and organisation	
General description	Students work from different angles on basic biological, medical and chemical knowledge.
Exit qualifications	Design Experimenting Results Analysis Quality control
Professional tasks and products	Carrying out life science research
Professional products	
Cohesion	CHLS2C is related to CHLS1A, CHLS1B, CHLS1C, CHLS2A and CHLS2B
Mandatory participation	
Maximum number of participants	
Compensation possibilities	Final grade CHLS2C = (CHLS2C-Tbm + CHLS2C-Tc) /2 ≥ 5.5 Compensation is possible for CHLS2C-Tbm and CHLS2C-Tc from 4.5.
Activities and/or teaching methods	**Supporting subjects: Biology & Medical** Form and function of plant and animal tissues Photosynthesis Digestion *Teaching methods: Combined lectures/tutorials* **Supporting subjects: Life Science/Biology & Medical Lab practicals theory**

	Theoretical background to lab practical *Teaching methods: Combined lectures/tutorials* **Supporting subjects: Chemistry** Acids and bases Buffers Organic Chemistry Macromolecules *Teaching methods: Combined lectures/tutorials* Supporting subjects: *Theory of the chemistry practicals* Theoretical background to lab practical *Teaching methods: Combined lectures/tutorials*
Required literature	Latest version of Campbell and Reece, Biology, a Global Approach, Pearson Education Latest version of Nivaldo J Tro, Chemistry, A Molecular Approach, Pearson Education
Required software/required materials	LabArchives
Recommended literature	Life Science: Latest version of Reed and Weyers, Practical Skills in Biomolecular Science, Pearson Education. Chemistry Students: Latest version of Reed and Weyers, Practical skills in Chemistry, Pearson Education.
Examination	
	CHLS2C-Tbm
Name of examination or modular examination	Basic Theory Biology & Medical
Examination or modular examination code	CHLS2C-Tbm
Assessment types(s):	Individual written open questions and/or multiple choice questions
Result	Grade
Passing grade	4.5
Weight factor of modular exams	1
Exam opportunities	Term 2, resit term 3 Participation in CHLS2C-Tbm is only possible twice per academic year.
Permitted resources	Ordinary calculator
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration term is several weeks prior to the exam period or the resit period. The period is stated in the SABC annual schedule on Insite - Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor.

	• The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key.
Possibilities for compensation	CHLS2C-Tbm may be compensated from ≥ 4.5.
Assessment dimensions	Competence 1: Design 1.1.4. Forms a hypothesis based on the research question. 1.1.5. Integrates information into a simple research plan. 1.1.6. Understands and applies simple English literature relevant to the given context. Competence 2: Experimenting 2.1.1. Reads and understand the practical guide; understands the theoretical background of the main steps of the methods. 2.1.2. Performs calculations prior to beginning lab work. Competence 3: Results Analysis 3.1.1. Carries out results analysis according to the prescribed methods; performs error analysis in the correct manner (if applicable). 3.1.3. Makes conclusions relating to the initial research question (if possible). Competence 4: Quality control 4.1.1. Is aware of the health and safety rules and works according to these rules.
Assessment criteria	The student has knowledge of the following subjects and is able to apply them: Biology & Medical Theory - The form and function of plant tissues - Structure and function of animal tissues - Photosynthesis - Digestion Background theory of experiments and analysis: - Inoculation and reading plates - Gram staining - Staining of digestive tract tissue - Yeast staining and counting chamber - Plant stem and microscope - Lab safety
Exam matrix	65 (±5)% Biology & Medical theory 35 (± 5)% Lab Practical theory and analysis

	CHLS2c-Tc
Name of examination or modular examination	Chemistry Theory
Examination or modular examination code	CHLS2c-Tc
Assessment types(s):	Individual, Written Open Questions
Result	Grade
Passing grade	4.5
Weight factor of modular exams	1
Exam opportunities	Term 1, resit Term 2 Participation in CHLS2C-Tc is only possible twice per academic year.
Permitted resources	Ordinary calculator
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration term is several weeks prior to the exam period or the resit period. The period is stated in the SABC annual schedule on Insite - Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	CHLS2C-Tc may be compensated from ≥ 4.5.
Assessment dimensions	Competence 1: Design 1.1.4. Forms a hypothesis based on the research question. 1.1.5. Integrates information into a simple research plan. 1.1.6. Understands and applies simple English literature relevant to the given context. Competence 2: Experimenting 2.1.1. Reads and understand the practical guide; understands the theoretical background of the main steps of the methods. 2.1.2. Performs calculations prior to beginning lab work. Competence 3: Results Analysis

	3.1.1. Carries out results analysis according to the prescribed methods; performs error analysis in the correct manner (if applicable). 3.1.3. Makes conclusions relating to the initial research question (if possible). Competence 4: Quality control 4.1.1. Is aware of the health and safety rules and works according to these rules.
Assessment criteria	The student has knowledge of the following subjects and can apply this knowledge: Chemistry Basic Theory: *Acids and bases:* - Balance acid-base reactions and identify acids and bases; calculate the pH and pOH of a solution of strong and weak acids and strong bases; - Calculate the concentration H3O+ and OH- from the pH and Kw; - Calculation of pH at every point in a titration of a strong acid with a strong base; - Calculation of pH at every point in a titration of a weak acid with a strong base; - Calculation of pH at every point in a titration of a strong acid with a weak base; - Calculate the volume of titrant at the end point of the titration. - Calculation of the pH of a buffer, buffer range and buffer capacity Organic Chemistry - Identify two molecules as structural isomers or stereoisomers; - Draw hydrocarbons with and without functional groups based on the name and determine whether the name is correct; - Nomenclature of hydrocarbons with and without functional groups; - Recognize and name functional groups (haloalkane, alcohol, ether, phenol, aldehyde, ketone, carboxylic acid, amine, amide or ester); predict the influence of hydrogen bonds on the physical properties of organic compounds; *Macromolecules* – Recognition of building blocks of macromolecules (lipids, carbohydrates, proteins, plastics) – Reactions between different building blocks of lipids, carbohydrates, proteins and plastics – Protein structures Background theory of experiments and analysis: - Benzoic acid synthesis - Infrared spectrometry - Spectrophotometry - TLC - Titration - Molecular cooking - Lab safety
Exam matrix	65 (±5) % Chemistry theory 35 (± 5)% Lab Practical theory and analysis

Course unit 3K: CH3K (5 study credits)

	CH3K
General information	
Target group	Full-time students foundation year Chemistry / Full-time students of the MLO-transfer programme.
Name of unit of study	ECU 3K: Separation and purification: Organic and Polymer Chemistry Knowledge
Course unit code	C3K
Teaching Term	Term 4. If there are sufficient student numbers, the curriculum will be mirrored in Term 3.
ECTS credits	5 study credits
Study load in hours	140 SBU
Study hours (contact hours)	Programmed contact hours: 7 lesson periods per week = 49 lesson periods per term, 5.3 hours per week = 36.8 hours per term. Scheduled teaching time for self-study. 103.2 hours Total: 140 hours
Course entry requirements	HAVO (higher general continued education)/VWO (pre-university) diploma with the profile Nature and Technology or Nature and Health, and participated in course units CHLS1A, CHLS1B, CHLS1C, CHLS2A, CHLS2B and CHLS2C. 4th year MLO chemistry: MLO diploma chemistry transfer programme
Content and organisation	
General description	In this course unit, we introduce basic knowledge in organic and polymer chemistry. The subjects organic structures and bonds and polymer chemistry are offered.
Exit qualifications	
Professional tasks and products	Carrying out Life Science Research
Professional products	
Cohesion	This course follows CHLS!B, CHLS1C, CHLS2B, CHLS2C and preparation for CH6, CH7, and CH8. CH3 is divided into three course units, each worth 5 study credits: CH3K (knowledge), CH3P (practical), CH3T (theme, project).
Mandatory participation	
Maximum number of participants	
Compensation possibilities	Kpk and Kosb may be compensated from ≥ 4.0. Final grade CH3K ≥ 5.5
Activities and/or instructional formats	**Supporting subject Polymer Chemistry** - Plastics: what are plastics, how are they made, -The polymer chain, the most common polymers and their monomers, how to recognise a polymer, what happens to plastics after use. - Properties of polymers: states, crystalline polymers, stiffness and creep, strength, thermal softening, shaping *Working methods: combined lectures/response classes* **Supporting subject Organic structures and bonds** - Molecule construction: chemical bonding, organic compound orbitals, functional groups, stereochemistry - Mechanisms: esters and amides *Working methods: combined lectures/response classes* **Supporting subject Physics** Electricity, light, forces and energy

Required literature	The latest edition of: - McMurry, J. Organic Chemistry Cengage Learning Inc, Belmont CA, - John W. Nicholson, the chemistry of polymers - Nivaldo. J Tro, Principles of chemistry, a molecular approach, Person Global Edition -Giancoli, D. C. *Physics for Scientists & Engineers with Modern Physics* ,Harlow: Pearson
Required software/required materials	
Recommended literature	
Examinations	
	CH3K-Kpk
Name of examination or modular examination	Theory Exam Polymers
Examination or modular examination code	CH3K-Kpk
Assessment type(s):	Individual written open questions
Result	Grade
Minimum result	5.5
Weight factor of modular exam	2
Exam opportunities	Term 4, resit term 4
Permitted resources	
Method of enrolment for exam / enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the assessment period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • At the end of term 4 the discussion is held before the start of the resit period of term 4. • Indicate for an exam made in a resit period to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 examiners for the construction and the evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	Kpk and Kosb may be compensated from ≥ 4.0.
Assessment dimensions	The student: - can describe what plastics are and which technical classification is usually applied; - can describe the following concepts relating to polymers: - composition and properties of chains - relationship between chain regularity and properties - can describe the concept of copolymers and name a number of general copolymers; name copolymers; - knows and can name the difference between amorphic and crystalline polymers; - with consideration for environmental aspects, name benefits of plastics. - describe a number of methods (with the advantages and disadvantages) of waste processing such as incineration, pyrolysation, dumping;

	knows definitions in the field of polymer chemistry; synthesis of polymers. - synthesis of polymers.
Assessment criteria	Polymers: Introduction The student: - can describe what plastics are and what technical classification is usually applied; - can describe unique aspects of polymers, advantages and disadvantages; - can describe how polymers and polymer networks are made (addition polymerisation, polycondensation); - can describe extra components of a plastic (auxillaries and fillers) and the aim of adding these components. Structure of the polymers in relation to the physical properties; - can describe the composition and properties of chains: main and side chains, chain flexibility, chain interaction; - can calculate the various molar mass averages and can indicate the practical usefulness of these averages; - describe what is meant by chain regularity and can give examples (isotactic, syndiotactic); - can describe the relationship between the chain regularity and a characteristic (shape stability, processing); - can describe the concept of copolymers and name a number of general copolymers; - knows and can name the difference between amorphic and crystalline polymers; - can draw the V(-T) diagram for amorphic and crystalline polymers; - draw a log (E) T-diagram for amorphous polymers and give an explanation (from the molecular behavior) for the course of the curve (Tg); - can indicate what the sec. glass transition is and the causes of it; - can state the influence of time on the elasticity modulus at constant temperature; - can indicate what mechanical energy dissipation is; - describe what is meant by entropy and energy elasticity; - knows the dependence of the time scale on the length of the rubber plateau (silly putty); - can state when a polymer can and cannot crystallize; - can indicate the influence of the chain stiffness and chain interaction on the melting point of crystalline polymers; - can indicate the relationship between Tg and Tm; - can indicate what the crystallization process involves (germination, speed); - knows the effect of crystallization on the properties; - can describe a number of properties of the liquid state: viscosity, melt elasticity, die-swell, melt fracture; - can indicate the influence of the molar mass distribution on the processibility. Structure of polymers in relation to the mechanical properties - can read the stress-strain diagram: modulus of elasticity, yield stress, yield stress, fracture stress, fracture strain, fracture energy; - can indicate the differences between the polymers in terms of stiffness (in relation to the structure), hardness; - can describe the concept of viscoelasticity, creep, stress relaxation; Recycling of plastics

	- knows a number of advantages of plastics with regard to the environment: - knows a number of methods (with advantages and disadvantages) of waste processing,
Exam matrix	~20% polymer synthesis ~60% relationship between structure and properties ~ 20% processing methods
	CH3K-Kosb
Name of examination or modular examination	Theory exam Organic structures and bonds
Examination or modular examination code	CH3K-Kosb
Assessment type(s):	Individual, Written Open Questions
Result	Grade
Minimum result	5.5
Weight factor of modular exam	3
Exam opportunities	Term 4, resit term 4
Permitted resources	
Method of enrolment for exam / enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the assessment period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • At the end of term 4 the discussion is held before the start of the resit period of term 4. • Indicate for an exam made in a resit period to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 examiners for the construction and the evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	Kpk and Kosb may be compensated from ≥ 4.0.
Assessment dimensions	- Knowledge of aliphatic organic chemistry: spatial structure, chemical and physical-chemical properties. - Indicate in a molecule of formal and partial charges, free electron pairs, dipole moments, electronegativity. - Know and apply the model of Bohr / orbital theory. - Knowing and applying the four different quantum numbers - To know and apply the Aufbau principle, Hund's rule and Pauli exclusion principle. - Knowing the different trends in the periodic table: atomic radius, ion radius, ionisation energy, metal character and electron affinity - To know and apply concepts such as polar, apolar, Lewis acid and base, carbocation, carbanion, radical. - Lewis structures of elements and multiple atom molecules and ions. - Recognition of structural isomers. - Being able to read and use different forms of representation of organic molecules (written out line structures). - Spatial signs of organic compounds in different projections (Newman, Fischer, spatial). Application of the VSEPR theory. - Relating the geometry and polarity of molecules

	- Valence Bond (explaining VB theory) - Use of chemical drawing programs. - Knowing and naming functional groups and classes. - Know trivial names of common org. substances and side groups. - Knowing and applying nomenclature for alkanes. - Knowing and applying nomenclature for aromatic compounds. - Knowing and applying nomenclature rules for aliphatic compounds (halogen alkanes, alcohols, ethers, aldehydes, ketones, carboxylic acids and carboxylic acid derivatives). - Calculating molar mass a.d.h.v. gross formula (vv), degree of unsaturation (DBE), performing calculations based on reaction comparisons. - Knowing and recognizing the hybridization state of C, N and O atoms in a compound. - Is able to describe/draw the shape of atomic and molecular orbitals (bonding and anti-bonding orbitals). - Knowledge of intermolecular forces. - Knowing different intermolecular forces and aggregation states of a compound. - Drawing resonance (boundary structures) of a connection (including electron relocations) and indicate which is (are) the most important. - Knowing concepts such as chirality, diastereomers, enantiomers, epimers. - Recognize double bond isomers and determine the stereochemistry (Z / E). - Recognize chiral compounds and chiral centers in organic molecules and determine their stereochemistry (R / S). - Drawing of chair and boat conformations of cyclohexanes (including Newman projections) and estimate relative importance. - Predict whether substituents on cyclohexanes have axial or equatorial position.
Assessment criteria	The student: - Knows the terms: charges, partial charge, free electron pairs, dipole moments and can indicate where they are located in the molecule; - recognizes polar and non-polar (parts of) molecules; knows what is meant by Lewis acids, Lewis bases, carbocations, carbanions and functional groups and recognizes these and can name them; - knows what is meant by constitutional isomers, and can draw these on the basis of a gross formula; - knows and recognizes groups of organic compounds; - knows the principle of naming simple org. compounds (nomenclature); - knows trivial names of common organic compounds and side groups; - can write down gross formulas a.d.h.v. structural formulas; - can a.d.h.v. a gross formula calculate the number of double-band equivalents and arrive at a structural proposal; - recognizes hybridization states of C, N and O; - can determine stereochemistry of chiral C atoms (R / S) and of double bonds (Z / E); - can draw the spatial structure of organic connections (incl. Newman projections) of both linear and cyclic connections; - can indicate whether groups are axially or equatorially in six-membered rings and can draw them correctly; - can draw boundary structures (incl. electron relocations) of organic compounds; - can represent the mechanism of amide formation and hydrolysis; - can draw the mechanism of ester formation and hydrolysis; - knows what is meant by Lewis formula, Lewis symbol, octet rule and valencies; - can draw a Lewis structure of simple single and multiple bonds; - can calculate formal charges of the different resonance structures of poly atoms;

	- can establish a relationship between properties of molecules and geometry (VSEPR theory); - can make a proposal for the geometry of a molecule based on Lewis structures; - can explain the Valence Bond (VB) model; - can establish a relationship between in the intermolecular forces and the phase of a compound; - can relate various intermolecular forces and aggregation states. - Can explain the different trends in the periodic table: atomic radius, ion radius, ionisation energy, metal character and electron affinity
Exam matrix	- ~20% charges, partial charges, free electron pairs, dipole moments polar apolar, Lewis acids, Lewis bases, carbocation cations, carbanion functional groups - ~5% constitutional isomers incl., nomenclature - ~5% double band equivalents, calculate gross formulas etc. - ~10% hybridization states - ~20% stereochemistry (chiral C-atoms, alkenes) - ~20% boundary structures + reaction mechanism - ~10% VSEPR theory and geometry - ~10% intermolecular forces
	CH3K-Nk
Name of examination or modular examination	Assignment Physics
Examination or modular examination code	CH3K-Nk
Assessment type(s):	Individual, Written
Result	Satisfactory/unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exam	0
Exam opportunities	Term 3 and 4, resit term 4.
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in Course CH3K gives automatic registration for CH3K-Knat.
Discussion and review	There is no plenary review/discussion. The student can make an appointment to receive explanation about the questions.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	**-**
Assessment dimensions	Basic Physics
Assessment criteria	The student knows the basis physics of - Electricity - Optics - forces - Magnetism - Energy
Exam matrix	- ~30% electricity - ~30% forces - ~20% Optics - ~20% energy and magnetism

Course unit 3P: CH3P (5 study credits)

	CH3P
General information	
Target group	Full-time students foundation year Chemistry / Full-time students of the MLO-transfer programme.
Name of unit of study	ECU 3P: Separation and purification: Organic and Polymer Chemistry Practical
Unit of study code	CH3P
Teaching Term	Term 4. If there are sufficient student numbers, the curriculum will be mirrored in Term 3.
ECTS credits	5 study credits
Study load in hours	140 SBU
Study hours (contact hours)	Programmed contact hours: 10 lesson periods per week = 70 lesson periods per term, 7.5 hours per week = 52.5 hours per term. Scheduled teaching time for self-study. 87.5 hours Total: 140 hours
Course entry requirements	HAVO /VWO diploma with the Nature and Technology or Nature and Health profile and participated in OWE CHLS1A, CHLS1B, CHLS1C, CHLS2A, CHLS2B and CHLS2C. 4th year MLO chemistry: transfer programme MLO Chemistry diploma programme
Content and organisation	
General description	Title: Separation and Purification. In this course unit, the basic skills in organic and polymer chemistry experiments are learned. The students learn how an organic/polymer chemistry lab journal and measurement report is made. They do this by working on, for example, synthesis of organic molecules and polymers with the relevant analyses.
Exit qualifications	**- Design** **- Experimenting** - Results analysis - Quality control - Management and administration - Reporting and presenting **- Planning and project-based working** **- Team work** - Advising - Professional development The competencies in bold are those which are emphasized in this course.
Professional task(s)	Carrying out Life Science Research
Professional products	
Cohesion	This course follows CHLS1B, CHLS1C, CHLS2B, CHLS2C and preparation for CH6, CH7, and CH8. CH3 is divided into three course units, each worth 5 study credits: CH3K (knowledge), CH3P (practical), CH3T (theme, project).
Mandatory participation	Attendance at the practicals is a prerequisite for participation in the modular examination Pi.
Maximum number of participants	
Compensation possibilities	

Activities and/or instructional formats	**Organic Chemistry and Polymer Chemistry Practical** Extraction, Isolation and Synthesis of Painkillers Thin layer chromatography Synthesis and characterization of different polymers Separation and purification of an unknown mixture *Teaching methods: lab practicals* **Theory for the practical** The background theory of the chemistry practical is explained. *Working methods: lecture*
Required literature	The latest edition of: - Holmes, D.A., Reed, R., Jones, A.M., Dean, J. Practical Skills in Chemistry, New York NY: Pearson Education Ltd.
Required software/required materials	LabArchives
Recommended literature	
Examinations	
	CH3P-Pi
Name of examination or modular examination	Practical performance
Examination or modular examination code	CH3P-Pi
Assessment types(s):	Individual Practical
Result	Grade
Minimum result	5.5
Weight factor of modular exam	1
Exam opportunities	Term 4, there is only one opportunity per academic year for the modular exam Pi (EER paragraph 8.5)
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in Course CH3P gives automatic registration for CH3P-Pi.
Discussion and review	Returning the completed assessment form to the student and any remarks on the form or in the professional product serves as inspection and discussion of this partial examination.
Number of examiners	One examiner (practical teacher) for the assessment (assessment form)
Possibilities for compensation	
Assessment dimensions	Competence 1: Design 1.1.4. Forms a hypothesis based on the research question. Competence 2: Experimenting 2.1.1. Reads and understand the practical guide; understands the theoretical background of the main steps of the methods. 2.1.2. Performs calculations prior to beginning lab work. 2.1.3. Ensures that all requirements are present before beginning the experiment. 2.1.4. Carries out experiments accurately according to the protocol. 2.1.5. Carries out the experiments within the given time frame. Competence 3: Results analysis 3.1.1. Carries out results analysis according to the prescribed methods; performs error analysis in the correct manner (if applicable).

	3.1.2. Evaluates the obtained results based on their accuracy and reliability. 3.1.3. Makes conclusions relating to the initial research question (if possible). 3.1.4. Discusses the execution of the experiment and results. Competence 4: Quality control 4.1.1. Is aware of the health and safety rules and works according to these rules. 4.1.2. Uses materials and equipment correctly. 4.1.3. Uses controls, and uses these to assess the reliability of the results. Competence 5: Management and administration 5.1.1. Encodes chemicals and samples; stores these in the prescribed manner. 5.1.2. Leaves the work space tidy and clean. 5.1.3. Manages and archives data in lab journal (aim, experiment description, alterations, results, conclusion) and if relevant, other ways of storing data. Competence 6: Reporting and presenting 6.1.1. Reports their research according to the product criteria for lab journal and reports; level 1: uses correct spelling and grammar; is aware of the scientific style; uses simple and logical structure; describes results so the reader can understand; uses clearly labelled figures and tables. Competence 7: Working in a planned and project-based manner 7.1.2. Plans the study tasks. Competence 11: Professional development 11.1.3. Reflects critically on own performance and learning process; learns from mistakes 11.1.5. Has study skills required by higher professional education; is motivated and determined.
Assessment criteria	See assessment form for Practical with Lab Journal for the assessment of Chemistry Practical on #OnderwijsOnline - General Information
Exam matrix	See assessment form for Practical with lab journal level 1 for the assessment of Chemistry Practical on #OnderwijsOnline - General Information
	CH3P-Pm
Name of examination or modular examination	Measurement reports
Examination or modular examination code	CH3P-Pm
Assessment type(s):	Written, individual
Result	Grade
Minimum result	5.5
Weight factor of modular exam	1
Exam opportunities	Term 4, resit term 4
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in Course C3P gives automatic registration for CH3P-Pi.

Discussion and review	Returning the completed assessment form to the student and any remarks on the form or in the professional product serves as inspection and discussion of this partial examination.
Number of examiners	One examiner (practical teacher) for the assessment (assessment form)
Possibilities for compensation	
Assessment dimensions	Competence 1: Question clarification 1.1.4. Forms a hypothesis based on the research question. Competence 2: Experimenting 2.1.1. Reads and understand the practical guide; understands the theoretical background of the main steps of the methods. 2.1.2. Performs calculations prior to beginning lab work. 2.1.3. Ensures that all requirements are present before beginning the experiment. Competence 3: Results analysis 3.1.1. Carries out results analysis according to the prescribed methods; performs error analysis in the correct manner (if applicable). 3.1.2. Evaluates the obtained results based on their accuracy and reliability. 3.1.3. Makes conclusions relating to the initial research question (if possible). 3.1.4. Discusses the execution of the experiment and results. Competence 6 Reporting and presenting 6.1.1. Reports their research according to the product criteria for lab journal and reports; level 1: uses correct spelling and grammar; is aware of the scientific style; uses simple and logical structure; describes results so the reader can understand; uses clearly labelled figures and tables.
Assessment criteria	See Measurement Report Assessment Form on OnderwijsOnline - General Information
Exam matrix	See Assessment form on #OnderwijsOnline - General Information

Course unit 3T: CH3T (5 study credits)

	CH3T
General information	
Target group	Full-time students foundation year Chemistry / Full-time students of the MLO-transfer programme.
Name of unit of study	ECU 3T: Separation and purification: Organic and Polymer Chemistry Theme
Course unit code	CH3T
Teaching Term	Term 4. If there are sufficient student numbers, the curriculum will be mirrored in Term 3.
ECTS credits	5 study credits
Study load in hours	140 SBU
Study hours (contact hours)	Programmed contact hours: 6,1 lesson periods per week = 43 lesson periods per term, 4.4 hours per week = 30.7 hours per term. Scheduled teaching time for self-study. 109.3 hours Total: 140 hours
Course entry requirements	HAVO /VWO diploma with the Nature and Technology or Nature and Health profile and participated in CHLS1A, CHLS1B, CHLS1C, CHLS2A, CHLSB and CHLS2C. 4th year MLO chemistry: transfer programme MLO Chemistry diploma programme

Content and organisation	
General description	Title: Separation and purification: The central task of this course is to design a step-by-step plan in which a mixture can be purified using various techniques such as acid-base separation, for example. In addition, the student must ultimately write a short advice report on how to best deal with the purification of an unknown mixture.
Exit qualifications	**- Design** **- Experimenting** - Results analysis - Quality control - Management and administration - Reporting and presenting **- Planning and project-based working** **- Team work** **- Advising** - Professional development The competencies in bold are those which are emphasized in this course.
Professional task(s)	Carrying out Life Science Research
Professional products	
Cohesion	This course follows CHLS!B, CHLS1C, CHLS2B, CHLS2C and preparation for CH6, CH7, and CH8. CH3 is divided into three course units, each worth 5 study credits: CH3K (knowledge), CH3P (practical), CH3T (theme, project).
Mandatory participation	Attendance at the tutor meetings is a prerequisite for participation in the modular examination IPS.
Maximum number of participants	
Compensation possibilities	
Activities and/or instructional formats	**Tutor** Pre and post discussion of assignments. *Method: Tutor* **Personal tutoring** **Expert** Extra information is given with relation to the week tasks, practical and the central assignment. *Working methods: lecture* **Workshop scientific writing, report structure, and design.** Searching for reliable scientific information Developing an experimental plan *Method: workshop* **Workshop Professional Skills 3 (term 3 or in term 4)** Professional attitude Communication Cooperation *Method: workshop*
Required literature	- McMurry, J. Organic Chemistry Cengage Learning Inc, Belmont CA, latest edition - Nivaldo. J Tro, Principles of chemistry, a molecular approach, latest ed., Person Global Edition
Required software/required materials	Marvin sketch (free download)

Recommended literature	
Examinations	
	CH3T-T
Name of examination or modular examination	Theme test
Examination or modular examination code	CH3T-T
Assessment type(s):	Individual, Written
Result	Grade
Minimum result	5.5
Weight factor of modular exam	2
Exam opportunities	Term 4, resit Term 4
Permitted resources	Non-graphical calculator, molecular model building box, periodical table
Method of enrolment for exam / enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the assessment period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • At the end of term 4 the discussion is held before the start of the resit period of term 4. • Indicate for an exam made in a resit period to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 examiners for the construction and the evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	
Assessment dimensions	Competence 2: Experimenting 2.1.1. Reads and understand the practical guide; understands the theoretical background of the main steps of the methods. Competence 3: Results analysis 3.1.1. Carries out results analysis according to the prescribed methods; performs error analysis in the correct manner (if applicable). 3.1.3. Makes conclusions relating to the initial research question (if possible). Competence 4: Quality control 4.1.1. Is aware of the health and safety rules and works according to these rules. In the theme test, the subjects covered in the week tasks and practical experiments are included. In the context of: - Polymer chemistry - Organic Chemistry - Separation and purification of an unknown mixture
Assessment criteria	The student knows or can, in relation to the week tasks:

	- derive the structural formula of a substance from the mass percentages found with elemental analysis; - write down the reaction equation of different polymers - write down the reaction mechanism of different polymerizations - preparing the reaction mechanism of an acid with an alcohol; - explain the different ways to perform a separation. - explain what happens chemically during an acid-base extraction. The student knows or can, in relation to practical work: - indicate how a reflux arrangement can be made and what all components are for; - explain the principle of DSC; explain how a thermogram is created and explain the thermogram; - explain the principle behind TLC; calculate the Rf value of a substance by using a TLC plate and determining which substance is present in the sample; - calculations on reactions; - set up reaction mechanisms for radical polymerization, ester formation and amide formation; - the theory of organic chemistry and polymer chemistry in relation to practice; - the theoretical and practical backgrounds of separating and purifying a mixture.
Exam matrix	The theme test is comprised of questions about practical work and about the week tasks in relation to the theory of organic and polymer chemistry: - ~40% Organic Chemistry - ~40% Polymer Chemistry - ~20% Separation and purification mixtures
	CH3T-IPV
Name of examination or modular examination	IPS
Examination or modular examination code	CH3T-IPV
Assessment type(s):	Oral, Individual
Result	Satisfactory/unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exam	0
Exam opportunities	Term 4 Participation in modular exam IPV is only possible once per academic year (EER paragraph 8.5).
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in Course CH3T gives automatic registration for CH3T-IPV.
Discussion and review	For questions about assessment, contact the examiner.
Number of examiners	One examiner for the assessment based on participation and effort (tutor)
Possibilities for compensation	
Assessment dimensions	Competence 7: Working in a planned and project-based manner 7.1.2. Plans the study tasks. Competence 8: Teamwork Functioning in a group 8.1.1. Adheres to rules. 8.1.2. Makes a valuable contribution to the group

	Communication Communicates his task to fellow students and teacher according to the basic rules of communication; if needed, with teacher supervision: 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.1.8. Verbally expresses their opinion/message. Competence 11: Professional development 11.1.5. Has study skills required by higher professional education; is motivated and determined.
Assessment criteria	The student can: - the student has prepared for the meeting by completing the assignment to be discussed, and also completed the required reading for the following assignment to be discussed. - the student is able to show weekly assignments to the tutor (according to agreement, in writing or as a presentation); all required aspects are complete in all assignments; - Fulfils his/her roles (Chair, secretary etc.); - the student adheres to the rules agreed upon; - the student asks questions and shares knowledge regarding the assignment during tutor meetings; verbalises these clearly and audibly, maintains eye contact; - Allows others to finish speaking - the student offers feedback to group- and class members and is open to receiving feedback. - Participates in tutor lessons that are (partially) carried out in English.
	CH3T-Ad
Name of examination or modular examination	Advice Report
Examination or modular examination code	CH3T-Ad
Assessment type(s):	Written, group
Result	Grade
Minimum result	5.5
Weight factor of modular exam	1
Exam opportunities	Term 4, resit Term 4
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in Course CH3T gives automatic registration for CH3T-Ad.
Discussion and review	Returning the completed assessment form to the student and any feedback on the form or in the professional product serves as inspection and discussion of this partial examination.
Number of examiners	One examiner (practical teacher) for the assessment (assessment form)
Possibilities for compensation	
Assessment dimensions	Competence 6: Reporting and presenting 6.1.1. Reports their research according to the product criteria for lab journal and reports; level 1: uses correct spelling and grammar; is aware of the scientific style; uses simple and logical structure; describes results so the reader can understand; uses clearly labelled figures and tables.

	6.1.3. Is familiar with the international conventions of scientific and academic writing. **Competence 10:** Advising Advises on the purchase and use of materials, equipment: 10.1.1. Understands the needs and practical requirements. 10.1.2. Advises about purchase of reagents based on product specifications and sales conditions.
Assessment criteria	See assessment form Advice report on #OnderwijsOnline General Information
Exam matrix	See assessment form Advice report on #OnderwijsOnline General Information
	CH3T-Op
Name of examination or modular examination	Research plan
Examination or modular examination code	CH3T-Op
Assessment type(s):	Written, Group
Result	Grade
Minimum result	5.5
Weight factor of modular exam	1
Exam opportunities	Term 4, resit term 4
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in Course CH3T gives automatic registration for CH3T-Op.
Discussion and review	Returning the completed assessment form to the student and any feedback on the form or in the professional product serves as inspection and discussion of this partial examination.
Number of examiners	One examiner (practical teacher) for the assessment (assessment form)
Possibilities for compensation	
Assessment dimensions	Competence 1: Design Question clarification 1.1.1. Identifies relevant background information required to answer the research question. 1.1.2. Knows the criteria defining reliable sources of information in scientific research. 1.1.3. Consults simple and relevant sources of scientific information. These sources are presented in the assignment. 1.1.4. Forms a hypothesis based on the research question. 1.1.5. Integrates information into a simple research plan. 1.1.6. Understands and applies simple English literature relevant to the given context. Competence 2: Experimenting: 2.1.1. Reads and understand the practical guide; understands the theoretical background of the main steps of the methods. 2.1.2. Performs calculations prior to beginning lab work. 2.1.3. Ensures that all requirements are present before beginning the experiment. Competence 3: Results analysis: 3.1.3. Makes conclusions relating to the initial research question (if possible).

	Competence 4: Quality control 4.1.1. Is aware of the health and safety rules and works according to these rules. 4.1.3. Uses controls, and uses these to assess the reliability of the results. Competence 6: Reporting and presenting 6.1.1. Reports their research according to the product criteria for lab journal and reports; level 1: uses correct spelling and grammar; is aware of the scientific style; uses simple and logical structure; describes results so the reader can understand; uses clearly labelled figures and tables. 6.1.3. Is familiar with the international conventions of scientific and academic writing. Competence 7: Working in a planned and project-based manner 7.1.1. Plans and organises activities in a simple work plan 7.1.3. Plans the study tasks Controlled dispensation medicines
Assessment criteria	See assessment form research report on #OnderwijsOnline - General Information
Exam matrix	See assessment form research report on #OnderwijsOnline - General Information

Course unit 4K: CH4K (5 study credits)

	CH4K
General information	
Target group	Full-time students foundation year Chemistry / Full-time students of the MLO-transfer programme.
Name of unit of study	ECU 4K: General Chemistry: Knowledge Chemical Equilibria and Analytical Chemistry
Course unit code	CH4K
Teaching Term	Term 3. If there are sufficient student numbers, the curriculum will be mirrored in Term 4.
ECTS credits	5 study credits
Study load in hours	140 SBU
Study hours (contact hours)	Programmed contact hours: 5 lesson periods per week= 35 lesson periods per term = 3.75 hours per week = 26.25 hours per week Planned time for self-study: 113.25 hours Total: 140 hours
Course entry requirements	HAVO (higher general continued education)/VWO (pre-university) diploma with the profile Nature and Technology or Nature and Health, and participated in course units CHLS1A, CHLS1B, CHLS1C, CHLS2A, CHLS2B and CHLS2C. 4th year MLO chemistry: transfer programme participant. MLO Chemistry diploma programme
Content and organization	
General description	This course unit is an introduction to analytical chemistry. Students receive general chemistry, thermodynamics and mathematics subjects.
Exit qualifications	-
Professional tasks and products	Carrying out Life Science Research
Professional products	

Cohesion	This course follows CHLS1B, CHLS1C, CHLS2B, CHLS2C and preparation for CH5 and CH7. CH4 is divided into three course units, each worth 5 study credits: CH4K (knowledge), CH4P (practical), CH4T (theme, project).
Mandatory participation	
Maximum number of participants	
Compensation possibilities	Kthermo, Kwis and Kchemie can be compensated from 4.0. C4K end grade must be at least 5.5.
Activities and/or instructional formats	**Supporting subjects General Chemistry** Weak acids and bases, polyprotic acids, titrations Buffers Equilibrium constants Electrochemistry (redox reactions, Nernst equation) *Working methods: combined lectures/response classes* **Supporting subject: Thermodynamics** Systems, states and energy Enthalpy The enthalpy of physical and chemical changes Entropy Changes in entropy Free Enthalpy *Working methods: lecture* **Supporting subject Mathematics** Differentiating Integration *Working methods: lecture*
Required literature	The latest edition of: - Tro,N.J., Principles of chemistry, a molecular approach, Prentice Hall / Pearson Education. - Harris, D.C., Quantitative Chemical Analysis, W.H. Freeman & Company. - Erich Steiner, The Chemistry Maths Book, Oxford University press.
Required software/required materials	
Recommended literature	
Examinations	
	CH4K-Kthermo
Name of examination or modular examination	Theory Exam Thermodynamics
Examination or modular examination code	CH4K-Kthermo
Assessment type(s):	Individual, Written Open Questions
Result	Grade
Minimum result	5.5
Weight factor of modular exam	2
Exam opportunities	Term 3, resit mid-term 4
Permitted resources	non-graphic calculator
Method of enrolment for exam / enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the assessment period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.

Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 examiners for the construction and the evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	Kthermo, Kwis and Kchemie can be compensated from 4.0.
Assessment dimensions	Thermodynamics - Ideal gas wet, volume-work - the first law of thermodynamics - the second law of thermodynamics - Chemical equilibria of thermodynamics
Assessment criteria	The aim is to introduce the student to a broad range of thermodynamic concepts. The student knows the following concepts and subjects: the ideal gas law the first law - systems, energy and labor, heat, state functions, calorimetry; - enthalpy, phase transition enthalpy, reaction enthalpy, relationship between DH and DU, standard reaction enthalpy, Hess' law, standard enthalpy of formation. the second law spontaneous changes, entropy and disorder, change in entropy, standard molar entropy, standard reaction entropy; - environment, total entropy change, equilibrium, Gibbs' free energy, reaction free energy, change of free energy in biological systems. Chemical equilibria - thermodynamics of the chemical equilibrium, equilibrium constants, heterogeneous equilibrium, progress of the reaction, direction of the reaction: adding / removing a substance, compressing a reaction mixture, temperature and equilibrium; - equilibrium constants and equilibrium calculations, derivation of the Nernst Equation.
Exam matrix	~ 40-60% Ideal gas law and first law of thermodynamics ~ 40-60% The second law of thermodynamics and chemical equilibria
	CH4K-Kchemie
Name of examination or modular examination	General Chemistry Theory Exam
Examination or modular examination code	CH4K-Kchemie
Assessment type(s):	Individual, Written Open Questions
Result	Grade
Minimum result	5.5
Weight factor of modular exam	2

Exam opportunities	Term 3, resit mid-term 4
Permitted resources	non-graphic calculator
Method of enrolment for exam / enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the assessment period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 examiners for the construction and the evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	Kthermo, Kwis and Kchemie can be compensated from 4.0.
Assessment dimensions	Chemistry: - Chemical equilibria; - pH calculations, acids and bases; - Electrochemistry
Assessment criteria	Chemistry: Chemical equilibria; The student: - knows what is meant by homogeneous and heterogeneous balances and can define the equilibrium constant (K) for both types and formulate them in formula, based on a balanced reaction comparison; - knows what is meant by K and KC; - can calculate K on the basis of equilibrium concentrations; - can calculate the equilibrium concentrations based on K; - knows the concept of Q and can predict which side a reaction increases if the concentrations and K are known; - understands the Le Chatelier principle and can predict which direction a reaction will go if reactants / products are added / removed; if the temperature is raised / lowered; if the pressure is changed. - pH calculations, acids and bases The student: - knows what is meant by a "proton transfer reaction": understands what a Bronsted acid/base is; can write acid/base reactions; - know what is meant by strong and weak acids and bases; what conjugated acids and bases are; - knows what is meant by Lewis acids and bases; - know that the autoprotolysis of water (KW = [H3O +] [OH-] = 10-14) is central to pH calculations; know that pH + pOH = 14; - knows how the pH scale works and what is meant by acid and alkaline; - can calculate the pH of strong and weak acids and bases ; - know that for basic solutions the pH is calculated via the pOH; - know what is meant by acid and base constants (KA, KB); - know that many nitrogen compounds react as bases; can write down the reaction equation for the basic reaction; knows these molecules globally;

	- know what is meant by the "conjugate seesaw"; the stronger the weak acid, the weaker the conjugated base; - know that salts of strong acids and bases react neutrally; that salts of weak acids react basically and salts of weak bases react as acids; - can calculate the pH of such (salt) solutions; - know what is meant by polyprotic acids and can calculate the pH of polyprotic acids; know what is meant by buffer solutions; knows the buffer formula and can calculate the pH of buffer solutions; - can calculate the buffer capacity of buffer solutions and know what this means; - can calculate the pH in acid / base titrations (of both strong and weak acids/bases) at every point of the titration. Electrochemistry The student: - know what is meant by reduction and oxidation; what redox reactions and half reactions are; - can write redox responses (balancing redox equations; - knows what galvanic cells are; knows the structure and notation; can calculate (standard) potentials thereof; - knows the meaning of standard potentials; knows what is meant by a redox table (electrochemical series) and has insight into and understanding of these; - knows the meaning of Nernst Equation and can perform simple calculations on it.
Exam matrix	~ 60% Equilibria and pH calculations ~ 40% Electrochemistry
	CH4K-Kwis
Name of examination or modular examination	Theory Exam Mathematics
Examination or modular examination code	CH4K-Kwis
Assessment type(s):	Individual, Written Open Questions
Result	Grade
Minimum result	5.5
Weight factor of modular exam	1
Exam opportunities	Term 3, resit mid-term 4.
Permitted resources	non-graphic calculator
Method of enrolment for exam / enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the assessment period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam

Number of examiners	2 examiners for the construction and the evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	Kthermo, Kwis and Kchemie can be compensated from 4.0.
Assessment dimensions	Mathematics - Differentiation, advanced - Integration, simple
Assessment criteria	The student can apply the following rules with differentiation: - Chain rule; - Product rule; - Quotient rule. The student can: - determine primitives; - calculate standard integrals.
Exam matrix	~60% Differentiation ~40% Integration

Course unit 4P: CH4P (5 study credits)

	CH4P
General information	
Target group	Full-time students foundation year Chemistry / Full-time students of the MLO-transfer programme.
Name of unit of study	ECU 4P General Chemistry: Practical Chemical Equilibria and Analytical Chemistry.
Course unit code	CH4P
Teaching period	Term 3. If there are sufficient student numbers, the curriculum will be mirrored in Term 4.
ECTS credits	5 study credits
Study load in hours	140 SBU
Study hours (contact hours)	Planned contact time: 8.4 lesson periods per week = 59 lesson periods per term, 6.3 hours per week = 44.25 hours per term. Planned time for self-study: 95.75 hours Total: 140 hours
Course entry requirements	HAVO (higher general continued education)/VWO (pre-university) diploma with the profile Nature and Technology or Nature and Health, and participated in course units CHLS1A, CHLS1B, CHLS1C, CHLS2A, CHLS2B and CHLS2C . 4th year MLO chemistry: transfer programme MLO Chemistry diploma programme
Content and organisation	
General description	Title: Chemistry in Equilibrium The main theme of this course unit involves chemical equilibria and gaining experience with spectrophotometric and titration techniques. The emphasis lies on analysing and assessing the results acquired from experiments using these techniques. In addition to this, the analytical chemistry practical skills are developed further.

