UNIVERSITÀ DI PISA

FINE CHEMISTRY FOR INDUSTRY

ANTONELLA PETRI

Anno accademico	2020/21
CdS	INDUSTRIAL CHEMISTRY
Codice	152CC
CFU	6

Moduli	Settore/i	Tipo	Ore	Docente/i
CHIMICA FINE PER L'INDUSTRIA	CHIM/06	LEZIONI	48	ANTONELLA PETRI

Learning outcomes

Knowledge

- The course allows students to acquire knowledge about the methods for obtaining enantiopure compounds and their application in industrial processes for the synthesis of Fine Chemicals. Particular attention will be given to asymmetric catalysis and the use of biocatalysts for the preparation of biologically active compounds.

Assessment criteria of knowledge

- Knowledge assessment will be carried out through the evaluation of participation in the discussions that will be held in the classroom at the end of each topic.

Skills

By the end of the course:

- the student should be able to demonstrate that he has learned the topics presented in the course and be able to evaluate the effectiveness of the different methods proposed.

Assessment criteria of skills

- Use of the concepts learned in the course during classroom discussions.

Behaviors

- The student will develop the ability to deepen the topics presented in the course through the use of additional teaching material and bibliography.

Assessment criteria of behaviors

- During the final examination, the student's ability to deepen and to discuss the topics using an appropriate language will be assessed.

Prerequisites

- Fundamentals of organic chemistry

Teaching methods

- The course consists of lectures and discussions.
- Power point presentations are used during the lectures.

- The teacher will be available to respond to students inquiries and requests for assistance and will communicate with them by e-mail.

Syllabus

- Introduction: definition of fine chemicals and importance of obtaining enantiomerically pure compounds. Basic concepts of stereochemistry. Optical activity, optical purity, enantiomeric excess. Measurement of enantiomer excess. Chirality and biological activity.
- Main strategies for obtaining enantiomerically pure compounds. Resolution of racemates. Crystallization. Kinetic resolution. Synthesis of enantiomerically pure compounds from the "Chiral pool".
- Asymmetric catalytic synthesis. Asymmetric oxidation reactions. Asymmetric epoxidation of allylic alcohols. Asymmetric epoxidation of unfunctionalized olefins. Asymmetric cis hydroxylation. Asymmetric reduction reactions. Asymmetric hydrogenation of double bonds C = C. Asymmetric hydroboration of carbonyl compounds.
- Introduction to biotransformations. Advantages and disadvantages of the use of enzymes in organic synthesis. Classification and nomenclature. Mechanistic and kinetic aspects.
- Hydrolysis reactions catalyzed by enzymes. Resolution of amino acids by hydrolytic enzymes. Ester hydrolysis by esterase, protease and lipase. Hydrolysis of epoxides by epoxide hydrolases. Nitrile hydrolysis. Redox Enzymes. Methods for recycling cofactors. Carbonyl compounds reduction reactions. Oxidation reactions. Epoxidation reactions by peroxidase.
- Special techniques in biotransformation. Use of enzymes in organic solvent. Immobilization of enzymes. Use of immobilized enzymes in bioreactors.
- Asymmetric catalysis on an industrial scale. General aspects and applications for the synthesis of fine chemicals from the literature.
- Biotransformation on an industrial scale. General aspects and applications for the synthesis of fine chemicals from the literature.

Bibliography

1. March's *Advanced Organic Chemistry: Reaction, Mechanisms, and Structure*, Sixth Edition, 2007 John Wiley &Sons: Capitolo 4 (Stereochemistry)
2. Gawley, R. E., Aubè, J. *Principles of Asymmetric Synthesis*, Elsevier, 2012
3. Ojima, I., *Catalytic Asymmetric Synthesis*, Second edition - Wiley-VCH; 2000.
4. Procter, G. *Stereoselectivity in organic synthesis,* Oxford University Press; 1998
5. Donohoe Timothy J. *Oxidation and reduction in organic synthesis,* Oxford University Press ; 2000
6. Robinson, M.J.T. Organic Stereochemistry, Oxford University Press; 2000
7. Faber, Kurt *Biotransformations in organic chemistry: a textbook* - Sixth revised and corrected edition - Berlin: Springer, 2011.

- Power point presentations used in lectures.
- Bibliographic material for further study includes recently reported reviews and contributions and will be indicated on e-learning.

Assessment methods

- An oral examination will be used as assessment method.
- The oral exam consists of a 30-45 minute interview between the candidate and the teacher. In the first part of the exam, the candidate is asked to illustrate and discuss one of the main topics presented during the course. In the second part questions will be asked about the other topics of the program (at least 2).
- In order to get a positive evaluation, the student should demonstrate that he is able to illustrate and discuss the course contents using an appropriate language and connecting the different sections of the program.

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