GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Organic Chemistry 2: Advanced Reactivity (0000092)

Course size *(nominal values; actual values may depend on programme)*

Credits 5.0 **Study time 150 h**

Course offerings and teaching methods in academic year 2024-2025

A (semester 2)	English	Incheon	practical
			lecture

Lecturers in academic year 2024-2025

Wu, Di	KRO1	lecturer-in-charge

Offered in the following programmes in 2024-2025	crdts	offering
Bachelor of Science in Environmental Technology	5	A
Bachelor of Science in Food Technology	5	A
Bachelor of Science in Molecular Biotechnology	5	A
Joint Section Bachelor of Science in Environmental Technology, Food Technology and Molecular Biotechnology	5	A

Teaching languages

English

Keywords

Organic chemistry, nomenclature, addition reactions, substitutions reactions, industrial relevant rearrangement reactions, advanced chemical reactivity, retrosynthesis, polymers, detailed reaction mechanisms

Position of the course

The course of 'Organic Chemistry II' is a continuation of 'Organic Chemistry I'. Topics such as electrophilic addition reactions, electrophilic aromatic substitution reactions, nucleophilic substitution reactions, S_N1 and S_N2, and elimination reactions E1 and E2 are retaken in a much deeper detail than in 'Organic Chemistry I'. Also, the stability of organic compounds, intermolecular reactions and interactions are addressed. The central part of the course comprises the advanced study of different mechanisms of chemical reactions, which are linked to functional groups. A good knowledge of chemical reactivity is essential in the course. This knowledge is then applied to a number of classes of compounds, natural products and industrial materials, on a more advanced level than in Organic Chemistry I. Attention is paid to the relevant link between organic chemistry and every day's life and agrochemical and pharmaceutical sciences. Especially, some typical compounds for biochemistry are highlighted with respect to their formation mechanisms. Additionally, attention is paid to the industrial preparation of the most important industrial (intermediate) compounds (e.g., benzene, acetaldehyde…) and the principles of oil refinery. Natural products, an introduction on the use of dyes and synthesis and applications of the most common polymers are included. Laboratory experiments help the student to acquire the needed insights in Organic Chemistry. Priority is given to the understanding of the chemical reactivity of the compounds that are used and their properties. The different mechanisms of chemical reactions are illustrated by means of selected practical exercises. These experiments are accompanied by an introduction concerning safety and toxicology and a theoretical explanation of the different exercises.

Contents

1. Theory:
- Repetition of reactions from 'Organic Chemistry I'

- Nomenclature of polycyclic hydrocarbons (e.g. spiro compounds, terpenes, steroids...)
- Alkenes and alkynes: reactions (addition reactions, Markovnikov, hydroboration)
- Aromatic compounds (electrophilic substitution reactions in five- and six-membered rings)
- Substitution and elimination reactions (S_N1 and S_N2; E1 and E2)
- Stability of organic compounds
- Intermolecular reactions
- Retrosynthesis
- Reactions mechanisms, applied to the synthesis/retrosynthesis of halogen compounds, alcohols, phenols, ethers, amines, carbonyl compounds, carbon-nitrogen double and triple bonds, heterocyclic aromatic compounds, sulphur and phosphorous compounds...
- Natural products (biodiesel production)
- Industrial preparation of the most important industrial (intermediate) compounds (e.g., benzene, acetaldehyde...)
- Principles of oil refinery (optional)
- Dyes and pigments (examples of synthesis)
- Polymers (synthesis and properties)

2. Practical sessions:
- 1.3-diphenyl-2-propenone (aldol condensation)
- Isoamyl acetate synthesis (esterification, cfr. aroma products)
- Diphenylmethanol synthesis (reduction)
- Aspirine synthesis (analgetic)
- Biodiesel (transesterification)
- Phenoxyacetic acid (cfr. Herbicides - Williamson ether synthesis)
- Methyl orange synthesis
- Synthesis of nylon
- Niacinamide detection in cosmetics (optional)
- HPLC determination of compounds in energy drinks (caffeine and B6) (optional)

Initial competences

The student should be familiar with the concepts given in Organic Chemistry 1

Final competences

1 Know the following concepts: advanced nomenclature, molecular structure of C bonds, electrophilic addition reactions, electrophilic aromatic substitution reactions, nucleophilic substitution reactions, and elimination reactions, stability of organic compounds, acid and bases.
2 Have insight in: relevant link between organic chemistry and every day's life and agrochemical life, detailed notion in organic molecules, with their elements, bonds, steric structure, stability, mutual interaction; elaboration of reaction mechanisms; interpretation of physical and chemical properties of functional groups; good knowledge of chemical reactivity (advanced level – retrosynthetic analysis).
3 Have experience in organic chemistry laboratory, able to handle organic compounds (safety), know safety principles, able to perform simple experiments and purification methods