Exit qualifications	**Experimenting** **Results analysis** Quality assurance Management and administration **Reporting/presenting** Planning and project-based working Cooperation Leadership/Coaching Professional development The competencies in bold are those which are emphasized in this course.
Professional tasks and products	Carrying out Life Science Research
Professional products	
Cohesion	This course follows CHLS1B, CHLS1C, CHLS2B, CHLS2C and preparation for CH5 and CH7. CH4 is divided into three course units, each worth 5 study credits: CH4K (knowledge), CH4P (practical), CH4T (theme, project).
Mandatory participation	Attendance in the practical lessons is a prerequisite for participation in the modular examination Pi. The student may not miss more than 1 practical lesson. More than one lesson missed will result in having to resit in the following academic year.
Maximum number of participants	
Compensation possibilities	
Activities and/or instructional formats	**Analytical Chemistry Practical** - Analyses of different samples using UV/VIS spectrophotometry, GC, AAS, pH electrodes, redox electrodes. - comparison of different measurement methods. *Teaching methods: lab practicals* **Theory for the practical lessons** - Theoretical background for the practical *Working methods: lecture*
Required literature	The latest edition of: - Jones, A.M., Dean, J.R., et al. Practical skills in Chemistry, New York, NY: Pearson Education.
Required software/required materials	
Recommended literature	
Examinations	
	CH4P-Pi
Name of examination or modular examination	Practical performance
Code of examination or modular examination	CH4P-Pi
Assessment type(s):	Individual Practical
Result	Grade
Minimum result	5.5
Weight factor of modular exam	1
Exam opportunities	Term 3 There is only one opportunity per academic year for the modular exams Pi (EER paragraph 8.5)
Permitted resources	

Method of enrolment for exam / enrolment period	Participation in Course CH4P gives automatic registration for CH4P-Pi.
Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this interim assessment.
Number of examiners	Assessment by one examiner based on the assessment form (study career coach).
Possibilities for compensation	
Assessment dimensions	Competence 1: Design 1.1.4. Forms a hypothesis based on the research question. Competence 2: Experimenting 2.1.1. Reads and understand the practical guide; understands the theoretical background of the main steps of the methods. 2.1.2. Performs calculations prior to beginning lab work. 2.1.3. Ensures that all requirements are present before beginning the experiment. 2.1.4. Carries out experiments accurately according to the protocol. 2.1.5. Carries out the experiments within the given time frame. Competence 3: Results analysis 3.1.1. Carries out results analysis according to the prescribed methods; performs error analysis in the correct manner (if applicable). 3.1.2. Evaluates the obtained results based on their accuracy and reliability. 3.1.3. Makes conclusions relating to the initial research question (if possible). 3.1.4. Discusses the execution of the experiment and results. Competence 4: Quality control 4.1.1. Is aware of the health and safety rules and works according to these rules. 4.1.2. Uses materials and equipment correctly. Competence 5: Management and administration 5.1.1. Encodes chemicals and samples; stores these in the prescribed manner. 5.1.2. Leaves the work space tidy and clean. 5.1.3. Manages and archives data in lab journal (aim, experiment description, alterations, results, conclusion) and if relevant, other ways of storing data. Competence 6: Reporting and presenting 6.1.1. Reports their research according to the product criteria for lab journal and reports; level 1: uses correct spelling and grammar; is aware of the scientific style; uses simple and logical structure; describes results so the reader can understand; uses clearly labelled figures and tables. Competence 7: Working in a planned and project-based manner 7.1.2. Plans the study tasks. Competence 11: Professional development 11.1.3. Reflects critically on own performance and learning process; learns from mistakes. In the context of: acid-base, polyprotic acid buffers, equilibrium constant pH calculations, electrochemistry, electricity

Assessment criteria	See assessment form for Practical with Lab Journal for the Chemistry Practical on #OnderwijsOnline under Algemene Informatie (General Information)
Exam matrix	See assessment form for Practical with Lab Journal for the Chemistry Practical on #OnderwijsOnline under Algemene Informatie (General Information).
	CH4P-Pm
Name of examination or modular examination	Measurement Report
Code of examination or modular examination	CH4P-Pm
Assessment type(s):	Written, individual
Result	Grade
Minimum result	5.5
Weight factor of modular exam	1
Exam opportunities	Term 3, resit mid-term 4.
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in Course CH4P gives automatic registration for CH4P-Pm.
Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this interim assessment.
Number of examiners	Assessment by one examiner based on the assessment form (study career coach).
Possibilities for compensation	
Assessment dimensions	Competence 1: Question clarification 1.1.4. Forms a hypothesis based on the research question. Competence 2: Experimenting 2.1.1. Reads and understand the practical guide; understands the theoretical background of the main steps of the methods. 2.1.2. Performs calculations prior to beginning lab work. Competence 3: Results analysis Data processing 3.1.1. Carries out results analysis according to the prescribed methods; performs error analysis in the correct manner (if applicable). 3.1.2. Evaluates the obtained results based on their accuracy and reliability. 3.1.3. Makes conclusions relating to the initial research question (if possible). 3.1.4. Discusses the execution of the experiment and results. Competence 4: Quality control 4.1.1. Is aware of the health and safety rules and works according to these rules. Competence 6: Reporting and presenting 6.1.1. Reports their research according to the product criteria for lab journal and reports; level 1: uses correct spelling and grammar; is aware of the scientific style; uses simple and logical structure; describes results so the reader can understand; uses clearly labelled figures and tables.

Assessment criteria	See Measurement Report Assessment Form on OnderwijsOnline - General Information.
Exam matrix	See assessment form on #OnderwijsOnline - General Information.

Course unit 4T: CH4T (5 study credits)

	CH4T
General information	
Target group	Full-time students foundation year Chemistry / Full-time students of the MLO-transfer programme.
Name of unit of study	ECU 4T General Chemistry: Project Chemical Equilibria and Analytical Chemistry
Course unit code	CH4T
Teaching Term	Term 3. If there are sufficient student numbers, the curriculum will be mirrored in Term 4.
ECTS credits	5 study credits
Study load in hours	140 SBU
Study hours (contact hours)	Programmed contact hours: 5.3 lesson periods per week = 37 lesson periods per term, 3.8 hours per week = 26.4 hours per term. Planned time for self-study: 113.6 hours Total: 140 hours
Course entry requirements	HAVO (higher general continued education)/VWO (pre-university) diploma with the profile Nature and Technology or Nature and Health, and participated in course units CHLS1A, CHLS1B, CHLS1C, CHLS2A, CHLS2B and CHLS2C. 4th year MLO chemistry: transfer programme MLO Chemistry programme
Content and organisation	
General description	The main theme of this course unit involves chemical equilibria. The emphasis lies on analysing and assessing the results acquired from experiments using these techniques. For the central theme, the results of different analytical methods are compared statistically and with the reference value.
Exit qualifications	**- Experimenting** **- Results analysis** - Quality assurance - Management and administration **- Reporting/presenting** - Planning and project-based working - Teamwork - Leadership/Coaching ***- Professional development*** The competencies in bold are those which are emphasized in this course.
Professional tasks and products	Carrying out Life Science Research
Professional products	Results analysis and a poster
Cohesion	This course follows CHLS1B, CHLS1C, CHLS2B, CHLS2C and preparation for CH5 and CH7. CH4 is divided into three course units, each worth 5 study credits: CH4K (knowledge), CH4P (practical), CH4T (theme, project).
Mandatory participation	Attendance at the tutor meetings is a prerequisite for participation in the modular examination IPS.

Maximum number of participants	
Compensation possibilities	
Activities and/or instructional formats	**Tutor** Pre and post discussion of assignments. *Method: Tutor* **Expert** Extra information is given in relation to the week tasks, practical and the central assignment. *Working methods: lecture* **Supporting subject: Chromatography** Introduction to Chromatography This subject is assessed in an assignment. *Working methods: combined lectures/response classes* **Supporting subject Mathematics** Typing errors, calculation errors, outliers, standard deviation, confidence interval, t-test, comparison of results with reference value. This subject is assessed in the theme report. *Working methods: lecture* **Supporting subject: Scientific writing Results analysis** *Method: workshop* **Workshop Professional Skills 3 (term 3 or term 4)** Professional attitude Communication Cooperation *Method: workshop + team meeting*
Required literature	The latest edition of: - Tro, N.J., Principles of chemistry, a molecular approach, Prentice Hall / Pearson Education. - Harris, D.C., Quantitative Chemical Analysis, W.H. Freeman & Company. - Giancoli, D.C., Physics for Scientists & Engineers, Indianapolis: Pearson Education Informit. - Douwes D. J. et al, Basisvaardigheden Wiskunde, Groningen: Wolters-Noordhoff. - Jones, A.M., Dean, J.R., et al. Practical skills in Chemistry, New York, NY: Pearson Education.
Required software/required materials	
Recommended literature	
Examinations	
	CH4T-PS3
Name of examination or modular examination	LPO Professional Skills 3
Examination or modular examination code	CH4T-PS3
Assessment type(s):	Individual, Written
Result	Satisfactory/unsatisfactory

Minimum result	Satisfactory
Weight factor of modular exam	0
Exam opportunities	Term 3 or 4. Resit assignment term 4. For participation in the workshop there is only one opportunity per academic year (EER paragraph. 8.5)
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in Course CH4T gives automatic registration for CH4T-LPO-PS3. Students will attend the workshop during term 3 or 4
Discussion and review	For questions about assessment, contact the examiner.
Number of examiners	One examiner for the assessment based on participation and participation in the team meeting (workshop lecturer)
Possibilities for compensation	
Assessment dimensions	Competence 8: Team work / communication 8.1.1. Adheres to rules. 8.1.2. Makes a valuable contribution to the group. 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.1.8. Verbally expresses their opinion/message. 8.1.9. Is active in conflict resolution. Competence 11: Professional development 11.1.3. Reflects critically on own performance and learning process; learns from mistakes.
Assessment criteria	Participation in the workshop and participation in the team meeting is required for a satisfactory grade.
	CH4T-IPV
Name of examination or modular examination	IPS
Examination or modular examination code	CH4T-IPV
Assessment type(s):	Oral, Individual
Result	Satisfactory/unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exam	0
Exam opportunities	Term 3 There is only one opportunity per academic year for the modular exam IPS (EER paragraph 8.5)
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in Course CH4T gives automatic registration for CH4T-IPV.
Discussion and review	For questions about the assessment, contact the examiner.
Number of examiners	One examiner for the assessment based on participation and effort (tutor)
Possibilities for compensation	
Assessment dimensions	Competence 6: Presentation 6.1.6. In English: can communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters. Competence 7: Working in a planned and project-based manner 7.1.2. Plans the study tasks.

	Competence 8: Teamwork Functioning in a group 8.1.1. Adheres to rules. 8.1.2. Makes a valuable contribution to the group Communication Communicates his task to fellow students and lecturer according to the basic rules of communication; if needed, supervised by the lecturer. 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.1.8. Verbally expresses their opinion/message. Competence 11: Professional development 11.1.5. Has study skills required by higher professional education; is motivated and determined. 11.1.6. Is aware of internationally accepted codes of scientific conduct.
Assessment criteria	The student can: - the student has prepared for the meeting by completing the assignment to be discussed - and also completed the required reading for the following assignment to be discussed; - the student is able to show weekly assignments to the tutor (according to agreement, in writing or as a presentation); all required aspects are complete in all assignments; - Fulfils his/her roles (Chair, secretary etc.); - the student adheres to the rules agreed upon; - the student asks questions and shares knowledge regarding the assignment during tutor meetings; verbalizes these clearly and audibly, maintains eye contact; - Allows others to finish speaking; - the student offers feedback to group- and class members and is open to receiving feedback.
	CH4T-R
Name of examination or modular examination	Theme report: Results analysis
Examination or modular examination code	CH4T-R
Assessment type(s):	Written, Group
Result	Grade
Minimum result	5.5
Weight factor of modular exam	1
Exam opportunities	Term 3, resit mid-term 4
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in Course CH4T gives automatic registration for CH4T-R.
Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this interim assessment.
Number of examiners	One examiner for the assessment based on the assessment form (subject expert)
Possibilities for compensation	
Assessment dimensions	Competence 2: Experimenting 2.1.2. Performs calculations prior to beginning lab work. Competence 3: Results analysis Data processing

	3.1.1. Carries out results analysis according to the prescribed methods; performs error analysis in the correct manner (if applicable). 3.1.2. Evaluates the obtained results based on their accuracy and reliability. 3.1.3. Makes conclusions relating to the initial research question (if possible). 3.1.4. Discusses the execution of the experiment and results. Competence 6: Reporting and presenting 6.1.1. Reports their research according to the product criteria for lab journal and reports; level 1: uses correct spelling and grammar; is aware of the scientific style; uses simple and logical structure; describes results so the reader can understand; uses clearly labelled figures and tables. 6.1.3. Is familiar with the international conventions of scientific and academic writing. Competence 8: Cooperation Communication Communicates his task to fellow students and lecturer according to the basic rules of communication; if needed, supervised by the lecturer. 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.1.8. Verbally expresses their opinion/message. In the context of: Comparison of analysis methods.
Assessment criteria	See assessment form: Results Analysis on #OnderwijsOnline - General Information
Exam matrix	See assessment form: Results Analysis on #OnderwijsOnline - General Information
	CH4T-P
Name of examination or modular examination	Central Theme Poster
Examination or modular examination code	CH4T-P
Assessment type(s):	Written, Group
Result	Satisfactory/unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exam	0
Exam opportunities	Term 3, resit in consultation with lecturer
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in Course CH4T gives automatic registration for CH4T-P.

Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this interim assessment.
Number of examiners	One examiner for the assessment based on the assessment form (subject expert)
Possibilities for compensation	
Assessment dimensions	Competence 1: Question clarification 1.1.2. Knows the criteria defining reliable sources of information in scientific research. Competence 6: Reporting and presenting 6.1.1. Reports their research according to the product criteria for lab journal and reports; level 1: uses correct spelling and grammar; is aware of the scientific style; uses simple and logical structure; describes results so the reader can understand; uses clearly labelled figures and tables. 6.1.3. Is familiar with the international conventions of scientific and academic writing. 6.1.5. Presents research to a target audience with similar knowledge background, applies general presentation techniques and answers questions: uses correct spelling and grammar; describes results so that the reader can understand, uses clearly labelled figures and tables; there is an introduction-body-conclusion structure to the presentation; speaks clearly and coherently; has upright posture and hands are freely used; makes eye contact with the audience; makes organized and clear slides or other visual products Competence 8: Teamwork Communication Communicates his task to fellow students and lecturer according to the basic rules of communication; if needed, supervised by the lecturer. 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.1.8. Verbally expresses their opinion/message. In the context of: Comparison of analysis methods.
Assessment criteria	Poster *See Poster assessment form on #OnderwijsOnline under Algemene Informatie (General Information)* Structure Title Authors Research Aim Introduction: Identify analytical methods with a short explanation and a short explanation about the analysis of the results Results: in table form and graph, possibly short explanation Apply statistics to the results: Comparison of the measured values with each other. Determine according to own insight whether the measured values differ significantly from each other by using confidence intervals. Conclusion: State which method gives the best results and the actual results found.
Exam matrix	See Poster assessment form on #OnderwijsOnline - General Information

	CH4T-C
Name of examination or modular examination	Assignment Chromatography
Examination or modular examination code	CH4T-C
Assessment type(s):	Individual, Written
Result	Satisfactory/unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exam	0
Exam opportunities	Term 3, resit in consultation with lecturer
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in Course CH4T gives automatic registration for CH4T-C.
Discussion and review	There is no plenary review/discussion. The student can make an appointment to receive explanation about the questions.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	
Assessment dimensions	Basic chromatography
Assessment criteria	Chromatography The student can discuss and explain the following topics: • Thin layer chromatography • HPLC techniques • GC techniques shows this in an assignment
Exam matrix	~ 40% HPLC ~40% GC ~20% TLC
	CH4T-HBO
Name of examination or modular examination	Competency card
Examination or modular examination code	CH4T-HBO
Assessment type(s):	Written, Oral, Individual
Result	Satisfactory/unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exam	0
Exam opportunities	1st year
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in Course CH4T gives automatic registration for CH4T-HBO.
Discussion and review	For questions about the assessment, contact the examiner.
Number of examiners	One examiner (tutor) for the assessment (using assessment form)
Possibilities for compensation	
Assessment dimensions	Competence 6: Reporting and presenting 6.1.2. Takes minutes of meetings according to product criteria for meeting minutes; level 1 Competence 8: Team work / communication

	8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.1.8. Verbally expresses their opinion/message. 8.1.12. Is aware of the international character of the professional community. Competence 9: Coaching / supervising 9.1.1. Composes an agenda in a standard format and uses it to chair a meeting. Competence 11: Professional development 11.1.2. Works on learning aims as described in the PDP and collated competency assessment products. 11.1.5. Has study skills required by higher professional education; is motivated and determined. 11.1.6. Is aware of internationally accepted codes of scientific conduct.
Assessment criteria	See Assessment form Meeting Minutes Level 1 - 2 signatures (=satisfactory) on the competency card are required See assessment form below 'Agenda/Chairperson, level I' - 2 signatures (=satisfactory) for 'Agenda' and 2 signatures (=satisfactory) for 'Chairing tutor-group' on the HBO competency card are required. For the assessment forms, see #OnderwijsOnline by Algemene Informatie (General Information) Internationalisation The student - actively participates in a tutor class held in English in course CHLS2 - actively participates in a tutor class held in English in course CHLS3 - explains a practical guide, in English, in course CHLS4
	CH4T-Stage
Name of examination or modular examination	Mini-internship
Examination or modular examination code	CH4T-Stage
Assessment type(s):	Individual, Written
Result	Satisfactory/unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exam	0
Exam opportunities	Term 3 or 4, resit in consultation with lecturer
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in Course CH4T gives automatic registration for CH4T-Stage.
Discussion and review	For questions about the assessment, contact the examiner.
Number of examiners	1 Examiner for assessment (study coach).
Possibilities for compensation	
Assessment dimensions	Competence 8: Internationalisation 8.1.12. Is aware of the international character of the professional community. Competence 11: Professional development 11.1.2. Works on learning aims as described in the PDP and collated competency assessment products.

	11.1.3. Reflects critically on own performance and learning process; learns from mistakes. 11.1.5. Has study skills required by higher professional education; is motivated and determined. 11.1.6. Is aware of internationally accepted codes of scientific conduct.
Assessment criteria	Participation in the mini-internship. Describing the experience in a report.
	CH4T-FG2 / CH4T-FG3
Name of examination or modular examination	Performance Review 2/3
Examination or modular examination code	CH4T-FG2 / CH4T-FG3
Assessment type(s):	Individual oral
Result	Satisfactory/unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exam	0
Exam opportunities	Term 3 or 4, resit in consultation with lecturer (SLB).
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in Course CH4T gives automatic registration for CH4T-FG2 / CH4T-FG3.
Discussion and review	For questions about assessment, contact the examiner.
Number of examiners	1 Examiner for assessment (study coach).
Possibilities for compensation	
Assessment dimensions	Competence 8: Teamwork/ communication Functioning in a group 8.1.1. Adheres to rules. Competence 11: Professional development 11.1.2. Works on learning aims as described in the PDP and collated competency assessment products. 11.1.3. Reflects critically on own performance and learning process; learns from mistakes. 11.1.5. Has study skills required by higher professional education; is motivated and determined.
Assessment criteria	The student - meets agreements, is punctual, and has completed the preparatory assignment (e.g. DPF is orderly). - can demonstrate that he has actively worked on the learning outcomes that are described in the PDP. - critically takes a critical look at his/her learning process, identifies what went well, and what didn't go well, identifies the causes of these, and links it to his/her own actions. A plan for improvement in the future is formulated. - demonstrates a pro-active attitude and is motivated. - shows determination in his study.
	CH4T-POP
Name of examination or modular examination	PDP
Examination or modular examination code	CH4T-POP

Assessment type(s):	Individual, Written
Result	Satisfactory/unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exam	0
Exam opportunities	Term 3 or 4, resit in consultation with lecturer
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in Course CH4T gives automatic registration for CH4T-POP.
Discussion and review	For questions about the assessment, contact the examiner.
Number of examiners	One examiner for assessment (study coach).
Possibilities for compensation	
Assessment dimensions	Competence 11: Professional development 11.1.1. Formulates PDP according to guidelines.
Assessment criteria	See PDP assessment form on #OnderwijsOnline - General Information
Exam matrix	See PDP assessment form on #OnderwijsOnline - General Information

9.2

Units of study of the post-propaedeutic phase

The post-propaedeutical phase of the study degree program includes the following eductional units with the associated studyload.

A. Full-time Chemie (Dutch)

Level 2, Graduation level

a. Course unit 7K: C7K (5 credits)
b. Course unit 7T: C7T (5 credits)
c. Course unit 5K: C5K (5 credits)
d. Course unit 5T: C5T (5 credits)
e. Course unit 5-7Pa: C5-7Pa (5 credits)
f. Course unit 5-7Po: C5-7Po (5 credits)
g. Course unit 6K: C6K (5 credits)
h. Course unit 6T: C6T (5 credits)
i. Course unit 8K: C8K (5 credits)
j. Course unit 8T: C8T (5 credits)
k. Course unit 6-8Pa: C6-8Pa (5 credits)
l. Course unit 6-8Po: C6-8Po (5 creditsLevel 3, Professional level

Level 3, Professional level

Graduation specialisation Organic and Polymer chemistry

m. Course unit 9: C9 (30 credits)
n. Course unit 13: C13 (30 credits)
o. Course unit 14: C14 (30 credits)

Graduation specialisation Analytical chemistry:

p. Course unit 11: C11 (15 credits)
q. Course unit 12: C12 (15 credits)
r. Course unit 13: C13 (30 credits)
s. Course unit 14: C14 (30 credits)

B. Full-time Chemistry (English variant)

Level 2, Graduation level

a. Course unit 7K: CH7K (5 credits)
b. Course unit 7T: CH7T (5 credits)
c. Course unit 5K: CH5K (5 credits)
d. Course unit 5T: CH5T (5 credits)
e. Course unit 5-7Pa: CH5-7Pa (5 credits)
f. Course unit 5-7Po: CH5-7Po (5 credits)
g. Course unit 6K: CH6K (5 credits)
h. Course unit 6T: CH6T (5 credits)
i. Course unit 8K: CH8K (5 credits)
j. Course unit 8T: CH8T (5 credits)
k. Course unit 6-8Pa: CH6-8Pa (5 credits)
l. Course unit 6-8Po: CH6-8Po (5 credits

Level 3, Professional level

Graduation specialisation Analytical chemistry:

a. Course unit 11: CH11 (15 credits)
b. Course unit 12: CH12 (15 credits)
c. Course unit 13: CH13 (30 credits)

The fouth year of the Chemistry degree program (English variant) starts in the academic year 2022-2023.

This section only contains the Course unit descriptions of the English variant of the study program. The Dutch Course unit descriptions can be found in the Onderwijs en Examenregeling of the study program Chemie.

Course unit 7K: CH7K (5 credits)

	CH7K
General information	
Target group	Full-time students, main phase Chemistry, Level 2
Name of course unit	ECU CH7K: Organic and Analytical Chemistry knowledge: Aromatic Chemistry and Chromatography
Study unit code	CH7K
Teaching term	Term 1
ECTS credits	5 study credits
Study load in hours	140 SBU
Study hours (contact hours)	Programmed contact hours: 9 lesson periods/week= 63 lessons per term= 47 hours Assessment: 4 lesson periods = 3 hours. Planned time for self-study: 90 hours Total: 140 hours
Unit of study entry requirements	Course 1-4 of the foundation year, MLO diploma or enrolled in the abridged VWO route. Minor palette: Propedeutical exam - Life Sciences, Biology and Medical Laboratory Research, Bioinformatics. If CH3K has not been taken, the student is required to study the theory from this course and take an entry exam. Based on the results of the entry exam it will be decided if participation is possible
Content and organisation	

General description	This term comprises 4 cohesive course units: CH7K, C5-7Pa, C5-7Po and CH7T. In this term, the focus is on organic chemistry and analytical chemistry. In the central assignment you will carry out an electrophilic aromatic substitution reaction and characterize the products with GC-MS. In this assignment you will therefore become acquainted with the connection between organic and analytical chemistry. In order to be able to carry out this central assignment, knowledge of aromatic chemistry, chromatography and mass spectrometry is required and these subjects are therefore offered in theory (in this OWE CH7K) and weekly tasks (see CH7T). Not only is conducting research important, but reporting and presenting is a skill an applied science graduate should master therefore, this competence will be given ample attention (see CH7T). In the analytical laboratory, chromatography, electrochemistry and statistics play an important role in (see CH7P), the theory of which will also be presented (this course unit CH7K).
Exit qualifications	Design **Experimenting** **Results Analysis** **Quality control** **Reporting and Presenting** **Methodology** Team Work Superivising/Coaching Professional Development The competencies in bold are those which are emphasized in this course.
Professional tasks and products	Carrying out Life Science Research
Professional products	
Cohesion	The term comprises four cohesive course units (CH7K, C5-7Pa, C5-7Po and CH7T) and is the general theme is chemistry. The students come into contact with aspects of both specializations (organic and polymer chemistry and analytical chemistry). This orientation in the field of chemistry, in combination with Competence 11 (Professional Development) for the full-time students will ultimately lead to a choice of the specialization in term 3. CH7K builds on CHLS1C, CHLS2C, CH3K and CH4K.
Mandatory participation	-
Maximum number of participants	
Compensation possibilities	Compensation for Kelec, Kchrom, Kstat is possible from 4.0 CH7K: (Kelec+ Kchrom + Kstat)/3 ≥ 5.5

Activities and/or teaching methods	Supporting subject: Organic Chemistry Aromaticity, electrophilic aromatic substitutions *Teaching methods: combined lectures/response classes* Supporting subject: Chromatography Introduction, liquid chromatography, HPLC, GC *Teaching methods: combined lectures/response classes* Supporting subject: Electrochemistry Oxidation/reduction reactions Galvanic Cell (review) Electrodes, ion selective electrode Electrolysis Electrogravimetry *Teaching methods: lecture* Supporting subject: Applied Statistics Confidence intervals Significance tests (F-test and t-test) Dixon and Grubbs test ANOVA *Teaching methods: Combined lectures/tutorials* Supporting subject: Mathematics (only for H2 transfer MLO students) Basic algebra Functions Differentiation Trigonometry *Teaching methods: Combined lectures/tutorials* Supporting subject: Organic chemistry (only for H2 transfer MLO and VWO students) Atomic and molecular structure, charges, polarities, hybridisation, mesometry, stereochemistry, conformations *Teaching methods: Combined lectures/tutorials*
Required literature	The latest edition of: - McMurry, J Organic Chemistry, Belmont CA, USA: Cengage Inc. - Miller J.N., Miller, J.C., Statistics and Chemometrics for Analytical Chemistry, Essex: Pearson Education. - Harris, D.C., Quantitative Chemical Analysis, New York NY: W.H.Freeman and Company LTD - Laan, A., van der, Kooij, R., van der. Communication for Laboratory Engineers, Utrecht: Syntax Media. - For other learning resources (websites/hand books), refer to OnderwijsOnline. - transfer students: Kemme, S, et al., Wiskunde voor het Hoger Onderwijs deel b. Groningen: Noordhoff Uitgevers B.V.
Required software/required materials	Free software: ChemSketch
Recommended literature	
Examination	
	CH7K-Kelec
Name of examination or modular examination	Electrochemistry Theory

Examination or modular examination code	CH7K-Kelec
Assessment types(s):	Individual, Written
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 1, resit Term 2
Permitted resources	
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the exam period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	Compensation is possible for CH7K-Kelec from 4.0.
Assessment dimensions	- Galvanic Cell - Nernst equation - Ion selective electrode - Electrolysis - Electro analytical techniques
Assessment criteria	The student: - Can describe the following principles: redox reactions, construction of an electrochemical cell (Galvanic cell and electrolytic cell), oxidation number, notations, standard potential; - Can write and balance half reactions and net reactions; - Knows the law of Nernst and can perform calculations with it; - Can perform equilibria calculations with Nernst's law; - Knows the difference between measuring and reference electrodes and knows the different types; - Knows different ISE; - Can describe the structure of an ISE; - Knows the structure of a pH electrode, how to use it and sources of error; - Can apply and calculate Nernst's law with an ISE; - know terms regarding electrolysis: about potential, polarization, electric bilayer; - Knows the principle of electrogravimetry and can perform calculations with it.
Exam matrix	30% Nernst equation 30% Electro gravimetry 40% Ion selective electrode
	CH7K-Kchrom

Name of examination or modular examination	Chromatography Theory
Examination or modular examination code	CH7K-Kchrom
Assessment types(s):	Individual, Written
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 1, resit Term 2
Permitted resources	
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the exam period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	Compensation is possible for CH7K-Kchrom from 4.0.
Assessment dimensions	- GC and HPLC: columns, detectors and injection techniques - Troubleshooting - Calculations with liquid-liquid extraction - Calculations the Deemter equation

Assessment criteria	**Chromatography Analytical Separation Techniques** The student: - knows the concept of extraction and can calculate the extraction efficiency; - knows the concept of distribution coefficient; - knows the different types of chromatography; - knows the concepts, retention time, selectivity and can perform calculations with these; - knows the concepts of resolution, plate height, theoretical number of plates and can use them to calculate; - knows the Van Deemter equation and can sketch the graph of the dish height as a function of the linear speed. **Gas Chromatography** The student: - can give a description of the principle of gas chromatography; - can give a description of the different types of columns; - knows the concept of retention index and can use it to perform calculations; - knows the principle of temperature and pressure programming; - can name the properties of a number of carrier gases; - can describe different methods of injection; - can describe a number of important detectors and their operation; **HPLC** The student: - Can describe the principle of HPLC; - Knows the Van Deemter curves for different particle sizes; - Can describe the composition of the particles in a HPLC column; - can describe the principle of normal-phase and reversed-phase chromatography; - Can describe the concept of isocratic - and gradient elution; - Can describe different detectors and their operation.
Exam matrix	30% General Analytical Separations 35% Gas Chromatography 35% HPLC
	CH7K-Kstat
Name of examination or modular examination	Statistics Theory
Examination or modular examination code	CH7K-Kstat
Assessment types(s):	Individual, Written
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 1, resit Term 2
Permitted resources	
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the exam period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period.

	• Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	Compensation is possible for CH7K-Kstat from 4.0.
Assessment dimensions	Types of errors, average, standard deviation, confidence interval, population, sampling, outlier test, boxplot Significance tests: t-test, F test, ANOVA, chi square
Assessment criteria	The student: - Is able to use the following basic statistical concepts: Mean, standard deviation, reproducibility and repeatability, absolute and relative error; sample, population; - Can determine which of the following statistical tests should be applied in a specific case: t-test, F-test, Chi-square test, ANOVA; - Can also apply these tests using Excel; - Can use Anova to compare averages; - Knows the concept of null hypothesis and alternative hypothesis; - Can draw up the null hypothesis and alternative hypothesis in a concrete case; - Can design a Shewhart card.
Exam matrix	50% t and F test, and chi square 25% ANOVA 25% other topics
	CH7K-Op
Name of examination or modular examination	Organic Chemistry Assignment
Examination or modular examination code	CH7K-Op
Assessment types(s):	Individual, Written
Result	Satisfactory/Unsatisfactory
Passing grade	Satisfactory
Weight factor of modular exams	0
Exam opportunities	Term 1, resit Term 2
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH7K gives automatic registration for CH7K-Op.
Discussion and review	There is no plenary review/discussion (individual assignment). The student can make an appointment with the lecturer to receive explanation about the assignment.
Number of examiners	Assessment by one examiner (theory lecturer) on the basis of assessment.
Possibilities for compensation	-
Assessment dimensions	Organic Aromatic Chemistry Assignment Aromaticity, nomenclature of substituted benzenes, Hückel's Rule, electrophilic aromatic substitution, activating and deactivating groups and targeting effect, benzene diazonium salts nucleophilic aromatic substitution.

Assessment criteria	The student: - Knows the nomenclature of substituted benzenes. (IUPAC and trivial names); - Knows the spatial construction of benzene; - Can draw boundary structures from substituted benzenes; - Knows the conditions for aromatic character (Hückel rule); - knows reaction patterns according to which aromatic compounds react; - knows reaction equations and mechanisms of the halogenation, the nitration, the -Friedel-Crafts alkylation and acylation (incl. by-pass reactions), the sulfonation; - Knows the directing and (de)activating effect of substituents; - Knows the common characteristics of o,p-positions and m-positions; - Knows the relative strength directing effect; - Can explain the direct effect of the mechanism on o,p- and m-positions; - Knows what inductive and mesomeric effects are; - Knows which reagents and reaction conditions are required for the different reactions; - Knows why alkylbenzenes preferentially react at the benzyl site, - knows the reactions of phenols: (acidity, esterification and oxidation), benzene diazonium salts (preparation and reactivity, reactions), halobenzenes and nucleophilic aromatic substitution: carbanion and benzyne mechanism; - Can write down synthesis routes of substituted benzenes and knows the importance of sequence substitution.
Exam matrix	As homework, the student is given 25 mechanisms to write out; of these, 5 are checked. If these are completely error-free (e.g. no mechanistic errors that point incorrectly, or incorrect or forgotten charges), then a satisfactory is entered into Alluris

Course unit 7T: CH7T (5 credits)

	CH7T
General information	
Target group	Full-time students, main phase Chemistry, Level 2
Name of course unit	ECU CH7T: Organic and Analytical Chemistry project: Aromatic Chemistry and Chromatography
Study unit code	CH7T
Teaching term	Term
ECTS credits	5 study credits
Study load in hours	140 SBU
Study hours (contact hours)	Programmed contact hours: Course introduction: 2 lesson periods Expert hour: 1 lesson period per week Tutor: 2 lesson periods per week; + 1 lesson period IPV Ethics Workshop: 2 lesson periods Total: 26 lesson periods per term (average 3,7 lesson periods per week)= 19,5 hours per term. Exam length: 6 lesson periods = 4.5 hours Programmed time for self-study: 116 hours Total: 140 hours
Unit of study entry requirements	Course 1-4 of the foundation year, MLO diploma or enrolled in the abridged VWO route. Minor palette: Propedeutical exam - Life Sciences, Biology and Medical Laboratory Research, Bioinformatics.
Content and organisation	

General description	The course contains four related course units (CH7K, CH5-7Pa, CH5-7Po and CH7T). In this course attention is paid to both organic and analytical chemistry. In the central assignment you will carry out an electrophilic aromatic substitution reaction and characterize the products with GC-MS. In this assignment you will therefore become acquainted with the connection between organic and analytical chemistry. In order to be able to carry out this central assignment, knowledge of aromatic chemistry, chromatography and mass spectrometry is required and these subjects are therefore offered in theory (in this OWE CH7K) and weekly tasks (see CH7T). It is not only important to carry out an investigation, but also reporting and presenting area skills that an applied science graduate must master and this competence will therefore be given ample attention (in this course unit CH7T). In the analytical laboratory, chromatography, electrochemistry and statistics play an important role in (see CH5), the theory of which will also be presented (this course unit 7Pa).
Exit qualifications	Design **Experimenting** **Results Analysis** **Quality control** **Reporting and Presenting** **Methodology** Team Work Superivising/Coaching Professional Development The competencies in bold are those which are emphasized in this course.
Professional tasks and products	Carrying out life science research
Professional products	Presentation about the central assignment
Cohesion	The period includes four related course units (CH7K, C5-7Pa, C5-7Po and CH7T) and is of a general chemical nature The students come into contact with aspects of both thesis disciplines (organic & polymer chemistry and analytical chemistry). This orientation in the field of chemistry, in combination with Competence 11 (Professional Development) for the full-time students will ultimately lead to a choice of the specialization in term 3. CH7T builds on CHLS1C, CHLS2C, CH3KPT and CH4KPT.
Mandatory participation	Participation in IPS modular examination is subject to an obligation to be present at the tutorial and the assignment interview must be ticked off with satisfactory.
Maximum number of participants	
Compensation possibilities	
Activities and/or teaching methods	Tutor group Discussion of weekly tasks Expert hour Extra information about weekly assignments, central assignment etc. Opportunity to ask questions about the course. *Teaching methods: Problem based learning, quizzes, extra questions etc.* Support box mass spectrometry

	MS Principle Molecule/ion Mw, number of C atoms, Isotope ratio, odd number of N atoms, homolytic and heterolytic splitting, Benzylic cleavage *Teaching methods: Combined lectures/response classes* Ethics *Teaching methods: Interactive workshop* The role of ethics in life science research
Required literature	The latest edition of: - McMurry, J Organic Chemistry, Belmont CA, USA: Cengage Inc. - Miller J.N., Miller,J.C., Statistics and Chemometrics for Analytical Chemistry, Essex: Pearson Education. - Harris, D.C., Quantitative Chemical Analysis, New York NY: W.H.Freeman and Company LTD - Laan, A., van der, Kooij, R., van der. Communication for Laboratory Engineers, Utrecht: Syntax Media. - For other learning resources (websites/hand books), refer to OnderwijsOnline. - transfer students: Kemme, S, et al., Wiskunde voor het Hoger Onderwijs deel b. Groningen: Noordhoff Uitgevers B.V.
Required software/required materials	Free software: ChemSketch
Recommended literature	
Examination	
	CH7T-T
Name of examination or modular examination	Theme test
Examination or modular examination code	CH7T-T
Assessment types(s):	Individual, Written
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 1, resit Term 2
Permitted resources	
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the exam period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).

Possibilities for compensation	-
Assessment dimensions	**Competence 2: Experimenting** Preparation 2.1.2. Performs calculations prior to beginning lab work. 2.2.1. Is able to explain the basic steps of the experiments. Execution 2.2.7. Attempts to trouble shoot experiments when problems are encountered. **Competence 3: Results analysis** 3.2.1. Carries out results analysis using appropriate methods; uses statistics (if applicable). 3.1.2. Evaluates the obtained results based on their accuracy and reliability. 3.1.4. Discusses the execution and results of the experiment with other results. 3.2.3. Independently makes conclusions relating to the initial research question (if possible). 3.2.5. 3.2.5. Relates results with results from their other experiments and also to data in published literature. 3.2.6. Suggests improvements to improve the execution of the research. **Competence 4: Quality control** 4.1.3. Uses controls, and uses these to assess the reliability of the results. In the context of: Aromatic chemistry, mass spectrometry, electrochemistry, statistics and chromatography.
Assessment criteria	The theme test will include questions that relate to the aims of the course. The student: - has gained insight into the fields of organic chemistry, polymer chemistry and analytical chemistry; - Has improved skills in chemical calculations; - Organic chemistry (see also CH7T-Op); - Can understand less straightforward reactions of aromatic compounds that are less straightforward, on a mechanistic level; Statistics - Can apply the different tests: e.g. t-test, the F-testand ANOVA, knows their meaning and can supplement tables from excel; - Can set up H0 and H1; - Can draw a box plot and knows how to interpret it; - Hypothesis: - Can write a null hypothesis and alternative hypothesis in a given case; - See also the description; Chromatography - Can the influence of different parameters (temperature, pressure length column, eluens, detector, etc.) on the retention time and separation efficiency predicted; - Can perform calculations with the concepts, retention time, selectivity, resolution, dish height, theoretical number of dishes; - knows the Van Deemter equation; - Can analyze the results of a chromatographic experiment; Electrochemistry - Can design a galvanic cell and an ion selective electrode; - Can analyze the results of an electrochemical experiment;

	Practical - Knows the guidelines of the organic and the analytical lab journal and uses them when writing a lab journal; - Can write out mechanisms by hand and with ChemSketch; - Can search for safety aspects of a reaction; - Can set up a calibration sequence; Mass spectrometry: - The molecular weight, number of C atoms, isotope ratio, homolytic and heterolytic cleavage and benzylic cleavage recognition in a mass spectrum; - Knows how to describe the principle of MS (quadrupole); - Can describe/draw up a constellation and the execution of the different organic chemistry techniques; - Knows the waste categories of the chemicals and cleans them up appropriately; - Carries out appropriate error analysis; - Includes relevant information in a lab journal; - Can describe and analyze the results of chromatographic analyses (GC, HPLC and possibly GPC) ; - Can set up and analyze the results of an experiment with the ion selective electrodes Results analysis; - Furthermore, the student has mastered the theory that was discussed in the course.
Exam matrix	Distribution of the Theme Test questions: approx 25% Experimenting approx 50% Results analysis Approx 20% Reporting approx 5% Quality control 20% also considered as theory (e.g. reaction mechanisms and explanations for why particular reactions and reaction patterns are followed) and ~30% chemical calculations, a proportion of all are also related to safety. The questions regarding the competence Results Analysis relate to chromatography, aromatic organic chemistry, mass spectrometry, electrochemistry, statistics and final calculations.
	CH7T-Pres
Name of examination or modular examination	Presentation
Examination or modular examination code	CH7T-Pres
Assessment types(s):	Oral, Group
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 1, resit Term 2
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH7T gives automatic registration for CH7T-Pres.
Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this interim assessment.
Number of examiners	Assessment by two examiners based on the assessment form (expert).

Possibilities for compensation	-
Assessment dimensions	**Competence 1: Design** 1.2.4. Forms intermediate research questions and related a hypothesis based on the given research question. 1.2.5. Integrates information into a comprehensive research plan (e.g. justifying the chosen method, describing necessary controls and availability of equipment). **Competence 2: Experimenting** 2.2.1. Is able to explain the basic steps of the experiments. **Competence 3: Results Analysis** 3.1.2. Evaluates the obtained results based on their accuracy and reliability. 3.1.4. Discusses the execution of the experiment and results. 3.2.1. Carries out results analysis using appropriate methods; uses statistics (if applicable). 3.2.3. Independently makes conclusions relating to the initial research question (if possible). 3.2.5. 3.2.5. Relates results with results from their other experiments and also to data in published literature. **Competence 4: Quality control** 4.1.3. Uses controls, and uses these to assess the reliability of the results. **Competence 6: Reporting and Presenting** 6.2.5. Presents research to a target audience with similar knowledge background in a clear manner; applies general presentation techniques and answers questions: - there is a introduction-body-conclusion structure to the presentation; - Speaks clearly and coherently; - Has upright posture and hands are freely used; - Makes eye contact with the audience. - Makes organised and clear slides or other visual products; - Verbal and visual message form a whole; - Uses visual aids in PowerPoint to support; - Holds an on-topic discussion with the audience. **Competence 8: Communication** Is able to communicate about their assignment with peers and lecturers applying basic rules of communication. 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.2.5. Takes initiative in the conversation. 8.2.8. Verbally expresses their opinion/message clearly. 8.2.10. Interacts with conversation partner. **Competence 11: Professional Development** 11.1.3. Reflects critically on own performance and learning process; learns from mistakes.
Assessment criteria	See Assessment form: Presentation. For the assessment form, see #OnderwijsOnline under General Information. The students carry out research in a group (about half of the tutor group): a certain type of electrophilic aromatic substitution (humming or nitriding) is chosen, after which everyone performs the same reaction with a different starting substances, i.e. a different substituent at the

	benzene ring. The reaction mixture is then analysed in the analytical lab using GC MS. Afterwards, all the results of the research group will be combined and presented.
Exam matrix	See Presentation Assessment Form on OnderwijsOnline under General Information.
	CH7T-IPV
Name of examination or modular examination	IPS
Examination or modular examination code	CH7T-IPV
Assessment types(s):	Individual, practical:
Result	Satisfactory/Unsatisfactory
Passing grade	Satisfactory
Weight factor of modular exams	0
Exam opportunities	Term 1: Participation in modular exam IPV is only possible once per academic year (EER art. 8.5).
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH7T gives automatic registration for CH7T-IPV.
Discussion and review	For questions about the assessment, please contact the examiner.
Number of examiners	One examiner (tutor) for the assessment based on participation and effort.
Possibilities for compensation	-
Assessment dimensions	**Competence 6: Reporting and Presenting** 6.2.6 Is able to conduct discussions on work-related subjects. **Competence 7: Methodology** 7.1.3. Plans study activities. 7.2.1. Plans and organises activities in a work plan that covers a duration of at least 4 practical lessons. 7.2.2. Works according to plan, also under time constraints. 7.2.3. Ensures that goals are reached and if necessary, makes adjustments to activities. 7.2.4. Is flexible in changing circumstances. **Competence 8: Team Work** Functioning in a group 8.1.1. Adheres to rules. 8.1.2. Makes a valuable contribution to the group. 8.2.3. Makes clear agreements with others and keeps to these. 8.2.4. Recognises their own role in a group and is aware of other roles in the group. Works harmoniously with others. Communication: Is able to communicate about their assignment with peers and lecturers applying basic rules of communication. 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.1.9 Is active in conflict resolution. 8.2.5. Takes initiative in the conversation. 8.2.8. Verbally expresses their opinion/message clearly. 8.2.10. Interacts with conversation partner.

	Competence 11: Professional Development 11.1.5. Has study skills required by higher professional education; is motivated and determined.
Assessment criteria	The student: - the student has prepared for the meeting by completing the assignment to be discussed, and also completed the required reading for the following assignment to be discussed. - the student is able to show weekly assignments to the tutor (according to agreement, in writing or as a presentation); all required aspects are complete in all assignments; - Fulfils their designated roles (Chair, secretary etc.); - the student adheres to the rules agreed upon; - the student asks questions and shares knowledge regarding the assignment during tutor meetings; verbalizes these clearly and audibly, maintains eye contact; - Gives others opportunity to speak. - The student offers feedback to group and class members and is open to receiving feedback. The weekly assignments must be be assessed satisfactorily. - The student has actively participated in two tutor lessons that are partly in English.
	CH7T-Et
Name of examination or modular examination	LPO-Ethics
Examination or modular examination code	CH7T-Et
Assessment types(s):	Written, Oral, Individual
Result	Satisfactory/Unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exams	0
Exam opportunities	For participation in the workshops LPO-ethics there is only one opportunity per academic year (EER art. 8.5) See the class roster.
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH7T gives automatic registration for CH7T-LPO-Et.
Discussion and review	For questions about assessment, contact the examiner.

