

**Advanced Organic Chemistry (C004125)**

**Cursusomvang** (nominale waarden; effectieve waarden kunnen verschillen per opleiding)

**Studiepunten 6.0**

**Studietijd 180 u**

**Aanbodsessies en werkvormen in academiejaar 2024-2025**

A (semester 1)

Engels

Gent

hoorcollege

werkcollege

**Lesgevers in academiejaar 2024-2025**

Madder, Annemieke

WE07

Verantwoordelijk lesgever

Cazin, Catherine

WE06

Medelesgever

Nolan, Steven

WE06

Medelesgever

Oelgemöller, Michael

WE07

Medelesgever

**Aangeboden in onderstaande opleidingen in 2024-2025**

**stptn**

**aanbodssessie**

Educatieve Master of Science in de wetenschappen en technologie (afstudeerrichting chemie)

6

A

Master of Science in Chemistry (afstudeerrichting (Bio)Organic and Polymer Chemistry)

6

A

Master of Science in de bio-ingenieurswetenschappen: chemie en bioprocestechnologie

6

A

Uitwisselingsprogramma chemie (niveau master)

6

A

**Onderwijstalen**

Engels

**Trefwoorden**

Transition metals, ligands, elementary steps, M-C bonds, M=C bonds, Organic chemistry of biomolecules, solid supported chemistry, peptides, carbohydrates, oligonucleotides, diversity oriented synthesis, organocatalysis, light induced synthesis.

**Situering**

This course is taught in master 1 when the student has acquired a sound basis in organic chemistry during the bachelor through the following courses: 'Chemical structures' (Ba1); 'Organic reactivity 1', 'Organic reactivity 2', 'Structural analysis' (Ba2) and 'Synthetic methods in Organic chemistry' (Ba3). This course aims at allowing the students to gain insight in research related novel techniques and concepts in organic and organometallic chemistry more specifically focused on biomolecules and on organometallic chemistry and transition metal complexed. Furthermore it aims at familiarizing the student with the concepts and applications of photo-induced organic chemistry. It is given as module offered to all students in the '(bio)organic and polymer chemistry' track, and the contents of this course are integrated in the course 'Experiments in (Bio)Organic and Polymer Chemistry' at the end of this semester. The modules organometallic chemistry and photo/bioorganic chemistry are accessible as Advanced Topics in Chemistry.

**Inhoud**

1. The lectures on organometallic chemistry will focus on:
  - (a) d-electron configuration (oxidation states, 18-electron rule)
  - (b) ligand properties (electronic, steric, hapticity, modes of coordination, Tolman electronic parameter, cone angle, percent buried volume)
  - (c) ligand families (1 to 6 electron donors, arenes, phosphines, carbenes)
  - (d) synthetic access to transition metal complexes
  - (e) elementary steps of organometallic species (ligand substitution, oxidative

- addition, reductive elimination, sigma-bond metathesis, migratory insertion)
- (f) chiral ligands and chirality in organometallic species
- (g) major applications of organometallic species
- 2. The guided exercises on organometallic chemistry will comprise:
  - (a) electron counting
  - (b) determination of steric and electronic properties of ligands
  - (c) organometallic problem solving
- 3. The lectures on biomolecular chemistry and organic photochemistry will focus on:
  - (a) Solid Phase Chemistry and Diversity Oriented Synthesis:
    - definition and historical perspective
    - combinatorial synthesis in solution
    - synthesis on solid support
    - identification and characterisation of library members
    - applications in oligopeptide and oligonucleotide synthesis, antisense/antigene strategy
  - (b) Organocatalysis:
    - introduction to organocatalysis
    - enamine, iminium en H-bond catalysis: aldol reactions, Mannich reactions, conjugated additions
    - biomimetic catalysis
  - (c) Light induced chemistry and photochemical reactions:
    - Jablonski diagrams
    - direct photochemical reaction types
    - photo(redox)catalysis and photosensitization

#### **Begincompetenties**

Having followed the courses 'Chemical structures' (Ba1), 'Organic reactivity 1', 'Organic reactivity 2', 'Structural analysis' (Ba2) and 'Synthetic methods in Organic chemistry' (Ba3) or being acquainted with the competences that were aimed for in these courses

#### **Eindcompetenties**

- 1 The student will have gained knowledge and understanding of the definitions and applications of organometallic chemistry.
- 2 The student will know electronic and steric properties of ligands and how these affect reactivity.
- 3 The student will be able to solve problems related to transition metal complex reactivity and stability.
- 4 To be able to recognize and name theoretical core concepts from biomolecular chemistry and organic photochemistry, and to illustrate them with a self-given example.
- 5 Being able to recognize and name common biomolecular compounds, their building blocks and precursors.
- 6 To have knowledge and insight into recent developments in synthetic methods and applications of organic chemistry specifically aimed at carbohydrates, peptides and oligonucleotides.
- 7 To have insight into the principles and possibilities of light-induced chemistry, and to be able to apply these to a given example.
- 8 To be able to integrate information from internationally published scientific literature within the field of biomolecular and organic (photo)chemistry.
- 9 Communicate about new developments within the field.
- 10 To be able to evaluate a photochemical process and suggest suitable conditions for a given transformation.
- 11 To be able to evaluate the orthogonality of standard reagents and protecting groups in biomolecular chemistry.
- 12 To propose suitable conditions for the synthesis of a simple target biomolecular compound (carbohydrate / oligonucleotide / peptide).
- 13 To be able to solve simple synthesis problems using modern organometallic, organocatalytic and photochemical methods.

#### **Creditcontractvoorwaarde**

Toelating tot dit opleidingsonderdeel via creditcontract is mogelijk na gunstige beoordeling van de competenties

#### **Examencontractvoorwaarde**

Dit opleidingsonderdeel kan niet via examencontract gevolgd worden

### **Didactische werkvormen**

Werkcollege, Hoorcollege

### **Studiemateriaal**

Type: Slides

Naam: Advanced Organic Chemistry

Richtprijs: Gratis of betaald door opleiding

Optioneel: nee

Taal : Engels

Aantal slides : 400

Beschikbaar op Ufora : Ja

Bijkomende info: De slides bevatten een kopie van het effectief getoonde materiaal, aangevuld met extra nota's met informatie ter ondersteuning van het getoonde materiaal.

### **Referenties**

Recommended reading but not required:

"Organotransition metal chemistry – From bonding to catalysis": John Hartwig, University Science Books (Sausalito, California), 2010, ISBN 978-1-891389-53-5.

### **Vakinhoudelijke studiebegeleiding**

The lecturer-in-charge can be approached after the lectures to answer questions, or can be contacted by email to ask questions or make an appointment for a meeting.

### **Evaluatiemomenten**

periodegebonden evaluatie

### **Evaluatievormen bij periodegebonden evaluatie in de eerste examenperiode**

Schriftelijke evaluatie met open vragen

### **Evaluatievormen bij periodegebonden evaluatie in de tweede examenperiode**

Schriftelijke evaluatie met open vragen

### **Evaluatievormen bij niet-periodegebonden evaluatie**

### **Tweede examenkans in geval van niet-periodegebonden evaluatie**

Niet van toepassing

### **Eindscoreberekening**

100% Periodic evaluation.

Exam will have two parts:

- 50% on organometallic chemistry content
- 50% on biomolecular/organic photochemistry contents