

Enzyme-Catalyzed Organic Synthesis: Principles and Applications (C004458)

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

Studiepunten 4.0

Studietijd 120 u

Aanbodsessies en werkvormen in academiejaar 2025-2026

A (semester 2)

Engels

Gent

hoorcollege

0.0u

Lesgevers in academiejaar 2025-2026

Aangeboden in onderstaande opleidingen in 2025-2026

stptn

aanbodsessie

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

4

A

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

4

A

Uitwisselingsprogramma chemie (niveau master)

4

A

Onderwijstalen

Engels

Trefwoorden

Enzymatic catalysis, molecular recognition, enzyme models, synzymes, abzymes, catalytic antibodies, enzyme inhibitors.

Enzyme-mediated (asymmetric) organic synthesis, enzyme-catalyzed kinetic resolution, enzyme-catalyzed enantioselective transformations, organocatalysis.

Situering

The principles of enzyme catalysis are discussed, making the students aware of the link between biochemical processes and organic chemistry. Mechanistic aspects of biochemical processes and molecular recognition on the molecular level are discussed.

The course illustrates how this knowledge can be applied for the design of enzyme models ("synzymes"), enzyme inhibitors for medical application, and catalytic antibodies ("abzymes").

Further, the use of enzymes for catalyzing (asymmetric) organic transformations is thoroughly illustrated and compared with alternative non-enzymatic approaches (in this respect, the course is *complementary* to the course on Asymmetric Synthesis).

Attention will also be dedicated to combined transition metal-enzymatic approaches, and to the application of the underlying principles of enzyme catalysis to design organocatalysts (cf. the Nobel Prize Chemistry 2021 for List and MacMillan).

The course builds further on the knowledge acquired in all previous organic chemistry courses (bachelor and master 1).

Inhoud

- Introduction
- Enzymatic catalyses: principles
- Enzyme models (synzymes)
- Abzymes: antibodies as tailor-made biocatalysts
- Enzyme-inhibitors: way of action and rational design
- Use of enzymes in (asymmetric) synthesis: (for each enzyme type also the mechanism will be discussed)
 - Hydrolases: esterases, lipases, proteases
 - Oxido-reductases: reduction of aldehydes and ketones with isolated enzymes; recycling of the cofactor; reduction with whole cells

- Oxidation reactions: hydroxylation, epoxidation, Baeyer-Villiger
- Formation of C-C bonds: Aldol reactions, acyloin reactions
- Addition and elimination reactions: cyanohydrin formation, addition of water and ammonia
- Halogenation and dehalogenation reactions
- Glycosyl transfer reactions
- Combined enzyme-transition metal catalyzed reactions
- Enzyme principles applied: Organocatalysis (cf. Nobel Prize Chemistry 2021 List en MacMillan!)
- Illustrations of (asymmetric) syntheses with enzymes and comparison with alternative approaches

Begincompetenties

Have acquired extended knowledge in the field of organic chemistry: both basic as well as advanced level.

Eindcompetenties

- 1 Thorough insight in the chemistry of bioorganic processes and molecular recognition.
- 2 Knowledge of the principles of enzyme catalysis.
- 3 Application of the principles of enzyme catalysis for designing enzyme models, enzyme inhibitors and catalytic antibodies.
- 4 Ability to recognize the relationship between "bio"chemistry and organic chemistry.
- 5 Thorough insight in the methods and principles of (asymmetric) enzyme-mediated synthesis.
- 6 Ability to compare and evaluate enzyme-mediated synthetic approaches with alternative non-enzymatic ones.
- 7 Insight in the principles and application of organocatalysis in synthesis.
- 8 Ability to use the acquired knowledge for solving synthetic problems.
- 9 Ability to understand and follow new developments in the field via the literature.

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

Hoorcollege

Studiemateriaal

Type: Handboek

Naam: K. Faber: Biotransformations in Organic Chemistry -A textbook (7th ed.), Springer Verlag, Berlin, Germany, 2018.

Richtprijs: Gratis of betaald door opleiding

Optioneel: nee

Taal : Engels

Online beschikbaar : Ja

Beschikbaar in de bibliotheek : Ja

Bijkomende info: Volledig online beschikbaar via de bibliotheek. Een pdf van het boek wordt ook ter beschikking gesteld Ufora.

Type: Handboek

Naam: H. Dugas: Bioorganic chemistry. A chemical approach to enzyme action.(3rd ed.), Springer Verlag, Berlin, Germany, 1996.

Richtprijs: Gratis of betaald door opleiding

Optioneel: nee

Taal : Engels

Bijkomende info: Kopietjes van de paar behandelde hoofdstukken als pdf beschikbaar via Ufora.

(Goedgekeurd)

Referenties

- H. Dugas: Bioorganic chemistry. A chemical approach to enzyme action.(3rd ed.), Springer Verlag, Berlin, Germany, 1996.
- K. Faber: Biotransformations in Organic Chemistry -A textbook (7th ed.), Springer Verlag, Berlin, Germany, 2018.

Vakinhoudelijke studiebegeleiding

Discussion of problems is possible after each course, or upon individual appointment.

Evaluatiemomenten

periodegebonden evaluatie

Evaluatievormen bij periodegebonden evaluatie in de eerste examenperiode

Mondelinge evaluatie, Schriftelijke evaluatie met open vragen

Evaluatievormen bij periodegebonden evaluatie in de tweede examenperiode

Mondelinge evaluatie, Schriftelijke evaluatie met open vragen

Evaluatievormen bij niet-periodegebonden evaluatie**Tweede examenkans in geval van niet-periodegebonden evaluatie**

Niet van toepassing

Toelichtingen bij de evaluatievormen

Insight in the basic concepts of the course will be checked, as well as the ability to apply these concepts to solve concrete problems.

Eindscoreberekening

100% periodegebonden evaluatie