Number of examiners	One examiner (workshop lecturer) for the assessment based on participation and effort.
Possibilities for compensation	
Assessment dimensions	Competence 11. Professional Development 11.1.6. Is aware of internationally accepted codes of scientific conduct.
Assessment criteria	Active participation in the workshop, activity and making the preparation assignment is mandatory for satisfactory ticking off of the workshop

Course unit 5K: CH5K (5 credits)

	CH5K
General information	
Target group	Full-time students, main phase Chemistry, Level 2
Name of course unit	ECU CH5K: Analytical chemistry knowledge: quality assurance, equilibria and spectroscopy
Study unit code	CH5K
Teaching term	Term 2
ECTS credits	5 study credits
Study load in hours	140 SBU
Study hours (contact hours)	General Analytical Chemistry: 3 lesson periods/week Spectrometry 2 lesson periods/week Biomolecules: 1 lesson period/week Off course mathematics: 3 lesson periods/week Programmed contact hours for full-time students: 9 lesson periods/week, 63 lesson periods/term 6.75 hours/week, 47 hours/term Exam length: 6 lesson periods = 4.5 hours. Planned time for self-study: 88,5 hours Total: 140 hours
Unit of study entry requirements	Course 1-4 of the foundation year, MLO diploma or enrolled in the abridged VWO route. Minor palette: Propedeutical exam - Life Sciences, Biology and Medical Laboratory Research, Bioinformatics.
Content and organisation	
General description	This course unit focusses on analytical chemistry. We will discuss knowledge of spectroscopic techniques and linear regression (statistics). It is also important to guarantee the quality of the analyses. These topics are therefore discussed in the theory (spectrometry, analytical chemistry and statistics) and weekly tasks (see CH5T). In addition to spectroscopic techniques, other instrumental techniques such as chromatography and the chemistry of biomolecules will also be discussed. In the context of the Biodiscovery Chain, the emphasis lies on the production of biomolecules.
Exit qualifications	-
Professional tasks and products	Carrying out life science research
Professional products	

Cohesion	In this term, the student is introduced to a significant amount of analytical chemistry. The block consists of four related course units (CH5K, CH5-7Pa, CH5-7Po and CH5T) and is centered around the analysis of natural materials in the context of Biodiscovery. These compounds are central to the various weekly tasks (see CH5T), and are also a focus of the central assignment and the practicals (see CH5-7Pa). The associated theory subjects are given in course 5K. CH5K builds upon what was covered in CHLS1C and CHLS2C, CH3K and CH7K. Mathematics 2 is included in the grades list of CH6K.
Mandatory participation	
Maximum number of participants	
Compensation possibilities	Final grade = (2*Kac + 2*Ksp1 + Kbiom)/5 Kac, Ksp1 and Kbiom compensation possible from 4.0.
Activities and/or instructional formats	Supporting subject: General Analytical Chemistry Solubility, ion strength, activities, mass and load balance, systematic approach to balances, buffers of polyprolytes, complexometry *Teaching methods: combined lectures/response classes* Supporting subject: Spectrometry Atom and molecular spectrometry Chemical bonds Organic compounds Fluorescence *Teaching methods: lecture* Supporting subject: Biomolecules Carbohydrates Fats and oils Amino acids, peptides, proteins Teaching methods: combined lectures/response classes Off Course Supporting subject Mathematics (CH6K) Differentiation Integration *Teaching methods: Combined lectures/tutorials* SCS Workshop Conflict management *Teaching methods: Workshop*
Required literature	The latest edition of: - Miller J.N., Miller,J.C., Statistics and chemometrics for analytical chemistry. Essex: Pearson Education. - Harris, D.C., Quantitative chemical Analysis, New York NY: W.H.Freeman and Company LTD. - Tro, N.J., Principles of Chemistry, Essex, Pearson Education Inc. - McMurry, J. Organic Chemistry Belmont CA: Cengage Learning, Inc. - Kemme, S. et al Wiskunde voor het Hoger Onderwijs deel b, Groningen: Wolters-Noordhoff Uitgevers B.V. - For other learning resources (websites/hand books), refer to OnderwijsOnline: Analytical Chemistry Course 5 Practical Guides
Required software/required materials	
Recommended literature	

Examination	
	CH5K-Kac
Name of examination or modular examination	General Chemistry
Examination or modular examination code	CH5K-Kac
Assessment types(s):	Individual, Written Open Questions
Result	Grade
Passing grade	5.5
Weight factor of modular exams	2
Exam opportunities	Term 2 (one part during a response class, one part in the exam period), resit mid-term 3 (one exam)
Permitted resources	
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the exam period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	CH5K-Kac may be compensated from ≥ 4.0.
Assessment dimensions	General Chemistry Chemical equilibria and solubility product Polyprotic acid and bases Activities and systematic handling of equilibration Complexometrie
Assessment criteria	General Chemistry BOKS The student: – calculates multivalent weak acids and bases: titration curves; – calculates multivalent weak acids and bases: buffers; – applies the Le Chatelier's Principle; – calculates poorly soluble salts, solubility product, complex formation; – can calculate the ionic strength and apply the Debye Huckel theory to calculate the activity coefficient; – can perform equilibrium calculations with activities instead of concentrations; – can solve complex equilibrium issues through systematic equilibrium treatment.
Exam matrix	20% Chemical equilibria 20% Activities and systematic handling of chemical equilibration 20% Polyprotic acids and bases, 20% Complexometry 20% Other

	CH5K-Ksp1
Name of examination or modular examination	Spectroscopy 1
Examination or modular examination code	CH5K-Ksp1
Assessment types(s):	Individual, Written Open Questions
Result	Grade
Passing grade	5.5
Weight factor of modular exams	2
Exam opportunities	Term 2, resit in term 3
Permitted resources	
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the exam period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	CH5K-Ksp1 may be compensated from ≥ 4.0.

Assessment dimensions	Spectroscopy 1 BOKS
	– Chemical bonds
	– Organic compounds: chromopohore
	– Spectrophotometry:
	  – UV/VIS
	  – Fluorescence
	  – AAS

Assessment criteria	The student:
	– knows with regard to the chemical bonds: the characteristics of the valence bond and molecular orbital theory and can apply them;
	– Knows spectroscopic properties of organic molecules; Fluorescence compounds for:
	  ○ UV/VIS
	  ○ Fluorescence
	– knows with regard to the properties of light: relationship bewteen wavelength and energy;
	– knows the Lambert-Beer law and can use it in calculations;
	– multicomponent analysis.
	– Knows block diagrams and basic principles of:
	  ○ AAS, AES
	  ○ UV-VIS
	  ○ Fluorescence

Exam matrix	25% Chemical bonds 45% Spectrophotometry 30% Organic compounds

	CH5K-Kbiom
Name of examination or modular examination	Biomolecules
Examination or modular examination code	CH5K-Kbiom
Assessment types(s):	Individual, Written Open Questions
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 2, resit in term 3
Permitted resources	
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the exam period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	Compensation is possible for Kbiom from 4.0.
Assessment dimensions	Organic Chemistry of Biomolecules Knowledge of organic chemistry of biomolecules: carbohydrates, fats and amino acids/proteins: (spatial) structure, chemical and physical chemical properties.
Assessment criteria	Organic Chemistry of Biomolecules: Can predict what reaction will occur with a given reagent and/or given reaction conditions; can also predict relative reactivities of related compounds for the aliphatic compounds (sugars, lipids, amino acids, and proteins); This is consistent with the theory from Chapters 25, 26, 27.1-2 of McMurry.
Exam matrix	approx. 50% Carbohydrates; approx. 25% Fats; approx 25% Amino acids/proteins.

Course unit 5T: CH5T (5 credits)

	CH5T
General information	
Target group	Full-time students, main phase Chemistry, Level 2
Name of course unit	ECU CH5T: Analytical chemistry project: quality assurance, equilibria and spectroscopy
Study unit code	CH5T
Teaching term	Term 2
ECTS credits	5 study credits

Study load in hours	140 SBU
Study hours (contact hours)	Expert: 1 lesson periods per week; Tutor: 2 lesson periods per week; + 1 lesson period IPV Applied Statistics Workshop 2 hours/week, Total LPO workshop Networking: 2 x 2 lesson periods programmed contact hours for full-time students: 40 lesson periods period (average 5.7 lesson periods per week) 30 hours per term Exam length: 3 lesson periods = 2.25 hours. Programmed time for self-study: 108 hours Total: 140 hours
Unit of study entry requirements	Course 1-4 of the foundation year, MLO diploma or participation of the abridged VWO route. Minor palette: Propedeutical exam Propedeuse - Life Sciences, Biology and Medical Laboratory Research, Bioinformatics.
Content and organisation	
General description	Title: Nutrition and quality In this course unit, the professional task “conducting applied research” is central to the context area “instrumental analysis”. The chosen education model is PBL: Problem based learning. This course unit focusses on analytical chemistry. In the central assignment you will analyze elements in food and the results will be interpreted statistically. The research results are described in a research report (this ECU CH5T). To properly carry out this assignment knowledge of spectroscopic techniques such as atomic absorption spectrometry and chemometry is required, for which lectures and seminars are given . During the tutor preparatory assignments will be carried out. As part of the Biodiscovery chain, this course focuses on the analysis of biomolecules. In addition to spectroscopic techniques, other instrumental techniques such as chromatography will also be applied.
Exit qualifications	Experimenting Results Analysis Reporting and Presenting Quality control Methodology Team Work Leadership Advising Professional Development The competencies in bold are those which are emphasized in this course.
Professional tasks and products	Carrying out life science research
Professional products	
Cohesion	In this block, the student is introduced to a significant amount of analytical chemistry. This block consists of four related course units (CH5K, CH5-7Pa, CH5-7Po and CH5T) and is centered around the analysis of biological matrices in the context of quality assurance and Biodiscovery. These compounds are central to the various weekly tasks (see CH5T), and are also a focus of the central assignment and the practicals (see CH5-7Pa). The associated theory subjects are given in Course 5K. CH5T builds upon what was covered in CHLS1C, CHLS2C, CH4KPT and CH7KPT.

Mandatory participation	Attendance at the tutor groups is a prerequisite for participation in IPS modular exams.
Maximum number of participants	
Compensation possibilities	
Activities and/or instructional formats	Tutor group Discussion of weekly tasks Expert hour Extra information about weekly assignments, central assignment etc. Opportunity to ask questions about the course. *Teaching methods: Problem based learning, quizzes, extra questions etc.* Applied Statistics Workshop Anova and linear regression Control cards, detection limit, standard addition, internal standard method and recover *Teaching methods: combined lectures/response classes* LPO workshop Networking *Working method: Workshop+ visit external network meetings*
Required literature	The latest edition of: - Miller J.N., Miller J.C., Statistics and chemometrics for analytical chemistry. Essex: Pearson Education. - Harris, D.C., Quantitative chemical Analysis, New York NY: W.H.Freeman and Company LTD. - Tro, N.J., Principles of Chemistry, Essex, Pearson Education Inc. - Kemme, S. et al Wiskunde voor het Hoger Onderwijs deel b, Groningen: Wolters-Noordhoff Uitgevers B.V. - For other sources (websites/documents): See OnderwijsOnline: Practical guide analytical chemistry c 5.
Required software/required materials	
Recommended literature	
Examination	
	CH5T-A
Name of examination or modular examination	Research report with advice
Examination or modular examination code	CH5T-A
Assessment types(s):	Written, Group
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 2, resit term 3
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in CH5T gives automatic registration for CH5T-A.
Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this interim assessment.
Number of examiners	Assessment by one examiner (practical teacher) based on the assessment form.

Possibilities for compensation	
Assessment dimensions	**Competence 1: Design** 1.2.2. Searches for, selects and integrates information from relevant scientific sources. **Competence 2: Experimenting** Preparation 2.2.1. Is able to explain the basic steps of the experiments. **Competence 3: Results Analysis** 3.1.2. Assesses the usability of the results based on of accuracy and reliability. 3.1.4. Discusses the execution of the experiment and results. 3.2.1. Carries out results analysis using prescribed methods; uses statistics (if applicable). 3.2.3. Independently makes conclusions relating to the initial research question (if possible). 3.2.5. 3.2.5. Relates results with results from their other experiments and also to data in published literature. **Competence 4: Quality control** 4.1.3. Uses controls, and uses these to assess the reliability of the results. **Competence 6: Reporting and Presenting** 6.2.1. Reports their research in the form of a research report/lab journal/poster according to in-house (HLO) guidelines (product criteria for lab journal and research report; level 2): - Uses correct spelling, grammar, sentence structure and scientific style; - Uses a clear and logical structure in complex passages of text; is aware of the cohesion between the different sections of text; - The document structure conforms to guidelines used in professional practise; - The report contains a reference list. The text refers to the literature in the this reference list; - Describes results so that the reader can understand these; uses for this purpose clearly labelled figures and tables; - Describes all relevant data in a summary. **Competence 10: Advising** The student is competent in giving advice about the acquisition and use of materials, equipment and methods: 10.2.1. Translates needs to practical requirements. 10.2.2. Gives justified advice about selecting a method after exploring alternatives. **Chemometry** The student knows how standard addition, internal standard method, recovery, sensitivity, decision limit, detection limit and determination limit and control cards are determined and applied in practice.

Assessment criteria	The student: - can set up an investigation in the form of an action plan. - can write out the underlying theory of the AAS. - is able to correctly describe the applied analysis methods in the method. - analyzes samples in such a way that statistics can be applied to the results. - can process results from the experiments in tables and graphs. - can apply the t-test, F-test, sx0, relative and percentage error and sampling error to the results for reliability, precision and correctness. - Performs standard additive and processes the results using statistical operations such as regression analysis and s_{xE} - makes comparisons between methods and samples using statistics such as ANOVA. Make statements about the reliability, precision and correctness of the results found in the discussion. - can draw correct conclusions from the results found and the statistics. **BOKS Chemometry** The student is able to: - use the following concepts in statistics: correctness, precision, repeatability and reproducibility, accidental and systematic error, absolute, relative and percentage error; - separating and estimating variances using one-way ANOVA; - make a Shewhart card; - apply linear regression; - fit measurement data from calibration line with the straight line model and calculate parameters with corresponding confidence interval; - apply quality assurance; - describe the following concepts: matrix, SOP, spike, selectivity, sensitivity, validation, recovery, robustness; Applying statistics to datasets is practised in tutorials. The results that the students have generated themselves are statistically analysed in the tutorial.
Exam matrix	See Reporting Level 2 Assessment Form on OnderwijsOnline under General Information.
	CH5T-IPV
Name of examination or modular examination	IPS
Examination or modular examination code	CH5T-IPV
Assessment types(s):	Oral, Individual
Result	Satisfactory/Unsatisfactory
Passing grade	Satisfactory
Weight factor of modular exams	0
Exam opportunities	**Term 2.** Participation in modular exam IPV is only possible once per academic year (EER art. 8.5).
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH5T gives automatic registration for CH5T-IPV.
Discussion and review	For questions about the assessment, please contact the examiner.
Number of examiners	One examiner (tutor) for the assessment based on participation and effort.

Possibilities for compensation	
Assessment dimensions	**Competence 7: Methodology** 7.1.3. Plans study activities. 7.2.1. Plans and organises activities in a work plan that covers a duration of at least 4 practical lessons. 7.2.2. Works according to plan, also under time constraints. 7.2.3. Ensures that goals are reached and if necessary, makes adjustments to activities. 7.2.4. Is flexible in changing circumstances. **Competence 8: Team Work** Functioning in a group 8.1.1. Adheres to rules. 8.1.2. Makes a valuable contribution to the group. 8.2.3. Makes clear agreements with others and keeps to these. 8.2.4. Recognises their own role in a group and is aware of other roles in the group. Works harmoniously with others. Communication Is able to communicate about their assignment with peers and lecturers applying basic rules of communication. 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.2.5. Takes initiative in the conversation. 8.2.5. Verbally expresses their opinion/message clearly. 8.2.10. Interacts with conversation partner. **Competence 11: Professional Development** 11.1.5. Has study skills required by higher professional education; is motivated and determined.
Assessment criteria	The student: - the student has prepared for the meeting by completing the assignment to be discussed, and also completed the required reading for the following assignment to be discussed; - the student is able to show weekly assignments to the tutor (according to agreement, in writing or as a presentation); all required aspects are complete in all assignments; - Fulfils their designated roles (Chair, secretary etc.); - the student adheres to the rules agreed upon; - the student asks questions and shares knowledge regarding the assignment during tutor meetings; verbalizes these clearly and audibly, maintains eye contact; - Gives others opportunity to speak; - The student offers feedback to group and class members and is open to receiving feedback. All criteria must be satisfactory to be able to check this off the list. 6 of the 7 weekly assignments must be satisfactorily assessed by the tutor.
	CH5T-Net
Name of examination or modular examination	LPO Networking skills
Examination or modular examination code	CH7T-Net
Assessment types(s):	Written, Oral, Individual
Result	Satisfactory/Unsatisfactory
Passing grade	Satisfactory

Weight factor of modular exams	0
Exam opportunities	Term 1, resit during term 2. For participation in the workshops LPO-Net there is only one opportunity per academic year (EER art. 8.5)
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH7T gives automatic registration for CH7T-LPO-Net.
Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this interim assessment.
Number of examiners	Assessment by one examiner based on the assessment form (study coach).
Possibilities for compensation	-
Assessment dimensions	**Competence 6: Reporting and Presenting** 6.2.1. Reports their research in the form of a research report/lab journal/poster according to in-house (HLO) guidelines (product criteria for lab journal and research report; level 2): - Uses correct spelling, grammar, sentence structure and scientific style; - Uses a clear and logical structure in complex passages of text; - Is aware of the cohesion between the different sections of text; - The document structure conforms to guidelines used in professional practise; - The report contains a reference list. - The text references to the literature in this list; - Describes results so that the reader can understand them; - Uses clearly labelled figures and tables. - Describes all relevant data in a summary. **Competence 8: Communication** Is able to communicate about their assignment with peers and lecturers applying basic rules of communication. 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.2.5. Takes initiative in the conversation. 8.2.8. Verbally expresses their opinion/message clearly. 8.2.10. Interacts with conversation partner.
Assessment criteria	Networking is assessed as satisfactory with active participation in the workshop and the workshop assignment has been turned in.

Course unit 5-7Pa: CH5-7Pa (5 credits)

	CH5-7Pa
General information	
Target group	Full-time students, main phase Chemistry, Level 2
Name of course unit	ECU 5-7Pa: Analytical chemistry practical
Study unit code	CH5-7Pa
Teaching term	Term 1 and 2
Study credits	5 study credits
Study load in hours	140 SBU

Study hours (contact hours)	Programmed contact hours: 5 lesson periods/week, 35 lesson periods/term 375 hours/week, 26.25 hours/term Programmed time for self-study: 78.75 hours Total: 140 hours
Course entry requirements	Course CHLS1-4 of the foundation year, MLO diploma or enrolled in the abridged VWO route. Minor palette: Propedeutical exam - Life Sciences, Biology and Medical Laboratory Research, Bioinformatics. Participation in the practical lessons is only allowed if the safety exam is passed. Transfer students in the main phase must pass the safety exam in the first year of enrolment.
Content and organisation	
General description	This course focuses on the professional task of "conducting scientific research" in the field of analytical chemistry. In the central assignment during term 1 (CH7), the compound made in the organic lab (CH5-7Po) with an electrophilic aromatic substitution reaction is characterized with GC-MS. In the central assignment during term 2 (CH5) you will analyse elements in food using AAS and the results will be interpreted using statistics. In addition to spectroscopic techniques, other instrumental techniques such as chromatography will also be applied.
Exit qualifications	Design **Experimenting** **Results Analysis** **Reporting and Presenting** Quality control Methodology Teamwork Leadership Advising Professional Development The competencies in bold are those which are emphasized in this course.
Professional tasks and products	Carrying out life science research
Professional products	
Cohesion	Term 1 includes four related course units CH7K, CH7T, CH5-7Pa and CH5-7Po) and is of a general chemical nature. In the central task an organic molecule is made at the organic lab (at CH5-7Po), which is characterized in the analytical lab (at CH5-7Pa) with GC-MS. This will be the subject of a presentation (CH7T). In order to be able to carry out this central assignment, knowledge of aromatic chemistry, chromatography and mass spectrometry is required and these subjects are therefore offered in theory (in CH7K) and weekly tasks (see CH7T). Term 2 also contains four related courses (CH5K, CH5T, CH5-7-Pa and CH5-7Po) and centres around the analysis of elements in biological matrices in the context of Biodiscovery. A number of week tasks (see CH5T) are devoted to the central assignment, which is worked on during the practical session (in CH5-7Pa). The associated theory subjects are given in Course CH5K. CH5-7Pa builds on CHLS2c and CH4P.

Mandatory participation	Attendance at the practical lessons is a prerequisite for participation in the practical modular examination (Pi1 and Pi2). A student may not (with a valid reason!) miss more than 1 practicum per term. In case of more absenteeism it is necessary to catch up.
Maximum number of participants	
Compensation possibilities	
Activities and/or instructional formats	Each week, 1 part of a day is spent on developing skills and conducting research in the laboratory. Techniques used include gas and liquid chromatography, AAS, spectrometry and electrochemistry (e.g. ion-selective electrode)
Required literature	-
Required software/required materials	LabArchives
Recommended literature	
Examination	
	CH5-7Pa-Pi1 / CH5-7Pa-Pi2
Name of examination or modular examination	Practical Analytical Chemistry: Performance
Examination or modular examination code	CH5-7Pa-Pi1 / CH5-7Pa-Pi2
Assessment types(s):	Individual, practical
Result	Grade
Passing grade	5.5
Weight factor of modular exams	CH5-7Pa-Pi1: 1 / CH5-7Pa-Pi2: 1
Exam opportunities	Term 1 and 2. There is only one opportunity per year for the modular exams CH5-7Pa-Pi1 and CH5-7Pa-Pi2 (EER art. 8.5).
Permitted resources	
Method of enrolment for exam/enrolment period	Enrolment in CH5-7Pa counts as registration for CH5-7Pa-Pi1 and CH5-7P-Pi2
Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this modular assessment.
Number of examiners	Assessment by two examiners (practical teacher) based on the assessment form.
Possibilities for compensation	
Assessment dimensions	**Competence 1: Experimenting** Preparation 1.2.3. Forms intermediate research questions and related a hypothesis based on the given research question. **Competence 2: Experimenting** 2.1.2. Performs calculations prior to beginning lab work. 2.2.1. Is able to explain the basic steps of the experiments. 2.2.3. Ensures that all requirements are present before beginning the experiment, makes solutions. Execution 2.1.5. Carries out the experiments within the given time.

	2.2.4. Carries out experiments according to protocol so that reliable and reproducible data is obtained; knows at all times exactly what he/she does. 2.2.6. Attempts to work on multiple experiments at the same time (multitasking). 2.2.7. Attempts to trouble shoot experiments when problems are encountered. **Competence 3: Results Analysis** 3.2.5. 3.2.5. Relates results with results from their other experiments and also to data in published literature. **Competence 4: Quality control** 4.1.1. Is aware of the health and safety rules and works according to these rules. 4.1.3. Uses controls, and uses these to assess the reliability of the results. 4.2.2. Uses advanced materials and equipment correctly. **Competence 5: Management and Administration** Management 5.2.1. Encodes chemicals and samples; stores these in the correct manner. 5.2.2. Contributes to an efficiently functioning lab (tidies up, reports when reagents are nearly finished, performs minor maintenance of equipment). Administration 5.2.3. Manages and archives data in lab journal (aim, experiment description, alterations, results, conclusion) and if relevant, other ways of storing data so that others can understand it. **Competence 7: Methodology** 7.2.2. Works according to plan, also under time constraints. **Competence 11: Professional Development** 11.1.5. Has study skills required by higher professional education; is motivated and determined.
Assessment criteria	See assessment form Chemistry Practical, on #OnderwijsOnline under General information.
Exam matrix	See assessment form Chemistry Practical, on #OnderwijsOnline under General Information.
	(CH5-7Pa-Pm1 / CH5-7Pa)
Name of examination or modular examination	Measurement Reports Practical Analytical Chemistry
Examination or modular examination code	CH5-7Pa-Pm1 / CH5-7Pa-Pm2
Assessment types(s):	Written, individual
Result	Grade
Passing grade	5.5
Weight factor of modular exams	CH5-7Pa-Pm1: 1 / CH5-7Pa-Pm2: 1
Exam opportunities	Term 1 and 2. Resit for measurement reports in Term 2 and 3.
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in CH5-7Pa counts as registration for CH5-7Pa-Pm1 and CH5-7Pa-Pm2.
Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this modular assessment.

Number of examiners	Assessment by one examiner (practical teacher) based on the assessment form.
Possibilities for compensation	
Assessment dimensions	**Competence 1: Experimenting** Preparation 1.2.2. Searches for, selects and integrates information from relevant scientific sources. 1.2.4. Formulates the research questions with an associated hypotheses, for a given research assignment. **Competence 2: Experimenting** 2.1.2. Performs calculations prior to beginning lab work. 2.2.3. Ensures that all requirements are present before beginning the experiment, makes solutions. **Competence 3:** Results analysis Data processing 3.2.1. Carries out results analysis using appropriate methods; uses statistics (if applicable). Validation 3.1.2. Evaluates the obtained results based on their accuracy and reliability. Conclusions and discussion 3.1.4. Discusses the execution of the experiment and results. 3.2.3. Independently makes conclusions relating to the initial research question (if possible). 3.2.5. Relates results with results from their other experiments and also to data in published literature. **Competence 4: Quality control** 4.1.3. Uses controls, and uses these to assess the reliability of the results. **Competence 6: Reporting and Presenting** Text 6.2.1. Reports their research in the form of a research report/lab journal/poster according to in-house (HLO) guidelines (product criteria for lab journal and research report; level 2): - Uses correct spelling, grammar, sentence structure and scientific style; - Uses a clear and logical structure in complex passages of text; - Is aware of the cohesion between the different sections of text; - The document structure conforms to guidelines used in professional practice; - The report contains a reference list. The text references to the literature in this list; - Describes results so that the reader can understand these; uses for this purpose clearly labelled figures and tables; - Describes all relevant data in a summary. 6.2.3. Is familiar with and applies the international conventions of scientific and academic writing. 6.2.4. In English, uses written tasks appropriate to the professional practice to communicate straightforward ideas as defined by CEFR B1 Level Writing.
Assessment criteria	See Measurement Report Assessment Form on OnderwijsOnline under General Information.
Exam matrix	See Measurement Report Assessment Form on OnderwijsOnline under General Information.

Course unit 5-7Po: CH5-7Po (5 credits)

	CH5-7Po
General information	
Target group	Full-time students, main phase Chemistry, Level 2
Name of course unit	ECU CH5-7Po: Organic and Polymer Chemistry Practical
Study unit code	CH5-7Po
Teaching term	Term 1 and 2
Study credits	5 study credits
Study load in hours	140 SBU
Study hours (contact hours)	Programmed contact hours: 5 lesson periods/week, 35 lesson periods/term 3.75 hours/week, 26.25 hours/term Programmed time for self-study: 78.75 hours Total: 140 hours
Course entry requirements	CHLS1-4 of the foundation year, MLO diploma or enrolled in the abridged VWO route. Minor palette: Propedeutical exam - Life Sciences, Biology and Medical Laboratory Research, Bioinformatics. Participation in the practical lessons is only allowed if the safety exam is passed. Transfer students in the main phase must pass the safety exam in the first year of enrolment.
Content and organisation	
General description	This course focuses on the professional task 'conducting applied research in the field of organic and polymer chemistry'. In the central assignment of period 1 (CH7) a compound is made with an electrophilic aromatic substitution reaction, which is characterised at the analytical lab with GC-MS (CH5-7Pa). In addition to carrying out the central assignment of CH7, the basic techniques of organic chemistry are practiced in practice.
Exit qualifications	**Experimenting** **Results Analysis** **Reporting and Presenting** Quality control Methodology Teamwork Leadership Advising Professional Development The competencies in bold are those which are emphasized in this course.
Professional tasks and products	Carrying out Life Science Research
Professional products	

Cohesion	Term 1 includes four related course units CH7K, CH7T, CH5-7Pa and CH5-7Po) and is of a general chemical nature In the central task an organic molecule is made at the organic lab (at CH5-7Po), which is characterized in the analytical lab (at CH5-7Pa) with GC-MS. This will be the subject of a presentation (CH7T). In order to be able to carry out this central assignment, knowledge of aromatic chemistry, chromatography and mass spectrometry is required and these subjects are therefore offered in theory (in CH7K) and weekly tasks (see CH7T). Term 2 also contains four related courses (CH5K, CH5T, CH5-7-Pa and CH5-7Po) and centres around the analysis of elements in biological matrices in the context of Biodiscovery. In P2 of CH5-7Po the techniques learned in period 1 are further practiced and developed. CH5-7Po builds on CHLS2c and CH3P.
Mandatory participation	Attendance at the practical lessons is a prerequisite for participation in the practical modular examination (Pi). A student may not (with a valid reason!) miss more than 1 practical per block. In case of more absenteeism it is necessary to catch up.
Maximum number of participants	
Compensation possibilities	
Activities and/or instructional formats	Per week 1 part of a day is spent on practicing practical skills and conducting research in the laboratory. Techniques used are reflux, distillation, schlenk line, recrystallisation, extraction, column chromatography, GPC, TLC, DSC, melt indexer, Ubbelohde.
Required literature	-
Required software/required materials	LabArchives
Recommended literature	
Examination	
	(CH5-7Po-Pi1 / CH5-7Po)
Name of examination or modular examination	Organic and Polymer Chemistry Practicals Performance
Examination or modular examination code	(CH5-7Po-Pi1 / CH5-7Po)
Assessment types(s):	Individual, practical
Result	Grade
Passing grade	5.5
Weight factor of modular exams	CH5-7Po-Pi1: 1 / CH5-7Po-Pi2: 1
Exam opportunities	Term 1 and 2. There is only one opportunity per year for the modular exams CH5-7Po-Pi1 and CH5-7Po-Pi2 (EER art. 8.5).
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in the CH5-7Po is considered as registration for CH5-7Po-Pi1 and CH5-7Po-Pi2
Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this modular assessment.

	In addition, the student can always make an appointment with the teacher who has reviewed the report to discuss this.
Number of examiners	Assessment by two examiners (practical teacher) based on the assessment form.
Possibilities for compensation	
Assessment dimensions	**Competence 1: Experimenting** Preparation 1.2.4. Formulates the research questions with an associated hypotheses, for a given research assignment. **Competence 2: Experimenting** 2.1.2. Performs calculations prior to beginning lab work. 2.2.1. Is able to explain the basic steps of the experiments. 2.2.3. Ensures that all requirements are present before beginning the experiment, makes solutions. Execution 2.1.5. Carries out the experiments within the given time. 2.2.5. Carries out experiments according to protocol so that reliable and reproducible data is obtained; knows at all times exactly what he/she does. 2.2.6. Attempts to work on multiple experiments at the same time (multitasking). 2.2.7. Attempts to trouble shoot experiments when problems are encountered. **Competence 3: Results Analysis** 3.2.5. Relates results with results from their other experiments and also to data in published literature. **Competence 4: Quality control** 4.1.1. Is aware of the health and safety rules and works according to these rules. 4.1.3. Uses controls, and uses these to assess the reliability of the results. 4.2.2. Calibrates advanced equipment at the start of experiments. **Competence 5: Management and administration** Management 5.2.1. Encodes chemicals and samples; stores these in the correct manner. 5.2.2. Contributes to an efficiently functioning lab (tidies up, reports when reagents are nearly finished, performs minor maintenance of equipment). Administration 5.1.3., (5.2.3.) Manages and archives data in lab journal (aim, experiment description, alterations, results, conclusion) and if relevant, other ways of storing data so that others can understand it. **Competence 7: Methodology** 7.2.2. Carries out activities according to planning; also under time pressure. **Competence 11: Professional Development** 11.1.5. Has study skills required by higher professional education; is motivated and determined.
Assessment criteria	See assessment form Chemistry Practical, on #OnderwijsOnline under General Information.
Exam matrix	See assessment form Chemistry Practical, on #OnderwijsOnline under General Information.

	CH5-7Po-Pm1 / CH5-7Po-Pm2
Name of examination or modular examination	Measurement reports Organic and Polymer Chemistry Practical
Examination or modular examination code	CH5-7Po-Pm1 / CH5-7Po-Pm2
Assessment types(s):	Written, individual
Result	Grade
Passing grade	5.5
Weight factor of modular exams	CH5-7Po-Pm1: 1 / CH5-7Po-Pm2: 1
Exam opportunities	Resit for measurement reports in Term 2 and 3.
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in CH5-7Po counts as a registration for CH5-7Po-Pm1 and CH5-7Po-Pm2
Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this modular assessment. In addition, the student can always make an appointment with the teacher who has reviewed the report to discuss this.
Number of examiners	Assessment by one examiner (practical teacher) based on the assessment form.
Possibilities for compensation	
Assessment dimensions	**Competence 1: Experimenting** Preparation 1.2.2. Searches for, selects and integrates information from relevant scientific sources for Life Science research 1.2.4. Formulates the research questions with an associated hypotheses, for a given research assignment. **Competence 2: Experimenting** 2.1.2. Performs calculations prior to beginning lab work. 2.2.3. Ensures that all requirements are present before beginning the experiment, makes solutions. **Competence 3: Results** Data processing analysis 3.2.1. Carries out results analysis using prescribed methods; uses statistics (if applicable). Validation 3.1.2. Evaluates the obtained results based on their accuracy and reliability. Conclusions and discussion 3.1.4. Discusses the execution of the experiment and results. 3.2.3. Independently makes conclusions relating to the initial research question (if possible). 3.2.5. Relates results with results from their other experiments and also to data in published literature. **Competence 4: Quality control** 4.1.3. Uses controls, and uses these to assess the reliability of the results. **Competence 6: Reporting and Presenting**

	Text 6.2.1. Reports their research in the form of a research report/lab journal/poster according to in-house (HLO) guidelines (product criteria for lab journal and research report; level 2): - Uses correct spelling, grammar, sentence structure and scientific style; - Uses a clear and logical structure in complex passages of text; - Is aware of the cohesion between the different sections of text; - The document structure conforms to guidelines used in professional practice; - The report contains a reference list. The text references to the literature in this list; - Describes results so that the reader can understand these; uses for this purpose clearly labelled figures and tables; - Describes all relevant data in a summary. 6.2.3. Is familiar with and applies the international conventions of scientific and academic writing. 6.2.4. In English, uses written tasks appropriate to the professional practice to communicate straightforward ideas as defined by CEFR B1 Level Writing.
Assessment criteria	See Measurement Report Assessment Form on OnderwijsOnline under General Information.
Exam matrix	See Measurement Report Assessment Form on OnderwijsOnline under General Information.

Course unit 6K: CH6K (5 credits)

	CH6K
General information	
Target group	Full-time students, Main phase Chemistry, Level 2
Name of study unit	ECU CH6K: Natural Product Synthesis knowledge: Pheromones
Unit of study code	CH6K
Teaching term	Term 3
ECTS credits	5 study credits
Study load in hours	140 SBU
Study hours (contact hours)	Programmed contact hours: Organic Chemistry: 3 lessons periods per week; Spectrum interpretation: 3 weeks 3 lesson periods per week; Reaction kinetics 4 weeks 2 lesson periods per week; Mathematics 3: 2 lessons periods per week; Physics 1 lesson period per week. week 1-3: 9 lesson periods/week, week 4-7: 8 lesson periods/week: total: 59 lesson periods (periods) /week= 44 hours per term Exam: 4 lesson periods = 3 hours. Programmed time for self-study: 96 hours Total: 140 hours
Unit of study entry requirements	Course 1-4 of the foundation year, MLO diploma or participation of the abridged VWO route. Minor palette: Propedeutical exam - Life Sciences, Biology and Medical Laboratory examination , Bioinformatics. If CH3K has not been taken, the student is required to study the theory from this course and take an entry exam if this has not been done before CH7K. Based on the results of the entry exam it will be decided if participation is possible
Content and organisation	

General description	In Course CH6K, the student is introduced to a significant component of organic chemistry (aliphatic compounds: reactions and reaction mechanisms) and important organic chemistry analysis techniques (IR and 1HNMR). Furthermore, a thorough basis is laid for reaction kinetics. Mathematics and physics are also offered.
Exit qualifications	-
Professional tasks and products	Carrying out life science research
Professional products	
Cohesion	The entire term comprises 4 related course units (CH6K, CH6-8Po, CH6-8Pa and CH6T) and is centered around the synthesis of natural products and specifically, pheromones. These compounds are central to the various weekly tasks (see CH6T), while in the central assignment, during the practicals, one or more pheromones are synthesised (see CH6-8Po). A report will be written about the syntheses where the report structure follows is according that of specific organic-chemistry scientific literature (see CH6T). CH6K continues from CHLS2 and CH3K.
Mandatory participation	-
Maximum number of participants	-
Compensation possibilities	Kwn = (Kw2 +Kw3+Kn)/3 Kw2, Kw3 and Kn from 4.0
Activities and/or instructional formats	The theory of organic chemistry and the reaction kinetic is offered in a series of lectures throughout the term. Students follow a spectrum interpretation course (IR and 1H NMR) in the first 3 week of the course. Supporting subject Organic Chemistry Aliphatic chemistry (nucleophilic substitution elimination, additions to unsaturated compounds and additions and substitutions to carbonyl compounds) *Teaching methods: combined lectures/response classes* Supporting subject Reaction Kinetics Zero, first and second order reactions and equilibria *Teaching methods: combined lectures/response classes* Supporting subject Spectrum interpretation IR, 1H NMR *Methods: Combination of lectures, tutorials and weekly spectrum assignments* Mathematics 2 Differentiation/Integration This subject is given in term 2 in preparation for the subject Reaction Kinetics *Teaching methods: Combined lectures/tutorials* Mathematics 3 Complex numbers and differential equations *Methods: Combinations lectures and tutorials* Physics (Electro-)magnetism and harmonic vibration *Teaching methods: combined lectures/response classes*

Required literature	The latest edition of : - McMurry, J. Organic Chemistry, Belmont CA: Cengage Learning, Inc. - Tro N.J., Principles of chemistry, a molecular approach (3rd Edition). Prentice Hall / Pearson Education. For Mathematics and Physics - Kemme, S. et al Wiskunde voor het Hoger Onderwijs deel b, Groningen: Noordhoff Uitgevers B.V. - Giancoli, D.C. Physics for Scientists & Engineers with Modern Physics: Pearson Education Limited Indianapolis
Required software/required materials	ChemSketch (ACD-labs) (freeware) Chem Basic, molecular models
Recommended literature	-
Examination	
	CH6K-Koc
Name of examination or modular examination	Theory Exam Organic Chemistry
Examination or modular examination code	CH6K-Koc
Assessment type(s):	Individual written open questions
Result	Grade
Minimum result	5.5
Weight factor of modular exams	1
Exam opportunities	Term 3, resit term 4
Permitted resources	PS card, chemical model box, calculator
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the exam period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer Organic Chemistry).
Possibilities for compensation	-
Assessment dimensions	Organic Chemistry The student: - Has knowledge of aliphatic organic chemistry: spatial structure, chemical and physical-chemical properties. - has knowledge of the reactions of the functional groups: reactivity and non-reactivity, reaction mechanisms and toxic properties;

	- has knowledge of other safety aspects Syntheses that require multiple steps will not be an aim of this module.
Assessment criteria	Organic Chemistry The student: - Knows and applies nomenclature rules for aliphatic compounds (halogen alkanes, alcohols, ethers, aldehydes, ketones, carboxylic acids and carboxylic acid derivatives); - Can reproduce the mechanisms of the following reactions, can write the reaction equations and knows the names of these reactions: - Nucleophilic substitution reactions: Sn1, Sn2; - Elimination reactions: E1, E2; - Addition to double and triple bonds (hydrohalogenations, hydration incl. Oxymercuration-demercuration and hydroboration, dihalogenation, halohydrin formation, epoxidation, hydroxylation and ozonolysis); - Nucleophilic addition to the carbonyl group (hydride reduction, water addition, HCN addition, organometallic nucleophiles addition [e.g. Grignard], phosphorylides addition [Wittig], nitrogen nucleophiles addition, alcohols); - Nucleophilic acyl substitution (reduction, hydrolysis, alkylation and formation of carboxylic acid derivatives). - can predict what reaction will occur with a given reagent and/or given reaction conditions; can also predict relative reactivities of related compounds for the aliphatic compounds (alkyl halides, alcohols, olefins and alkynes, aldehydes and ketones, carboxylic acids and derivatives, terpenes); - knows the use of substitution and elimination reactions in organic synthesis; knows how to convert different functional groups into others. - can explain the biosynthesis of natural products (terpenoids and stereoids) mechanistically. This is consistent with the theory from Chapters 6-11, 17-21 and 27 of McMurry
Exam matrix	approx 15% nomenclature approx 50% nucleophile substitutions and elimination reactions approx 35% addition and substitution reactions with multiple compounds (alkenes, alkynes, aldehydes, ketones, carbonic acid derivatives).
	CH6K-Kin
Name of examination or modular examination	Reaction Kinetics Assignment
Examination or modular examination code	CH6K-Kin
Assessment types(s):	Individual, Written Assignment
Result	Satisfactory/Unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exams	0
Exam opportunities	Term 3, resit term 4
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH6K gives automatic registration for CH6K-Kkin.
Discussion and review	There is no plenary review/discussion (individual assignment). The student can make an appointment with the lecturer to receive explanation about the assignment.

Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer Reaction Kinetics).
Possibilities for compensation	-
Assessment dimensions	Reaction Kinetics The student - has knowledge of the rates of a number of simple reactions and can carry out related calculations; - has knowledge of the influence of temperature and a catalyst on the reaction; - has insight into simple reaction mechanisms.
Assessment criteria	Reaction Kinetics The student: - knows the difference between average and instantaneous reaction rate and knows what is meant by the 'true' reaction rate; - knows the differential rate laws for the 0th, 1st, 2nd… nth order; - can obtain the integrated rate laws and fill in the correct limits by separating variables; - from experimental data, can determine the order of the reaction, the rate law and the reaction rate constant with the correct units; - can calculate the concentration, time or reaction rate constant using the integrated rate law; - can perform calculations for the 1st and 2nd order reaction using the integrated rate law and can determine, among other things, the half-life; - can derive a rate law from a given mechanism; - from experimental data, can determine the activation energy and the pre-exponential factor of the reaction rate constants and the associated temperatures; - can indicate the influence of a catalyst in a reaction profile.
Exam matrix	approx. 50% reaction rates; approx. 30% Arrhenius equation/ catalysts approx. 20% reaction mechanisms
	CH6K-Kw2
Name of examination or modular examination	Mathematics 2
Examination or modular examination code	CH6K-Kw2
Assessment types(s):	Individual written open questions
Result	Grade
Minimum result	5.5
Weight factor of modular exams	0
Exam opportunities	Term 2, resit term 3
Permitted resources	
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the exam period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period.

	• Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	Compensation is possible for Kw2, Kw3 and Kn from 4.0
Assessment dimensions	Contents: - Differential calculus - 50% Integral calculus - Interpreting graphs
Assessment criteria	By the end of the course, the student must be able to calculate and interpret the following: - first order derivatives; - higher order derivatives; - partial derivatives; - total differential; - primitives of functions; - integrals; - partial integrals.
Exam matrix	50% Differential calculus 50% Integral calculus
	CH6K-Kw3
Name of examination or modular examination	Mathematics 3
Examination or modular examination code	CH6K-Kw3
Assessment types(s):	Individual written open questions
Result	Grade
Minimum result	5.5
Weight factor of modular exams	0
Exam opportunities	Term 3, resit term 4
Permitted resources	
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the exam period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.

Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	Compensation is possible for Kw2, Kw3 and Kn from 4.0
Assessment dimensions	The student has knowledge of - Complex numbers - Differential equations
Assessment criteria	The student is able to: - perform calculations with complex numbers written in the following forms $z = re^{i\varphi}$ and $z = a + bi$ with $a = r\cos\varphi$ and $b = r\sin\varphi$ - solve binomial equations; - set up and solve a simple differential equation (DV) for a practical situation; - solve linear, first-order DVs by: - primitivizing - separating variables; - solving homogeneous second order linear differential equations with constant coefficients.
Exam matrix	approx. 30% Complex numbers approx. 70% differential equations
	CH6K-Kn
Name of examination or modular examination	Physics
Examination or modular examination code	CH6K-Kn
Assessment types(s):	Individual written open questions
Result	Grade
Minimum result	5.5
Weight factor of modular exams	0
Exam opportunities	Term 3, resit term 4
Permitted resources	
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the exam period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	Compensation is possible for Kw2, Kw3 and Kn from 4.0

Assessment dimensions	The student has knowledge of (Electro-)magnetism and harmonic vibration
Assessment criteria	The student knows and can perform calculations using the following concepts of magnetism: - Magnetic field lines - force on charge/current in magnetic field - Lorentz force - magnetic torque (torque); electric motor - mass spectrometer with potential difference/speed filter The student knows and can perform calculations using the following concepts of magnetism: - spring constant - distance/velocity/acceleration - kinetic/potential energy
Exam matrix	approx. 70% magnetism approx. 30% harmonic vibration
	CH6K-Kwn
Name of examination or modular examination	Mathematics and Physics Exams
Examination or modular examination code	CH6K-Kwn
Assessment types(s):	Administrative
Result	Grade
Minimum result	5.5
Weight factor of modular exams	0
Exam opportunities	Term 3, resit term 4
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH6K gives automatic registration for CH6K-Kwn.
Discussion and review	Not applicable
Number of examiners	Assessment by an examiner based on grades in Alluris (lecturer or course coordinator).
Possibilities for compensation	Compensation is possible for Kw2, Kw3 and Kn from 4.0
Assessment dimensions	The indicators are described under each subject.
Assessment criteria	Kwn = (Kw2 +Kw3+Kn)/3
	CH6K-Spin
Name of examination or modular examination	Assignment spectrum interpretation (IR, 1H NMR)
Examination or modular examination code	CH6K-Spin
Assessment types(s):	Individual, Written
Result	Satisfactory/Unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exams	0
Exam opportunities	Term 3, resit term 4
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH6K gives automatic registration for CH6K-Kspin.