Conditions for credit contract

Access to this course unit via a credit contract is unrestricted: the student takes into consideration the conditions mentioned in 'Starting Competences'

Conditions for exam contract

Access to this course unit via an exam contract is unrestricted

Teaching methods

Lecture, Practical

Extra information on the teaching methods

Lecture, 30 hrs
Practical, 30 hrs

Study material

Type: Handouts

Name: Course Notes and Lecture PPT
Indicative price: Free or paid by faculty
Optional: no

References

John McMurry, Organic Chemistry. 8th edition. Cengage Learning.
Dewick P. M. Essentials of Organic Chemistry. John Wiley & Sons.
Hart H., Hadad C. M., Craine L. E., Hart D. J. Organic Chemistry, A Short Course, 13th edition. Houghton Mifflin Company.
Solomons T. W., Fryhle C. B., Snyder S. A. Organic Chemistry, 11th edition. Wiley.
Wade L. G. Organic Chemistry, 8th edition. Prentice Hall.

Course content-related study coaching

Professor and assistants have office hours to give a possibility for extra input/explanation/... after the scheduled course hours.

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment with multiple-choice questions, Written assessment with open-ended questions

Examination methods in case of periodic assessment during the second examination period

Written assessment with multiple-choice questions, Written assessment with open-ended questions

Examination methods in case of permanent assessment

Participation, Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is not possible

Extra information on the examination methods

During the first and second examination period, the periodic evaluation accounts for 50% (10/20) for the final score. The non-periodic evaluation takes up 50% (10/20). This non-periodic evaluation consists of 5% for presence and attitude (participation) during lectures and lectures for plenary exercises and coached exercises, 25% for pop-up quizzes during exercise classes, and for 20% on laboratory reports (assignment) to be made during the laboratory exercises (Practical + Group work). No telephones are allowed during classes.
A pop-up quiz is organized every exercise session and covers the previous theory classes (until previous pop-up quiz). All pop-up quizzes are scored onto 20 pts, the weighting factor is the number of theory classes, prior to the pop-up quiz, and the weighted total sum is reduced to 5 points for the final result (maximally 5/20).
All laboratory practical session reports have to be delivered to the assistant at the end of the session (unless differently announced) and they are scored onto 20 pts; the total is reduced to 4 points for the final result (maximally 4/20). The practical sessions are mandatory to attend.
If students are legally absent for a pop-up quiz due to sickness, the pop-up quiz has to be retaken during a later moment (a subsequent exercise class or during break of theory class) or during the catch-up activity week (week 13 in the semester) if a student is not present in week 12. Legal absence is justified by legal documents (doctor's note, Korean Army note...), handed in to GUGC Academic Affairs. In any other cases, the session will be scored as 0/20.
If students are legally absent for laboratory practical sessions due to sickness, practical session (or a replacing session) has to be taken during the catch-up activity week (week 13 in the semester). Legal absence is justified by legal documents (doctor's note, Korean Army note...), handed in to GUGC Academic Affairs. In any other cases, the session will be scored as 0/20.
The written examination (maximally 10/20) exists of a part open questions (maximally 8/20) and multiple choice questions (maximally 2/20).
If different courses collide in the teaching schedule for non-model trajectory students, the course from the year in which the student is enrolled has priority and no special (re)arrangements are made for this student.
Student can be granted an exemption for the practical sessions (for maximally 4/20), if they passed them the academic year before (at least 2/4). This exemption

only reflects the practical laboratory sessions; the pop-up quizzes are not part of this, i.e., these have to be redone in the current academic year.
To qualify for passing, (1) both the score of the practical session needs to be higher than 2/4 and (2) the total score (= summation of the score for periodic evaluation, maximal 10 pts, laboratory reports, maximal 4 pts, and the participation and pop-up quizzes, maximal 5 pts, and score for participation) needs to be at least 10/20.
Students who eschew period aligned and/or non-period aligned evaluations for this course unit may be failed by the examiner.
In case that the contribution to the final score, regarding physical presence, pop-up quizzes or laboratory report scores, are jeopardized by the measures taken due to the Covid-19 situation, appropriate changes in score distribution will be executed and communicated to the students in advance.During the second examination period, the non-periodic evaluation (maximal 10 pts) cannot be retaken.

Calculation of the examination mark

5% participation (presence and attitude)
25% pop-up quizzes
20% Laboratory reports (assignment to be handed in after each laboratory session)
50% Written exam