Discussion and review	There is no plenary review/discussion (individual assignment). The student can make an appointment with the lecturer to receive explanation about the assignment.
Number of examiners	Assessment by one examiner (theory lecturer).
Possibilities for compensation	-
Assessment dimensions	The student can correctly interpret IR and 1H NMR spectra.
Assessment criteria	The student: - knows the theoretical background of IR (stretching and bending vibrations) and 1H NMR (chem. shift values, explaining multiplicities, integrals - can determine coupling constants; - can interpret IR spectra (recognize group frequencies, fingerprint area cf. with reference); - can interpret 1H NMR spectra (use correlation tables, chemical shift, multiplicities, integrals for aliphatic and aromatic compounds).
Exam matrix	The student receives 25 spectra (7 IR and 18 1H NMR) to interpret. If less than 23 are correct, more spectra are provided until the 23 correct minimum is reached

Course unit 6T: CH6T (5 credits)

	CH6T
General information	
Target group	Full-time students, Main phase Chemistry, Level 2
Name of study unit	ECU CH6T: Natural Product Synthesis Project: Pheromones
Unit of study code	CH6T
Teaching term	Term 3
ECTS credits	5 study credits
Study load in hours	140 SBU
Study hours (contact hours)	Programmed contact hours: Course introduction: 2 lesson periods (once) Expert hour: 1 lesson period per week Tutor: 2 lesson periods per week; + 1 lesson period IPV Internship preparation 1 lesson period per week; 2 times 2 hours job application training Total: 35 lesson periods period (average 5 lesson periods per week); 26.25 clock hours per term. Exam length: 3 lesson periods = 2.25 hours. Programmed time for self-study: 111.5 hours Total: 140 hours
Unit of study entry requirements	Course 1-4 of the foundation year, MLO diploma or enrolled in the abridged VWO route. Minor palette: Propedeutical exam - Life Sciences, Biology and Medical Laboratory examination , Bioinformatics.
Content and organisation	
General description	In this term, the professional task 'Carrying out Life Science Research' is central in the context of natural products, in the field of organic chemistry. The chosen education model is PBL: Problem based learning. As a central assignment, each project group receives the assignment to synthesize a (number of) pheromone(s) (see CH6P). This concerns in all cases multiple step syntheses. A report will be written in the form of a scientific article (this course unit CH6T). In addition to this, there will be smaller weekly assignments that are all related to the central assignment. The theory is handled in CH6K: Organic Chemistry (aliphatic compounds: reactions and reaction mechanisms), spectrum interpretation (IR and 1HNMR) and reaction kinetics (see CH6K). The practical component is covered in CH6-8Po. In the context of the Biodiscovery Chain, the emphasis lies on the production of biomolecules.
Exit qualifications	Design **Experimenting** **Results Analysis** **Management and administration** **Reporting and Presenting** Working in a methodical and project-based manner Team Work Leadership and Coaching Professional Development The competencies in bold are those which are emphasized in this course.
Professional tasks and products	Carrying out Life Science Research
Professional products	Central Assignment Report in the form of a scientific article

Cohesion	The entire term comprises 4 related course units (CH6K, CH6-8Po, CH6-8Pa and CH6T) and is centered around the synthesis of natural products and specifically, pheromones. These compounds are central to the various weekly tasks (see CH6T), while with the central assignment, during the practical, one or more pheromones are synthesized (see CH6-8Po). A report will be written about the syntheses where the report structure follows is according that of specific organic-chemistry scientific literature (see CH6T).
Mandatory participation	Attendance at the tutor groups is a prerequisite for participation in IPS modular exams.
Maximum number of participants	**-**
Compensation possibilities	**-**
Activities and/or instructional formats	Tutor group Discussion of weekly tasks Expert hour Extra information about weekly assignments, central assignment etc. Opportunity to ask questions about the course. *Teaching methods: Problem based learning, quizzes, extra questions etc.* Preparation for your work placement and job application workshop preparation for your work placement (C8-Sv) and LPO Job application (C8-ST) are given in this term but signed off in C8T *Teaching methods: Training*
Required literature	The latest edition of: - McMurry, J Organic Chemistry, Belmont CA, USA: Cengage Inc. - Tro N.J., Principles of chemistry, a molecular approach (3rd Edition). Prentice Hall / Pearson Education.
Required software/required materials	- ChemSketch (ACD-labs) (freeware)- Chem Basic, molecular models
Recommended literature	
Examination	
	CH6T-T
Name of examination or modular examination	Theme test
Examination or modular examination code	CH6T-T
Assessment types(s):	Individual written open questions
Result	Grade
Minimum result	5.5
Weight factor of modular exams	1
Exam opportunities	Term 3, resit term 4
Permitted resources	PS card, chemical model box, calculator
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the exam period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the

	presence of a supervisor. • The discussion of the exam is scheduled in the following teaching period. The discussion of exams taken in a resit period is scheduled at the end of the education period. • Indicate (for an exam made in a resit period) to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	-
Assessment dimensions	**Competence 2: Experimenting** Preparation 2.1.2. Performs calculations prior to beginning lab work. 2.2.1. Can justify the basic steps of the experiments theoretically. Execution 2.2.4. Carries out experiments according to protocol so that reliable and reproducible data is obtained; knows at all times exactly what he/she does. **Competence 3: Results Analysis** Data processing 3.2.1. Carries out results analysis using prescribed methods; uses statistics (if applicable). Validation 3.1.2. Assesses the usability of the results based on of accuracy and reliability. Conclusions and discussion 3.2.3. Independently makes conclusions relating to the initial research question (if possible). 3.2.5. 3.2.5. Relates results with results from their other experiments and also to data in published literature. 3.2.6. Suggests improvements to improve the execution of the research. **Competence 4: Quality control** 4.1.3. Uses controls, and uses these to assess the reliability of the results. **Competence 5: Management and administration** Management 5.2.1. Encodes chemicals and samples; stores these in the correct manner. 5.2.2. Contributes to an efficiently functioning lab (tidies up, reports when reagents are nearly finished, performs minor maintenance of equipment). Administration 5.2.3. Manages and archives data in lab journal (aim, experiment description, alterations, results, conclusion) and if relevant, other ways of storing data so that others can understand it. **Competence 6: Reporting and Presenting** Text 6.2.1. Reports their research in the form of a research report/lab journal/poster according to in-house (HLO) guidelines (product criteria for lab journal and research report; level 2): - Uses correct spelling, grammar, sentence structure and scientific style; - Uses a clear and logical structure in complex passages of text; - Is aware of the cohesion between the different sections of text; - The document structure conforms to guidelines used in professional practise;

	- The report contains a reference list. The text references to the literature in this list; - Describes results so that the reader can understand them; - Uses clearly labelled figures and tables. - Describes all relevant data in a summary. In the context of: - Aliphatic organic chemistry (reaction equations, reaction mechanisms, carrying out experiments) - Reaction kinetics (0, 1st, 2nd, 3rd order) - Spectrum interpretation (IR, 1H NMR) - Safety
Assessment criteria	The student: - knows the organic chemical jargon (names of organic compounds, types of reactions and concepts that are important in organic chemical experiments (e.g. extraction, equivalents, reprocessing etc.); - can write down reaction equations and reaction mechanisms; - can perform calculations relevant to an organic chemical experiment; - can describe techniques relevant to an organic chemical experiment; - can interpret IR and 1H NMR spectra relating to the reactions performed; - can make statements about the reaction pathways followed using IR and 1H NMR spectra; - can link kinetic data and IR and 1H NMR spectra of a reaction to organic chemistry theory; - can make conclusions regarding safety aspects related to reactions; - can report correctly (e.g. reaction mechanisms, lab journal, description spectra, etc.).
Exam matrix	Distribution of the Theme Test questions: Experimenting: approx. 25% Results analysis approx. 50% Reporting approx. 20% Management and administration approx. 5% Approximately 20% also considered as theory (e.g. reaction mechanisms and explanations for why particular reactions and reaction patterns are followed) and approximately 30% chemical calculations, a small proportion (%) is also related to safety. The questions regarding the competence Results Analysis relate to spectrum interpretation, kinetic data analysis and final calculations.
	CH6T-L
Name of examination or modular examination	Scientific Article Report
Examination or modular examination code	CH6T-L
Assessment types(s):	Written, Group
Result	Grade
Minimum result	5.5
Weight factor of modular exams	1
Exam opportunities	Term 3, resit term 4
Permitted resources	
Method of enrolment for	Participation in Course CH6T gives automatic registration for CH6T-L.

exam/enrolment period	
Discussion and review	On the basis of the assessment form, the student will gain insight into how the grade was determined. In addition, the student can always make an appointment with the teacher who has reviewed the report to discuss this.
Number of examiners	Assessment by several examiners on the basis of the assessment form (practical teachers).
Possibilities for compensation	-
Assessment dimensions	**Competence 1: Design** 1.2.1. > 1.2.1. Independently identifies relevant background information required to answer the research question. 1.2.2. Searches for, selects and integrates information from relevant scientific sources. 1.2.4. Forms intermediate research questions and related a hypothesis based on the given research question. 1.2.5. Integrates information into a comprehensive research plan (e.g. justifying the chosen method, describing necessary controls and availability of equipment). 1.2.7. Is aware of the broader research context of their own experiments. **Competence 2: Experimenting** 2.1.2. Performs calculations prior to beginning lab work. 2.2.4. Carries out experiments according to protocol so that reliable and reproducible data is obtained; knows at all times exactly what he/she does. 2.2.7. Attempts to trouble shoot experiments when problems are encountered. **Competence 3: Results Analysis** 3.1.2. Assesses the usability of the results based on of accuracy and reliability. 3.1.4. Discusses the execution of the experiment and results. 3.2.3. Independently makes conclusions relating to the initial research question (if possible). 3.2.5. 3.2.5. Relates results with results from their other experiments and also to data in published literature. **Competence 6: Reporting and Presenting** 6.2.1. Reports their research in the form of a research report/lab journal/poster according to in-house (HLO) guidelines (product criteria for lab journal and research report; level 2): - Uses correct spelling, grammar, sentence structure and scientific style; - Uses a clear and logical structure in complex passages of text; - Is aware of the cohesion between the different sections of text; - The document structure conforms to guidelines used in professional practise; - The report contains a reference list. The text references to the literature in this list; - Describes results so that the reader can understand these; uses for this purpose clearly labelled figures and tables; - Describes all relevant data in a summary. 6.2.3. Is familiar with and applies the international conventions of scientific and academic writing. 6.2.4. In English, uses written tasks appropriate to the professional practise to communicate straightforward ideas as defined by CEFR B1 Level Writing. 6.2.6. In English: Is able to conduct discussions on work-related subjects
Assessment criteria	*See assessment form on #OnderwijsOnline under General Information.*
Exam matrix	*See assessment form on #OnderwijsOnline under General Information.*
	CH6T-IPV
Name of examination or	IPS

modular examination	
Examination or modular examination code	CH6T-IPV
Assessment types(s):	Oral, Individual
Result	Satisfactory/Unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exams	0
Exam opportunities	Term 3 Participation in modular exam IPV is only possible once per academic year (EER art. 8.5).
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH6T gives automatic registration for CH6T-IPV.
Discussion and review	For questions about the assessment, please contact the examiner.
Number of examiners	One examiner for the assessment based on participation and effort (tutor).
Possibilities for compensation	
Assessment dimensions	**Competence 6:** 6.2.6. In English: Is able to conduct discussions on work-related subjects **Competence 7: Working in a methodical and project-based manner** 7.2.1. Plans and organizes activities in a work plan that covers a duration of at least 4 practical lessons. 7.2.2. Works according to plan, also under time constraints. 7.2.3. Ensures that goals are reached and if necessary, makes adjustments to activities. 7.2.4. Is flexible in changing circumstances. **Competence 8: Team work** 8.1.1. Adheres to rules. 8.1.2. Makes a valuable contribution to the group. 8.2.3. Makes clear agreements with others and keeps to these. 8.2.4. Recognizes their own role in a group and is aware of other roles in the group. Works harmoniously with others. Is able to communicate about their assignment with peers and lecturers applying basic rules of communication: 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.1.9. Is active in conflict resolution. 8.2.5. Takes initiative in the conversation. 8.2.8. Verbally expresses their opinion/message clearly. 8.2.10. Interacts with conversation partner. **Competence 11: Professional Development** 11.1.5. Has study skills required by higher professional education; is motivated and determined.
Assessment criteria	The student: - the student has prepared for the meeting by completing the assignment to be discussed, and also completed the required reading for the following assignment to be discussed. - the student is able to show weekly assignments to the tutor (according to agreement, in writing or as a presentation); all required aspects are complete in all assignments; - Fulfils their designated roles (Chair, secretary etc.); - the student adheres to the rules agreed upon;

	- the student asks questions and shares knowledge regarding the assignment during tutor meetings; verbalizes these clearly and audibly, maintains eye contact; - Gives others opportunity to speak. - The student offers feedback to group and class members and is open to receiving feedback. The weekly assignments must be be assessed satisfactorily. - The student has actively participated in two tutor lessons that are partly in English.

Course unit 8K: CH8K (5 credits)

	CH8K
General information	
Target group	Full-time students, Chemistry foundation year, Level 2
Name of study unit	ECU CH8K: Biobased Polymers Knowledge
Unit of study code	CH8K
Teaching term	Term 4
ECTS credits	5 study credits
Study load in hours	140 SBU
Study hours (contact hours)	Programmed contact hours: 63 lesson periods (periods) /week= 47 hours per term Exam length: 6 lesson periods = 4.5 hours. Planned time for self-study: 88.5 hours Total: 140 hours
Unit of study entry requirements	The professional task must be performed at level 2. This course unit builds on CH3K and CH6K. Mastery of the theory taught in CH3K and CH6K is necessary to properly follow this course unit. Minor palette: Propedeutical exam - Life Sciences, Biology and Medical Laboratory examination, Bioinformatics. If CH3K has not been taken, the student is required to study the theory from this course and take an entry exam if this has not yet been done for CH6K. Based on the results of the entry exam it will be decided if participation is possible
Content and organisation	
General description	The central theme of this course unit is biobased polymers. Within the top sector in Chemistry, there are a number of Top Consortia for Knowledge and Innovation (in Dutch: *Topconsortia voor Kennis en Innovatie, TKI)* initiated. Biobased polymers is a theme that is the focus of two of these TKIs: TKI Smart Polymeric Materials, and TKI Biobased Economy. In this course, monomers and polymers are produced from sources such as biomass. Theory subjects in this course are: organic chemistry of polymers, polymer science (analytical chemistry of polymers and polymer physics), fluid dynamics, green chemistry and mathematics. In the context of the Biodiscovery Chain, the emphasis lies on the production of biomolecules in a biobased economy.
Exit qualifications	-
Professional tasks and products	Carrying out life scientific research
Professional products	Green Chemistry Assignment
Cohesion	This course deals with Biobased polymers. The organic chemistry and analytical chemistry of polymers are very important here. It is therefore a good follow-up to OWE 5, 6 and 7, which was a general approach to

	organic and analytical chemistry. This block focuses on the competences of designing and planning and project work. These are practiced in Course unit 5, 6 and 7 and tested in this term. The entire course comprises four interrelated course units (CH8K, CH6-8Pa, CH6-8Po and CH8T) and is centered around the synthesis and analysis of biobased polymers. During the practicals in P1, P2 and P3 (OWE CH5-7Po and CH6-8Po), skills have been built up in synthesizing and analyzing polymers. In project groups, an action plan is written (see CH8T) for making and analyzing a biobased polymer, which is carried out in the practical. A poster is made about the synthesis/analysis (CH8T). CH8K builds on CH3K and CH6K.
Mandatory participation	
Maximum number of participants	
Compensation possibilities	Compensation possible for CH8K-Ks, CH8K-Kpk, CH8K-Kop from 4.0. CH8K: (Kpk + Kop + Ks)/3 ≥ 5.5
Activities and/or instructional formats	The theory of organic chemistry of polymers, polymer science, fluid mechanics, green chemistry and mathematics is offered in a series of lectures throughout the course. Supporting subject Organic Chemistry of Polymers Nomenclature Radical polymerization Anionic and cationic polymerization Condensation polymerization Kinetics *Teaching methods: Lecture* Supporting subject: Polymer Chemistry Analysis methods such as GPC, IR, RAMAN, end group analysis, TLC, DSC, TGA Main categories molecular structure Glass condition and glass-rubber transition Semi crystalline thermoplastic Rubber state and liquid state *Teaching methods: Lecture* Supporting subject: Fluid Mechanics Alternating current Liquid flow *Teaching methods: Combined lectures/response classes* Supporting subjects: Green Chemistry Green Chemistry: Concepts and Applications Teaching methods: Combined lectures/tutor group and assignments that are discussed during the tutorial. Mathematics 4 Matrix calculations *Teaching methods: Lectures/tutorials*

Required literature	- Course theme guide 8C (#OnderwijsOnline) - Practical guide course CH6-8Po and CH6-8Pa (#OnderwijsOnline and LabArchives) The latest edition of: - Bolck, C et al, Biobased Plastics, Wageningen: WUR - Giancoli, D.C. Physics for Scientists & Engineers with Modern Physics: Pearson Education Limited - Tro,N.J., Principles of chemistry, a molecular approach, Prentice Hall / Pearson Education. - Jones, A.M., Dean, J.R., et al. Practical skills in Chemistry, New York, NY: Pearson Education. - Kemme, S. et al Wiskunde voor het Hoger Onderwijs deel b, Groningen: Noordhoff Uitgevers B.V. - Lancaster, M., Green Chemistry; An Introductory Text Cambridge, UK: RSCPublishing- McMurry, J., Organic Chemistry, Cengage Learning Inc, Belmont CA
Required software/required materials	
Recommended literature	
Examination	
	CH8K-Kp
Name of examination or modular examination	Knowledge Exam Polymer Science
Examination or modular examination code	CH8K-Kp
Assessment types(s):	Individual, Written
Result	Grade
Minimum result	5.5
Weight factor of modular exams	1
Exam opportunities	Term 4, resit end term 4
Permitted resources	non-graphic calculator, formula sheet
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the exam period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • At the end of term 4 the discussion is held before the start of the resit period of term 4. • Indicate for an exam made in a resit period to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	CH8K-Kp may be compensated from ≥ 4.0.
Assessment dimensions	Polymers science The student:

	- has knowledge of polymer physics. In order to understand the properties of plastics in practise, a thorough knowledge of polymer behaviour is required. A first introduction into the properties of polymers, such as those determined by the molecular structure, and on the other hand, those properties that determine the practical behavior of plastics either in the processing or in the properties of the final product; - has knowledge of the analysis of polymers.
Assessment criteria	Polymers science Polymer physics The student: - knows the origin of plastics/polymers; - knows the main categories of plastics and knows a number of significant plastics; - knows the molecular structure: chain structure, chain regularity, chain conformations, chain flexibility, cross-linking; - knows the various molecular weight averages and can use them to perform calculations, both on a mixture of monodisperse polymers and on a mixture of polydisperse polymers; - knows the various states in which a polymer can occur as a function of the T: glass state, rubber state, liquid state; - knows the concept of glass-rubber transition and knows the molecular picture; - can tell something about the thermodynamics of the glass-rubber transition; - has a number of determination methods of the glass-rubber transition temperature Tg; - knows the conditions for crystallization for crystalline polymers; - knows the crystallization process and the effect on the properties; -knows a number of consequences for the processing; - knows a number of mechanical properties such as force-stretch diagram, stiffness and creep, damping, strength; - Knows a number of other properties such as thermic, electrical and optical properties. Analytical chemistry of polymers The student: - can name different methods to analyze polymers; - knows the different methods to characterize and analyze polymeric surfaces (SEM); - knows the methods to determine the molecular weight (GPC, end group analysis, TLC, mass spectrometry, light scattering); - knows the methods to determine thermal properties of polymers (DSC, TMA, TGA); - knows methods for determining mechanical and electrical properties.
Exam matrix	approx. 50% Polymer physics approx. 50% Analysis of polymers
	CH8K-Ks
Name of examination or modular examination	Knowledge exam Fluid mechanics
Examination or modular examination code	CH8K-Ks
Assessment types(s):	Individual, Written
Result	Grade
Minimum result	5.5
Weight factor of modular exams	1
Exam opportunities	Term 4, resit end term 4

Permitted resources	non-graphic calculator, formula sheet
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the exam period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • At the end of term 4 the discussion is held before the start of the resit period of term 4. • Indicate for an exam made in a resit period to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	CH8K-Ks may be compensated from ≥ 4.0.
Assessment dimensions	Fluid Mechanics - Alternating current - Liquid flow
Assessment criteria	The student is familiar with and can calculate with the following aspects of alternating current: - behavior and properties of alternating current and alternating voltage; - rms value of current/voltage; - (average) power; - properties of resistor and capacitor. The student is familiar with and can calculate with the following aspects of liquid flow: - Equation of continuity; - Bernoulli's Law; - Poiseuille's Law; - Torricelli's Law; - Ubbelohde - Viscosity - Shearing - Laminar/turbulent flow; - Osmosis; surface tension.
Exam matrix	approx. 40% Alternating current approx. 60% Liquid flow
	CH8K-Kw4
Name of examination or modular examination	Mathematics 4
Examination or modular examination code	CH8K-Kw4
Assessment types(s):	Individual, Written
Result	Grade
Minimum result	5.5
Weight factor of modular exams	0
Exam opportunities	Term 4, resit end term 4
Permitted resources	Non-graphic calculator
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the exam period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.

Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • At the end of term 4 the discussion is held before the start of the resit period of term 4. • Indicate for an exam made in a resit period to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	
Assessment dimensions	The student has knowledge of: Matrices
Assessment criteria	The student is able to: - add and subtract matrices; - multiply matrices with a scalar; - multiply matrices and determine the inverse of a matrix; - show that a given number is an eigenvalue of a matrix - explain the meaning of a matrix.
Exam matrix	100% Matrices
	CH8K-Gc
Name of examination or modular examination	Green Chemistry
Examination or modular examination code	CH8K-Gc
Assessment types(s):	Individual assignment
Result	Satisfactory/Unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exams	0
Exam opportunities	Term 4 Participation in modular exam Gc is only possible once per academic year (EER art. 8.5).
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH8K gives automatic registration for CH8K-Gc.
Discussion and review	For questions about assessment, contact the examiner.
Number of examiners	Assessment by one examiner (theory lecturer).
Possibilities for compensation	
Assessment dimensions	Knowledge of the green chemistry concept
Assessment criteria	The student: - knows the concept of green chemistry; - knows the concepts and background of the biobased economy; - has knowledge of ‘green’ organic and polymer chemical syntheses; - has knowledge of green processes; - can apply green concepts in assignments; - can devise "green" alternatives to existing processes.
	CH8K-Kop
Name of examination or modular examination	Knowledge Exam: Organic Chemistry of Polymers

Examination or modular examination code	CH8K-Kop
Assessment types(s):	Individual, Written
Result	grade
Minimum result	5.5
Weight factor of modular exams	1
Exam opportunities	Term 4, resit end term 4
Permitted resources	Non-graphic calculator
Method of enrolment for exam/enrolment period	Registration for the modular exam via Alluris. The registration period is a few weeks prior to the exam period or the resits. The period is published in the SABC annual schedule on Insite-Timetables.
Discussion and review	• The annual schedule of SABC indicates when the exam periods / resit periods are and when the work can be reviewed. Review takes place in the presence of a supervisor. • At the end of term 4 the discussion is held before the start of the resit period of term 4. • Indicate for an exam made in a resit period to the examiner / course leader if you want to make use of the opportunity to discuss the exam. If there is no interest, the discussion will not take place. • Participation in the discussion of the exam is only permitted if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	CH8K-Kop may be compensated from ≥ 4.0.
Assessment dimensions	The student has knowledge of the synthesis of polymers
Assessment criteria	Organic chemistry of polymers The student: - knows the rules of polymer nomenclature and can name simple polymers; - knows the concept of chain polymerization, initiation, propagation and termination and knows the reaction mechanism and kinetics; - knows the two processes in chain polymerization that cause branching; - knows the principle of living polymerization: anionic and cationic polymerization; - knows the concept of step polymerization and has a number of known polymers such as, polyester, polyamide and polyurethanes; - knows the reaction mechanism and kinetics of step polymerization.
Exam matrix	100% organic chemistry of polymers

Course unit 8T: CH8T (5 credits)

	CH8T
General information	
Target group	Full-time students, Main phase Chemistry, Level 2
Name of study unit	ECU CH8T: Biobased Polymers Project
Unit of study code	CH8T
Teaching term	Term 4
ECTS credits	5 study credits
Study load in hours	140 SBU

Study hours (contact hours)	Programmed contact hours: Course introduction: 2 lesson periods Expert hour: 1 lesson period per week Tutor: 2 lesson periods per week; + 1 lesson period IPV + 2 lesson periods library visit Job application: 2x 2 lesson periods Total: 30 lesson periods per term (average 4.3 lesson periods per week)= 22,5 hours per term. Programmed time for self-study: 117,5 hours Total: 140 hours
Unit of study entry requirements	Course 1-4 of the foundation year, MLO diploma or participation of the abridged VWO route. Minor palette: Propedeutical exam - Life Sciences, Biology and Medical Laboratory examination , Bioinformatics.
Content and organization	
General description	The central theme of the course unit is biobased polymers. Within the top sector in Chemistry, there are a number of Top Consortia for Knowledge and Innovation (in Dutch: *Topconsortia voor Kennis en Innovatie, TKI)* initiated. Biobased polymers is a theme that is the focus of two of these TKIs: TKI Smart Polymeric Materials, and TKI Biobased Economy. In this course, monomers and polymers are produced from sources such as biomass. The theory subjects that support this are organic chemistry of polymers, analytical chemistry of polymers and polymer physics. Producing and measuring polymers are thus the focus. In addition, two interactive workshops will be held in this course on the role of ethics in scientific research. In the context of the Biodiscovery Chain, the emphasis lies on the production of biomolecules in a biobased economy.
Exit qualifications	**Design** Experimenting **Results Analysis** **Reporting and Presenting** **Working in a methodical and project-based manner** Team Work **Superivising/Coaching** Professional Development The competencies in bold are those which are emphasized in this course.
Professional tasks and products	Carrying out life science research
Professional products	

Cohesion	The focus of this course is on biobased polymers. Organic chemistry and analytical chemistry of polymers are a major components. It is therefore a good follow-up to OWE 5, 6 and 7, which was a general approach to organic and analytical chemistry. This course focuses on the competences of designing and planning and project work. These are practiced in course unit 5, 6 and 7 and tested in this term. The entire block comprises four interrelated course units (CH8K, CH6-8-Pa, CH6-8Po and CH8T) and is focused on the synthesis and analysis of biobased polymers. During the practicals in P1, P2 and P3 (Course unit CH5-7Po and CH6-8Po), skills have been built up in synthesizing and analyzing polymers. An action plan is written in project groups for making and analyzing a biobased polymer, and is carried out in the practical. A poster is made about the synthesis/analysis (This course unit CH8T).
Mandatory participation	Attendance at the tutor groups is a prerequisite for participation in IPS assessment.
Maximum number of participants	
Compensation possibilities	
Activities and/or instructional formats	The general higher education competences are linked to this course unit. These are developed throughout the year. If the project gives reason to do so, workshops on specific topics will be provided. Tutor *Teaching methods: Work discussion* Weekly discussion of the project and the related products. Expert hour: *Teaching methods: Problem* Extra information and question time about the project and the practical assignments Job application *Teaching methods: Interactive workshop* Job Application
Required literature	- Course theme guide 8C (OnderwijsOnline) - Practical guide course CH6-8Po and CH6-8Pa8 (#OnderwijsOnline and LabArchives) The latest edition of: - Bolck, C et al, Biobased Plastics, Wageningen: WUR - Giancoli, D.C. Physics for Scientists & Engineers with Modern Physics: Pearson Education Limited - Tro, N.J., Chemistry, a molecular approach, Prentice Hall / Pearson Education. - Jones,A.M., Dean, J.R., et al. Practical skills in Chemistry, New York, NY: Pearson Education. - Kemme, S. et al Wiskunde voor het Hoger Onderwijs deel b, Groningen: Noordhoff Uitgevers B.V. - Lancaster, M., Green Chemistry; An Introductory Text Cambridge, UK: RSCPublishing
Required software/required materials	

Recommended literature	
Examination	
	CH8T-Po
Name of examination or modular examination	Poster
Examination or modular examination code	CH8T-Po
Assessment types(s):	Written, Group
Result	Grade
Minimum result	5.5
Weight factor of modular exams	2
Exam opportunities	Term 4, resit end term 4
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH8T gives automatic registration for CH8T-Po.
Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this interim assessment.
Number of examiners	Assessment by at least one examiner (practical teacher or tutor) based on the assessment form.
Possibilities for compensation	
Assessment dimensions	Competence 1: Defining the research question 1.2.1. Independently identifies relevant background information required to answer the research question. Gathering information and developing a research plan 1.2.2. Searches for, selects and integrates information from relevant scientific sources. 1.2.4. Forms intermediate research questions and related a hypothesis based on the given research question. Competence 3: Results Analysis 3.2.3. Independently makes conclusions relating to the initial research question (if possible). Competence 6: Reporting and Presenting 6.2.1. Reports their research in the form of a research report/lab journal/poster according to in-house (HLO) guidelines (product criteria for lab journal and research report; level 2): Uses correct spelling, grammar, sentence structure and scientific style; uses a clear and logical structure in complex passages of text; is aware of the cohesion between the different sections of text; the document structure conforms to guidelines used in professional practice; The report has a reference list. The text refers to the literature in the this reference list; Describes results so the reader can understand; Uses clearly labelled figures and tables; Describes all relevant data in a summary. 6.2.3. Is familiar with and applies the international conventions of scientific and academic writing. Competence 8: Team work Is able to communicate about their assignment with peers and lecturers applying basic rules of communication: 8.1.6. Maintains eye contact with conversation partner;

	8.1.7. Gives others opportunity to speak; 8.2.5. Takes initiative in the conversation; 8.2.8. Verbally expresses their opinion/message clearly; 8.2.10. Interacts with conversation partner; In the context of: Polymer chemistry
Assessment criteria	See assessment form for the poster. For the assessment form, see #OnderwijsOnline under General Information
Exam matrix	See the Poster Assessment Form on OnderwijsOnline under General Information.
	CH8T-V
Name of examination or modular examination	Research plan
Examination or modular examination code	CH8T-V
Assessment types(s):	Written, Group
Result	Grade
Minimum result	5.5
Weight factor of modular exams	1
Exam opportunities	Term 4, resit end term 4
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH8T gives automatic registration for CH8T-V.
Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this interim assessment.
Number of examiners	Assessment by one examiner (practical teacher or tutor) based on the assessment form.
Possibilities for compensation	
Assessment dimensions	Competence 1: Defining the research question 1.2.1. Independently identifies relevant background information required to answer the research question. Gathering information and developing a research plan 1.2.2. Searches for, selects and integrates information from relevant scientific sources. 1.2.4. Forms intermediate research questions and related a hypothesis based on the given research question. 1.2.5. Integrates information into a comprehensive research plan (e.g. justifying the chosen method, describing necessary controls and availability of equipment). 1.2.6. Understands and applies moderately complex English literature relevant to the given context. Competence 2: Experimenting Preparation 2.1.2. Performs calculations prior to beginning lab work. 2.2.1. Is able to explain the basic steps of the experiments. 2.2.3. Ensures that all requirements are present before beginning the experiment, makes solutions. Competence 4: Quality control 4.1.1. Is aware of the workplace health and safety rules and works according to these rules.

	Competence 6: Reporting and Presenting 6.2.1. Reports their research in the form of a research report/lab journal/poster according to in-house (HLO) guidelines (product criteria for lab journal and research report; level 2): Uses correct spelling, grammar, sentence structure and scientific style; uses a clear and logical structure in complex passages of text; is aware of the cohesion between the different sections of text; the document structure conforms to guidelines used in professional practice; The report has a reference list. The text refers to the literature in the this reference list; Describes results so the reader can understand; Uses clearly labelled figures and tables; Describes all relevant data in a summary. Competence 7: Working in a methodical and project-based manner 7.2.1. Plans and organises activities in a work plan that covers a duration of at least 4 practical lessons. In the context of: Polymer chemistry.
Exam matrix	See assessment form on #OnderwijsOnline under General Information.
	CH8T-IPV
Name of examination or modular examination	IPS
Examination or modular examination code	CH8T-IPV
Assessment types(s):	Oral, Individual
Result	Satisfactory/Unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exams	0
Exam opportunities	Term 4 Participation in modular exam IPV is only possible once per academic year (EER art. 8.5).
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH8T gives automatic registration for CH8T-IPV.
Discussion and review	For questions about assessment, contact the examiner.
Number of examiners	One examiner (tutor) for the assessment based on participation and effort.
Possibilities for compensation	
Assessment dimensions	Competence 8: Teamwork / Communication Functioning in a group 8.1.1. Adheres to rules. 8.1.2. Makes a valuable contribution to the group. 8.2.3. Makes clear agreements with others and keeps to these. 8.2.4. Recognises their own role in a group and is aware of other roles in the group. Works harmoniously with others. Communication Is able to communicate about their assignment with peers and lecturers applying basic rules of communication. 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.1.9. Is active in conflict resolution. 8.2.5. Takes initiative in the conversation. 8.2.8. Verbally expresses their opinion/message clearly.

	8.2.10. Interacts with conversation partner. Competence 11: Professional Development 11.1.5. Has study skills required by higher professional education; is motivated and determined.
Assessment criteria	The student: - the student has prepared for the meeting by completing the assignment to be discussed, and also completed the required reading for the following assignment to be discussed; - the student is able to show weekly assignments to the tutor (according to agreement, in writing or as a presentation); all required aspects are complete in all assignments; - Fulfils their designated roles (Chair, secretary etc.); - The student adheres to the rules agreed upon; - The student asks questions and shares knowledge regarding the assignment during tutor meetings; - Verbalises these clearly and audibly, maintains eye contact; - Gives others opportunity to speak; - The student offers feedback to group and class members and is open to receiving feedback.
	CH8T-HBO
Name of examination or modular examination	Competency card
Examination or modular examination code	CH8T-HBO
Assessment types(s):	Written, Oral, Individual
Result	Satisfactory/Unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exams	0
Exam opportunities	2nd year
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH8T gives automatic registration for CH8T-HBO.
Discussion and review	For questions about assessment, contact the examiner.
Number of examiners	Assessment by one examiner (tutor) based on the assessment form.
Possibilities for compensation	
Assessment dimensions	Competence 6: Reporting and Presenting 6.2.2. Takes minutes of meetings according to product criteria for meeting minutes; level 2. 6.2.5. Presents research to a target audience with similar knowledge background in a clear manner; applies general presentation techniques and answers questions: - There is a introduction-body-conclusion structure to the presentation; - Speaks clearly and coherently; - Has upright posture and hands are freely used; - Makes eye contact with the audience; - Makes organised and clear slides or other visual products; - Verbal and visual messages complement each other; - Uses visual aids in PowerPoint to support; - Holds an on-topic discussion with the audience. Competence 8: Teamwork / Communication 8.1.6. Maintains eye contact with conversation partner.

	8.2.8. Verbally expresses their opinion/message clearly. 8.2.10. Interacts with conversation partner. Competence 9: Leadership 9.2.1. Composes an agenda in a standard format and uses it to independently lead a meeting.
Assessment criteria	For the assessment form, see #OnderwijsOnline under General Information. See Assessment form Meeting Minutes Level 2. 2 signatures (=satisfactory) on the competency card are required. See assessment form below 'Leading a OGO/PO Group Level II'. 2 signatures (=satisfactory) on the competency card are required. See Assessment form Meeting Minutes Level 2. 2 signatures (=satisfactory) on the competency card are required.
	CH8T-Cop
Name of examination or modular examination	Coaching assignment
Examination or modular examination code	CH8T-Cop
Assessment types(s):	Written, Oral, Individual
Result	Satisfactory/Unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exams	0
Exam opportunities	Term 4, resit end term 4
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH8T gives automatic registration for CH8T-POP.
Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this interim assessment.
Number of examiners	Assessment by one examiner (study coach) based on the assessment form.
Possibilities for compensation	
Assessment dimensions	Competence 9: Leadership Coaching 9.2.2. Adjusts supervision manner to suit the level and personalities of the fellow students. 9.2.3. Is able to motivate others.
Assessment criteria	For the assessment form, see #OnderwijsOnline under General Information. Coaching is assessed with the aid of: - Assessment form 'Coaching, to be filled in by the student coached' OR - Assessment form 'Coaching, to be signed by study coach'
Exam matrix	See Coaching Assessment Form on OnderwijsOnline under General Information
	CH8T-FG1 / CH8T-FG2
Name of examination or modular examination	Performance interview 1 and 2

Examination or modular examination code	CH8T-FG1 / CH8T-FG2
Assessment types(s):	Written, Oral, Individual
Result	Satisfactory/Unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exams	0
Exam opportunities	2nd year, resit in consultation with study career coach
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH8T gives automatic registration for CH8T-FG1 and CH8T-FG2.
Discussion and review	For questions about assessment, contact the examiner.
Number of examiners	Assessment based on participation in discussion and preparation by one examiner (study career coach).
Possibilities for compensation	
Assessment dimensions	Competence 8: Team Work 8.1.1. Adheres to rules. 8.2.1. Makes clear agreements with others and keeps to these. 8.2.3. Shows initiative in conversation. 8.1.3. Maintains eye contact with conversation partner. 8.1.4. Gives others opportunity to speak; 8.2.4. Verbally expresses their opinion/message clearly. 8.2.5.Interacts with conversation partner; 8.1.6 Is active in conflict resolution. Competence 11: Professional Development 11.2.1. Identifies strengths and weaknesses. 11.2.2. Formulates POP based on strength-weakness analysis. Works on learning aims as described in the PDP and collated competency assessment products. 11.2.4. Reflects critically on own performance and learning process; learns from mistakes. 11.2.5. Works with integrity, adjusts to new situations, shows determination and is a motivated student.
Assessment criteria	- The student independently makes agreements, keeps to these agreements and is prepared. - Can demonstrate that he has actively worked on the learning outcomes that are described in the PDP. - In the portfolio, the documents are clearly archived and clearly coupled to the competences which they prove. - The student looks methodically and critically at their learning process, identifies what went well, and what didn't go well, names the causes of these, and links it to their own actions. A plan for improvement in the future is formulated. The student reflects on their study attitude as well as professional competencies. Demonstrates a pro-active attitude and is motivated. - The student shows a pro-active attitude and is motivated. - The student shows perseverance in his study and is able to adapt to different circumstances. The student acts with integrity.
	CH8T-St
Name of examination or modular examination	Internship Preparation
Examination or modular examination code	CH8T-St

Assessment types(s):	Written, Oral, Individual
Result	Satisfactory/Unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exams	0
Exam opportunities	For participation in the workshops LPO-ethics there is only one opportunity per academic year (EER art. 8.5) See the class roster.
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH8T gives automatic registration for CH8T-St.
Discussion and review	For questions about assessment, contact the examiner.
Number of examiners	One examiner (workshop lecturer) for the assessment based on participation and effort.
Possibilities for compensation	
Assessment dimensions	Competence 8: Teamwork / Communication 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.2.5. Takes initiative in the conversation. 8.2.8. States his/her opinion/message clearly. 8.2.10. Interacts with conversation partner. Competence 11: Professional Development Guides own competency development 11.1.2. Works on learning aims as described in the PDP and collated competency assessment products. 11.2.1. Identifies strengths and weaknesses. 11.2.4. Formulates POP based on strength-weakness analysis Possesses a work attitude appropriate to higher professional education: 11.2.5. Works with integrity, adjusts to new situations, shows determination and is a motivated student.
Assessment criteria	Participation in the internship preparation lessons is signed off.
	CH8T-Sol
Name of examination or modular examination	LPO Job application
Examination or modular examination code	CH8T-Sol
Assessment types(s):	Written, Oral, Individual
Result	Satisfactory/Unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exams	0
Exam opportunities	For participation in the workshops LPO Job application there is only one opportunity per academic year (EER art. 8.5) See the class roster.
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH8T gives automatic registration for CH8T-LPO-Sol.
Discussion and review	For questions about assessment, contact the examiner.
Number of examiners	One examiner (workshop lecturer) for the assessment based on participation and effort.
Possibilities for compensation	
Assessment dimensions	Competence 8: Teamwork / Communication 8.1.6. Maintains eye contact with conversation partner.

	8.1.7. Gives others opportunity to speak. 8.2.5. Takes initiative in the conversation. 8.2.8. States his/her opinion/message clearly. 8.2.10. Interacts with conversation partner. Competence 11: Professional Development Guides own competency development 11.1.2. Works on learning aims as described in the PDP and collated competency assessment products. *Demonstrates an attitude fitting to professional higher education* 11.2.5. Works with integrity, adjusts to new situations, shows determination and is a motivated student.
Assessment criteria	Participation in the workshop is required for a satisfactory grade. To participate in the job application workshop, completion of the preparatory assignment is compulsory.

Course unit 6-8Pa: CH6-8Pa (5 credits)

	CH6-8Pa
General information	
Target group	Full-time students, main phase Chemistry, Level 2
Name of course unit	EEU CH6-8Pa: Analytical Chemistry practical
Study unit code	CH6-8Pa
Teaching term	Term 1 and 2
Study credits	5 study credits
Study load in hours	140 SBU
Study hours (contact hours)	Programmed contact hours: 5 lesson periods/week, 35 lesson periods/term 3.75 hours/week, 26.25 hours/term Programmed time for self-study: 78.75 hours Total: 140 hours
Course entry requirements	CHLS1-4 of the foundation year, MLO diploma or enrolled in the abridged VWO route. Palette minor – Propedeutical exam - Life Sciences, Biology and Medical Laboratory Research, Bioinformatics. Participation in the practical lessons is only allowed if the safety exam is passed. Transfer students in the main phase must pass the safety exam in the first year of enrolment.
Content and organisation	
General description	In this course (CH6-8Pa) a lot of work is done on troubleshooting (GC, HPLC) and sample preparation in which the analysis techniques taught in CH5-7a are applied. At the end of the Course, a number of overarching experiments will be carried out using different analysis techniques.
Exit qualifications	Design **Experimenting** **Results Analysis** **Reporting and Presenting** Management and Administration Methodology Teamwork

	Leadership Professional Development The competencies in bold are those which are emphasized in this course.
Professional tasks and products	Carrying out Life Science Research
Professional products	
Cohesion	Term 3 comprises 4 related course units (CH6K, CH6-8Pa, CH6-8Po and CH6T) and is centered around the synthesis of natural products and specifically, pheromones. One of the theory subjects of CH6K is kinetics. In CH6-8Pa a test is carried out to illustrate this subject. The entire block comprises four interrelated course units (CH8K, CH6-8Pa, CH6-8Po en CH8T) and is centered around the synthesis and analysis of biobased polymers. The theory of the subjects from CH8K are applied in practice. CH6-8Pa builds on CHLS2c, C4P and CH5-7Pa. The analysis techniques learned in CH5-7a are applied.
Mandatory participation	Attendance at the practical lessons is a prerequisite for participation in the practical modular examination (Pi). A student may not (with a valid reason!) omit more than 1 practicum. This practicum has to be caught up.
Maximum number of participants	
Compensation possibilities	
Activities and/or instructional formats	One part of a day per week is spent on the research in the laboratory. In this course a lot of work is done on troubleshooting (GC, HPLC) and sample preparation in which the analysis techniques taught in CH5-7a are applied.
Required literature	-
Required software/required materials	LabArchives
Recommended literature	
Examination	
	CH6-8Pa-Pm1 / CH6-8Pa-Pm2
Name of examination or modular examination	Measurement Reports Practical Analytical Chemistry
Examination or modular examination code	CH6-8Pa-Pm1 / CH6-8Pa-Pm2
Assessment types(s):	Written, individual
Result	Grade
Passing grade	5.5
Weight factor of modular exams	CH6-8Pa-Pm1: 1 / CH6-8Pa-Pm2 :1
Exam opportunities	Term 1 & 2, Resit for measurement reports in term 2 & 3.
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in CH6-8Pa counts as registration for CH6-8Pa-Pm1 and CH6-8Pa-Pm2.
Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this modular assessment.

	In addition, the student can always make an appointment with the teacher who has reviewed the report to discuss this.
Number of examiners	Assessment by one examiner (practical teacher) based on the assessment form.
Possibilities for compensation	
Assessment dimensions	**Competence 1: Experimenting** Preparation 1.2.2. Searches for, selects and integrates information from relevant scientific sources for Life Science research 1.2.4. Formulates the research questions with an associated hypotheses, for a given research assignment. **Competence 2: Experimenting** 2.1.2. Performs calculations prior to beginning lab work. 2.2.3. Ensures that all requirements are present before beginning the experiment, makes solutions. **Competence 3: Results** Data processing analysis 3.2.1. Carries out results analysis using prescribed methods; uses statistics (if applicable). Validation 3.1.2. Evaluates the obtained results based on their accuracy and reliability. Conclusions and discussion 3.1.4. Discusses the execution of the experiment and results. 3.2.3. Independently makes conclusions relating to the initial research question (if possible). 3.2.5. Relates results with results from their other experiments and also to data in published literature. **Competence 4: Quality control** 4.1.3. Uses controls, and uses these to assess the reliability of the results. **Competence 6: Reporting and Presenting** Text 6.2.1. Reports their research in the form of a research report/lab journal/poster according to in-house (HLO) guidelines (product criteria for lab journal and research report; level 2): - Uses correct spelling, grammar, sentence structure and scientific style; - Uses a clear and logical structure in complex passages of text; - Is aware of the cohesion between the different sections of text; - The document structure conforms to guidelines used in professional practice; - The report contains a reference list. The text references to the literature in this list; - Describes results so that the reader can understand them; - Uses clearly labelled figures and tables. - Describes all relevant data in a summary. 6.2.3. Is familiar with and applies the international conventions of scientific and academic writing. 6.2.4. In English, uses written tasks appropriate to the professional practice to communicate straightforward ideas as defined by CEFR B1 Level Writing.

Assessment criteria	See Measurement Report Assessment Form on OnderwijsOnline under General Information.
Exam matrix	See Measurement Report Assessment Form on OnderwijsOnline under General Information.
	CH6-8Pa-Pi1 / CH6-8Pa-Pi2
Name of examination or modular examination	Practical Analytical Chemistry: Performance
Examination or modular examination code	CH6-8Pa-Pi1 / CH6-8Pa-Pi2
Assessment types(s):	Individual, practical
Result	Grade
Passing grade	5.5
Weight factor of modular exams	CH6-8Pa-Pi1: 1 / CH6-8Pa-Pi2: 1
Exam opportunities	Term 1 and 2. There is only one opportunity per year for the modular exams CH6-8Pa-Pi1 and CH6-8Pa-Pi2 (EER art. 8.5).
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH6-8Pa is considered as registration for CH6-8Pa-P1 and CH6-8Pa-P2
Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this modular assessment. In addition, the student can always make an appointment with the teacher who has reviewed the report to discuss this.
Number of examiners	Assessment by two examiners (practical teacher) based on the assessment form.
Possibilities for compensation	
Assessment dimensions	**Competence 1: Experimenting** Preparation 1.2.4. Formulates the research questions with an associated hypotheses, for a given research assignment. **Competence 2: Experimenting** 2.1.2. Performs calculations prior to beginning lab work. 2.2.1. Is able to explain the basic steps of the experiments. 2.2.3. Ensures that all requirements are present before beginning the experiment, makes solutions. Execution 2.1.5. Carries out the experiments within the given time. 2.2.4. Carries out experiments according to protocol so that reliable and reproducible data is obtained; knows at all times exactly what he/she does. 2.2.6. Attempts to work on multiple experiments at the same time (multitasking). 2.2.7. Attempts to trouble shoot experiments when problems are encountered. **Competence 3: Results Analysis** 3.2.5. Relates results with results from their other experiments and also to data in published literature. **Competence 4: Quality control** 4.1.1. Is aware of the health and safety rules and works according to these rules.

	4.1.3. Uses controls, and uses these to assess the reliability of the results. 4.2.2. Calibrates advanced equipment at the start of experiments. **Competence 5: Management and administration** Management 5.1.3. Manages and archives data in lab journal (aim, experiment description, alterations, results, conclusion) and if relevant, other ways of storing data. 5.2.1. Encodes chemicals and samples; stores these in the correct manner. 5.2.2. Contributes to an efficiently functioning lab (tidies up, reports when reagents are nearly finished, performs minor maintenance of equipment). Administration 5.1.3., (5.2.3.) Manages and archives data in lab journal (aim, experiment description, alterations, results, conclusion) and if relevant, other ways of storing data so that others can understand it. **Competence 7: Methodology** 7.2.2. Works according to plan, also under time constraints. **Competence 11: Professional Development** 11.1.5. Has study skills required by higher professional education; is motivated and determined.
Assessment criteria	See assessment form Chemistry Practical, on #OnderwijsOnline under General Information.
Exam matrix	See assessment form Chemistry Practical, on #OnderwijsOnline under General Information.

Course unit 6-8Po: CH6-8Po (5 credits)

	CH6-8Po
General information	
Target group	Full-time students, main phase Chemistry, Level 2
Name of course unit	ECU CH6-8Po: Organic and Polymer Chemistry Practical
Study unit code	CH6-8Po
Teaching term	Term 1 and 2
Study credits	5 study credits
Study load in hours	140 SBU
Study hours (contact hours)	Programmed contact hours: 5 lesson periods/week, 35 lesson periods/term 3.75 hours/week, 26.25 hours/term Programmed time for self-study: 78.75 hours Total: 140 hours
Course entry requirements	CHLS1-4 of the foundation year, MLO diploma or enrolled in the abridged VWO route. Minor palette: Propedeutical exam - Life Sciences, Biology and Medical Laboratory Research, Bioinformatics. Participation in the practical lessons is only allowed if the safety exam is passed. Transfer students in the main phase must pass the safety exam in the first year of enrolment.
Content and organisation	
General description	In this course, the professional task ‘Carrying out Life Science Research’ is central in the context of natural products, in the field of organic

	chemistry. In Term 3, a number of organic/polymer chemical experiments are first performed, after which each project group is given the central task of synthesizing a number of pheromones. This concerns in all cases multiple step syntheses. In addition, the students are given assignments related to lab management. The theory is handled in term 3: Organic Chemistry (aliphatic compounds: reactions and reaction mechanisms), spectrum interpretation (IR and CH6K) and reaction kinetics (see 1HNMR). In term 4, one or more total syntheses are first performed in the field of organic and/or polymer chemistry. Then, based on a self-written research plan (CH8T), we work on the creation and analysis of Biobased polymers. The theory subjects that support this are organic chemistry of polymers, analytical chemistry of polymers and polymer physics (CH8K). Producing and measuring polymers are thus the focus. In the context of the Biodiscovery Chain, the emphasis lies on the production and analysis of biomolecules and biobased polymers.
Exit qualifications	Design **Experimenting** **Results Analysis** **Reporting and Presenting** Management and Administration Methodology Teamwork Leadership Professional Development The competencies in bold are those which are emphasized in this course.
Professional tasks and products	Carrying out Life Science Research
Professional products	
Cohesion	Term 3 comprises 4 related course units (CH6K, CH6-8Pa, CH6-8Po and CH6T) and is centered around the synthesis of natural products and specifically, pheromones. These compounds are central to the various weekly tasks (see CH6T), while with the central assignment, during the practical, one or more pheromones are synthesised (see CH6-8Po). A report will be written about the syntheses where the report structure follows is according that of specific organic-chemistry scientific literature (see CH6T). Term 4 deals with Biobased polymers. Organic chemistry and analytical chemistry of polymers are a major component. It is therefore a good follow-up to CH5, 6 and 7, which was a general approach to organic and analytical chemistry. This block focuses on the competences of designing and planning and project work. These are practiced in Course unit CH5, 6 and 7 and tested in this term. The entire term comprises four interrelated course units (CH8K, CH6-8Pa, CH6-8Po and CH8T) and is centered around the synthesis and analysis of biobased polymers. A plan of approach is written in project groups (see CH8T) for the creation and analysis of a biopolymer, to be carried out during the practical, after obtaining the proficiency in Term 1, 2 and 3. A poster of this synthesis/analysis will be made and presented (see CH8T). CH6-8Po builds on CHLS1B, CHLS2c, CH3P and CH5-7Po

Mandatory participation	Attendance at the practical lessons is a prerequisite for participation in the practical modular examination (Pi). A student may not (with a valid reason!) omit more than 1 practicum. This practicum has to be caught up.
Maximum number of participants	
Compensation possibilities	
Activities and/or instructional formats	Per week 1 part of a day is spent on practicing practical skills and conducting research in the laboratory. It builds on the techniques learned in CH5-7Po. The Schlenk line is used in a more complex experiment and a number of total syntheses are carried out.
Required literature	
Required software/required materials	LabArchives
Recommended literature	
Examination	
	CH6-8Po-Pm1 / CH6-8Po-Pm2
Name of examination or modular examination	Measurement reports Organic and Polymer Chemistry Practical
Examination or modular examination code	CH6-8Po-Pm1 / CH6-8Po-Pm2
Assessment types(s):	Written, individual
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 3 and 4 Resit for measurement reports in Term 4.
Permitted resources	
Method of enrolment for exam/enrolment period	Enrolment in CH6-8Po counts as a registration for CH6-8Po-Pm1 and CH6-8Po-Pm2
Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this modular assessment. In addition, the student can always make an appointment with the teacher who has reviewed the report to discuss this.
Number of examiners	Assessment by one examiner (practical teacher) based on the assessment form.
Possibilities for compensation	
Assessment dimensions	**Competence 1: Experimenting** Preparation 1.2.2. Searches for, selects and integrates information from relevant scientific sources Life science research 1.2.4. Formulates the research questions with an associated hypotheses, for a given research assignment. **Competence 2: Experimenting** 2.1.2. Performs calculations prior to beginning lab work. 2.2.3. Ensures that all requirements are present before beginning the experiment, makes solutions.

	Competence 3: Results Data processing analysis 3.2.1. Carries out results analysis using prescribed methods; uses statistics (if applicable). Validation 3.1.2. Evaluates the obtained results based on their accuracy and reliability. Conclusions and discussion 3.1.4. Discusses the execution of the experiment and results. 3.2.3. Independently makes conclusions relating to the initial research question (if possible). 3.2.5. Relates results with results from their other experiments and also to data in published literature. **Competence 4: Quality control** 4.1.3. Uses controls, and uses these to assess the reliability of the results. **Competence 6: Reporting and Presenting** Text 6.2.1. Reports their research in the form of a research report/lab journal/poster according to in-house (HLO) guidelines (product criteria for lab journal and research report; level 2): - Uses correct spelling, grammar, sentence structure and scientific style; - Uses a clear and logical structure in complex passages of text; - Is aware of the cohesion between the different sections of text; - The document structure conforms to guidelines used in professional practice; - The report contains a reference list. The text references to the literature in this list; - Describes results so that the reader can understand these; uses for this purpose clearly labelled figures and tables; - Describes all relevant data in a summary. 6.2.3. Is familiar with and applies the international conventions of scientific and academic writing. 6.2.4. In English, uses written tasks appropriate to the professional practice to communicate straightforward ideas as defined by CEFR B1 Level Writing.
Assessment criteria	See assessment form for the Measurement Report on #OnderwijsOnline under General information.
Exam matrix	See assessment form for Measurement Report on #OnderwijsOnline under General Information.
	CH6-8Po-Pi1 / CH6-8Po-Pi2
Name of examination or modular examination	Organic and Polymer Chemistry Practicals Performance
Examination or modular examination code	CH6-8Po-Pi1 / CH6-8Po-Pi2
Assessment types(s):	Individual, practical
Result	Grade
Passing grade	5.5
Weight factor of modular exams	CH6-8Po-Pi1: 1 / CH6-8Po-Pi2: 1
Exam opportunities	Term 1 and 2. There is only one opportunity per year for the modular exams CH6-8Po-Pi1 and CH6-8Po-Pi2 (EER art. 8.5).
Permitted resources	

Method of enrolment for exam/enrolment period	Participation in Ch6-8Po is considered as registration for CH6-8Po-Pi1 and CH6-8Po-Pi2
Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this modular assessment. In addition, the student can always make an appointment with the teacher who has reviewed the report to discuss this.
Number of examiners	Assessment by two examiners (practical teacher) based on the assessment form.
Possibilities for compensation	
Assessment dimensions	**Competence 1: Experimenting** Preparation 1.2.4. Formulates the research questions with an associated hypotheses, for a given research assignment. **Competence 2: Experimenting** 2.1.2. Performs calculations prior to beginning lab work. 2.2.1. Is able to explain the basic steps of the experiments. 2.2.3. Ensures that all requirements are present before beginning the experiment, makes solutions. Execution 2.1.5. Carries out the experiments within the given time. 2.2.4. Carries out experiments according to protocol so that reliable and reproducible data is obtained; knows at all times exactly what he/she does. 2.2.6. Attempts to work on multiple experiments at the same time (multitasking). 2.2.7. Attempts to trouble shoot experiments when problems are encountered. **Competence 3: Results Analysis** 3.2.5. Relates results with results from their other experiments and also to data in published literature. **Competence 4: Quality control** 4.1.1. Is aware of the health and safety rules and works according to these rules. 4.1.3. Uses controls, and uses these to assess the reliability of the results. 4.2.2. Calibrates advanced equipment at the start of experiments. **Competence 5: Management and administration** Management 5.1.3. Manages and archives data in lab journal (aim, experiment description, alterations, results, conclusion) and if relevant, other ways of storing data. 5.2.1. Encodes chemicals and samples; stores these in the correct manner. 5.2.2. Contributes to an efficiently functioning lab (tidies up, reports when reagents are nearly finished, performs minor maintenance of equipment). Administration 5.1.3., (5.2.3.) Manages and archives data in lab journal (aim, experiment description, alterations, results, conclusion) and if relevant, other ways of storing data so that others can understand it. **Competence 7: Methodology** 7.2.2. Carries out activities according to planning; also under time pressure.

Assessment criteria	See assessment form Chemistry Practical, on #OnderwijsOnline under *Algemene Informatie* (General Information)
Exam matrix	See assessment form Chemistry Practical, on #OnderwijsOnline under *Algemene Informatie* (General Information)

Course unit 11: CH11 (15 credits)

	CH11
General information	
Target group	Full-time students, main phase, analytical chemistry graduation specialization, level 3
Name of course unit	Course unit 11: Analytical Chemistry Research: Quality assurance and optimization / ECU 11 Analytical Chemistry: Quality Assurance and Optimization
Study unit code	CH11
Teaching term	Term 3
Study credits	15 study credits
Study load in hours	420 SBU
Study hours (contact hours)	Scheduled contact hours: 22 lesson periods/week, 154 lesson periods/ term = 116 hours Planned time for self-study: 304 hours Total: 420 hours
Course entry requirements	Foundation year must have been completed and the course units CH5 and CH7 must have at least been taken. CH5-7 Pa and CH6-8 Pa, CH7K and CH5T-A (report) must be satisfactory to be able to start the practical projects of CH11. If a student has not fully completed CH5K, CH5T and/or CH7K, CH7T (and/or the student still has more things left from the course units CH6 or CH8 KT and practical), a personalized designed schedule will be made to ensure certain parts from this course unit in addition to the parts from the previous course unit will be done.
Content and organisation	
General description	In this course unit you will focus on the quality assurance of analysis and validation. Optimization and chemometrics are also important aspects. The chosen educational model is project-based education. . During the course unit you will also follow a number of theoretical modules. In the context of the Biodiscovery Chain, the emphasis lies on the analysis of biomolecules.
Exit qualifications	Design Experimenting Results Analysis Quality control Management and Administration Methodology Reporting and Presenting Professional Development
Professional tasks and products	Carrying out Life Science Research
Professional products	Report, research plan, presentation, assignment

Cohesion	This course unit is part of the analytical chemistry specialisation in the third year. The second part (CH12) of the specialisation focuses on method development and literature research. CH11 focuses on the other important part of the analytical laboratory, namely quality assurance and validation. Students work in pairs and on 1or 2 laboratory projects, namely quality assurance and prossibly optimization. Each pair has their own research topic. The aim is to have a range of projects with bio-based materials as their theme.
Mandatory participation	- Attendance at all practicals is mandatory to satisfy the modular exam Pi. - For optimization, attendance is mandatory at the practical work seminars (except for the students who followed CH9 and CH10) - Chemometrics classes are mandatory, the student may be absent a maximum of 2 times. - To participate in the IPV modular examination, attendance at the tutor lessons and research skills classes is required.
Maximum number of participants	
Compensation possibilities	
Activities and/or instructional formats	There will be approximately 2 half-days per week dedicated to the research at the laboratory. The theory of specific analytical chemistry, optimization and chemometrics is offered in the form of lectures, workshops and tutorials. Optimization is completed with a presentation, Chemometrics with an assignment and the General Analytical Techniques with a knowledge test. Furthermore, an individual report is made on quality assurance Supporting subject: General Analytical Chemistry *Teaching methods: Combination of lectures/tutorials* Atomic spectroscopy: Basic principles and interferences, GF and FAAS ICP Separation methods: Basic principles of separation methods, Headspace GC, HPLC: Ion pair, ion chromatography, supercritical LC, UPLC Mass spectrometry, ionisation, separation methods and applications Supporting subjects: Chemometrics 3 *Teaching methods: Combined lectures/tutorials* ANOVA Linear regression analysis Validation
	The latest edition of: - Miller J.N., Miller,J.C., Statistics and chemometrics for Analytical Chemistry. Essex: Pearson Education. - Skoog D.A., Holler F.J., Crough, S.R., Principles of instrumental analysis, (latest edition), Cheriton House, Andover: Cengage Learning, Inc. - ~~Andries, J.P.M. Chemometrie, Utrecht Syntax Media~~.
Required software/required materials	Excel, Word, Design expert
Recommended literature	
Examination	
	CH11-Chem3

Name of examination or modular examination	**Chemometry 3 Assignment**
Examination or modular examination code	CH11-Chem3
Assessment types(s):	Written, Group
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 3, resit Term 4
Permitted resources	Excel and calculator
Method of enrolment for exam/enrolment period	Participation in CH11 gives automatic registration for CH11-Chem3.
Discussion and review	The filled-in assessment form with any feedback is considered the discussion and review of this modular assessment.
Number of examiners	Assessment by one examiner based on participation in the tutor meetings and assessment form.
Possibilities for compensation	
Assessment dimensions	Competence 1: Design of Experimental Plan 1.3.4. Independently formulates sub-questions/aims with associated hypotheses based on the given research aim. 1.3.5. Independently integrates information into a comprehensive research plan (e.g. justifying the chosen method, describing necessary controls and availability of equipment). Competence 3: Results Analysis Data processing 3.3.1. Independently carries out results analysis according appropriate methods; uses statistics (if applicable). Validation 3.3.2. Independently assesses the usability of results based on accuracy and reliability. Conclusions and discussion. 3.1.4. Discusses the execution and results of the experiment. 3.3.3. Independently makes conclusions relating to the initial research question (if possible) and overarching research project. 3.3.5. Discusses results relative to other experiments and compares them with the results in literature. Competence 4: Quality control 4.1.3. Uses controls to evaluate the reliability of the results. In the context of chemometrics, Fen T testsANOVA, regression analysis, calibration and validation Competence 8: 8.1.1. Adheres to rules. 8.1.2. Makes a clear contribution to the group. 8.2.3. Makes concrete agreements and keeps to these 8.3.4. Recognizes own role and contribution to the group and know what other roles there are in the team; functions adequately; takes others into consideration.

Assessment criteria	The student - is able to formulate sub questions based on a case/ assignment and to propose an experimental design. - can apply the following chemometric techniques when analyzing results. ANOVA The student - knows the basic concepts involved in one-way and multi-way - knows the different applications for one-way or multi-way - using an analytical chemistry problem, is able to set up a one-way or multi-way ANOVA table, calculate it and interpret the outcome - can set up an experiment for different applications of single or multi-way ANOVA REGRESSION and CALIBRATION The student: - can perform first- and second-degree regression in Excel; - knows various analytical chemistry applications and validation techniques for using first and second degree regression analysis and calibration, can perform these and interpret the results (examples are: determining detection limit, comparing methods, choosing best model etc); - can perform weighted regression and knows its applications. CORE MEASUREMENT UNITS The student: - knows different (internal) validation parameters and can apply these to analytical chemical issues. - can set up analytical chemical experiments for the different validation parameters, can calculate and interpret the parameters. Weighted regression - The student knows when weighted regression is applied. - The student can perform and interpret a weighted regression analysis in excel. *The assignment consists of statistical analysis for the quality assurance project and cases, relating to the competences design, quality management, results analysis, discussion and conclusion in the context of the subjects mentioned below.* See assessment form chemometrics 3 on Onderwijsonline under General information.
Exam matrix	(Linear) regression analysis 45% 30% ANOVA 25% Other validation and chemometric techniques See assessment form Chemometrics 3 on Onderwijsonline under General information.
	CH11-Kante
Name of examination or modular examination	General analytical techniques

Examination or modular examination code	CH11-Kante
Assessment types(s):	Individual, Written
Result	Grade
Passing grade	5.5
Weight factor of modular exams	0
Exam opportunities	Term 3, resit Term 4
Permitted resources	Calculators
Method of enrolment for exam/enrolment period	Registration for the modular exam through Alluris. The registration period is several weeks prior to the exam period or the resit period. The period is stated in the academic calendar of the ATBC on Insite - Timetables.
Discussion and review	• The exam and resit periods and inspection of exam results are indicated in the ATBC academic calendar. • Review takes place in the presence of a supervisor. • Review takes place under supervision- the post-exam discussion is rostered during the following teaching period. • For exams taken during resit periods, the post-exam discussions are planned at the end of the teaching period. • Contact the examiner/course coordinator (for exams taken during a resit period) if you would like to discus the exam. • With no interest, the post-exam discussion does not take place. • Participation in the post-exam discussion is only allowed if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	
Assessment dimensions	General analytical techniques Atomic spectroscopy: Basic principles and interferences, GF and FAAS ICP Separation methods: Basic principles of separation methods, Headspace GC, HPLC: Ion pair, ion chromatography, supercritical LC, UPLC Mass spectrometry, ionization, separation techniques and capillary electrophoresis
Assessment criteria	Atom spectroscopy The student: - the spectrometric methods and their applicability can be named; - can interpret term sheets and calculate or convert energy differences ; - can describe the processes involved in atomization in flame and; - knows the principle of the flame and graphite furnace, ICP-AES and ICP-MS, can describe them and can name the advantages and disadvantages of these methods; - knows the various interferences in atomic spectroscopy and knows the techniques to counteract these interferences; - knows the principle of quantitative analysis and knows how to deal with matrix effects; - can make a responsible choice for a certain technique for a given problem; Separation methods

	The student: - knows the principle of and can calculate liquid extraction as a function of pH - can explain and reproduce the van Deemter equation; - can do calculations with polarity index for the mobile phase; - knows the steps involved in developing a chromatographic method; - knows the principle of head space GC, - knows the principle of LC, capillary electrophoresis, ion-pair SFC and can name applications MS - can explain the principle of different ionization methods and focussing methods for mass spectrosopy - can name and explain a number of recent developments in: coupling GC,HPLC and MS such as for GCxGC, LC-MSMS, LC-ICPMS, triple quad - can interpret different mass spectra. See also study guide for additional information
Exam matrix	30-40% % spectroscopy 60-70% separation methods and MS
	CH11-Op
Name of examination or modular examination	Optimization
Examination or modular examination code	CH11-Op
Assessment types(s):	Presentation, Written, Group
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 3, resit term 4
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH7K gives automatic registration for CH11-Op.
Discussion and review	The filled-in assessment form with any feedback is considered the discussion and review of this interim assessment.
Number of examiners	Assessment by two examiners based on assessment form and answer model (lecturer).
Possibilities for compensation	
Assessment dimensions	The course consists of theory lessons and tutorial and possibly parctical Assignments from the tutorials must be handed in and there will be a presentation about the practicals. Theory topics: • response surface; • model description and model fit; • Sequential optimization methods: - Univariate: - Multivariate: Simplex, modified simplex, • Simultaneous methods, - Factorial Design

	See Presentation Assessment Form on OnderwijsOnline under Algemene Informatie (General Information) Competencies that will be tested in the presentation: Competence 1: Design of experimental plan 1.3.4. Independently formulates sub-questions/aims with associated hypotheses based on the given research aim. Competence 2: Experimenting 2.3.1 Can justify all steps of the experiments theoretically. Competence 3: Results Analysis Data processing 3.3.1. Carries out results analysis with appropriate methods (independently); if applicable uses statistics. Validation 3.3.2. Independently assesses the usability of results based on accuracy and reliability. Conclusions and discussion. 3.1.4. Discusses the execution and results of the experiment. 3.2.6. Makes proposals for improving the execution of the research. 3.3.3. Independently makes conclusions relating to the initial research question (if possible) and overarching research project. 3.3.5. Discusses results relative to other experiments and compares them with the results in literature. Competence 6: Reporting and Presenting See assessment form 6.3.2. Presents research to a diverse audience in a clear and convincing way, according to the conventional standards of presentation techniques and answers questions: there is structure in the presentation (introduction-body-conclusion); speaks clearly and coherently; stands upright and keeps hands relaxed; makes eye contact with the public and checks whether the essence of the message comes across to the target group; makes well-structured and clear slides or other visual products verbal and visual message form a whole; uses PowerPoint effectively as visual support to communicate the message; Conducts a substantive discussion with the audience. 6.3.6. Can communicate in English at a sufficient level so that interaction with native speakers is possible Competence 8: Teamwork 8.1.6. Maintains eye contact with conversation partner
Assessment criteria	Processing the results of the practical exercises: - can create a complete drawing table for a design; - knows advantages and disadvantages of factorial design; - can calculate effects and coefficients; - main effects; - interaction effects; - can identify and interpret the influence of factors and their interactions on the response;

	- can work with Design Expert software package and apply it to practical situations. Presentation General: See evaluation form 'Presentation: Optimization'. The presentation will be given in English. The presentation is about Factorial Design, optimization of the experiment for project 1. Key points to include in the presentation: Description of the principle of the optimization method, i.e. Factorial Design; Elaboration of the results. If possible, use multiple responses in Design Expert, such as resolution, peak area, dish number etc. You have to decide what are the important responses for your optimization. You can always consult with the teacher; Calculate coefficients of the response equation and optimal settings of the factors. Drawing conclusions from the calculated coefficients: main and interaction effects. Conclusions from the results of Design Extra have to be supported by data you get in Design Ease like interaction graph, response surface etc. You have to decide what is useful for your results.
Exam matrix	The project comprises of practical and theory components The grade is for presentation of the results of the factorial design optimization performed during the practical classes of via dataset Presentation: See assessment form presentation level 3 on Onderwijsonline under General information
	CH11-Pi
Name of examination or modular examination	Practical Performance
Examination or modular examination code	CH11-Pi
Assessment types(s):	Individual, practical
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 3 There is only one opportunity per academic year for the modular exams Pi (EER art. 8.5)
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH11 gives automatic registration for CH11-Pi.
Discussion and review	The filled-in assessment form with any feedback is considered the discussion and review of this modular assessment.
Number of examiners	Assessment by two examiners based on assessment form (practical teacher).
Possibilities for compensation	
Assessment dimensions	Competence 2: Experimenting Preparation 2.1.2. Performs calculations prior to beginning lab work. 2.3.1. Can justify all steps of the experiments theoretically 2.3.3. Independently ensures that all requirements are ready before the experiment is started; makes solutions Execution

	2.3.4. Carries out experiments according to protocol so that reliable reproducible data is obtained; but can, if necessary, deviate from this; knows at all times exactly what he/she does. 2.3.6. Is able to work on multiple experiments simultaneously and complete them within the proposed time frame (multitasking), can switch easily and keep an overview. 2.3.7. Solve practical problems if the experiment does not run as anticipated (trouble shooting). 2.3.8. Masters techniques quickly. Competence 3: Results analysis 3.1.2. Evaluates the obtained results based on their accuracy and reliability. 3.3.1. Independently carries out results analysis according to appropriate methods. If applicable, uses statistics. Competence 4: Quality control 4.1.1. Is aware of the health and safety rules and works according to these rules. 4.1.3. Uses controls to evaluate the reliability of the results. 4.2.2. Uses advanced materials and equipment correctly. Calibrates advanced equipment at the start of experiments. 4.3.4. Checks the shelf-life of reagents and solutions. 4.3.5. Adheres to prescribed quality standards. Competence 5: Management and Administration Administration 5.2.1. Codes chemicals and samples and stores these in a correct way 5.3.2. Contributes to an efficiently functioning lab (clears up, indicates if reagents are almost finished, carries out minor maintenance on the equipment and solves minor malfunctions). 5.3.3. Manages and archives data in lab journal (purpose, experiments description, changes, results, conclusion, future proposals) and, in other ways so that others can use these (if applicable). Competence 6: Reporting 6.2.1. Reports their research in the form of a research report/lab journal/poster according to in-house guidelines (product criteria for lab journal and research report; level 2): Uses correct spelling, grammar, sentence structure and scientific style; uses a clear and logical structure in complex passages of text; is aware of the cohesion between the different sections of text; the document structure conforms to guidelines used in professional practice; The report has a reference list. The text refers to the literature in the this reference list; Describes results so the reader can understand; Uses clearly labelled figures and tables; Describes all relevant data in a summary. Competence 7: Methodology 7.2.2. Works according to plan, also under time constraints. 7.2.3. Ensures that aims are achieved and adapts the work if required. 7.3.1. Plans and organizes his project resulting in a work plan for a minimum of 4 weeks.

	7.3.4. Responds to changing circumstances; determines priorities in activities. Competence 11: Professional Development 11.2.5. Shows professional work attitude: Adapts quickly, shows determination, and is a motivated student.
Assessment criteria	See assessment form Chemistry Practical, on #OnderwijsOnline under *Algemene Informatie* (General Information) General information
Exam matrix	*See Practical assessment form on #OnderwijsOnline under Algemene Informatie (General Information)*
	CH11-IPV
Name of examination or modular examination	IPS
Examination or modular examination code	CH11-IPV
Assessment types(s):	Oral, Individual
Result	Satisfactory/Unsatisfactory
Passing grade	Satisfactory
Weight factor of modular exams	0
Exam opportunities	Term 3 Participation in modular exam IPS is only possible once per academic year (EER art. 8.5).
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH11 gives automatic registration for CH11-IPV.
Discussion and review	For questions about assessment, contact the examiner.
Number of examiners	One examiner (tutor) for the assessment based on participation and effort.
Possibilities for compensation	
Assessment dimensions	Competence 6 6.2.6 Is able to conduct discussions on work-related subjects. Competence 8: Teamwork Functioning in a group 8.1.1. Adheres to rules. 8.1.2. Makes a clear contribution to the group. 8.2.3. Makes concrete agreements and keeps to these 8.3.4. Recognizes own role and contribution to the group and know what other roles there are in the team; functions adequately; takes others into consideration; coordinates activities with others. Communication Communicates in an open and clear manner with colleagues and supervisors according to basic communication guidelines. 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.2.5. Takes initiative in the conversation. 8.2.8. States his/her opinion/message clearly. 8.3.9. Is able to deal with conflicts. 8.3.10. Interacts with discussion partner/checks if message is understood. 8.3.11. Keeps to the aim of the conversation. Competence 11: Professional Development

	11.1.2. Works on learning aims as described in the PDP and collated competency assessment products. 11.2.1. Describes strengths and weaknesses. 11.3.3. Looks back critically (reflects) on their own actions and learning process; learns from mistakes; is open to learning moments. 11.3.4. Based on the strength-weakness analysis, independently develops a PDP: Demonstrates a professional work attitude 11.3.5. Shows professional work attitude, adapts quickly, shows determination, and is motivated.
Assessment criteria	The student: - has prepared for the meeting by completing the week's assignment to be discussed and reading through the next week's assignment to be discussed in preparation; - Can show the tutor the completed assignment according to agreements (in writing or presentation); all assignments have been completed according to the description. - Fulfils their designated roles (Chair, secretary etc.); - Adheres to the rules agreed upon; - The student asks questions and shares knowledge regarding the assignment during tutor meetings; - Verbalize these clearly and intelligibly, - maintains eye contact; - gives others opportunity to speak. - the student offers feedback to group and class members and is open to receiving feedback; **Feedback**
	CH11-V
Name of examination or modular examination	Theme quality assurance report
Examination or modular examination code	CH11-V
Assessment types(s):	Written, Group
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 3, resit Term 4
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH11 gives automatic registration for CH11-V.
Discussion and review	The filled-in assessment form with any feedback is considered the discussion and review of this modular assessment.
Number of examiners	Assessment by one examiner (practical teacher) based on the assessment form.
Possibilities for compensation	
Assessment dimensions	Competence 1: Design of experimental plan Defining the research question 1.2.1. Identifies independently which background information is required to answer the research question. Gathering information and integrating into a research plan. 1.3.3. Independently searches for, selects and processes information from relevant sources for scientific research.

	1.3.4. Independently formulates sub-questions/aims with associated hypotheses based on the given research aim. 1.3.5. Independently integrates information into a comprehensive research plan (e.g. justifying the chosen method, describing necessary controls and availability of equipment). 1.3.7. Links own research with the overarching research project. 1.3.8. Adjusts the research plan on the basis of results 1.3.6. Understands and applies simple English literature relevant to the given context. Competence 2 Experimenting 2.3.1. Can justify all steps of the experiments theoretically 2.3.3. Independently ensures that all supplies be ready before the experiment starts; makes solutions. Competence 3: Results Analysis Data processing 3.3.1. Independently carries out results analysis according appropriate methods; uses statistics (if applicable). Validation 3.3.2. Independently assesses the usability of results based on accuracy and reliability. Conclusions and discussion. 3.1.4. Discusses the execution and results of the experiment. 3.2.6. Makes proposals for improving the execution of the research. 3.3.3. Independently makes conclusions relating to the initial research question (if possible) and overarching research project. 3.3.5. Discusses results relative to other experiments and compares them with the results in literature. Competence 6: Reporting and Presenting Text 6.3.1. Reports on the research in the form of a report/lab journal according to internationally accepted criteria (product criteria lab journal and report level 3): Uses correct spelling, grammar, sentence structure and scientific style; provides clear and logical structure in more complex texts. There is cohesion within the text; is aware of the cohesion between the different sections of text; the document structure conforms to guidelines used in professional practice; The report has a reference list. The text refers to the literature in the this reference list; Describes results so the reader can understand; Uses clearly labelled figures and tables; describes all relevant data from the research in a summary that can be read independently. 6.2.3. Is familiar with and applies the international conventions of scientific and academic writing.
Assessment criteria	The theme report includes topics on quality assurance and validation. Specific information can be found on onderwijsonline course 11CH, project quality assurance. For the assessment form, see #OnderwijsOnline under *Algemene Informatie* (General Information).
Exam matrix	See Quality Assurance Research Report Assessment form (Handin)

Method of enrolment for exam/enrolment period	Participation in Course CH11 gives automatic registration for CH11-V.
	CH11-PVA
Name of examination or modular examination	Research plan
Examination or modular examination code	CH11-PVA
Assessment types(s):	Written, Group
Result	Satisfactory/Unsatisfactory
Passing grade	Satisfactory
Weight factor of modular exams	0
Exam opportunities	term 3, resit term 3
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH11 gives automatic registration for CH11-PVA.
Discussion and review	The filled-in assessment form with any feedback is considered the discussion and review of this modular assessment.
Number of examiners	Assessment by one examiner (tutor/practical teacher) based on the assessment form.
Possibilities for compensation	
Assessment criteria	*For assessment see the Research Plan Checklist (Handin)* A maximum of one unsatisfactory criteria is permitted.
Assessment dimensions	Competence 1 Designing 1.2.2. Identifies independently which background information is required to answer the research question. 1.3.3. Independently searches for, selects and processes information from relevant sources for scientific research. 1.3.4. Independently formulates sub-questions/aims with associated hypotheses based on the given research aim. 1.3.5. Independently integrates information into a comprehensive research plan (e.g. justifying the chosen method, describing necessary controls and availability of equipment). 1.3.8. Adjusts the research plan based on results. 1.3.6. Understands and applies simple English literature relevant to the given context. Competence 2 Experimenting 2.1.2. Performs calculations prior to beginning lab work. 2.3.1. Can justify all steps of the experiments theoretically. 2.3.3. Independently ensures that all supplies be ready before the experiment starts; makes solutions. Competence 4: Quality control 4.1.1. Is aware of the health and safety rules and works according to these rules. 4.1.3. Uses controls, and uses these to assess the reliability of the results. Competence 6

	6.3.1. Reports on the research in the form of a report/lab journal according to internationally accepted criteria (product criteria lab journal and report level 3): - uses correct spelling, grammar, sentence structure and scientific style; - uses clear and logical structure in complex texts. There is cohesion within the text; is aware of the cohesion between the different sections of text; the document structure conforms to guidelines used in professional practice; The report has a reference list. The text refers to the literature in the this reference list; Describes results so the reader can understand; Uses clearly labelled figures and tables; describes all relevant data from the research in a summary that can be read independently. 6.2.3. Is familiar with and applies the international conventions of scientific and academic writing. Competence 7 7.3.1. Plans and organizes his project resulting in a work plan for a minimum of 4 weeks.
Exam matrix	*For assessment see the Research Plan Checklist*

Course unit 12: CH12 (15 credits)

	CH12
General information	
Target group	Full-time students, main phase, analytical chemistry graduation specialization, level 3
Name of course unit	Course unit 12: Analytical Chemistry: Method development and literature research / ECU CH12: Analytical Chemistry: Method Development and Literature Review (CH12)
Study unit code	CH12
Teaching term	Term 4
Study credits	15 study credits
Study load in hours	420 SBU
Study hours (contact hours)	Scheduled contact hours: 20 lesson periods/week, 140 lesson periods/ term = 105 hours Planned time for self-study: 315 hours Total: 420 hours
Course entry requirements	The foundation year must have been completed and CH5 and CH7 must have been taken as a minimum. CH5-7 Pa and CH6-8 Pa, CH7K and CH5T-A (report) must be passed to be able to start the practical projects of OWE CH12. If a student has not fully completed CH5K, CH5 T and/or CH7K, CH7T (and/or the student still has more things left from CH6 or CH8 KT and practical) then a personal planning will be made to do certain parts from this course in addition to the parts from the previous courses.
Content and organisation	
General description	In this course unit, fundamental analytical chemical research is carried out by developing an analytical method. In addition, a literature review is conducted The chosen educational model is project-based education. During the course unit you will also follow theoretical modules in the field of analytical chemistry. In the context of the Biodiscovery Chain, the emphasis lies on the production of biomolecules.

Exit qualifications	Design Experimenting Results Analysis Quality control Reporting and Presenting Methodology Advising. Team Work Professional Development
Professional tasks and products	Carrying out life science research
Professional products	Research plan, research report, poster, literature review.
Cohesion	This course unit is part of the analytical chemistry major in the third year. The first part (CH11) of the major focuses on quality assurance in the analytical laboratory. CH12 focuses on the other important part of the analytical laboratory, namely method development and literature review. Students work in pairs on the method development project. A number of projects are carried out in collaboration with the Biocentre in the theme of biodiscovery.
Mandatory participation	Attendance at all practical lessons is a prerequisite for participation in the modular examination Pi. Attendance at the tutor groups is a prerequisite for participation in the modular examination IPS. To take part in the CH12-OPChem4 modular examination, attendance at the lectures is mandatory
Maximum number of participants	
Compensation possibilities	
Activities and/or instructional formats	Supporting subject Spectroscopy 2 *Teaching methods: Lecture* Xray, NIR, Raman, NMR and Fluorescence **Supporting subjects: Chemometrics 4** Working methods: Combined lectures/tutor group and assignment Multivariate data analysis, such as principal component analysis; cluster analysis, discriminant analysis Supporting subject: Biomolecules 2 *Teaching methods: Combined lectures/tutorials/practical* Proteins Lipids Carbohydrates Secondary metabolites
Required literature	The latest edition of: - Miller J.N., Miller,J.C., Statistics and Chemometrics for Analytical Chemistry, Essex: Pearson Education. - Skoog D.A., Holler F.J., Crough, S.R., Principles of instrumental analysis, (int 6th rev ed), Cheriton House, Andover: Cengage Learning, Inc.
Required software/required materials	SPSS (available at school)
Recommended literature	
Examination	
	CH12-Ksp2
Name of examination or modular examination	Knowledge test Spectroscopy 2

Examination or modular examination code	CH12-Ksp2
Assessment types(s):	Written, individual
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 4, resit term 4
Permitted resources	
Method of enrolment for exam/enrolment period	Registration for the modular exam through Alluris. The registration period is opened a few weeks prior to the exam period or the resit period. The period is published in the academic calendar of the ATBC on Insite - Timetables. Insite rosters.
Discussion and review	The exam and resit periods, and inspection of exam results are published in the ATBC academic calendar. Review takes place in the presence of a supervisor. • The post-discussion of the exam is scheduled after the exam but before the inspection. • Contact the examiner/course coordinator (for exams taken during a resit period) if you would like to discus the exam. • With no interest, the post-exam discussion does not take place. • Participation in the post-exam discussion is only allowed if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	
Assessment dimensions	Spectroscopy: Xray Raman NIR, mid IR, Fluorescence NMR
Assessment criteria	Xray Raman NIR, mid IR The student: - knows the general theory of vibrational spectroscopy and Xray and can perform calculations on it - can describe the concepts related to vibrational spectroscopy and Xray - can explain the principle of Xray, NIR and Raman spectroscopy; and knows applications - knows the principle of quantitative analysis and know how to deal with matrix effects and interferences - can make a responsible choice of technique for a given problem; - can explain the similarities and differences between Raman and mid-IR and NIR spectroscopy **NMR,** the student knows: • The basic knowledge and principles of nuclear magnetic resonance • Chemical shift and spin coupling • NMR spectrometer, block diagram • QNMR **Fluorescence** the student knows: • The basic knowledge and principles of molecular fluorescence • Fluorimeter, schematic diagram • Quantitative analysis • Applications • Quenching

	• Fluorescence lifetime.
Exam matrix	35% Xray Raman NIR, mid IR 25% Fluorescence 40% NMR
	CH12-Opbm
Name of examination or modular examination	Biomolecules Assignment 2
Examination or modular examination code	CH12-Opbm
Assessment types(s):	Written, Group
Result	Satisfactory/Unsatisfactory
Passing grade	Satisfactory
Weight factor of modular exams	0
Exam opportunities	Term 4, resit term 4
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH12 gives automatic registration for CH12-Opbm.
Discussion and review	The filled-in assessment form with any feedback is considered the discussion and review of this modular assessment.
Number of examiners	Assessment by one examiner based on the assessment form (lecturer).
Possibilities for compensation	
Assessment dimensions	Biomolecules: Proteins Lipids Carbohydrates Secondary metabolites
Assessment criteria	The student is given a practical assignment, various assignments and makes a poster. The student: - knows proteins in relation to isolating proteins, removing proteins from the sample and methods of analysis; - different methods to analyse proteins can be described; - can give a correct and clear description of different methods to analyze proteins and to determine the AZ sequence of a protein. - knows the physical properties of saccharides in relation to sample elaboration; - can give a correct and clear description of different methods to analyse carbohydrates; - can provide a description of the Maillard reaction and the important products that are created. - knows the different chemical reactions that sugars can undergo for analysis; - can give a correct and clear description of different methods to analyse lipids. Assignments The student has to do 4 assignments in groups: - Assignment 1 Protein purification and analysis - Assignment 2 Biomolecules literature - Assignment 3 Poster - Assignment 4 practical assignment, separate milk proteins using gel electrophoresis and analysis with LC-MS General

	The student: - can look up relevant information in articles and discuss it in a poster; - uses the knowledge gained during the lessons; - can make a poster that meets the requirements (see attached assessment form).
Exam matrix	See Poster assessment form on #OnderwijsOnline under Algemene Informatie (General Information)
	CH12-Pi
Name of examination or modular examination	Practical Performance
Examination or modular examination code	CH12-Pi
Assessment types(s):	Individual, practical
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 4 There is only one opportunity per academic year for the modular exams Pi (EER art. 8.5)
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH12 gives automatic registration for CH12-Pi.
Discussion and review	The filled-in assessment form with any feedback is considered the discussion and review of this modular assessment.
Number of examiners	Assessment by two examiners based on assessment form (practical teacher).
Possibilities for compensation	
Assessment dimensions	Competence 2: Experimenting Preparation 2.1.2. Performs calculations prior to beginning lab work. 2.3.1. Can justify all steps of the experiments theoretically 2.3.3. Independently ensures that all requirements are ready before the experiment is started; makes solutions Execution 2.3.4. Carries out experiments according to protocol so that reliable reproducible data is obtained; but can, if necessary, deviate from this; knows at all times exactly what he/she does. 2.3.6. Is able to work on multiple experiments simultaneously and complete them within the proposed time frame (multitasking), can switch easily and keep an overview. 2.3.7. Solve practical problems if the experiment does not run as anticipated (trouble shooting). 2.3.8. Masters techniques quickly. Competence 3: Results analysis 3.1.2. Evaluates the obtained results based on their accuracy and reliability. 3.3.1. Independently carries out results analysis according appropriate methods; uses statistics (if applicable). Competence 4: Quality control 4.1.1. Is aware of the health and safety rules and works according to these rules.

	4.1.3. Uses controls to evaluate the reliability of the results. 4.2.2. Uses advanced materials and equipment correctly. 4.3.4. Checks the shelf-life of reagents and solutions. 4.3.5. Adheres to prescribed quality standards. Competence 5: Management and Administration Management 5.2.1. Codes chemicals and samples and stores these in a correct way 5.3.2. Contributes to an efficiently functioning lab (clears up, indicates if reagents are almost finished, carries out minor maintenance on the equipment and solves minor malfunctions). Administration 5.3.3. Manages and archives data in lab journal (purpose, experiments description, changes, results, conclusion, future proposals) and, in other ways so that others can use these (if applicable). Competence 6: Reporting 6.2.1. Reports their research in the form of a research report/lab journal/poster according to in-house guidelines (product criteria for lab journal and research report; level 2): Uses correct spelling, grammar, sentence structure and scientific style; uses a clear and logical structure in complex passages of text; is aware of the cohesion between the different sections of text; the document structure conforms to guidelines used in professional practice; The report has a reference list. The text refers to the literature in the this reference list; Describes results so the reader can understand; Uses clearly labelled figures and tables; Describes all relevant data in a summary. Competence 7: Methodology 7.2.2. Works according to plan, also under time constraints. 7.2.3. Ensures that aims are achieved and adapts the work if required. 7.3.1. Plans and organizes his project resulting in a work plan for a minimum of 4 weeks. 7.3.4. Responds to changing circumstances; determines priorities in activities. In the context of the methods development project. **Competence 11:** Professional Development 11.2.5. Works with integrity, adjusts to new situations, shows determination and is a motivated student.
Assessment criteria	See Practical Assessment Form on OnderwijsOnline under Algemene Informatie (General Information) General information
Exam matrix	See Practical Assessment Form on OnderwijsOnline under Algemene Informatie (General Information)
	CH12-IPV
Name of examination or modular examination	IPS
Examination or modular examination code	CH12-IPV
Assessment types(s):	Oral, Individual
Result	Satisfactory/Unsatisfactory
Passing grade	Satisfactory
Weight factor of modular exams	0

Exam opportunities	Term 4 Participation in modular exam IPS is only possible once per academic year (EER art. 8.5).
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH12 gives automatic registration for CH12-IPV.
Discussion and review	For questions about assessment, contact the examiner.
Number of examiners	One examiner (tutor) for the assessment based on participation and effort.
Possibilities for compensation	
Assessment dimensions	Competence 6: Reporting 6.2.6 Is able to conduct discussions on work-related subjects. Competence 8: Teamwork Functioning in a group 8.1.1. Adheres to rules. 8.1.2. Makes a clear contribution to the group. 8.2.3. Makes concrete agreements and keeps to these 8.3.4. Recognizes own role and contribution to the group and know what other roles there are in the team; functions adequately; takes others into consideration. Communication Communicates in an open and clear manner with colleagues and supervisors according to basic communication guidelines. 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.2.5. Takes initiative in the conversation. 8.2.8. States his/her opinion/message clearly. 8.3.9. Is able to deal with conflicts. 8.3.10. Interacts with discussion partner/checks if message is understood. 8.3.11. Keeps to the aim of the conversation. Competence 11: Professional Development Guides own competency development 11.1.2. Works on learning aims as described in the PDP and collated competency assessment products. 11.2.1. Describes strengths and weaknesses. 11.3.3. Looks back critically (reflects) on their own actions and learning process; learns from mistakes; is open to learning moments. 11.3.4. Based on the strength-weakness analysis, independently develops a PDP: Demonstrates a professional work attitude 11.3.5. Shows professional work attitude, adapts quickly, shows determination, and is motivated.
Assessment criteria	The student: - the student has prepared for the meeting by completing the assignment to be discussed, and also completed the required reading for the following assignment to be discussed. - Is able to show weekly assignments to the tutor (according to agreement, in writing or as a presentation); all required aspects are complete in all assignments; - Fulfils their designated roles (Chair, secretary etc.); - Adheres to the rules agreed upon; - Asks questions and shares knowledge regarding the assignment during tutorials; verbalizes these clearly and audibly, maintains eye contact; - Gives others opportunity to speak. - The student offers feedback to group and class members and is open to receiving feedback;

	CH12-V
Name of examination or modular examination	Theme report and presentation
Examination or modular examination code	CH12-V
Assessment types(s):	Written, Group
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 4, resit August
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH12 gives automatic registration for CH12-V.
Discussion and review	The filled-in assessment form with any feedback is considered the discussion and review of this modular assessment.
Number of examiners	Assessment by one examiner (practical teacher) based on the assessment form.
Possibilities for compensation	
Assessment dimensions	Competence 1: Design of experimental plan Defining the research question 1.2.1. Identifies independently which background information is required to answer the research question. Gathering and integrating information 1.3.3. Independently searches for, selects and processes information from relevant sources for scientific research. 1.3.4. Independently formulates sub-questions/aims with associated hypotheses based on the given research aim. 1.3.5. Integrates information independently to design a justified research plan (e.g. selection of appropriate methods and equipment). 1.3.6. Understands and applies simple English literature relevant to the given context. 1.3.7. Links own research with the overarching research project. 1.3.8. Adjusts the research plan on the basis of results Competence 2 Experimenting 2.3.1. Can justify all steps of the experiments theoretically 2.3.3. Independently ensures that all requirements are ready before the experiment is started; makes solutions Competence 3: Results Analysis Data processing 3.3.1. Independently carries out results analysis according appropriate methods; uses statistics (if applicable). Validation 3.3.2. Independently assesses the usability of results based on accuracy and reliability. Conclusions and discussion. 3.3.3. Independently makes conclusions relating to the initial research question (if possible) and overarching research project. 3.1.4. Discusses the execution and results of the experiment. 3.3.5. Discusses results relative to other experiments and compares them with the results in literature. 3.2.6. Makes proposals for improving the execution of the research. Competence 6: Reporting and presenting Text

	6.3.1. Reports on the research in the form of a report/lab journal according to internationally accepted criteria (product criteria lab journal and report level 3): Uses correct spelling, grammar, sentence structure and scientific style; provides clear and logical structure in more complex texts. There is cohesion within the text; is aware of the cohesion between the different sections of text; the document structure conforms to guidelines used in professional practice; The report has a reference list. The text refers to the literature in the this reference list; Describes results so the reader can understand; Uses clearly labelled figures and tables; describes all relevant data from the research in a summary that can be read independently. In the context of the methods development project . 6.3.5 Presents research to varying audiences in a clear and convincing way, according to the conventional standards of presentation techniques and answers questions 6.2.3. Is familiar with and applies the international conventions of scientific and academic writing.
Assessment criteria	See Assessment Form "Research Report Course 12: 'method development and presentation' on #OnderwijsOnline at General Information.
Exam matrix	See Course 12 Research Report: Method Development Assessment Form
	CH12-L
Name of examination or modular examination	Literature review
Examination or modular examination code	CH12-L
Assessment types(s):	Written, Group
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 4 (halfway) , Resit Term 4
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH12 gives automatic registration for CH12-L.
Discussion and review	The filled-in assessment form with any feedback is considered the discussion and review of this modular assessment.
Number of examiners	Assessment by one examiner based on the assessment form (lecturer).
Possibilities for compensation	
Assessment dimensions	Competence 1: Design of experimental plan Defining the research question 1.2.1. Identifies independently which background information is required to answer the research question. Gathering and integrating information 1.3.3. Independently searches for, selects and processes information from relevant sources for scientific research. 1.3.4. Independently formulates sub-questions/aims with associated hypotheses based on the given research aim. 1.3.5. Independently integrates information into a comprehensive research plan (e.g. justifying the chosen method, describing necessary controls and availability of equipment).

	1.3.6. Understands and applies simple English literature relevant to the given context. 1.3.7. Links own research with the overarching research project. 1.3.8. Adjusts the research plan on the basis of results Competence 3: Results Analysis Conclusions and discussion. 3.3.3. Independently makes conclusions relating to the initial research question (if possible) and overarching research project. 3.3.5. Discusses results relative to other experiments and compares them with the results in literature. Competence 6: Reporting and presenting Text 6.3.1. Reports on the research in the form of a report/lab journal according to internationally accepted criteria (product criteria lab journal and report level 3): Uses correct spelling, grammar, sentence structure and scientific style; provides clear and logical structure in more complex texts. There is cohesion within the text; is aware of the cohesion between the different sections of text; the document structure conforms to guidelines used in professional practice; The report has a reference list. The text refers to the literature in the this reference list; Describes results so the reader can understand; Uses clearly labelled figures and tables; describes all relevant data from the research in a summary that can be read independently. In the context of a chosen analytical subject. 6.2.3. Is familiar with and applies the international conventions of scientific and academic writing.
Assessment criteria	See Literature Review Assessment Form Level III
Exam matrix	See Literature Review Assessment Form Level III
	CH12-PVA
Name of examination or modular examination	Research plan
Examination or modular examination code	CH12-PVA
Assessment types(s):	Written, Group
Result	Satisfactory/Unsatisfactory
Passing grade	Satisfactory
Weight factor of modular exams	0
Exam opportunities	Term 4, resit Term 4
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in Course CH12 gives automatic registration for CH12-PVA.
Discussion and review	The filled-in assessment form with any feedback is considered the discussion and review of this modular assessment.
Number of examiners	One examiner for the assessment based on the assessment form (tutor)
Possibilities for compensation	

Assessment dimensions	Competence 1 Design Defining the research question 1.2.1. Identifies independently which background information is required to answer the research question. Gathering information and developing a research plan 1.3.3. Independently searches for, selects and processes information from relevant sources for scientific research. 1.3.4. Independently formulates sub-questions/aims with associated hypotheses based on the given research aim. 1.3.5. Independently integrates information into a comprehensive research plan (e.g. justifying the chosen method, describing necessary controls and availability of equipment). 1.3.6. Understands and applies simple English literature relevant to the given context. 1.3.8. Adjusts the research plan on the basis of results Competence 2 Experimenting 2.1.2. Performs calculations prior to beginning lab work. 2.3.1. Can justify all steps of the experiments theoretically 2.3.3. Independently ensures that all requirements are ready before the experiment is started; makes solutions Competence 4: Quality control 4.1.1. Is aware of the health and safety rules and works according to these rules. 4.1.3. Uses controls, and uses these to assess the reliability of the results. Competence 6 6.3.1. Reports on the research in the form of a report/lab journal according to internationally accepted criteria (product criteria lab journal and report level 3): Uses correct spelling, grammar, sentence structure and scientific style; provides clear and logical structure in more complex texts. There is cohesion within the text; is aware of the cohesion between the different sections of text; the document structure conforms to guidelines used in professional practice; The report has a reference list. The text refers to the literature in the this reference list; Describes results so the reader can understand; Uses clearly labelled figures and tables; describes all relevant data from the research in a summary that can be read independently. 6.2.3. Is familiar with and applies the international conventions of scientific and academic writing. Competence 7 7.3.1. Plans and organizes his project resulting in a work plan for a minimum of 4 weeks.
Assessment criteria	See Research Plan Checklist Assessment Form
Exam matrix	See Research Plan Checklist Assessment Form
	CH12-Chem4
Name of examination or modular examination	Chemometry Assignment
Examination or modular examination code	CH12-Chem4
Assessment types(s):	Written, Group

Result	Satisfactory/Unsatisfactory
Passing grade	Satisfactory
Weight factor of modular exams	0
Exam opportunities	Term 4, resit term 4
Permitted resources	SPSS
Method of enrolment for exam/enrolment period	Participation in Course CH12 gives automatic registration for CH12-Chem4.
Discussion and review	The filled-in assessment form with any feedback is considered the discussion and review of this modular assessment.
Number of examiners	Assessment by one examiner based on participation in the tutor meetings and assessment form.
Possibilities for compensation	-
Assessment dimensions	The student: - can describe what the following terms mean: multivariate data analysis, covariance matrix, correlation matrix, characteristic vector, characteristic value, principal component, loading matrix, score plot, dendrogram, PCA, cluster analysis and discriminant analysis; - can perform the following using a statistical package: - a (simple) cluster analysis, - a (simple) principal components analysis and a - a (simple) discriminant analysis; - MLR - Combination of PCA and MLR - can interpret the result of the multivariate analysis. - can explain why a certain multivariate technique is chosen based on a case study - can answer questions in the field of multivariate analysis techniques on the basis of articles Competence 8: 8.1.1. Adheres to rules. 8.1.2. Makes a clear contribution to the group. 8.2.3. Makes concrete agreements and keeps to these 8.3.4. Recognizes own role and contribution to the group and know what other roles there are in the team; functions adequately; takes others into consideration.
Assessment criteria	The student must be present at the lectures, complete the assignments and must hand these in. An assessment form is used to evaluate. Subject: Multivariate data analysis, concrete learning objectives The student can answer questions in the field of multivariate data analysis on the basis of a scientific article The student can complete and interpret an assignment in SPSS in the field of multivariate data analysis using a case study

Course unit 13: CH13 (30 credits)

	CH13
General information	
Target group/groups	Full-time students main phase Chemistry, level 3
Name of unit of study	ECU 13: Internship Chemistry
Code of unit of study	CH13
Lecture period	P1, P2, P3, P4

ECTS credits	30 stp
Study load in hours	840 SBU
Study hours (contact hours)	There are no lessons planned, there is an obligatory peer-feedback moment. The supervising examiner has 12,5 hours for supervising and evaluation. The second examiner has 2,5 hours for evaluation.
Entry requirements for unit of study	Foundation year successfully completed. At least 45 stp have been earned in the 2nd study year and the practical assessment in the 2nd study year must be at least satisfactory. To start an analytical internship, the course units C5K, C5T, C7K and C7T must have been passed. To start an organic/polymer internship the course units C6T, C6K, C8K and C8T must have been passed.. If a research minor (R15 or R30) took place prior to the internship, the research report and literature report of R30 or report of R15 must be handed in to the work placement supervisor (compulsory). If the entry requirements are satisfied, the internship may only be started after the official approval of the project handed off by the internship coordinator.
Content and organisation	
General description	The internship aims to give you work experience in an independent research project to contribute to your development as a (starting) professional. Students can complete the internship project with a company/organization of choice. The place where the internship takes place is in general different from the place where the graduation project is done. If the place where the internship takes place is the same as the place for the graduation project, consent from the exam committee is needed.
Exit qualifications	Designing of experimental set up Experimenting Results analysis Quality control Management and administration Reporting and presenting Methodology Teamwork Professional development
Professional task	Carrying out scientific research
Professional products	Internship PDP and supporting professional products Research report Reflection report
Cohesion	The internship project is in line with the course units of the major. During the graduation project, the developed competencies will be individually practiced and assessed.
Mandatory participation	-
Maximum number of participants	**-**
Compensation options	**-**
Activities and/or instructional formats	The study coach guides the student in finding an internship that fits with the personal development plan of the student.

	The internship coordinator provides internship preparation classes that provide the student with tools to find an internship. During the main phase there is a compulsory workshop job application. The student is responsible for finding a work placement (applying for a work placement). During the internship period, a peer-feedback meeting is organized that requires active participation.
Required literature	Information on #OnderwijsOnline – ATBC Internship/Stage
Required software / required materials	
Recommended literature	
Examination	
	CH13-PB
Name [exams or modular exams]	Portfolio Assessment
Code [exams or modular exams]	CH13-PB
Exam and modular exam format(s)	In writing, Oral, Individual
Judgement	Grade
Minimum result	5,5
Weight factor of modular exam	1
Exam opportunities	Offered throughout the year. 2 opportunities per year. Portfolio deadline is the last day of the internship. If handed in late, a 0 is given for the first chance. In consultation with the internship lecturer, a new deadline is set. Resits are possible up to 2 months after the last day of the internship.
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in ECU CH13 is sufficient for enrolment in CH13-PB
Discussion and review	Returning the completed assessment form to the student and any remarks on the form or in the professional product serves as inspection and discussion of this partial examination.
Number of examiners	Assessment by two examiners based on assessment form (Internship lecturer and 2nd assessor).
Compensation possibility	
Competences and indicators	Competence 1: Design of experimental set up 1.3.6. Understands and applies advanced English literature relevant to the given context 1.3.7. Links own research with the overarching research project. 1.3.8. Adjusts the research plan on the basis of results. Competence 2: Experimenting 2.2.4., (2.3.4) Carries out experiments according to protocol so that reliable reproducible data is obtained; but can, if necessary, deviate from this; knows at all times exactly what he/she does.

	2.2.6. Attempts to work on multiple experiments at the same time (multitasking). 2.3.6. Works on multiple experiments at the same time, and can complete these experiments within the given time frame; adept at switching tasks and keeps a clear overview of all activities. Competence 3: Results analysis 3.2.5 (3.3.5) Relates results with results from their other experiments and also data in published literature. 3.2.6 Suggests improvements to improve the execution of the research. 3.3.7. Suggests follow-up experiments. Competence 6: Reporting and presenting 6.1.5. Presents research to a target audience with similar knowledge background, applies general presentation techniques and answers questions: • uses correct spelling and grammar; • describes results so the reader can understand, uses clearly labelled figures and tables; • there is a introduction-body-conclusion structure to the presentation; • speaks clearly and coherently; • has upright posture and hands are freely used; • makes eye contact with the audience; • makes organised and clear slides or other visual products. Competence 8: Teamwork Communication 8.1.6. Maintains eye contact with conversation partner. 8.1.7 Gives others opportunity to speak. 8.2.8. Verbally expresses their opinion/message clearly. 8.3.10. Interacts with conversation partner/ensures the message is understood. 8.3.11. Keeps conversation on topic. Competence 11: Professional development Guides own competency development 11.1.2. Works on learning aims as described in the PDP and collated competency assessment products. 11.2.1. Identifies strengths and weaknesses. 11.2.4. Formulates PDP based on strength-weakness analysis. 11.3.3. Reflects critically on own performance and learning process; learns from mistakes; is eager to learn.
Assessment criteria	See assessment form Portfolio & assessment internship BML, Life Sciences and Chemistry on #OnderwijsOnline - General information. All parts of the portfolio must be present in the portfolio and the minimum result must be satisfactory (>5,5).The portfolio products, including the research report, is uploaded in Handin.
Test matrix	See assessment form Portfolio & assessment internship BML, Life Sciences and Chemistry on #OnderwijsOnline - General information.
	CH13-P
Name [exams or modular exams]	Practical work

Code [exams or modular exams]	CH13-P
Exam and modular exam format(s)	Practical
Judgement	Grade
Minimum result	5,5
Weight factor of modular exam	2
Exam opportunities	There is only one chance per year for the modular exam CH13-P (EER paragraph 8.5)
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in ECU CH13 is sufficient for enrolment in CH13-P
Discussion and review	Returning the completed assessment form to the student and any remarks on the form or in the professional product serves as inspection and discussion of this partial examination.
Number of examiners	Assessment by one examiner (internship lecturer) based on assessment form filled in by the company supervisor
Compensation possibility	
Competences and indicators	Competence 1: Design of experimental set up 1.2.1. Independently identified relevant background information required to answer the research question. 1.2.2., (1.3.3.) Searches for, selects and integrates information from relevant scientific sources 1.2.5., (1.3.5.) Integrates information into a comprehensive research plan (e.g. justifying the chosen method, describing necessary controls and availability of equipment). 1.3.6. Understands and applies advanced English literature relevant to the given context. 1.3.8. Adjusts the research plan on the basis of results1.2.1. Identifies independently which background information is required to answer the research question. Competence 2: Experimenting Preparation 2.1.2. Performs calculations prior to beginning lab work. 2.1.5. Carries out the experiments within the given time frame. 2.2.1., (2.3.1.) Is able to explain the basic steps of the experiments. 2.2.3., (2.3.3.) Ensures that all requirements are present before beginning the experiment, makes solutions. Execution 2.2.4. Carries out experiments according to the protocol in order to obtain reliable, reproducible data; is aware of what he/she is doing at all times / 2.3.4. Carries out experiments according to the protocol in order to obtain reliable, reproducible data; is able to deviate from/adjust the protocol where needed; is aware of what he/she is doing at all times. 2.2.6. Attempts to work on multiple experiments at the same time (multitasking). 2.2.7. Attempts to trouble shoot experiments when problems are encountered.

	2.3.6. Works on multiple experiments at the same time, and complete these experiments within the given time frame; adept at switching tasks and keeps clear overview of all activities. 2.3.7. Trouble shoots if problems are encountered in the experiments. Competence 3: Results analysis 3.1.2., (3.3.2.) Evaluates the obtained results based on their accuracy and reliability. 3.1.4. Discusses the execution of the experiment and results. 3.2.1., (3 .3.1.) Carries out results analysis using appropriate methods; uses statistics (if applicable). 3.2.3., (3.3.3.) Independently makes conclusions relating to the initial research question (if possible). 3.2.5., (3.3.5.) Relates results with results from their other experiments and also data in published literature. 3.2.6. Suggests improvements to improve the execution of the research. 3.3.7. Suggests follow-up experiments. Competence 4: Quality control 4.1.1. Is aware of the health and safety rules and works according to these rules. 4.1.3. Uses controls, and uses these ta assess the reliability of the results. Competence 5: Management and administration 5.2.1. Encodes chemicals and samples; stores these in a correct way. 5.2.2., (5.3.2) Contributes to an efficiently functioning lab (tidies up, reports when reagents are nearly finished, performs minor maintenance of equipment). 5.2.3. (5.3.2) Manages and archives data in lab journal (aim, experiment, description alternations, results, conclusion) and if relevant, other ways of storing data so that others can understand it. Competence 6: Reporting and presenting 6.2.5., (6.3.5) Presents research to a target audience with similar knowledge background in a clear manner; applies general presentation techniques and answers questions: • there is a introduction-body-conclusion structure to the presentation; • speaks clearly and coherently; • makes eye contact with the audience; • makes organised and clear slides or other visual products; • verbal and visual messages complement each other; • uses visual aids in PowerPoint to support; • holds an on-topic discussion with the audience. Competence 7: Methodology 7.2.1., (7.3.1) Plans and organises activities in a work plan that covers a duration of at least 4 practical lessons 7.2.2. Works accordingly to plan; also under time constraints. 7.2.3. Ensures that goals are reached and if necessary, makes adjustments to activities. 7.3.4. Is flexilble in changing circumstances; determines priorities in the work.

	Competence 8: Team work Performance in a group 8.1.1. Adheres to rules. 8.2.3. Makes clear agreements with others and keeps to these. 8.3.4. Recognises their own role in a group; is aware of other roles in the group and works efficiently in the team structure. Works harmoniously with others. Communication Is able to communicate about their assignment with peers and lecturers applying basic rules of communication. 8.1.6. Maintains eye contact with conversation partner. 8.1.7 Gives others opportunity to speak. 8.1.9. Is active in conflict resolution. 8.2.5. Takes initiative in conversation. 8.2.8. Verbally expresses their opinion/message clearly. 8.2.10. Interacts with conversation 8.2.12. Is aware of intercultural differences in the professional field. Competence 11: Professional development 11.3.5. Works with integrity, adjusts to new situations, shows determination and is a motivated employee.
Assessment criteria	See assessment form: “Practical Work: BML, Life Sciences and Chemistry” on #OnderwijsOnline - General information.
Test matrix	See assessment form “Practical Work: BML, Life Sciences and Chemistry” on #OnderwijsOnline - General information.
	CH13-V
Name [exams or modular exams]	Internship report
Code [exams or modular exams]	CH131-V
Exam and modular exam format(s)	In writing, Individual
Judgement	Grade
Minimum result	5,5
Weight factor of modular exam	1
Exam opportunities	Offered throughout the year. 2 opportunities per year. Report deadline is the last day of the internship. If handed in late, a 0 is given for the first chance. In consultation with the internship lecturer, a new deadline is set. Resits are possible up to 2 months after the last day of the internship.
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in ECU CH13 is sufficient for enrolment in CH13-V
Discussion and review	Returning the completed assessment form to the student and any remarks on the form or in the professional product serves as inspection and discussion of this partial examination.
Number of examiners	Two examiners for assessment based on assessment form (Internship lecturer and 2nd assessor).

Compensation possibility	
Competences and indicators	Competence 1: Design of experimental plan 1.2.1. Independently identified relevant background information required to answer the research question. 1.2.2., (1.3.3.) Searches for, selects and integrates information from relevant scientific sources 1.3.4. Independently forms intermediate research questions and related hypothesis based on the given question. 1.3.6. Understands and applies advanced English literature relevant to the given context. 1.3.7. Makes connections between experiments and the broader research context. Competence 2: Experimenting 2.3.1. Is able to explain the theory behind all steps of the experiments. Competence 3: Results analysis 3.1.2., (3.3.2.) Evaluates the obtained results based on their accuracy and reliability. 3.1.4. Discusses the execution of the experiment and results. 3.2.1., (3 .3.1.) Carries out results analysis using appropriate methods; uses statistics (if applicable). 3.2.3., (3.3.3.) Independently makes conclusions relating to the initial research question (if possible). 3.2.5., (3.3.5.) Relates results with results from their other experiments and also data in published literature. 3.2.6. Suggests improvements to improve the execution of the research. 3.3.7. Suggests follow-up experiments. Competence 4: Quality control 4.1.3. Uses controls, and uses these ta assess the reliability of the results. Competence 5: Management and administration 5.3.3. Manages and archives data in a lab journal (aim, experiment description, alternations, results, conclusion) and if relevant, other ways of storing data so that others can use it. Competence 6: Reporting and presenting 6.2.3. Is familiar with and applies the international conventions of scientific and academic writing. 6.3.1. Reports their research in the form of a research report/lab journal/poster according to international guidelines (product criteria for lab journal and research report; level 3) • uses correct spelling, grammar, sentence structure and scientific style; • uses a clear and logical structure in complex passages of text; • the document structure conforms to guidelines used in professional practice; • the reports contains a reference list. The text references to the literature in this list; • describes results so the reader can understand, uses clearly labelled figures and tables; • all relevant data is describes in a summary that is independent to the report.

Assessment criteria	See assessment form “Internship Report Assessment Form Biology and medical laboratory research, Life Sciences & Chemistry” on #OnderwijsOnline - General information.
Test matrix	See assessment form “Internship Report Assessment Form Biology and medical laboratory research, Life Sciences & Chemistry” on #OnderwijsOnline - General information.

9.3 Minors of the degree program

In this academic year, the degree program offers the following minors:

a. M_ATBC-M-BN Bio-Nano introductie in de Bio-Nanotechnologie (30 credits) (Dutch)
b. M_ATBC-M-BBS BioBased Innovations (30 studiepunten)
c. M_ATBC-M-DD Drug Discovery (30 studiepunten)
d. M_ATBC-M-P Scientific Research (30 credits)

Units of study LS-R15 en LS-R30 – Researchminor – can be chosen as part of the minor ‘Scientific Research’.

You can also choose a minor from another HAN degree program. You can find the overview of HAN minors and their entry requirements here: www.minoren-han.nl.

M_ATBC-M-BN Bio-Nano introductie in de Bio-Nanotechnologie (30 credits) (Dutch)

	M_ATBC-M-BN
General information	
Target group	Main phase students from all chemical and (bio) medical disciplines
Name of course unit	Minor Bio-Nano: Introductie in de Bio-Nanotechnologie / Minor Bio-Nano: Introduction to Bio-nanotechnology
Study unit code	M_ATBC-M-BN
Teaching term	semester 1 (NL) and 2 (ENG) (term 1-2 / 3-4)
Study credits	30 study credits
Study load in hours	840 SBU
Study hours (contact hours)	Term 3: Rostered contact hours (105 lesson periods) 78.25 clock hours: Practical: 8 lesson periods per week Tutor: 3 lesson hours periods per week Theory ‘Self organization’: 9 lesson periods Theory “Bioconjugation": 9 lesson periods Theory: "Analysis of nanomaterials" 7 credit hours, 1 lesson period/week. Guest lectures 3 lesson periods Term 4: Rostered contact hours (105 lesson periods) 78.25 clock hours: Practical: 8 lesson periods per week Tutor: 3 lesson hours periods per week Theory "Nanomaterials and biological interaction": Theory "Oncology and targeting of nano drugs": 9 lesson periods of theory: "Proteins as nano materials" 7 lessons, 1 lesson period/week. Guest lectures 3 lesson periods Self-study hours (341.25 hours): The student needs to plan 341.25 hours for group work and self-study.

	Total programmed contact time per period: Term 3: 15 lesson periods/week; 105 lesson periods/term= 78.25 hours Term 4: 15 lesson periods/week;105 lesson periods/term= 78.25 hour Time for independent work: 685.5 hours Total: 840 hours
Course entry requirements	The competencies applied in this minor, are practiced at level 2. LS6A, LS6C, LS5A, LS5B, LS5C followed. LS6B is completed. Or second year chemistry. Before starting this course unit, the student must at least have completed their foundation year (in the case of newcomers, exceptions are possible).
Content and organisation	
General description	The minor in Bio-Nanotechnology focuses on the interface between biomedical technology and chemistry, in this sense broadening and deepening. As a central theme of the minor, there is a practical that starts with the chemical manufacture of polymers and biohybrid nanoparticles. In addition, the physical properties of these particles are mapped, ultimately to study the interaction with biological systems (cells). Two double lab sessions are scheduled per week to work on the practical assignments. The theory modules “Self-organization", "Bioconjugation", “Analysis of nanomaterials", “Proteins as nanomaterials", “Biological interactions of nanomaterials" and "Monitoring and targeting of nanodrugs" are offered in the form of lectures and seminars, and have a direct connection with the practical assignments. The tutor meetings cover various weekly assignments with the ultimate goal of writing a research proposal. In this course unit, the professional task ‘performing scientific research’ in the area of (bio)nano-technology in a multidisciplinary team is a central theme. The chosen context areas are: Pharma, bioinspired and biobased. The chosen educational model is project-based education. This course unit builds on chemical, biological and medical course units from the second year. (Bio) medical students and chemistry students will collaborate using each other's input and multidisciplinary work is essential. This means that students from different specialisations will take the lead at different times and coach other students. This is reflected in the final research proposal that students will write together in a multidisciplinary team. The language of the minor Bio-Nano is Dutch in semester 1 and English in semester 2. The examinations for students who do not participate in the English variant of the programme are, if so desired, offered in Dutch and/or can be answered in Dutch. The professional products must be written in English.
Exit qualifications	Design of experimental plan Experimenting

	Results Analysis Quality Control Management and Administration Reporting and Presenting Methodology Teamwork (multidisciplinary) Professional Development
Professional tasks and products	Carrying out Life Science Research
Professional products	
Cohesion	In the minor nanotechnology, you will work on an extensive project that combines biomedical technology and chemistry.
Mandatory participation	
Maximum number of participants	15
Compensation possibilities	K1 and K2 ≥ 5.5; when calculating K1 and K2, a maximum of two of the six components may be ≤ 5.5 and all components must be at least a 4.
Activities and/or instructional formats	Supporting subject Nanotechnology and applications Self organization Bioconjugation Analysis of nanomaterials Proteins as nanomaterial Biological interaction of nanomaterials Monitoring (Oncology) and targeting of nanodrugs *Work form: Lecture* Supporting subject Nanotechnology and applications Research proposal; write a research proposal (in a group) in the field of bio-nanotechnology. *Work forms: Group assignment* Supporting subject Nanotechnology and applications Presentation; present in group a recent articles and a research proposal written in group within the field of "Nano medicines". *Work forms: Group assignment* Supporting subject Nanotechnology and applications Practical education, experiment and experience. *Work form: Lecture and practical*
Required literature	- Collection of the articles and reviews covered in the lessons (free to download from the university library)
Required software/required materials	ChemSketch (www.acdlabs.com or similar)
Recommended literature	
Examination	
	M_ATBC-M-BN-K1

Name of examination or modular examination	Theory Exam 1
Examination or modular examination code	M_ATBC-M-BN-K1
Assessment types(s):	Individual written open questions
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities Permitted resources	Term 1, resit during term 2, or Term 3, resit end term 4
Method of enrolment for exam/enrolment period	Registration for the modular exam through Alluris. The registration period is opened a few weeks prior to the exam period or the resit period. The period is published in the academic calendar of the ATBC on Insite - Timetables. Insite rosters.
Discussion and review	• The exam and resit periods and inspection of exam results are indicated in the ATBC academic calendar. Review takes place in the presence of a supervisor. • Review takes place under supervision- the post-exam discussion is rostered during the following teaching period. • For exams taken during resit periods, the post-exam discussions are planned at the end of the teaching period. At the end of term 4, the post-exam discussion will be held before the start of the resit period of term 4. • Contact the examiner/course coordinator (for exams taken during a resit period) if you would like to discus the exam. • With no interest, the post-exam discussion does not take place. • Participation in the post-exam discussion is only allowed if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Permitted resources	
Possibilities for compensation	The average of knowledge test K1 must be ≥ 5.5. Two items in Q1 and Q2 combined may be ≤ 5.5 but ≥ 4.0.
Assessment dimensions	Knowledge of the driving forces in the self-organization of molecules and (bio)polymers in nano-and mesostructures. Knowledge of chemical modifications as well as biological systems for functionalising, modification and linking of (bio) polymers and nanoparticles for the use of these materials in drug delivery. Knowledge of commonly used analysis techniques for nanomaterials.
Assessment criteria	Part 1: Self organization The student has knowledge of - Ionic, electronic and molecular interactions in the solid, liquid and dissolved state; - the structure, formation and properties of zeolites; - gold nanoparticles and their "near infrared" properties; - the theory and physical basis behind the formation of liposomes; - critical micelle concentration;

	- the theoretically expected secondary and tertiary structure of (bio) polymers in aqueous environment; - Polymeric nanoparticles; - the theoretical physical basis behind the formation of different nanostructures from amphiphilic polymers; - natural and synthetic membranes; - polyion complexes; - binding of DNA/RNA to polymers to polyion complexen (lipofectamine); - Hydrogels and nanohydrogels. Part 2: Bioconjugation General The student has knowledge of - different administration routes of drugs in the human body; - properties of medicines and materials that are important in the design of drug carriers. (This includes: - Drug decomposition, stability, solubility, toxicity, biocompatibility); - Active targeted drug delivery (accessibility ligands and targets, labeling, different methods applied etc.). Chemistry The student has knowledge of - Maleimide linkage - (copper-free) click chemistry - Thiol-ene chemistry - Isothiocyanate linking (FITC/RITC) - Native chemical ligation - EDCI linking - Crosslinking - Biochemical: The student has knowledge of - Amino acids and homologues - Recombinant DNA techniques - Functional peptides. - Streptavidin Biotin - SATA modification Part 3: Analysis of nanomaterials The student has knowledge of - SEM/TEM - AFM/STM - Confocal microscopy - FACS - Dynamic light scattering - ITC - SEC - FFF/MALS - Zeta potential As well as the physical basis for the above techniques.
Exam matrix	~ 33% Self organization ~ 33% Bioconjugatie

	~ 33% Analysis of nanomaterials
	M_ATBC-M-BN-K2
Name of examination or modular examination	Knowledge exam 2
Examination or modular examination code	M_ATBC-M-BN-K2
Assessment types(s):	Individual written open questions
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 2, resit during term 3 or Term 4, and resit end of term 4
Permitted resources	
Method of enrolment for exam/enrolment period	Registration for the modular exam through Alluris. The registration period is opened a few weeks prior to the exam period or the resit period. The period is published in the academic calendar of the ATBC on Insite - Timetables. Insite rosters.
Discussion and review	• The exam and resit periods and inspection of exam results are indicated in the ATBC academic calendar. Review takes place in the presence of a supervisor. • The post-examination discussion is scheduled after the examination, but before the examination review. • Contact the examiner/course coordinator (for exams taken during a resit period) if you would like to discus the exam. • With no interest, the post-exam discussion does not take place. • Participation in the post-exam discussion is only allowed if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	The average of knowledge test K2 must be ≥ 5.5. Two items in Q1 and Q2 combined may be ≤ 5.5 but ≥ 4.0.
Assessment dimensions	Knowledge of the self-organization and potential application after modification of proteins and biopolymers in nanostructures for drug delivery Knowledge of the interaction and dissemination of nanomaterials in biological systems, as well as preventing interactions. Monitoring - Monitoring (Oncology) and targeting of nanodrugs biological systems, in combination with analytical techniques on the nanomaterials, with the following fields of application: - Immunohistochemistry - Immunofluorescence - Electron microscopy - Neoplasias - Cells and tissues
Assessment criteria	Part 1: Proteins as nanomaterial The student has knowledge of: - advantages and disadvantages of the use of protein materials for drug delivery; - factors that are important in modifying and application protein materials; - synthesis methods for whole protein-based nanomaterials

	- virus particles as nanomaterials; - morphology and structure of virus particles in relation to nanomaterials; - modifications in proteins for structuring in nanomaterials; - elastin-like peptides, their biological function, (bio) synthesis and self-organization; - applicability ELP materials in drug delivery; - protein materials as functional handles in targeted drug delivery; - the activity of enzymes before and after modification; - techniques to determine the (biological) activity of proteins; -assembly methods of ELP and VLP nanomaterials - functional peptides. Part 2: Biological interaction of nanomaterials The student has knowledge of - mechanisms of cellular uptake; - the effect of PEI, PEG, Polyoxazolines and Polysulphonic acid on cell interactions; - stealth effect; - effect of size, shape and Zeta potential on cellular uptake ; - cell penetrating peptides; - lipophectamine for cell perforation; - Some literature examples of functionalized nanoparticles in cell cultures; - methods to measure biodistribution (radio labeling, fluorescence, NIR); - Biodistribution of nanoparticles; - EPR effect; - the dimensions of nanoparticles and the amount of active ingredients that fit in a nanoparticle (drug: carrier); - recent literature examples of biodistributions of functionalized nanoparticles; - nano particles as artificial organelles. Part 3: Monitoring (Oncology) and targeting of nanodrugs The student has knowledge of - structure and function of cells and organs; - microscopy: LM-CLSM-TEM/SEM. The student can describe and theoretically justify the following processes: - fixation, tissue processing, embedding and cutting; - antigens, antibodies, immunology; - resolution/microscopy; - triple labeling with appropriate dyes on sections for fluorescence and CLSM; - fluorescence; - excitation / emission.
Exam matrix	~ 33% Proteins as nanomaterials ~ 33% Biological interaction of nanomaterials ~ 33% Monitoring (Oncology) and targeting of nanodrugs
	M_ATBC-M-BN-T

Name of examination or modular examination	Theme test
Examination or modular examination code	M_ATBC-M-BN-T
Assessment types(s):	Individual written open questions
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 2, resit during term 3 or Term 4, and resit end of term 4
Permitted resources	The students have access to study the selected literature (article) two weeks prior to the exam.
Method of enrolment for exam/enrolment period	Registration for the modular exam through Alluris. The application period is a The registration period is opened a few weeks prior to the exam period or the resit period. The period is published in the academic calendar of the ATBC on Insite - Timetables. Insite rosters.
Discussion and review	• The exam and resit periods and inspection of exam results are indicated in the ATBC academic calendar. Review takes place in the presence of a supervisor. • The post-examination discussion is scheduled after the examination, but before the examination review. • Contact the examiner/course coordinator (for exams taken during a resit period) if you would like to discus the exam. • With no interest, the post-exam discussion does not take place. • Participation in the post-exam discussion is only allowed if you have taken the exam.
Number of examiners	2 Examiners for construction and evaluation. Assessment by one examiner based on the answer key (theory lecturer).
Possibilities for compensation	
Assessment dimensions	Competence 1: Design 1.3.3. Independently searches for, selects and processes information from relevant sources for scientific research. 1.3.6. Understands and applies complex English literature relevant to the given context. Competence 2: Experimenting 2.1.2. Performs calculations prior to beginning lab work. 2.3.1. Can justify all steps of the experiments theoretically Competence 3: Results Analysis 3.2.2. Independently makes conclusions relating to the initial research question (if possible). 3.3.1. Independently carries out results analysis according appropriate methods; uses statistics (if applicable). Competence 4: Quality Control

	4.1.3. Uses controls, and uses these to assess the reliability of the results. Competence 10: Advising 10.2.1. Translates needs to practical requirements.
Assessment criteria	The student is able to: Read, understand and interpret recently published literature about bio-nanotechnology. That is to say: - reads and understands articles; - can read and explain the reaction diagrams and figures shown; - can indicate why certain techniques were chosen (from the theory modules); evaluate pros and cons and discuss them; - alternatives methods proposals; - make connections between data and conclusions found (relating to the theory); - assesses and justifies what the value of the published results are; - give critical commentary on the methods used and conclusion; - knows the specific terminology and can explain them. Additionally, the student has knowledge of - which factors are important in the design of a nanoparticle for a specific purpose; - can indicate what the dangers and potential of nanomaterials and nanodrugs; - can describe methods and design experiments to produce and modify proteins, peptides and enzymes. - can describe methods and design experiments to produce and modify polymeric nanomaterials; - can explain the relationship between the physical properties and biological interactions of nanomaterials; - can describe methods and design experiments to demonstrate or monitor proteins, peptides and enzymes. - can use the theory from the entire minor and translate this to relevant developments in medical science and in particular oncology;
Exam matrix	The following topics appear equally in the thematic test: - Self-organization - Bioconjugation - Analysis of nanomaterials - Proteins as nanomaterial - Biological interaction of nanomaterials - Monitoring (Oncology) and targeting of nanodrugs - all knowledge gained in practical classes (synthesis, cell biology, SEM and CLSM - All knowledge gained in the tutor meetings.
	M_ATBC-M-BN-V
Name of examination or modular examination	Research Proposal
Examination or modular examination code	M_ATBC-M-BN-V

Assessment types(s):	Written, Group
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 2, resit during term 3 or Term 4, and resit end of term 4
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in M_ATBC-M-BN counts as registration for M_ATBC-M-BN-V.
Discussion and review	The filled-in assessment form with any feedback is considered the discussion and review of this modular assessment.
Number of examiners	Assessment by two examiners based on assessment form.
Possibilities for compensation	
Assessment dimensions	Competence 1: Design 1.2.2., (1.3.3.) Independently searches for, selects and processes information from relevant sources for scientific research 1.3.4 Independently formulates sub-questions/aims with associated hypotheses based on the given research aim. 1.3.6. Understands and applies simple English literature relevant to the given context. 1.3.7. Links own research with the overarching research project. Competence 2: Experiment preparation 2.3.1. Can justify all steps of the experiments theoretically Competence 6: Reporting and Presenting 6.2.1. Reports their research in the form of a research report/lab journal/poster according to in-house guidelines (product criteria for lab journal and research report; level 2): - uses correct spelling, grammar, sentence structure and scientific style; - Uses a clear and logical structure in complex passages of text; - Is aware of the cohesion between the different sections of text; - The document structure conforms to guidelines used in professional practice; - The report contains a reference list. The text refers to the literature in the this reference list; - Describes results so that the reader can understand them; - Uses clearly labelled figures and tables. - Describes all relevant data in a summary. 6.3.1. Reports on the research in the form of a report/lab journal according to internationally accepted criteria (product criteria lab journal and report level 3): - uses correct spelling, grammar, sentence structure and scientific style; - Uses a clear and logical structure in complex passages of text; - Is aware of the cohesion between the different sections of text; - The document structure conforms to guidelines used in professional practice;

	- The report contains a reference list. The text refers to the literature in the this reference list; - Describes results so that the reader can understand them; - Uses clearly labelled figures and tables. - describes all relevant data from the research in a summary that can be read independently. 11.2.6. Is aware of the internationally accepted scientific code of conduct.
Assessment criteria	See assessment form for research proposal on #OnderwijsOnline under General information
Exam matrix	*See assessment form on #OnderwijsOnline under Algemene Informatie (General Information)*
	M_ATBC-M-BN-Pr
Name of examination or modular examination	Presentation
Examination or modular examination code	M_ATBC-M-BN-Pr
Assessment types(s):	Oral, Group
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 2, resit during term 3 or Term 4, and resit end of term 4
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in M_ATBC-M-BN counts as registration for M_ATBC-M-BN-Pr.
Discussion and review	The filled-in assessment form with any feedback is considered the discussion and review of this modular assessment.
Number of examiners	Assessment by two examiners based on assessment form (practical teacher).
Possibilities for compensation	
Assessment dimensions	Competence 1: Design of experimental plan 1.3.3. Independently searches for, selects and processes information from relevant sources for scientific research. 1.3.4. Independently formulates sub-questions/aims with associated hypotheses based on the given research aim. 1.3.6. Understands and applies simple English literature relevant to the given context. 1.3.7. Links own research with the overarching research project. Competence 2: Experiment preparation 2.1.2. Performs calculations prior to beginning lab work. Competence 3: Results Analysis 3.1.2., (3.3.2.) Independently assesses the usability of results based on accuracy and reliability. 3.2.1., (3.3.1.) Carries out results analysis with appropriate methods (independently); if applicable uses statistics.

	3.2.3., (3.3.3.) Independently makes conclusions relating to the initial research question (if possible) and overarching research project. 3.2.5., (3.3.5.) Independently discusses results relative to other experiments and compares them with the results in literature. 3.2.6. Makes proposals for improving the execution of the research. 3.3.7. Makes proposals for follow-up experiments. Competence 4: Quality Control 4.1.3. Controls used, the result of which gives an opinion on the reliability of results. Competence 6: Reporting and Presenting 6.3.5 Presents research to a diverse audience in a clear and convincing way, according to the conventional standards of presentation techniques and answers questions: there is structure in the presentation (head-body-tail); Speaks clearly and intelligibly; Stands up straight and leaves hands free; Makes eye contact with the audience and checks whether the essence of the message comes across to the target group; Makes clear and concise statements slides or other visual products; Verbal and visual message forms a whole; uses capabilities of Powerpoint as visual support for transferring the message; conducts a substantive discussion with audience. Competence 8: Team work 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.2.8. States his/her opinion/message clearly. 8.2.12. Is aware of intercultural differences in the profession Competency 11 Professional development Guides own competence development 11.1.2. Works on learning aims according to the PDP and collects evidence of competency. 11.2.6. Is aware of the internationally accepted scientific code of conduct. 11.2.7. Formulates and justifies an opinion regarding ethical aspects of the profession.
Assessment criteria	See Presentation (Research Article and Research Proposal) Assessment Form on OnderwijsOnline under Algemene Informatie (General Information)
Exam matrix	See Presentation (Research Article and Research Proposal) Assessment Form on OnderwijsOnline under Algemene Informatie (General Information)
	M_ATBC-M-BN-P
Name of examination or modular examination	Practical work
Examination or modular examination code	M_ATBC-M-BN-P

Assessment types(s):	Individual, practical
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Terms 2 or 4 There is only one opportunity per academic year for the modular exams P (EER art. 8.5)
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in M_ATBC-M-BN counts as registration for M_ATBC-M-BN-P.
Discussion and review	The filled-in assessment form with any feedback is considered the discussion and review of this modular assessment.
Number of examiners	Assessment by one examiner (practical teacher) based on the assessment form.
Possibilities for compensation	
Assessment dimensions	Competence 1: Design of experimental plan 1.3.3. Independently searches for, selects and processes information from relevant sources for scientific research. 1.3.4. Independently formulates sub-questions/aims with associated hypotheses based on the given research aim. 1.3.5. Independently integrates information into a comprehensive research plan (e.g. justifying the chosen method, describing necessary controls and availability of equipment). 1.3.6. Understands and applies complex English literature relevant to the given context. Competence 2: Experiment preparation 2.1.2. Performs calculations prior to beginning lab work. 2.1.5. Carries out the experiments within the stated time 2.2.1., (2.3.1.) Can justify (all) the basic steps of the experiments theoretically 2.2.3., (2.3.3.) Ensures (independently) that all requirements are ready before the experiment is started; makes solutions 2.2.4., (2.3.4.) Carries out experiments according to protocol so that reliable reproducible data is obtained; but can, if necessary, deviate from this; knows at all times exactly what he/she does. 2.2.6. Attempts running concurrent experiments (multitasking) Is able to work on multiple experiments simultaneously and complete them within the proposed time frame (multitasking), can switch easily and keep an overview. 2.2.7. Attempts to trouble shoot experiments when problems are encountered. 2.3.7. Solve practical problems if the experiment does not run as anticipated (trouble shooting). Competence 3: Results Analysis 3.1.2., (3.3.2.) Independently assesses the usability of results based on accuracy and reliability. 3.2.1., (3.3.1.) Carries out results analysis with appropriate methods (independently); if applicable uses statistics. 3.2.3., (3.3.3.) Independently makes conclusions relating to the initial research question (if possible) and overarching research project.

	3.2.5., (3.3.5.) Independently discusses results relative to other experiments and compares them with the results in literature. 3.2.6. Makes proposals for improving the execution of the research. 3.3.7. Makes proposals for follow-up experiments. Competence 4: Quality Control 4.1.1. Is aware of and adheres to the workplace health and safety rules. 4.1.3. Uses controls, and uses these to assess the reliability of the results. Competence 5: Management and Administration 5.2.1. Codes chemicals and samples and stores these in a correct way 5.2.2. Contributes to an efficiently functioning lab (clears up, indicates if reagents are almost finished, carries out minor maintenance on the equipment) 5.2.3. Manages and archives data in lab journal (aim, experiments description, results, conclusion) and if required, in other ways so that others can understand these. Competence 6: Reporting 6.2.1. Reports on his research in the form of a report / lab journal in accordance with internationally applicable rules (product criteria: lab journal and report level 2): uses correct spelling, grammar, sentence structure and scientific style; adds a clear and logical structure to more complex text parts; the structure of the text is in accordance with the guidelines used in the field; report includes a bibliography. In the text is referenced to sources in bibliography; describes results so that the reader can understand them; uses clearly labeled graphics and tables; describes all relevant data in a summary 6.3.1. Reports on his research in the form of a report / lab journal in accordance with internationally applicable rules (product criteria: lab journal and report level 3): Uses correct spelling, grammar, sentence structure and scientific style; adds a clear and logical structure to more complex texts There is coherence between text parts; is aware of coherence between text parts; structure of text is in accordance with guidelines used in the field; report includes a literature list. The text refers to sources in the reference list; describes results so that the reader can understand them; uses clearly labeled images and tables for this purpose; describes all relevant data from a study in a summary that can be read independently. Competence 7: Planning/project-based working 7.2.1. (7.3.1) Plans and organizes his experiments resulting in a work plan that covers a minimum of 4 lessons (plans and organizes his project resulting in a work plan of a minimum of 4 weeks) 7.2.2. Works according to plan, also under time constraints. 7.2.3. Ensures that aims are achieved and adapts the work if required.

	7.3.4. Responds to changing circumstances; determines priorities in activities.
Assessment criteria	See Practical Assessment Form on OnderwijsOnline under Algemene Informatie (General Information)
Exam matrix	See Practical Assessment Form on OnderwijsOnline under Algemene Informatie (General Information)
	M_ ATBC-M-BN-PA
Name of examination or modular examination	Portfolio Assessment
Examination or modular examination code	M_ATBC-M-BN-PA
Assessment types(s):	Oral, Individual
Result	Grade
Passing grade	5.5
Weight factor of modular exams	1
Exam opportunities	Term 2, resit during term 3, or in term 4, resit end of term 4.
Permitted resources	
Method of enrolment for exam/enrolment period	Participation in M_ATBC-M-BN counts as registration for M_ATBC-M-BN-Pa.
Discussion and review	The filled-in assessment form with any feedback is considered the discussion and review of this modular assessment.
Number of examiners	Assessment by two examiners based on assessment form.
Possibilities for compensation	
Assessment dimensions	Competence 1: Design 1.3.6. Understands and applies simple English literature relevant to the given context. 1.3.7. Links own research with the overarching research project. Competence 2: Experiment preparation 2.3.1. Can justify all steps of the experiments theoretically Competence 3: Results Analysis 3.2.3., (3.3.3.) Independently makes conclusions relating to the initial research question (if possible) and overarching research project. 3.2.5 (3.3.5) Independently discusses results relative to other experiments and compares them with the results in literature. 3.2.6. Makes proposals for improving the execution of the research. 3.3.7. Makes proposals for follow-up experiments. Competence 6: Reporting and Presenting 6.1.5. Presents research to audience members of the same background according to standards of presentation techniques and answers questions: Applies correct spelling and grammar; describes results so that the reader can understand them; uses clearly labeled pictures and tables; there is structure to the presentation (introduction-body-conclusion); speaks clearly and intelligibly; stands up straight and leaves

	hands free; makes eye contact with audience; creates clear and orderly slides or other visual products. 6.3.1. Reports on his research in the form of a report / lab journal in accordance with internationally applicable rules (product criteria: lab journal and report level 3): uses correct spelling, grammar, sentence structure and scientific style; adds a clear and logical structure to more complex texts There is coherence between text parts; is aware of coherence between text parts; structure of text is in accordance with guidelines used in the field; report includes a literature list. Text refers to sources in bibliography; describes results so reader can understand; uses clearly labeled images and tables; describes all relevant data in a summary that can be read independently. Competence 8: Team work 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.1.9. Shows initiative to actively solve conflicts. 8.2.5. Takes initiative in the conversation. 8.2.8. States his/her opinion/message clearly. 8.2.12. Is aware of intercultural differences in the profession 8.3.9. Is able to deal with conflicts 8.3.10. Interacts with discussion partner/checks if message is understood. 8.3.11. Keeps to the aim of the conversation. Competency 11 Professional development Guides own competency development 11.2.1. Describes strengths and weaknesses. 11.3.3. Looks back critically (reflects) on their own actions and learning process; learns from mistakes; is open to learning moments.
Assessment criteria	See Portfolio Assessment Form on OnderwijsOnline under Algemene Informatie (General Information)
Exam matrix	See Portfolio Assessment Form on OnderwijsOnline under Algemene Informatie (General Information)
	M_ATBC-M-BN-IPV
Name of examination or modular examination	IPS
Examination or modular examination code	M_ATBC-M-BN-IPV
Assessment types(s):	Oral, Individual
Result	Satisfactory/Unsatisfactory
Passing grade	Satisfactory
Weight factor of modular exams	0
Exam opportunities	Terms 2 or 4 Participation in modular exam IPV is only possible once per academic year (EER art. 8.5).
Permitted resources	

Method of enrolment for exam/enrolment period	Participation in M_ATBC-M-BN counts as registration for M_ATBC-M-BN-IPV.
Discussion and review	For questions about the assessment, please contact the examiner.
Number of examiners	One examiner (tutor) for the assessment based on participation and effort.
Possibilities for compensation	
Assessment dimensions	Competence 8: Team work Functioning in a group 8.1.1. Adheres to rules. 8.1.2. Makes a clear contribution to the group. 8.2.3. Makes concrete agreements and keeps to these 8.3.4. Recognizes own role and contribution to the group and know what other roles there are in the team; functions adequately; takes others into consideration. Communication Communicates in an open and clear manner with colleagues and supervisors according to basic communication guidelines: 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.1.9. Is active in conflict resolution. 8.2.5. Takes initiative in the conversation. 8.2.8. States his/her opinion/message clearly. 8.3.9. Is able to deal with conflicts. 8.3.10. Interacts with discussion partner/checks if message is understood. 8.3.11. Keeps to the aim of the conversation. Internationalisation 8.2.12. Is aware of intercultural differences in the profession Competency 11 Professional development 11.3.3. Looks back critically (reflects) on their own actions and learning process; learns from mistakes; is open to learning moments. 11.3.5. Acts with integrity, adapts quickly, shows determination, and is a motivated employee.
Assessment criteria	The student: - the student has prepared for the meeting by completing the assignment to be discussed, and also completed the required reading for the following assignment to be discussed; - Is able to show weekly assignments to the tutor (according to agreement, in writing or as a presentation); all required aspects are complete in all assignments; - fulfils their designated roles (Chair, secretary etc.); - the student adheres to the rules agreed upon; - Asks questions and shares knowledge regarding the assignment during tutorials; verbalizes these clearly and audibly, maintains eye contact; - Gives others opportunity to speak; - The student offers feedback to group and class members and is open to receiving feedback;

M_ATBC-M-BBS BioBased Innovations (30 studiepunten)

	M_ATBC-M-BBS
General information	
Target group/groups	Full-time students main phase - Life Sciences (LS), Biology and Medical Laboratory Research (BML), Chemistry Full time students - Industrial Product Design (IPD) Full time students - Architecture Similar courses at other Universities of Applied Science
Name of unit of study	Minor Biobased Innovations
Code of unit of study	M_ATBC-M-BBs
Lecture period	Semester 1: period 1 and 2 (Sep-Jan) Semester 2: period 3 and 4 (Feb-Jul)
ECTS credits	30 EC
Study load in hours	840 SBU
Study hours (contact hours)	Planned lesson/contact hours: - Introduction: 10-15 hours theory/guest lectures, excursion/workshop 8 hours and 60-70 hours self-study - Module multidisciplinary approach: 20 contact hours and 8 hours self-study - Specialization module: 10-15 hours theory/guest lectures, 40-60 hours workshop/practical, 80-100 hours self-study - Scheduled time for project period is 14 weeks with 100-110 contact hours with supervisors/experts/project team and 440-460 hours of practical work/self-study/writing of products Total hours: 840 hours (30 EC)
Entry requirements for unit of study	Propaedeutical phase should be completed (first study year). In total at least 60 credits from the main phase should be earned and IPS from all courses in the 1st and 2nd year must be completed. The requirements above are applicable for students from all studies (including IPD & Architecture). In addition, for BML/LS/Chemistry students: • BML/LS: BM5B/LS5B and BM6B/LS6B must be completed (sufficient). • Chemistry: the practical assessments (including reports) in the 2nd study year must be at least satisfactory.
Content and organisation	
General description	The minor Biobased Innovations gives an insight on the different aspects of the biobased economy and the opportunities of biomass as raw material. The program consists of: 1. A theoretical introduction, 2. A specialization module (Biobased design (ATBC-M-BBS-BD) or Biorefinery (ATBC-M-BBS-BR). They will get specialized knowledge about the biobased aspects of their own discipline (such as biorefinery and fermentation for chemistry and biology students, and biobased design for students

	architecture and industrial product design). The students will be graded individually. 3. Project: students will work in a project on developing biobased, circular and innovative products or processes together with companies and with students with various (technical) backgrounds. Each student will cover his/her area of expertise within the project. At the same time, they will open up their horizon and learn to collaborate in a multidisciplinary team. Project consists of: a. Research Plan b. Practical execution c. Report d. Presentation The language of instruction is English. The exams for students that do not participate in the English variant of the study program, if desired, are provided in Dutch or can be answered in Dutch.
Exit qualifications	Designing an experimental plan Experimenting/developing Results analysis Quality control Management and administration Reporting and presenting Planning and project-based working Working in a team
Professional task	Carrying out scientific research and/or designing.
Professional products	Poster presentation Plan of Approach (including literature study) Research report Presentation
Cohesion	Biomass (waste and/or sidestreams) is used as a basis for food, food supplements, chemicals, materials, transport fuels, electricity and heat. Because of this broad range of applications, professionals are needed who can work together in multidisciplinary teams. That is why the School of Applied Bioscience and Chemistry (via HAN BioCentre) developed the minor in collaboration with de HAN School of Built Environment and Automotive & Engineering. It builds on the skills acquired in the first and second year by students from the studies chemistry, life sciences, biology and medical laboratory research, industrial product design and architecture.
Mandatory participation	Presence during at least 90% of the working days during the project period is mandatory in order to get a sufficient mark for the practical performance. Presence is obliged during the workshops of the “Multidisciplinair Approach Module”.

Maximum number of participants	16. Maximum 8 students from ATBC.
Compensation options	No compensation for exams or products. If amount of working days is not reached, the project time can be extended.
Activities and/or instructional formats	In about 12 of the 20 weeks practical research and/or development will be performed (central research project). *Work form: practical*. The research project is preceded by a written plan of approach (including literature study) and concluded with a report and presentation. *Work form: tutorial and self-study*. Prior to the project the student will gain knowledge during the introductory, multidisciplinary and specialization modules. *Work forms: combined theory lectures/work groups/excursions/practicals/workshops*
Required literature	None
Required software / required materials	*CES Edupack software*
Recommended literature	*Biorefineries and chemical processes, Ed. Jhuma Sadhukhan, Kok Siew Ng en Elias Martinez H., Wiley, ISBN 9781119990864*
Examination	
	M_ATBC-M-BBS-T
Name [exams or modular exams]	Theoretical exam
Code [exams or modular exams]	M_ATBC-M-BBS-T
Exam and modular exam format(s)	Individual, Written
Judgement	Mark
Minimum result	5,5
Weight factor of modular exam	2
Exam opportunities	Halfway semester 1 and halfway semester 2; see course manual and schedule for the exact date. Resit via consultation with the minor coordinator.
Permitted resources	Calculator (non- graphical).
Method of enrolment for exam / enrolment period	Participation to M_ATBC-M-BBS counts as registration for theoretical test M_ATBC-M-BBS-T. Registration for the resit via consultation with the minor coordinator.
Discussion and review	• The discussion and review of the exam are scheduled by the examiner. • Indicate (for an exam made in a resit period) to the examiner if you want to make use of the opportunity to discuss the exam. If there is no interest, the follow-up discussion will not take place. • Participation in the discussion is only permitted if you have taken the exam.
Number of examiners	Two examiners for construction and evaluation. Assessment by one examiner using the correction model (theory lecturer).
Compensation possibility	none

Competences and indicators	-
Assessment criteria	The student: (1) is able to give a definition of sustainable development; including global, European and Dutch view on this topic; (2) can explain the general principles of the biobased economy; (3) has basic knowledge on circular economy; circular vs linear, production processes, logistic chains; (4) is able to give a definition of life cycle analysis (LCA); including basic knowledge of the contents of this cycle; (5) has basic knowledge on legislation and regulations on sustainable development;
Test Matrix	Assessment criteria 1 and 2 contributes between 20-30% and all other assessment criteria contribute between 10 and 20% of the total.
	M_ATBC-M-BBS_MA
Name [exams or modular exams]	Module Multidisciplinair Approach
Code [exams or modular exams]	M_ATBC-M-BR-BBS_MA
Exam and modular exam format(s)	Oral, Individual
Judgement	Satisfactory/unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exam	0
Exam opportunities	Participation in modular exam MA is only possible once per semester.
Permitted resources	N/A
Method of enrolment for exam / enrolment period	Participation in OWE M_ATBC-M-BBS counts as registration for M_ATBC-M-BR_MA
Discussion and review	Presence and active participation in four (4) workshops/practicals is required.
Number of examiners	One examiner for the assessment based on participation and effort.
Compensation possibility	-
Competences and indicators	**Competence 7: Methodology** 7.1.3. Plans study activities. 7.2.2. Works according to plan, also under time constraints. 7.2.3. Ensures that goals are reached and if necessary, makes adjustments to activities. 7.2.4. Is flexible in changing circumstances. **Competence 8: Team Work** Functioning in a group 8.1.1. Adheres to rules. 8.1.2. Makes a valuable contribution to the group. 8.2.4. Recognises their own role in a group and is aware of other roles in the group. Works harmoniously with others. **Communication**

	Is able to communicate about their assignment with peers and lecturers applying basic rules of communication. 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.2.5. Takes initiative in the conversation. 8.2.5. Verbally expresses their opinion/message clearly. 8.2.10. Interacts with conversation partner. 8.2.12. Is aware of intercultural differences in the professional field **Competence 10: Advising** 10.2.1. Translates needs to practical requirements. **Competence 11: Professional Development** 11.2.5. Works with integrity, adjusts to new situations, shows determination and is a motivated student.
Assessment criteria	The student: -the student is present during all 4 workshops/practicals -the student has prepared for the workshop/practical by reading the assignment and answering the preparative questions -the student shows active participation by asking questions -the student shares knowledge regarding the discipline in case
Test matrix	All assessment criteria should be satisfactory. Student should be present during all 4 workshops/practicals
	M_ATBC-M-BBS-BD
Name [exams or modular exams]	Biobased Design
Code [exams or modular exams]	M_ATBC-M-BBS-BD
Exam and modular exam format(s)	Individual, Written (Poster) and Assessment
Judgement	Mark
Minimum result	5,5
Weight factor of modular exam	4
Exam opportunities	2 attempts per year. First attempt approximately halfway of semester. See course manual for exact date. Second attempt/resit in agreement with examiner.
Permitted resources	-
Method of enrolment for exam / enrolment period	Participation to M_ATBC-M-BBS counts as registration for theoretical test M_ATBC-M-BBS-BD. Registration for the resit via the minor coordinator.
Discussion and review	Returning the completed assessment form to the student with any remarks serves as review and discussion of this modular exam..
Number of examiners	Assessment by two examiners based on the assessment form.
Compensation possibility	-
Competences and indicators	**Reporting and presenting**

	Competence 6.2.1. Reports their research in the form of a research report/lab journal/poster according to in-house guidelines (product criteria for lab journal and research report; level 2): • uses correct spelling, grammar, sentence structure and scientific style; • uses a clear and logical structure in complex passages of text; • is aware of the cohesion between the different sections of text; • the document structure conforms to guidelines used in professional practice; • the report contains a reference list. The text references to the literature in this list; • describes results so the reader can understand, uses clearly labelled figures and tables; Competence 6.2.3. Is familiar with and applies the international conventions of scientific and academic writing. Competence 6.2.4. In English, uses written tasks appropriate to the professional practice to communicate straightforward ideas as defined by CEFR B1 Level Writing **In the context of biobased design.**
Assessment criteria	Consult the evaluation form: 'Biobased design Assignment' on #OnderwijsOnline – General information.
Test Matrix	Consult the evaluation form: 'Biobased design Assignment' on #OnderwijsOnline – General information.
	M_ATBC-M-BBS_BR
Name [exams or modular exams]	Biorefinery
Code [exams or modular exams]	M-ATBC-M-BBS_BR
Exam and modular exam format(s)	Individual, Written (Poster) and Assessment
Judgement	mark
Minimum result	5.5
Weight factor of modular exam	4
Exam opportunities	2 attempts per year. First attempt approximately halfway of semester. See course manual for exact date. Second attempt/resit in agreement with examiner.
Permitted resources	-
Method of enrolment for exam / enrolment period	Participation to M_ATBC-M-BBS counts as registration for M_ATBC-M-BBS-BR.
Discussion and review	The filled-in assessment form with any remarks is considered the discussion and review of this modular exam.

Number of examiners	Assessment by two examiners based on the assessment form.
Compensation possibility	-
Competences and indicators	**Reporting and presenting** Competence 6.2.1. Reports their research in the form of a research report/lab journal/poster according to in-house (HLO) guidelines (product criteria for lab journal and research report; level 2): • uses correct spelling, grammar, sentence structure and scientific style; • uses a clear and logical structure in complex passages of text; • is aware of the cohesion between the different sections of text; • the document structure conforms to guidelines used in professional practice; • the report contains a reference list. The text references to the literature in this list; • describes results so the reader can understand, uses clearly labelled figures and tables; Competence 6.2.3. Is familiar with and applies the international conventions of scientific and academic writing. Competence 6.2.4. In English, uses written tasks appropriate to the professional practice to communicate straightforward ideas as defined by CEFR B1 Level Writing **In the context of biorefinery and fermentation technology.**
Assessment criteria	Consult the evaluation form: 'BioRefinery Assignment' on #OnderwijsOnline – General information.
Test Matrix	Consult the evaluation form: 'BioRefinery Assignment' on #OnderwijsOnline – General information.
	M_ATBC-M-BBS-RP
Name [exams or modular exams]	Research Plan
Code [exams or modular exams]	M-ATBC-M-BBS-RP
Exam and modular exam format(s)	Written plan, Group*. *) Students are graded individually based on their contribution in the project.
Judgement	Mark
Minimum result	5.5
Weight factor of modular exam	4
Exam opportunities	2 attempts per year. Hand in first attempt approximately halfway of the semester. See course manual for exact date. If submitted too

	late, a 0 is given for the first chance. Second attempt/resit 1 to 4 weeks after first attempt. See course manual for exact date. A sufficient research plan is mandatory for execution of the project.
Permitted resources	-
Method of enrolment for exam / enrolment period	Participation to M_ATBC-M-BBS counts as registration for M_ATBC-M-BBS-RP.
Discussion and review	The completed assessment form will be returned to the student. On request additional remarks can be given by the examiner.
Number of examiners	Assessment by one examiner based on the assessment form.
Compensation possibility	None
Competences and indicators	**Competence 1 Design of experimental setup** 1.3.3. Independently searches for, selects and integrates information from relevant scientific sources. 1.3.4. Independently forms intermediate research questions and related hypothesis based on the given research question. 1.3.5. Independently integrates information into a comprehensive research plan (e.g. justifying the chosen method, describing necessary controls and availability of equipment) 1.3.8. Adjusts the research plan accordingly based on acquired results. 1.3.6. Understands and applies advanced English literature relevant to the given context. **Competence 2 Experimenting** 2.1.2. Performs calculations prior to beginning practical work. 2.3.1. Is able to explain the theory behind all steps of the experiments. 2.3.3. Independently ensures that all requirements are present before beginning the experiment. **Competence 4 Quality control** 4.1.1. Is aware of the health and safety rules and works according to these rules. 4.1.3. Uses controls, and uses these to assess the reliability of the results. **Competence 6 Reporting and presenting** 6.3.1. Reports their research in the form of a research report/lab journal/poster according to international guidelines (product criteria for lab journal and research report; level 3 ➢ uses correct spelling, grammar, sentence structure and scientific style; ➢ uses a clear and logical structure in complex passages of text. There is cohesions between the different sections of text; ➢ the document structure conforms to guidelines used in professional practise; ➢ the report contains a reference list. The text references to the literature in this list; ➢ describes results so the reader can understand, uses clearly labelled figures and tables; ➢ all relevant data is described in a summary that is independent to the report. . 6.2.3. Is familiar with and applies the international conventions of scientific and academic writing. 6.2.4. In English, uses written tasks appropriate to the professional practise to communicate straightforward ideas as defined by CEFR B1 Level Writing **Competence 7 Methodology**

	7.3.1. Plans and organises activities in a work plan covering a duration of at least 4 weeks.
Assessment criteria	Consult the assessment form: 'Biobased Innovation Research Plan' on #OnderwijsOnline – General information.
Test Matrix	Consult the assessment form: 'Biobased Innovation Research Plan' on #OnderwijsOnline – General information.
	M_ATBC-M-BBS-Pr
Name [exams or modular exams]	Presentation
Code [exams or modular exams]	M_ATBC-M-BBS-Pr
Exam and modular exam format(s)	Oral, Individual
Judgement	Mark
Minimum result	5,5
Weight factor of modular exam	1
Exam opportunities	2 attempts per year . The first attempt approximately at the end of the semester. See course manual for exact date. Second attempt/resit 1 to 4 weeks after first attempt. See course manual for exact date.
Permitted resources	-
Method of enrolment for exam / enrolment period	Participation in OWE M_ATBC-M-BBS counts as registration for M_ATBC-M-BBS-Pr
Discussion and review	Returning the completed assessment form to the student and any remarks on the form or in the professional product serves as inspection and discussion of this partial examination.
Number of examiners	Assessment by two examiners based on assessment form.
Compensation possibility	-
Competences and indicators	**Competence 1: Designing** 1.2.4. Forms intermediate research questions and related a hypothesis based on the given research question. 1.3.7. Makes connections between experiments and the broader research context. 1.3.8. Adjusts the research plan accordingly based on acquired results. **Competence 2: Experimenting** 2.3.1. Is able to explain the theory behind all steps of the experiments. **Competence 3: Analyzing Results** 3.1.4. Discusses the execution of the experiment and results. 3.2.3. Independently makes conclusions relating to the initial research question (if possible). 3.2.5. Relates results with results from their other experiments and also to data in published literature.

	3.3.1. Independently carries out results analysis according to the appropriate methods; uses statistics (if applicable). **Competence 6: Reporting and Presenting** 6.2.3. Is familiar with and applies the international conventions of scientific and academic writing. 6.3.5. Presents research to a target audience with similar knowledge background in a clear and persuasive manner; applies general presentation techniques and answers questions: there is an introduction-body-conclusion structure to the presentation; speaks clearly and coherently; has upright posture and hands are freely used; makes eye contact with the audience; makes organized and clear slides or other visual products; verbal and visual messages complement each other; Uses visual aids in PowerPoint to support; holds an on-topic discussion with the audience. 6.2.4. In English, uses written tasks appropriate to the professional practise to communicate straightforward ideas as defined by CEFR B1 Level Writing **Competence 8: Team work** 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.2.8. Verbally expresses their opinion/message clearly. 8.2.10. Interacts with conversation partner. 8.3.11. Keeps conversation on topic.
Assessment criteria	Consult the assessment form: 'Biobased Innovations - Presentation' on #OnderwijsOnline.
Test matrix	Consult the assessment form: 'Biobased Innovations - Presentation' on #OnderwijsOnline
	M_ATBC-M-BBS-R
Name [exams or modular exams]	Report
Code [exams or modular exams]	M_ATBC-M-BBS-R
Exam and modular exam format(s)	Written report, Group*. *) Students are graded individually based on their contribution in the project.
Judgement	Mark
Minimum result	5,5
Weight factor of modular exam	4
Exam opportunities	2 attempts per year. Hand in at the latest 2 weeks after the last day of the minor. If submitted too late, a 0 is given for the first chance. Resit at the latest two months after the last day of the minor.
Permitted resources	

Method of enrolment for exam / enrolment period	Participation in OWE M_ATBC-M-BBS counts as registration for M_ATBC-M-BBS-R
Discussion and review	Returning the completed assessment form to the student and any remarks on the form or in the professional product serves as inspection and discussion of this partial examination.
Number of examiners	Assessment by two examiners based on assessment form.
Compensation possibility	
Competences and indicators	**Competence 1: Designing** 1.2.1. Independently identifies relevant background information required to answer the research. 1.3.3. Independently searches for, selects and integrates information from relevant scientific sources. 1.3.4. Independently forms intermediate research questions and related hypothesis based on the given research question. 1.3.6. Understands and applies advanced English literature relevant to the given context. 1.3.7. Makes connections between experiments and the broader research context. **Competence 2: Experimenting** 2.3.1. Is able to explain the theory behind all steps of the experiments. **Competence 3: Analyzing Results** 3.3.1. Independently carries out results analysis according to the appropriate methods; uses statistics (if applicable). *Validation* 3.3.2. Independently evaluates the obtained results based on their accuracy and reliability. *Conclusion and discussion* 3.1.4. Discusses the execution of the experiment and results. 3.2.3. Independently makes conclusions relating to the initial research question (if possible) 3.2.5. Relates results with results from their other experiments and also to data in published literature. 3.2.6. Suggests improvements to improve the execution of the research. 3.3.7. Suggests follow-up experiments. **Competence 4: Quality Control** 4.1.3. Uses controls, and uses these to assess the reliability of the results. **Competence 5: Management and administration** 5.3.3. Manages and archives data in a lab journal or other logbook (aim, experiment description, alterations, results, conclusion) and if relevant, other ways of storing data so that others can use it.

	Competence 6: Reporting and Presenting 6.3.1. Reports their research in the form of a research report according to international guidelines (product criteria for lab journal and research report; level 2). - uses correct spelling, grammar, sentence structure and scientific style; - uses a clear and logical structure in complex passages of text. There is cohesion between the different sections of text; - the documents structure conforms to guidelines used in professional practice; - the report contains a reference list. The text references to the literature in this list; describes results so the reader can understand; - uses clearly labelled figures and tables; all relevant data is described in a summary that is independent to the report. 6.2.4. In English, uses written tasks appropriate to the professional practise to communicate straightforward ideas as defined by CEFR B1 Level Writing
Assessment criteria	Consult the evaluation form: 'Biobased Innovations – Project Report on #OnderwijsOnline.
Test matrix	Consult the evaluation form: 'Biobased Innovations - Project Report' on #OnderwijsOnline.
	M_ATBC-M-BBS-PP
Name [exams or modular exams]	Practical performance
Code [exams or modular exams]	M_ATBC-M-BBS-PP
Exam and modular exam format(s)	Practical, Individual
Judgement	Mark
Minimum result	5,5
Weight factor of modular exam	5
Exam opportunities	There is only one opportunity per year for the modular exam PP (EER paragraph 8.5)
Permitted resources	-
Method of enrolment for exam / enrolment period	Participation in OWE M_ATBC-M-BBS counts as registration for M_ATBC-M-BBS-PP
Discussion and review	Returning the completed assessment form to the student and any remarks on the form or in the professional product serves as review and discussion of this modular exam.
Number of examiners	Assessment by one examiner based on assessment form.
Compensation possibility	-
Competences and indicators	**Competence 1: Designing** 1.2.1. Independently identifies relevant background information required to answer the research question.

	1.3.3. Independently searches for, selects and integrates information from relevant scientific sources. 1.3.5. Independently integrates information into a comprehensive research plan (e.g. justifying the chosen method, describing necessary controls and availability of equipment) 1.3.8. Adjusts the research plan accordingly based on acquired results. **Competence 2: Experimenting** *Preparation* 2.1.2. Performs calculations prior to beginning lab work. 2.1.5. Carries out the experiment within the given time. 2.3.1. Is able to explain the theory behind all steps of the experiments. 2.3.3. Independently ensures that all requirements are present before beginning the experiment, makes solutions. *Execution* 2.2.4. Carries out experiments according to the protocol in order to obtain reliable, reproducible data; is aware of what he/she is doing at all times. 2.2.6. Attempts to work on multiple experiments at the same time (multitasking). 2.2.7. Attempts to trouble shoot experiments when problems are encountered. 2.3.7. Trouble shoots if problems are encountered in the experiments. **Competence 3: Analyzing Results** 3.1.4. Discusses the execution of the experiment and results. 3.3.1. Independently carries out results analysis according to the appropriate methods; uses statistics (if applicable). 3.2.3. Independently makes conclusions relating to the initial research question (if possible). 3.2.5. Relates results with results from their other experiments and also to data in published literature. 3.2.6. Suggests improvements to improve the execution of the research. 3.3.2. Independently evaluates the obtained results based on their accuracy and reliability. **Competence 4: Quality Control** 4.1.1. Is aware of the health and safety rules and works according to these rules. 4.1.3. Uses controls, and uses these to assess the reliability of the results. 4.2.2. Uses advanced tools and equipment in a correct manner. **Competence 5: Management and administration** 5.2.1. Encodes chemicals and samples; stores these in the correct manner. 5.2.2. Contributes to an efficiently functioning lab or workshop.

	5.3.3. Manages and archives data in lab journal or logbook (aim, experiment description, alterations, results, conclusion) and if relevant, other ways of storing data so that others can use it. **Competence 6: Reporting and Presenting** 6.3.1. Reports their research in the form of a research report/lab journal/poster according to international guidelines (product criteria for lab journal and research report; level 2): - uses correct spelling, grammar, sentence structure and scientific style; - uses a clear and logical structure in complex passages of text. There is cohesion between the different sections of text; - the documents structure conforms to guidelines used in professional practice; - the report contains a reference list. The text references to the literature in this list; - describes results so the reader can understand; uses clearly labelled figures and tables; all relevant data is described in a summary that is independent to the report. **Competence 7: Working in a planned and project-based manner** 7.2.1. Plans and organizes activities in a work plan that covers a duration of at least 4 practical lessons. 7.2.2. Works according to plan, also under time constraints. 7.2.3. Ensures that goals are reached and if necessary, makes adjustments to activities. 7.3.4. Is flexible in changing circumstances; determines priorities in the work. **Competence 8: Team work** *Functioning in a group* 8.1.1. Adheres to rules. 8.2.3. Makes clear agreements with others and keeps to these. 8.2.4. Recognizes their own role in a group and is aware of other roles in the group. Works harmoniously with others. *Communication* Is able to communicate about their assignment with peers and lecturers applying basic rules of communication: 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Gives others opportunity to speak. 8.1.9. Is active in conflict resolution. 8.2.5. Takes initiative in the conversation. 8.2.8. Verbally expresses their opinion/message clearly. 8.2.10. Interacts with conversation partner. **Competence 11: Professional development** 11.3.5. Works with integrity, adjusts to new situations, shows determination and is a motivated employee.
Assessment criteria	Consult the evaluation form: ‘Biobased Innovations - Practical performance’ on #OnderwijsOnline.

Test matrix	Consult the evaluation form: 'Biobased Innovations - Practical performance' on #OnderwijsOnline.

M_ATBC-M-DD Drug Discovery (30 studiepunten)

	M_ATBC-M-DD
Algemene informatie	
Doelgroep	Hoofdfase studenten uit alle chemische en (bio) medische richtingen
Naam onderwijseenheid	Minor Drug Discovery: Introductie in de Drug Discovery
Code onderwijseenheid	M_ATBC-M-DD
Onderwijsperiode	semester 2 (periode 3-4)
Studiepunten	30 stp
Studielast in uren	840 SBU
Onderwijstijd (contacturen)	Periode 3: Week 1-5 Het drug discovery proces bestaat uit 5 te onderscheiden fasen. De eerste 5 weken wordt per week een fase belicht. Gestreefd wordt naar de volgende opbouw per week: • ca 15 geroosterde lesuren; 15 klokuur: (ca 11,25 klokuren) • droge werkopdracht per fase welke in groepsverband (multidisciplinair) wordt uitgewerkt; zelfstudie en zelf roosteren (27 klokuren) • werkbezoek bedrijf (2 lesuren), 1.5 klokuur • tutor 3 lesuren (2,25 klokuur) per week om werkopdracht te bespreken Totaal geprogrammeerde contacttijd week 1-5: 20 lesuren p/week;100 lesuren = klokuren 75, Geprogrammeerde onderwijstijd voor zelfwerkzaamheid: 135 klokuren Totaal: 210 klokuren Theorieonderdelen: "Target identificatie en validatie": 15 lesuren (incl gastcolleges) "Assay development": 15 lesuren (incl gastcolleges) "HTS en compound libraries/eigenschappen" 15 lesuren. (incl gastcolleges) "Hit en lead optimalisatie": 15 lesuren (incl gastcolleges) "Pre development fase, 15 lesuren (incl gastcolleges) Vanaf week 6-20 wordt de opzet Praktijklessen waarin gestreefd wordt om in groepsverband aan reguliere opdrachten vanuit het werkveld te werken. 22,5 klokuren per week verdeeld. • Tutor: 2 lesuren per week (1,5 klokuur) • Zelfstudie uren (292,5 klokuren): Student dient zelf en in groepsverband 292,5 uur aan zelf- en groepsstudiewerkzaamheden te roosteren. Totaal geprogrammeerde contacttijd week 6-20: 30 lesuren p/week;450 lesuren = klokuren 337,75, Geprogrammeerde onderwijstijd voor zelfwerkzaamheid: 292,5 klokuren Totaal: 630 klokuren

	Totaal: 840 klokuren
Ingangseisen onderwijseenheid	Voor aanvang aan deze OWE dient de student minimaal zijn/haar propedeuse behaald te hebben (Bij instromers uitzonderingen mogelijk). De competenties die in deze minor aan de orde zijn, zijn op niveau 2 geoefend. Tweede jaar chemie gevolgd waarbij C8T en C8P of C6T en C6P behaald. Ofwel tweede jaar BML gevolgd waarbij BM6B is behaald. Hetzelfde geldt voor de overeenkomstige OWEs uit Chemistry en LS. Studenten van andere laboratoriumopleidingen kunnen zich ook aanmelden. Deze externe studenten worden eerst uitgenodigd voor een intake gesprek.
Inhoud en organisatie	
Algemene omschrijving	De minor Drug Discovery richt zich op de interface tussen biomoleculaire technologie en chemie, en is in deze zin dan ook verbredend en verdiepend. De opbouw is dat in de eerste weken de theoretische basis wordt gelegd van het drug discovery proces. Per week wordt een fase behandeld die een vergelijkbare opbouw zal hebben; theorie, gastcolleges, werkbezoek en een droge opdracht (simulatieopdracht) waarin je oefent met de theorie van die week. De tutorbijeenkomsten behandelen deze fasen aan de hand van opdrachten. De volgende 5 fasen worden onderscheiden; Target identificatie en validatie: “Assay development”: “HTS en compound libraries/eigenschappen “Hit en lead optimalisatie”: “Pre development fase, In week 6 start het praktijkgedeelte en zal doorlopen tot en met week 20. In deze fase wordt gestreefd om in groepsverband aan reguliere opdrachten vanuit het werkveld te werken. In de tutorbijeenkomsten bespreken we wekelijks de voortgang van het project met als einddoel een presentatie van een onderzoeksresulaten. In deze OWE staat de beroepstaak “het uitvoeren van een natuurweten-schappelijk onderzoek” op het gebied van de biomoleculaire technologie en chemie in een multidisciplinair team centraal. Het gekozen contextgebied is medicijnontwikkeling. Het gekozen onderwijsmodel is projectonderwijs. Deze OWE bouwt voort op chemische, biologische en biomoleculaire courses uit het tweede jaar. Zodoende zullen (bio)moleculaire studenten en chemie studenten elkaars input nodig hebben en is multidisciplinair samenwerken een must. Dat wil zeggen dat studenten uit verschillende richtingen op verschillende momenten het initiatief dienen te nemen en andere studenten dienen te begeleiden. Dit komt tot uiting in het uiteindelijke onderzoeksvoorstel (PVA) dat studenten in multidisciplinair teamverband dienen te schrijven.

	De voertaal van de minor Drug Discovery is Engels. De tentamens voor studenten die niet deelnemen aan de Engelse variant van de opleiding worden desgewenst in het Nederlands aangeboden en / of kunnen in het Nederlands worden beantwoord. De beroepsproducten moeten in het Engels worden gemaakt.
Eindkwalificaties	Ontwerpen Experimenteren Resultaten analyseren Kwaliteitsbeheer Beheer en administratie Rapporteren en presenteren Planmatig en projectmatig werken Samenwerken (multidisciplinair) Sturen professionele ontwikkeling
Beroepstaak, beroepstaken	Uitvoeren van natuurwetenschappelijk onderzoek
Beroepsproducten	Plan van aanpak, (poster)presentatie
Samenhang	In de minor Drug Discovery wordt gestreefd te werken aan reguliere opdrachten uit het bedrijfsleven (multidisciplinair) waarbij bio-moleculaire technologie en chemie samen komen.
Deelnameplicht onderwijs	Deelname aan praktijk en projectgroep/tutor is verplicht.
Maximaal aantal deelnemers	20 (HAN + AVANS samen)
Compensatie mogelijkheden	geen compensatie
Activiteiten en/of werkvormen	Ondersteunend vakken Drug Discovery en activiteiten/toepassingen Theorie • Target identificatie en validatie • “Assay development • “HTS en compound libraries/eigenschappen • “Hit en lead optimalisatie • “Pre development fase, *Werkvorm: hoorcollege* Casus uitwerken (simulatie/droge opdracht) en werkbesprekingen *Werkvorm: tutor en groepsopdracht / zelfstudie* Werkbezoek bedrijven Plan van aanpak schrijven voor onderzoek aan bedrijfsopdracht *Werkvorm: groepsopdracht* Praktijk onderwijs (uitvoeren praktijkopdracht), experimenteren en zelf ervaren. *Werkvorm: praktijk*
Verplichte literatuur	Drug Discovery and Development. Technology in Transition. Eds. H.P. Rang

Verplichte Software / verplicht materiaal	ChemSketch (www.acdlabs.com; of vergelijkbaar) LabArchives
Aanbevolen literatuur	
Tentaminering	
	M_ATBC-M-DD-K
Naam (deel)tentamen	Kennistoets
Code (deel)tentamen	M_ATBC-M-DD-K
Vorm(en) (deel)tentamen	Individueel, Schriftelijk, Open vragen
Oordeel	Cijfer
Minimaal oordeel	5,5
Weging deeltentamen	1
Tentamenmomenten **Toegestane hulpmiddelen**	Periode 3, herkansing periode 4
Wijze van aanmelden voor tentamen / aanmeldingstermijn	Aanmelden voor het deeltentamen via Alluris. De aanmeldingstermijn is een aantal weken voorafgaand aan die toetsperiode of de herkansingsperiode. De termijn staat aangegeven in het jaarrooster van de Academie ATBC op Insite-roosters.
Nabespreking en inzage	• In het ATBC jaarrooster is aangegeven wanneer de tentamenperiodes zijn en wanneer het gemaakte werk ingezien kan worden. Inzage gebeurt in aanwezigheid van een surveillant. • De nabespreking van het tentamen wordt ingeroosterd in de volgende onderwijsperiode. Nabespreking van tentamens gemaakt in een herkansingsperiode worden ingeroosterd aan het eind van de onderwijsperiode. • Geef bij de examinator/coursetrekker aan of je gebruik wilt maken van de mogelijkheid om het tentamen na te bespreken. Als er geen belangstelling is, gaat de nabespreking niet door. • Deelname aan de nabespreking is alleen toegestaan als je het tentamen hebt gemaakt.
Aantal examinatoren	Twee examinatoren voor de constructie en evaluatie. Beoordeling door één examinator op basis van antwoordmodel (theoriedocent).
Toegestane hulpmiddelen	
Compensatiemogelijkheden	
Beoordelingsdimensies	Target identificatie en validatie": Kennis van het proces van moleculair target identificatie en validatie van functie en effect. "Assay development": kennis van verschillen in assay technieken met hun voor en nadelen. "HTS en compound libraries/eigenschappen" Begrip van verschillende benaderingen in HTS en welke soorten stoffenbibliotheken daarbij horen. Kennis van drug-like en hit-like eigenschappen van verbindingen. "Hit en lead optimalisatie": Het proces van hit en lead optimalisatie, met daarbij aandacht voor de multidimensionale kant van deze optimalisatie zoals bv. metabolisme, toxiciteit, nieuwheid, PK, ADME etc. "Pre development fase, kennis omtrent de patenten (IP), safety, scale-up strategien, quality assurance

Beoordelingscriteria	Onderdeel 1: Target identificatie en validatie De student heeft kennis van en inzicht in het proces en de benodigde technologieën om nieuwe biologische targets (eiwitten, DNA, RNA) voor ziektebeelden te identificeren en te valideren. Onderdeel 2: Assay development De student heeft kennis van en inzicht in het proces van en de benodigde technologieën om robuuste assays te generen om activatie of remming van biologische targets te kunnen meten. Onderdeel 3: HTS en compound libraries/eigenschappen De student heeft kennis van en inzicht in het proces en de technologieën nodig voor het uitvoeren van high throughput screenen(HTS). Daarnaast heeft de student inzicht in de benodigde eigenschappen van chemische stoffen welke nodig zijn om verdere optimalisatie mogelijk te maken. Verder heeft de student kennis van verschillende typen van stoffenbibliotheken die ingezet worden in screeningscampagnes. De student kent het proces van actives naar confirmed hit. Onderdeel 4. Hit en lead optimalisatie": De student heeft kennis van en inzicht in het proces van confirmed hit naar lead compound en van lead compound naar development kandidaat. Hij weet welke parameters essentieel zijn in dit proces en kan multidimensionaal hiermee omgaan. Onderdeel 5 "Pre development fase De student heeft kennis van en inzicht in de activiteiten die na selectie development kandidaat uitgevoerd moeten worden, voordat een kandidaat stof ook daadwerkelijk de klinische fase in gaat.
Toetsmatrijs	~20% Target identificatie en validatie ~20% Assay development ~20%"HTS en compound libraries/eigenschappen ~20%"Hit en lead optimalisatie: ~20% Pre development fase,
	M_ATBC-M-DD-V
Naam (deel)tentamen	Onderzoeksvoorstel (Plan van aanpak)
Code (deel)tentamen	M_ATBC-M-DD-V
Vorm(en) (deel)tentamen	Groep, Schriftelijk
Oordeel	Cijfer
Minimaal oordeel	5,5
Weging deeltentamen	1
Tentamenmomenten	Periode 3, herkansing periode 4
Toegestane hulpmiddelen	
Wijze van aanmelden voor tentamen / aanmeldingstermijn	Deelname aan OWE M_ATBC-M-DD geldt als aanmelding voor M_ATBC-M-DD-V.

Nabespreking en inzage	Het aan de student teruggeven van het ingevulde beoordelingsformulier en eventueel opmerkingen op het formulier of in het beroepsproduct geldt als inzage en nabespreking van dit deeltentamen.
Aantal examinatoren	Beoordeling door twee examinatoren op basis van beoordelingsformulier.
Compensatiemogelijkheden	
Beoordelingsdimensies	Competentie 1: Ontwerpen 1.3.3. Zoekt, selecteert en verwerkt (zelfstandig) informatie uit relevante bronnen voor natuurwetenschappelijk onderzoek. 1.3.4.Formuleert op basis van gegeven onderzoeksvraag zelfstandig deelvragen met bijbehorende hypotheses. 1.3.6. Begrijpt complexe Engelstalige literatuur in de context van de module en past deze toe. 1.3.7. Legt verbanden van eigen onderzoek met overkoepelend project. Competentie 2: Experimenteren voorbereiden 2.3.1. Kan alle stappen van de experimenten theoretisch verantwoorden. Competentie 6: Rapporteren en presenteren 6.3.1. Rapporteert over zijn onderzoek in vorm van een verslag/labjournaal volgens internationaal geldende regels (productcriteria labjournaal en verslag (niveau 3): - hanteert correcte spelling, grammatica, zinsbouw en wetenschappelijke stijl; - brengt helder en logische structuur aan in complexere teksten; - is zich bewust van samenhang tussen tekstonderdelen; - opbouw van tekst is conform in het werkveld gebruikte richtlijnen; - rapport omvat een literatuurlijst. In de tekst wordt verwezen naar bronnen in literatuurlijst; - beschrijft resultaten zodat de lezer deze begrijpen kan; - gebruikt hiervoor duidelijke gelabelde afbeeldingen en tabellen; - beschrijft alle relevante gegevens in een samenvatting die als zelfstandig geheel gelezen kan worden.
Beoordelingscriteria	Zie beoordelingsformulier voor onderzoeksvoorstel op #OnderwijsOnline bij Algemene Informatie.
Toetsmatrijs	Zie beoordelingsformulier voor onderzoeksvoorstel op #OnderwijsOnline bij Algemene Informatie.
	M_ ATBC-M-BN-PA
Naam (deel)tentamen	Presentatie en assessment
Code (deel)tentamen	M_ATBC-M-DD-PA
Vorm(en) (deel)tentamen	Individueel, mondeling
Oordeel	Cijfer
Minimaal oordeel	5,5
Weging deeltentamen	1
Tentamenmomenten	Periode 4, herkansing eind periode 4
Toegestane hulpmiddelen	

Wijze van aanmelden voor tentamen / aanmeldingstermijn	Deelname aan OWE M_ATBC-M-DD geldt als aanmelding voor M_ATBC-M-DD-PA.
Nabespreking en inzage	Het aan de student teruggeven van het ingevulde beoordelingsformulier en eventueel opmerkingen op het formulier of in het beroepsproduct geldt als inzage en nabespreking van dit deeltentamen.
Aantal examinatoren	Beoordeling door twee examinatoren op basis van beoordelingsformulier.
Compensatiemogelijkheden	
Beoordelingsdimensies	Competentie 1: Ontwerpen van experimentele opzet 1.3.3. Zoekt, selecteert en verwerkt zelfstandig informatie uit relevante bronnen voor natuurwetenschappelijk onderzoek. 1.3.4. Formuleert op basis van gegeven onderzoeksvraag zelfstandig deelvragen met bijbehorende hypotheses. 1.3.6. Begrijpt complexe Engelstalige literatuur in de context van de module en past deze toe. 1.3.7. Legt verbanden van eigen onderzoek met overkoepelend project. Competentie 2: Experimenteren Voorbereiding 2.1.2. Maakt voorberekeningen. Competentie 3: Resultaten analyseren 3.2.1. (3.3.1) Voert (zelfstandig) op de juiste wijze volgens de geschikte methoden de analyse van de resultaten uit; i.v.t. maakt hiervoor gebruik van statistiek. 3.1.2. (3.3.2) Doet (zelfstandig) uitspraak over de bruikbaarheid van de behaalde resultaten op basis van nauwkeurigheid en betrouwbaarheid. 3.3.3. Trekt zelfstandig conclusie m.b.t. de onderzoeksvraagstelling (als mogelijk) (en overkoepelend project). 3.2.5. (3.3.5) Bediscussieert (zelfstandig) resultaten in relatie met andere deelexperimenten en vergelijkt (legt verbanden) met literatuurwaarden. 3.2.6. Maakt verbetervoorstellen voor de uitvoering van het onderzoek. 3.3.7. Maakt voorstellen voor vervolgexperimenten. Competentie 4: Kwaliteitsbeheer 4.1.3. Gebruikt controles, waarvan het resultaat een uitspraak doet over de betrouwbaarheid van de resultaten. Competentie 6: Rapporteren en presenteren 6.3.1. Rapporteert over zijn onderzoek in vorm van een verslag/labjournaal volgens internationaal geldende regels (productcriteria labjournaal en verslag niveau 3):hanteert correcte spelling, grammatica, zinsbouw en wetenschappelijke stijl; brengt helder en logische structuur aan in complexere teksten. Er is sprake van samenhang tussen tekstonderdelen; is zich bewust van samenhang tussen tekstonderdelen; opbouw van tekst is conform in het werkveld gebruikte richtlijnen; rapport omvat een literatuurlijst. In de tekst wordt verwezen naar bronnen in literatuurlijst; beschrijft resultaten zodat de lezer deze begrijpen kan; gebruikt hiervoor duidelijke gelabelde

	afbeeldingen en tabellen; beschrijft alle relevante gegevens in een samenvatting die als zelfstandig geheel gelezen kan worden. 6.3.5. Presenteert onderzoek aan diverse groep toehoorders op heldere en overtuigende wijze volgens de normen van presentatietechnieken en beantwoord vragen: Er zit structuur in de presentatie (kop-romp-staart); Spreekt duidelijk en verstaanbaar; Staat rechtop en laat de handen vrij; Maakt oogcontact met het publiek en controleert of essentie van boodschap bij doelgroep overkomt; Maakt overzichtelijke en duidelijke slides of andere visuele producten; Verbale en visuele boodschap vormen een geheel; Gebruikt mogelijkheden van PowerPoint als visuele ondersteuning voor het overbrengen van de boodschap; Gaat inhoudelijke discussie met publiek aan. Competentie 8: Samenwerken 8.1.6. Houdt oogcontact met gesprekspartner. 8.1.7. Laat anderen uitpraten. 8.2.5. Neemt initiatief voor gesprek. 8.2.8. Brengt zijn haar mening/boodschap helder onder woorden. 8.3.10. Sluit aan bij gesprekspartner/toetst of boodschap is overgekomen. 8.3.11. Houdt gespreksdoel in het oog. 8.2.12. Is zich bewust van interculturele verschillen in het werkveld Competentie 11 Sturen professionele ontwikkeling Geeft eigen competentieontwikkeling vorm 11.2.1. Benoemt zijn sterke en zwakke kanten. 11.1.2. Werkt aan leerdoelen volgens POP en verzamelt competentiebewijzen 11.2.6. Is zich bewust van de internationaal geaccepteerde wetenschappelijke gedragscode. 11.2.7. Formuleert en beargumenteert een mening met betrekking tot ethische aspecten van het beroepenveld. 11.3.3. Kijkt kritisch terug (reflecteert) op eigen handelingen en leerproces; leert van zijn fouten; staat open voor leermomenten.
Beoordelingscriteria	Zie beoordelingsformulier voor presentatie en assessment op #OnderwijsOnline bij Algemene Informatie.
Toetsmatrijs	Zie beoordelingsformulier voor presentatie en assessment op #OnderwijsOnline bij Algemene Informatie.
	M_ATBC-M-DD-P
Naam (deel)tentamen	Praktische werkzaamheden
Code (deel)tentamen	M_ATBC-M-DD-P
Vorm(en) (deel)tentamen	Individueel, Praktijk
Oordeel	cijfer
Minimaal oordeel	5,5
Weging deeltentamen	2

Tentamenmomenten	Periode 4. Voor deelname aan deeltentamen P is er maar één kans per studiejaar (OER paragraaf 8.5)
Toegestane hulpmiddelen	
Wijze van aanmelden voor tentamen / aanmeldingstermijn	Deelname aan OWE M_ATBC-M-DD geldt als aanmelding voor M_ATBC-M-DD-P.
Nabespreking en inzage	Het aan de student teruggeven van het ingevulde beoordelingsformulier en eventueel opmerkingen op het formulier of in het beroepsproduct geldt als inzage en nabespreking van dit deeltentamen.
Aantal examinatoren	Beoordeling door twee examinatoren op basis van beoordelingsformulier.
Compensatiemogelijkheden	
Beoordelingsdimensies	Competentie 1: Ontwerpen van experimentele opzet 1.3.3. Zoekt, selecteert en verwerkt zelfstandig informatie uit relevante bronnen voor natuurwetenschappelijk onderzoek. 1.3.4. Formuleert op basis van gegeven onderzoeksvraag zelfstandig deelvragen met bijbehorende hypotheses. 1.3.5. Integreert informatie zelfstandig om tot een beargumenteerd (b.v. geschiktheid methode en beschikbaarheid apparatuur) onderzoeksplan te komen. 1.3.6 Begrijpt complexe Engelstalige literatuur in de context van de module en past deze toe. Competentie 2: Experimenteren 2.1.2. Maakt voorberekeningen. 2.1.5. Voert de experimenten binnen de gestelde tijd uit. 2.2.1., (2.3.1.) Kan de basis (alle) stappen van de experimenten theoretisch verantwoorden. 2.2.3., (2.3.3.) Zorgt (zelfstandig) ervoor dat alle benodigdheden klaar staan voordat met het experiment begonnen wordt; maakt oplossingen. 2.2.4., (2.3.4.) Voert experimenten volgens protocol uit zodat betrouwbare reproduceerbare data wordt verkregen, (maar kan hiervan afwijken indien nodig); weet te allen tijde exact wat hij/zij doet. 2.2.6. Maakt een begin met het tegelijkertijd uitvoeren van meerdere experimenten (multitasking) 2.3.6. werkt aan meerdere experimenten tegelijkertijd en kan deze uitvoeren binnen de gestelde tijd, kan makkelijk switchen en behoudt overzicht. 2.2.7. Doet een poging om problemen op te lossen als het experiment niet loopt zoals was voorzien (trouble shooting) 2.3.7. lost praktische problemen op als het experiment niet loopt zoals was voorzien (trouble shooting). Competentie 3: Resultaten analyseren 3.1.2., (3.3.2.) Doet (zelfstandig) uitspraak over de bruikbaarheid van de behaalde resultaten op basis van nauwkeurigheid en betrouwbaarheid. 3.2.1., (3.3.1.) Voert (zelfstandig) op de juiste wijze volgens de geschikte methoden de analyse van de resultaten uit; i.v.t. maakt hiervoor gebruik van statistiek. 3.2.3., (3.3.3.) Trekt zelfstandig conclusie m.b.t. de onderzoeksvraagstelling (als mogelijk) (en overkoepelend project).

	3.2.5., (3.3.5.) Bediscussieert (zelfstandig) resultaten in relatie met andere deelexperimenten en vergelijkt met literatuurwaarden. 3.2.6. Maakt verbetervoorstellen voor de uitvoering van het onderzoek. 3.3.7. Maakt voorstellen voor vervolgexperimenten. Competentie 4: Kwaliteitsbeheer 4.1.1. Stelt zich op de hoogte van de veiligheids (arbo)- en milieuregels en werkt volgens deze regels. 4.1.3. Gebruikt controles, waarvan het resultaat een uitspraak doet over de betrouwbaarheid van de resultaten. 4.3.4. Controleert de houdbaarheid van reagentia en oplossingen. Competentie 5: Beheer en administratie 5.2.1. Codeert chemicaliën en monsters en bewaart deze op correcte wijze. 5.2.2. Draagt bij aan een efficiënt functionerend lab (ruimt op, signaleert als reagentia bijna op zijn, pleegt klein onderhoud aan de apparatuur). 5.2.3. Beheert en archiveert gegevens in labjournaal (doel, experimenten- beschrijving, resultaten, conclusie) en i.v.t. op andere manieren zodat anderen deze kunnen begrijpen. Competentie 6: Rapporteren en presenteren 6.3.1. Rapporteert over zijn onderzoek in vorm van een verslag/labjournaal volgens internationaal geldende regels (productcriteria labjournaal en verslag niveau 3):hanteert correcte spelling, grammatica, zinsbouw en wetenschappelijke stijl; brengt helder en logische structuur aan in complexere teksten. Er is sprake van samenhang tussen tekstonderdelen; is zich bewust van samenhang tussen tekstonderdelen; opbouw van tekst is conform in het werkveld gebruikte richtlijnen; rapport omvat een literatuurlijst. In de tekst wordt verwezen naar bronnen in literatuurlijst; beschrijft resultaten zodat de lezer deze begrijpen kan; gebruikt hiervoor duidelijke gelabelde afbeeldingen en tabellen; beschrijft alle relevante gegevens in een samenvatting die als zelfstandig geheel gelezen kan worden Competentie 7: Planmatig/projectmatig werken 7.2.1., (7.3.1) Plant en organiseert zijn experimenten resulterend in een werkplan dat minimaal 4 praktijklessen bestrijkt (Plant en organiseert zijn project resulterend in een werkplan van minimaal 4 weken). 7.2.2. Voert werkzaamheden volgens planning uit; ook onder tijdsdruk. 7.2.3. Ziet erop toe dat doelen worden behaald en stuurt werkzaamheden eventueel bij. 7.3.4. Speelt in op wijzigende omstandigheden; bepaalt prioriteiten in werkzaamheden. Competentie 8: Samenwerken 8.1.9. Toont initiatief conflicten actief op te lossen. 8.2.12. Is zich bewust van interculturele verschillen in het werkveld. 8.3.9. Weet goed met conflicten om te gaan

	Competentie 11: Sturen professionele ontwikkeling 11.2.5. Handelt integer, past zich snel aan, toont doorzettingsvermogen en is gemotiveerde student.
Beoordelingscriteria	Zie beoordelingsformulier voor Praktijk op #OnderwijsOnline bij Algemene Informatie.
Toetsmatrijs	Zie beoordelingsformulier voor Praktijk op #OnderwijsOnline bij Algemene Informatie.

M_ATBC-M-P Scientific Research (30 studiepunten)

	M_ATBC-M-P (CHLS)
General information	
Target group/groups	Full-time students main phase Life Science or Chemistry
Name of unit of study	Minor Scientific Research
Code of unit of study	M_ATBC-M-P (CHLS)
Lecture period	Dependent on the chosen course units
ECTS credits	30 EC
Study load in hours	420 SBU
Study hours (contact hours)	The minor comprises chosen course units that broaden or deepen the focus of the chosen major.
Entry requirements for unit of study	Foundation year completed. Additional entry requirements are dependent on the requirements for the chosen course units.
Content and organisation	
General description	Students can choose from: - the researchminor –M_ATBC-M-R30; - the mini researchminor – M_ATBC-M-R15 Students of the degree program Life Sciences, if they meet the entrance requirements as defined in the relevant course description, may choose one or more courses from: - the chemistry degree program: CH7KT, CH5KT, CH5-7Pa and CH5-7Po; - the chemistry degree program: CH6KT en CH8KT, CH6-8Pa en CH6-8Po; - the graduation subject biotechnology: BMLS8; - the graduation subject molecular plant biology: BMLS9; - the graduation subject biomedical research: BMLS10. Students of the degree program Chemistry, if they meet the entrance requirements as defined in the relevant course description, may choose one or more courses from: - the graduation subject organical chemistry C9, C10 (Dutch) - the graduation subject analytical chemistry CH11, CH12 - the Life Sciences degree program LS5A/LS5B/LS5C or LS6A/LS6B/LS6C. Depending on the semester when you participate in the minor you follow A1 (semester 1) or A2 (semester 2)

Exit qualifications	Dependent on the chosen course units
Professional task	Carrying out life science research
Professional products	Dependent on the chosen course units
Cohesion	The minor comprises chosen course units that broaden or deepen the focus of the chosen major.
Mandatory participation	Dependent on the chosen course units
Maximum number of participants	Dependent on the chosen course units
Compensation options	Dependent on the chosen course units
Activities and/or instructional formats	Dependent on the chosen course units
Required literature	Dependent on the chosen course units
Required software / required materials	Dependent on the chosen course units
Recommended literature	Dependent on the chosen course units
Examination	
Name [exams or modular exams]	Dependent on the chosen course units
Code [exams or modular exams]	Dependent on the chosen course units
Exam and modular exam format(s)	Dependent on the chosen course units
Judgement	Dependent on the chosen course units
Minimum result	Dependent on the chosen course units
Weight factor of modular exam	Dependent on the chosen course units
Exam opportunities	Dependent on the chosen course units
Permitted resources	Dependent on the chosen course units
Method of enrolment for exam / enrolment period	Dependent on the chosen course units
Discussion and review	Dependent on the chosen course units
Number of examiners	Dependent on the chosen course units
Compensation possibility	Dependent on the chosen course units
Assessment criteria	Dependent on the chosen course units
Competences and indicators	Dependent on the chosen course units
Test Matrix	Dependent on the chosen course units

M_ATBC-M-PR15 Research minor LS

	EEU R15 Research minor
General information	
Target group/groups	Full-time students main phase Life Sciences or Chemistry
Name of unit of study	EEU R15 Research minor

Code of unit of study	BMCBI-R15 (CHLS)
Lecture period	P1, P2, P3, P4
ECTS credits	15 EC
Study load in hours	420 SBU
Study hours (contact hours)	There are no lessons planned, the supervising lecturer has 5 hours allocated for supervising and evaluation.
Entry requirements for unit of study	Foundation year must be successfully completed. At least 50 stp have been earned in the 2nd study year and the practical assessment in the 2nd study year must be at least satisfactory. If the research minor follows the internship or graduation project, a prerequisite for starting is that the research report of the preceding internship or graduation project has been submitted to the supervisor. If the student does not fulfil the prerequisites, a request for exemption and permission to follow the research minor may submitted to the Examination Board.
Content and organisation	
General description	A minor must deepen or broaden the focus and have no large overlap with the major. A research minor is not an internship, as the internship is a part of the major. The aim of the research minor is therefore to focus on something new, and what has not (yet) been covered in the major. The combination of the chosen course unit (15 EC) and mini research minor (15 EC) consists of a theoretical component (for example a chosen unit of the course Chemistry or Life Sciences or at the university) and a practical component where the theory is applied with a total duration of 10 weeks (15 EC). If this combination is chosen, then the chosen course of 15 EC counts for the theoretical component of the research minor and a normal research report can be written about the practical component. If the mini research minor of 15 EC is combined with the internship or graduation, the theoretical compound must be filled in otherwise. To satisfy the theoretical component, the research report of the RM15 contains a more extensive introduction. A literature report may be written instead of a research report to meet the requirements of the theoretical component. The research minor remains an independent study unit. It must meet the requirements as described and will be assessed independently from the internship.
Exit qualifications	Designing an experimental plan Experimenting Results analysis Quality control Management and administration Reporting and presenting Planning and project-based working Teamwork Professional development
Professional task	Carrying out life science research
Professional products	
Cohesion	Elective component of the Minor Scientific research. During the mini research minor, the theory presented in the preceding (selected) course unit from the scientific research minor is applied.

Mandatory participation	
Maximum number of participants	-
Compensation options	-
Activities and/or instructional formats	The personal tutor guides the student in finding a research minor that fits with the PDP. The student is responsible for finding and applying for a minor research placement. During the research minor, the student is supervised by a workplace supervisor and a lecturer from the HAN.
Required literature	Information under the tile ATBC Minor on #OnderwijsOnline
Required software / required materials	
Recommended literature	
Examination	
	BMCBI-R15-Rv
Name [exams or modular exams]	Reflection report
Code [exams or modular exams]	BMCBI-R15-Rv
Exam and modular exam format(s)	In writing, individual
Judgement	Satisfactory/unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exam	0
Exam opportunities	2 opportunities per year. Deadline is the last day of the research minor. If handed in late, a 0 is given for the first chance. In consultation with the minor lecturer, a new deadline is set. Resits are possible up to 2 months after the last day of the research minor.
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in OWE BMCBI-R15 applies as registration for BMCBI-R15-Rv
Discussion and review	Returning the completed assessment form to the student and any remarks on the form or in the professional product serves as inspection and discussion of this partial examination.
Number of examiners	Assessment by one examiner based on assessment form (Minor lecturer).
Compensation possibility	
Assessment criteria	See assessment form "Reflection report" on #OnderwijsOnline - General information.
Competences and indicators	Competence 6: Reporting and presenting 6.3.1. Reports (on the research) in the form of a report/lab journal according to internationally accepted criteria (partially). Competency 11 Professional development Guides own competency development: 11.1.2. Works on learning aims according to the PDP and collects evidence of competency.

	11.3.2 Looks back critically (reflects) on their own actions and learning process; learns from mistakes; is open to learning opportunities.
Test matrix	See assessment form "Reflection report" on #OnderwijsOnline - General information.
	BMCBI-R15-P
Name [exams or modular exams]	Practical work
Code [exams or modular exams]	BMCBI-R15-P
Exam and modular exam format(s)	Practical
Judgement	Grade
Minimum result	5,5
Weight factor of modular exam	1
Exam opportunities	There is only one opportunity per academic year for the modular exam P (EER paragraph 8.5).
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in OWE BMCBI-R15 applies as registration for BMCBI-R15-P
Discussion and review	Returning the completed assessment form to the student and any remarks on the form or in the professional product serves as inspection and discussion of this partial examination.
Number of examiners	Assessment by one examiner based on assessment form (Minor lecturer) filled in by the workplace supervisor
Compensation possibility	
Assessment criteria	See assessment form “Practical work R15” on #OnderwijsOnline - General information.

Competences and indicators	Competence 1: Design 1.2.1. Identifies independently which background information is required to answer the research question. 1.2.2.,(1.3.3.) Independently searches for, selects and processes information from relevant sources for scientific research 1.2.5.,(1.3.5.) Independently integrates information into a comprehensive research plan (e.g. justifying the chosen method, describing necessary controls and availability of equipment). 1.2.6. Understands and applies intermediate English literature relevant to the given context. Competence 2: Experiment Preparation 2.1.2. Performs calculations prior to beginning lab work. 2.1.5. Carries out the experiments within the stated time 2.2.1.,(2.3.1.) Can justify (all) the basic steps of the experiments theoretically 2.2.3.,(2.3.3.) Ensures (independently) that all requirements are ready before the experiment is started; makes solutions 2.2.4.,(2.3.4.) Carries out experiments according to protocol so that reliable reproducible data is obtained; (but can, if necessary, deviate from this) 2.2.6.Makes a start with execution of several experiments at the same time (multitasking) 2.3.4. Works on several experiments at the same time and can carry out these within the stated time, can switch easily and keep an overview 2.2.7. Attempts to solve problems if the experiment does not run as was anticipated (trouble shooting) / 2.3.7. Solves practical problems if the experiment does not run as expected (trouble shooting Competence 3: Results analysis 3.1.2.,(3.3.2.) Independently assesses the usability of results based on accuracy and reliability. 3.1.4. Discusses the execution and experimental results 3.2.1.,(3.3.1.) Carries out results analysis with appropriate methods (independently); if applicable uses statistics. 3.2.2.,(3.3.3.) Independently makes conclusions relating to the initial research question (if possible) and overarching research project. 3.2.5.,(3.3.5.) Independently discusses results relative to other experiments and compares them with the results in literature. 3.2.6. Makes proposals for improving the execution of the research. 3.3.7. Makes proposals for follow-up experiments. Competence 4: Quality control 4.1.1. Is aware of and adheres to the workplace health and safety rules. 4.1.3. Uses controls to evaluate the reliability of the results. Competence 5: Management and administration 5.2.1.Codes chemicals and samples and keeps these in a correct way

	5.2.2.Contributes to an efficiently functioning lab (clears up, indicates if reagents are almost finished, carries out minor maintenance on the equipment) 5.2.3. Manages and archives data in lab journal (purpose, experiments description, results, conclusion) and if required, in other ways so that others can understand these. Competence 6:Reporting/presenting 6.2.5. Presents research to audience with same background in a clear manner according to the conventional standards of presentation techniques and answers questions there is structure in the presentation (head-body-tail)speaks clearly and intelligibly; stands upright and keeps hands relaxed; makes eye contact with the audience; makes well-structured and clear slides or other visual products verbal and visual message form a whole; uses visual capabilities of PowerPoint as visual support; Conducts a substantive discussion with audience. 6.3.5 Presents research to varying audiences in a clear and convincing way, according to the conventional standards of presentation techniques and answers questions: there is structure in the presentation (head-body-tail)speaks clearly and intelligibly; stands upright and keeps hands relaxed makes eye contact with the public and checks whether the essence of the message comes across to the target group; makes well-structured and clear slides or other visual products verbal and visual message form a whole; Uses visual aids of a presentation medium effectively to communicate the message Conducts a substantive discussion with audience. Competence 7:Planning/project-based working 7.2.2. Carries out activities according to planning; also under time pressure. 7.2.3.Ensures that aims are achieved and adapts the work if required. 7.3.2. Responds to changing circumstances; determines priorities in activities. Competence 8: Teamwork Functioning in a group 8.1.1. Observes the rules. 8.2.1. Makes concrete agreements and keeps to these 8.3.4. Recognizes own role and contribution to the group and know what other roles there are in the team; functions adequately; takes others into consideration. Communication Communicates about his research with fellow students and teacher according to basic rules of communication: 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Allows others to finish speaking 8.1.9. Shows initiative to actively solve conflicts. 8.2.5. Shows initiative in conversation. 8.2.8. States his/her opinion/message clearly. 8.2.10. Interacts with with discussion partner. 8.2.7. Is aware of intercultural differences in the professional field.
Test matrix	See assessment form “Practical work R15” on #OnderwijsOnline - General information.
	BMCBI-R15-V

Name [exams or modular exams]	Report
Code [exams or modular exams]	BMCBI-R15-V
Exam and modular exam format(s)	written individual
Judgement	Grade
Minimum result	5,5
Weight factor of modular exam	1
Exam opportunities	2 opportunities per year. Deadline is the last day of the research minor. If handed in late, a 0 is given for the first chance. In consultation with the minor lecturer, a new deadline is set. Resits are possible up to 2 months after the last day of the research minor.
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in OWE BMCBI-R15 applies as registration for BMCBI-R15-V
Discussion and review	Returning the completed assessment form to the student and any remarks on the form or in the professional product serves as inspection and discussion of this partial examination.
Number of examiners	Assessment by one examiner based on assessment form (Minor lecturer).
Compensation possibility	
Assessment criteria	See assessment forms “Research report R15” or “Literature report” on #OnderwijsOnline - General information.
Competences and indicators	*General:* Competence 1: Design 1.2.1. Identifies independently which background information is required to answer the research question. 1.2.2.,(1.3.3.) Independently searches for, selects and processes information from relevant sources for scientific research 1.3.6. Understands and applies advanced English literature relevant to the given context. 1.3.7. Links own research with the overarching research project Competence 3: Results analysis 3.2.2.(3.3.3.) Independently makes conclusions relating to the initial research question (if possible) and overarching research project. 3.3.7.Makes proposals for follow-up experiments. Competence 6: Reporting and presenting 6.2.1. Reports (on his research) in the form of a report/lab journal/poster according to the in-house standards as described in ‘product criteria: lab journal and report level 2’. 6.3.1. Reports (on the research) in the form ofa report/lab journal according to internationally accepted criteria (product criteria lab journal and report level 3).

	6.2.3. Is familiar with and applies the international conventions of scientific and academic writing. *Specific for research report:* Competence 2: Experiment preparation 2.3.1. Can justify all steps of the experiments theoretically Competence 3: Results analysis 3.1.2.(3.3.2.) Independently assesses the usability of results based on accuracy and reliability. 3.1.4. Discusses the execution and experimental results 3.2.1.(3.3.1.) Carries out (independently) results analysis according suitable methods; if applicable makes use of statistics. 3.2.5.,(3.3.5.) Independently discusses results relative to other experiments and compares them with the results in literature. 3.2.6.Makes proposals for improving the execution of the research. Competence 4: Quality control 4.1.3. Uses controls to evaluate the reliability of the results. Competence 5: Management and administration 5.3.3.Manages and archives data in lab journal (purpose, experiments description, changes, results, conclusion, future proposals) and if applicable in other ways so that others can use these.
Test matrix	See assessment form “Research report R15” or “Literature report” on #OnderwijsOnline - General information.

M_ATBC-M-PR30 Research minor LS

	EEU R30 Research minor
General information	
Target group/groups	Full-time students main phase Life Sciences or Chemistry
Name of unit of study	EEU R30 Research minor
Code of unit of study	BMCBI-R30 (CHLS)
Lecture period	P1, P2, P3, P4
ECTS credits	30 EC
Study load in hours	840 SBU
Study hours (contact hours)	There are no lessons planned, the supervising lecturer has 12,5 hours allocated for supervising and evaluation. The 2nd assessor has 2,5 hours for evaluation.
Entry requirements for unit of study	Foundation year must be successfully completed. At least 50 stp have been earned in the 2nd study year and the practical assessment in the 2nd study year must be at least satisfactory. If the research minor follows the internship or graduation project, a prerequisite for starting is that the research report of the preceding internship or graduation project has been submitted to the supervisor and the portfolio assessed as satisfactory (with the exception of the research report)If the student

	does not fulfil the prerequisites, a request for exemption and permission to follow the research minor may submitted to the Examination Board.
Content and organisation	
General description	A minor must deepen or broaden the focus and have no large overlap with the major. A research minor is not an internship, as the internship is a part of the major. The aim of the research minor is therefore to focus on something new, and what has not (yet) been covered in the major. The research minor therefore consists of a theoretical component (min. 4 study points = 4x28 SBU) and a practical component where you apply what you have learned. The total duration is 20 weeks (30 credits). The theoretical component can take the form of a literature review, but can also be implemented in a different way for example by a course (MOOC) or EEU of minimally 4 study points. The research minor may be completed at the same location as the internship/graduation internship. However, the research minor remains an independent study unit. It must meet the requirements as described and will be assessed independently from the internship.
Exit qualifications	Designing an experimental plan Experiment Results analysis Quality control Management and administration Reporting and presenting Planning and project-based working Teamwork Professional development
Professional task	Carrying out life science research
Professional products	
Cohesion	Elective component of the Minor Scientific research. During the research minor, the theory presented in the preceding (selected) course unit from the scientific research minor is applied.
Mandatory participation	
Maximum number of participants	-
Compensation options	-
Activities and/or instructional formats	The personal tutor guides the student in finding a research minor that fits with the PDP. The student is responsible for finding and applying for a minor research placement. During the research minor, the student is supervised by a workplace supervisor and a lecturer from the HAN.
Required literature	Information under the tile SABC Minor on #OnderwijsOnline
Required software / required materials	
Recommended literature	

Examination	
	BMCBI-R30-Rv
Name [exams or modular exams]	Reflection report
Code [exams or modular exams]	BMCBI-R30-Rv
Exam and modular exam format(s)	In writing, individual
Judgement	Satisfactory/unsatisfactory
Minimum result	Satisfactory
Weight factor of modular exam	0
Exam opportunities	2 opportunities per year. Deadline is the last day of the research minor. If handed in late, a 0 is given for the first chance. In consultation with the minor lecturer, a new deadline is set. Resits are possible up to 2 months after the last day of the research minor.
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in OWE BMCBI-R30 applies as registration for BMCBI-R30-Rv
Discussion and review	Returning the completed assessment form to the student and any remarks on the form or in the professional product serves as inspection and discussion of this partial examination.
Number of examiners	Assessment by one examiner based on assessment form (Minor lecturer).
Compensation possibility	
Assessment criteria	See assessment form "Reflection report" on #OnderwijsOnline - General information.
Competences and indicators	Competence 6: Reporting and presenting 6.3.1. Reports (on the research) in the form of a report/lab journal according to internationally accepted criteria (partially). Competency 11 Professional development Guides own competency development: 11.1.2. Works on learning aims according to the PDP and collects evidence of competency. 11.3.2 Looks back critically (reflects) on their own actions and learning process; learns from mistakes; is open to learning opportunities.
Test matrix	See assessment form "Reflection report" on #OnderwijsOnline - General information.
	BMCBI-R30-P
Name [exams or modular exams]	Practical work
Code [exams or modular exams]	BMCBI-R30-P
Exam and modular exam format(s)	Practical

Judgement	Grade
Minimum result	5,5
Weight factor of modular exam	1
Exam opportunities	There is only one opportunity per academic year for the modular exam P (EER paragraph 8.5).
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in OWE BMCBI-R30 applies as registration for BMCBI-R30-P
Discussion and review	Returning the completed assessment form to the student and any remarks on the form or in the professional product serves as inspection and discussion of this partial examination.
Number of examiners	Assessment by one examiner based on assessment form (Minor lecturer) filled in by the workplace supervisor
Compensation possibility	
Assessment criteria	See assessment form “Practical work R30” on #OnderwijsOnline - General information.
Competences and indicators	Competence 1: Design 1.2.1. Identifies independently which background information is required to answer the research question. 1.2.2.,(1.3.3.) Independently searches for, selects and processes information from relevant sources for scientific research 1.2.5.,(1.3.5.) Independently integrates information into a comprehensive research plan (e.g. justifying the chosen method, describing necessary controls and availability of equipment). 1.2.6. Understands and applies intermediate English literature relevant to the given context. Competence 2: Experiment Preparation 2.1.2. Performs calculations prior to beginning lab work. 2.1.5. Carries out the experiments within the stated time 2.2.1., (2.3.1.) Can justify (all) the basic steps of the experiments theoretically 2.2.3., (2.3.3.) Ensures (independently) that all requirements are ready before the experiment is started; makes solutions 2.2.4.,(2.3.4.) Carries out experiments according to protocol so that reliable reproducible data is obtained; (but can, if necessary, deviate from this) 2.2.6. Makes a start with execution of several experiments at the same time (multitasking) / 2.3.4. Works on several experiments at the same time and can carry out these within the stated time, can switch easily and keep an overview 2.2.7. Attempts to solve problems if the experiment does not run as was anticipated (trouble shooting) / 2.3.7. Solves practical problems if the experiment does not run as expected (trouble shooting Competence 3: Results analysis

	3.1.2.,(3.3.2.) Independently assesses the usability of results based on accuracy and reliability. 3.1.4. Discusses the execution and experimental results 3.2.1.,(3.3.1.) Carries out results analysis with appropriate methods (independently); if applicable uses statistics. 3.2.2.,(3.3.3.) Independently makes conclusions relating to the initial research question (if possible) and overarching research project. 3.2.5.,(3.3.5.) Independently discusses results relative to other experiments and compares them with the results in literature. 3.2.6. Makes proposals for improving the execution of the research. 3.3.7. Makes proposals for follow-up experiments. Competence 4: Quality control 4.1.1. Is aware of and adheres to the workplace health and safety rules. 4.1.3. Uses controls to evaluate the reliability of the results. Competence 5: Management and administration 5.2.1. Codes chemicals and samples and keeps these in a correct way 5.2.2. Contributes to an efficiently functioning lab (clears up, indicates if reagents are almost finished, carries out minor maintenance on the equipment) 5.2.3. Manages and archives data in lab journal (purpose, experiments description, results, conclusion) and if required, in other ways so that others can understand these. Competence 6: Reporting/presenting 6.2.5. Presents research to audience with same background in a clear manner according to the conventional standards of presentation techniques and answers questions there is structure in the presentation (head-body-tail)speaks clearly and intelligibly; stands upright and keeps hands relaxed; makes eye contact with the audience; makes well-structured and clear slides or other visual products verbal and visual message form a whole; uses visual capabilities of PowerPoint as visual support; Conducts a substantive discussion with audience. 6.3.5. Presents research to varying audiences in a clear and convincing way, according to the conventional standards of presentation techniques and answers questions: there is structure in the presentation (head-body-tail)speaks clearly and intelligibly; stands upright and keeps hands relaxed makes eye contact with the public and checks whether the essence of the message comes across to the target group; makes well-structured and clear slides or other visual products verbal and visual message form a whole; Uses visual aids of a presentation medium effectively to communicate the message Conducts a substantive discussion with audience. Competence 7: Planning/project-based working 7.2.1. Plans and organises his experiments resulting in a work plan that covers a minimum of 4 lessons to prepare for practical 7.2.2. Carries out activities according to planning; also under time pressure. 7.2.3. Ensures that aims are achieved and adapts the work if required.

	7.3.1. Plans and organises his project resulting in a work plan of a minimum of 4 weeks. 7.3.2. Responds to changing circumstances; determines priorities in activities. Competence 8: Teamwork Functioning in a group 8.1.1. Observes the rules. 8.2.1. Makes concrete agreements and keeps to these 8.3.4. Recognizes own role and contribution to the group and know what other roles there are in the team; functions adequately; takes others into consideration. Communication Communicates about his research with fellow students and teacher according to basic rules of communication: 8.1.6. Maintains eye contact with conversation partner. 8.1.7. Allows others to finish speaking 8.1.9. Shows initiative to actively solve conflicts. 8.2.5. Shows initiative in conversation. 8.2.8. States his/her opinion/message clearly. 8.2.10. Interacts with with discussion partner. 8.2.7. Is aware of intercultural differences in the professional field.
Test matrix	See assessment form “Practical work R30” on #OnderwijsOnline - General information.
	BMCBI-R30-V
Name [exams or modular exams]	Research report
Code [exams or modular exams]	BMCBI-R30-V
Exam and modular exam format(s)	written individual
Judgement	Grade
Minimum result	5,5
Weight factor of modular exam	1
Exam opportunities	2 opportunities per year. Deadline is the last day of the research minor. If handed in late, a 0 is given for the first chance. In consultation with the minor lecturer, a new deadline is set. Resits are possible up to 2 months after the last day of the research minor.
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in OWE BMCBI-R30 applies as registration for BMCBI-R30-V
Discussion and review	Returning the completed assessment form to the student and any remarks on the form or in the professional product serves as inspection and discussion of this partial examination.
Number of examiners	Assessment by two examiners based on assessment form (Minor lecturer and 2nd assessor).
Compensation possibility	

Assessment criteria	See assessment form “Research report R30” on #OnderwijsOnline - General information.
Competences and indicators	Competence 1: Design 1.2.2.,(1.3.3.) Independently searches for, selects and processes information from relevant sources for scientific research 1.3.6. Understands and applies complex English literature relevant to the given context. 1.3.7. Links own research with the overarching research project Competence 2: Experiment preparation 2.3.1. Can justify all steps of the experiments theoretically Competence 3: Results analysis 3.1.2. (3.3.2.) Independently assesses the usability of results based on accuracy and reliability. 3.1.4. Discusses the execution and experimental results 3.2.1. (3.3.1.) Carries out (independently) results analysis according suitable methods; if applicable makes use of statistics. 3.2.2. (3.3.3.) Independently makes conclusions relating to the initial research question (if possible) and overarching research project. 3.2.5., (3.3.5.) Independently discusses results relative to other experiments and compares them with the results in literature. 3.2.6. Makes proposals for improving the execution of the research. 3.3.7. Makes proposals for follow-up experiments. Competence 4: Quality control 4.1.3. Uses controls to evaluate the reliability of the results. Competence 5: Management and administration 5.3.3. Manages and archives data in lab journal (purpose, experiments description, changes, results, conclusion, future proposals) and if applicable in other ways so that others can use these. Competence 6: Reporting and presenting 6.2.1. Reports (on his research) in the form of a report/lab journal/poster according to the in-house standards as described in ‘product criteria: lab journal and report level 2’. 6.3.1. Reports (on the research) in the form of a report/lab journal according to internationally accepted criteria (product criteria lab journal and report level 3). 6.2.3. Is familiar with and applies the international conventions of scientific and academic writing.
Test matrix	See assessment form “Research report R30” on #OnderwijsOnline - General information.
	BMCBI-R30-L
Name [exams or modular exams]	Literature review

Code [exams or modular exams]	BMCBI-R30-L
Exam and modular exam format(s)	In writing, individual
Judgement	Grade
Minimum result	5,5
Weight factor of modular exam	1
Exam opportunities	2 opportunities per year. Deadline is the last day of the research minor. If handed in late, a 0 is given for the first chance. In consultation with the minor lecturer, a new deadline is set. Resits are possible up to 2 months after the last day of the research minor.
Permitted resources	
Method of enrolment for exam / enrolment period	Participation in OWE BMCBI-R30 applies as registration for BMCBI-R30-L
Discussion and review	Returning the completed assessment form to the student and any remarks on the form or in the professional product serves as inspection and discussion of this partial examination.
Number of examiners	Assessment by two examiners based on assessment form (Minor lecturer and 2nd assessor).
Compensation possibility	
Assessment criteria	See assessment form “Literature report” on #OnderwijsOnline - General information.
Competences and indicators	Competence 1: Design 1.2.1. Identifies independently which background information is required to answer the research question. 1.2.2., (1.3.3.) Independently searches for, selects and processes information from relevant sources for scientific research 1.3.7. Links own research with the overarching research project 1.2.6. Understands and applies intermediate English literature relevant to the given context Competence 3: Results analysis 3.3.3. Independently makes conclusions relating to the initial research question (if possible) and overarching research project. 3.3.7. Makes proposals for follow-up experiments. Competence 6: Reporting and presenting 6.2.1. Reports (on his research) in the form of a report/lab journal/poster according to the in-house standards as described in ‘product criteria: lab journal and report level 2’. 6.3.1. Reports (on the research) in the form ofa report/lab journal according to internationally accepted criteria (product criteria lab journal and report level 3). 6.2.3. Is familiar with and applies the international conventions of scientific and academic writing.
Test matrix	See assessment form “Literature report” on #OnderwijsOnline - General information.

9.4 Graduation specialisations

The study program Chemie (Dutch) has the following graduation specialisations: Organic and Polymerchemistry and Analytical chemistry. These include the following educational units with the associated study load. The Course unit descriptions can be found in section 9.2.

Graduation specialisation Organic and Polymer chemistry
- Course unit 9: C9 (30 credits)
- Course unit 13: C13 (30 credits)
- Course unit 14: C14 (30 credits)

Graduation specialisation Analytical chemistry:
- Course unit 11: C11 (15 credits)
- Course unit 12: C12 (15 credits)
- Course unit 13: C13 (30 credits)
- Course unit 14: C14 (30 credits)

Level 3 of the post-propaedeutucal phase of the Chemistry degree program (English variant) starts in the academic year 2021-2022.

9.5 Honours, talent and bridging programs

9.5.1 Honours programs

Not applicable

9.5.2 Talent programs

The degree program has no talent program, but it has an extra-curricular Analytical Sciences Talent Program (ASTP) in the area of analytical chemistry. The ASTP is offered by the Centre of Expertise Analytical Sciences, a partnership between HAN and COAST. The three-year ASTP program is not a part of the curriculum. The program is concluded with a COAST certificate; there is no mention of the ASTP program on the HAN Bachelor Diploma.

9.5.3 Bridging programs

The bridging programs (EER Chapter 5) offered by a university can be followed as part of a free minor.

9.6 Part-time and/or work-study degree format

9.6.1 Part-time degree format

Not applicable

9.6.2 Work-study degree format

Not applicable

9.7 Tracks with special feature

9.7.1 Fast track

Not applicable

9.7.2 Abridged track

For some well-defined target groups it is possible on the basis of exemptions to follow an abridged version of the degree course.

1. Composition of the abridged version of the degree course for Biology and Medical Laboratory Research, Life Sciences and Chemistry.

1.1
The following certificates lead to an abridged programme:

a. Students with a **MLO-4 diploma** who enroll in the BML, Life Sciences or Chemistry degree course receive exemption based on their MLO-4 diploma for Course units CHLS1B and CHLS2B (Practical and tutor) and Course units CHLS1C and CHLS2C (Basic knowledge LS and CH) and the mini-internship (CH4T-st).
b. Students with a **VWO diploma** including the profile subjects Maths A or B and Chemistry who enroll in the BML, Life Sciences or Chemistry degree course can participate in the abridged programme. They obtain exemption for the modular exams Labcalculation (CHLS1A-Lab and CHLS2A-Lab) with a qualification 7 or higher for Chemistry on the VWO-diploma and exemption for the modular exam Maths (CHLS1A-Wis and CHLS2A-Wis) with a qualification 7 or higher for Maths B on the VWO-diploma.
c. Students with a HBO or WO certificate or a certificate of related HBO or WO examinations based on which participation in the abridged programme can be justified. A foreign certificate of related examinations should be at least equivalent to HBO-level.

Students are not required to take the abridged programme, thery are free to choose for the regular 4-year degree programme.

1.2
The Examination Committee will grant students with a VWO or MLO diploma as referred to in 1.1, that wish to enroll in the BML, Life Sciences or Chemistry Degree access to the taking of one or more components of the final examination before the foundation year examination has been successfully completed.

1.3
Students referred to in paragraph 1.1 meet the requirements for the foundation year exam if it can be shown that course units CHLS1A and CHLS2A have been completed and the professional tasks of Course 3 and Course 4, including General Higher Vocational Education competences are mastered at level 1 by passing the exams associated with:

a. Course units CH3KPT and Course units CH4KPT (Level 1) including the Higher Professional Education competences Level 1.

or

b. Course unit CH6K, CH6-8Po (or CH5-7Po), CH6T (or CH8T) and Course unit CH5K, CH5-7Pa (or CH6-8Pa), CH5T from the second year of the degree course Chemie (level 2) and the Higher Professional Education competences Level 1. Course unit CH6K gives excemption for CH3K. CH6-8Po (or CH5-7Po) gives excemption for CH3P. CH6T (or CH8T) gives exemption for CH3T. Course unit CH5K gives exemption for CH4K. CH5-7Pa (or CH6-8Pa) gives excemption for CH4P. CH5T and the Higher Professional Education Competences level 1 give exemption for CH4T.

or

c. Module A (level 2), the Higher Professional Education competences Level 1, and BMC1 (or BHCK) of the part-time degree course Chemie.

After passing course units CHS3 and CHS4, exemption is granted for course units CHLS1B, CHLS1C, CHLS2B and CHLS2C, when these exemptions were not granted earlier (based on the MLO-4 diploma).

1.4

a. In case of 1.3 if the student can prove, as referred to in 1.1 that he has passed a (modular) exam associated with a course unit at a higher level, he has also passed this (modular) examination associated

with a course unit at a lower level (see course unit descriptions). This rule does not apply if the student participates in the course unit at the lower level.

b. For all other students, the examination committee decides whether the student that demonstrates components at a higher level also has mastered the components at a lower level.

9.7.3 Abridged track from associate to bachelor degree

Not applicable

9.7.4 Track for elite athletes

Not applicable

9.7.5 D-stream

Not applicable

9.7.6 Combined track

Not applicable

9.7.7 Other track with special feature

Not applicable