UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Applied Organic Chemistry To Biotechnologies

2627-1-F0803Q041

Aims

The course is focussed on selected industrial products and their synthetic methodologies through chemical and/or biocatalytic strategies, toward a more sustainable production approach. Advantages and disadvantages of chemical versus (chemo)enzymatic synthesis will be highlighted.

Knowledge and understanding
The student will gain knowledge of the chemical principles at the basis of selective and specific chemical reactions; of advantages/disadvantages of chemical vs enzymatic methods; of selcted enzyme classes relevant for industrial production (i.e. alcohol dehydrogenases, lipases, esterases)

Applying knowledge and understanding
The student will be able to apply the knowledge acquired in the course to synthetic methodologies used in research or in industrial processes.

Making judgements
The student will be able to process the acquired knowledge towards the application of chemical and enzymatic methodologies to real problems. These skills will be developed with the support of exercises

Communication skills
Use of an appropriate scientific/chemical vocabulary and ability in oral reports

Learning skills
Skills in literature reading and understanding, skills in the elaboration of interconnections among the course-related knowledge and other subjects related to industrial biotechnology.

Contents

1. Biotransformations and bioprocesses in industrial production
2. Biotechnological approaches to stereoselective and stereospecific tranformations, asymmetric synthesis, racemates resolution
3. Synthetic strategies of added value chemicals and industrial products by biotechnological approaches (biotransofrmations), pros and cons in respect to traditional chemical synthesis, green chemistry principles and approaches
4. Design of experiment (DoE)

Detailed program

1. Biotransformations and bioprocesses in industrial production: APIs, food additives and flavours, added-value chemicals, bio-based polymers.

2. Biotechnological approaches to stereoselective and stereospecific tranformations, asymmetric synthesis, racemates resolution Application to industrial production of APIs, food additives and flavours, added value chemicals, bio-based polymers. Green Chemistry principles and approaches.

3. Synthetic strategies of added value chemicals and industrial products by biotechnological approaches (biotransofrmations), pros and cons in respect to traditional chemical synthesis.
   3.1 Redox transformations: industrial relevance, classical and biotransformation approaches. Case study: keto-reductases (reaction mechanism, cofactors, substrate specificity, stereoselectivity)
   3.2 Carboxylic acid derivative interconversion: industrial relevance, classical and biotransformation approaches. Case study: lipase and esterase (reaction mechanism, substrate specificity, stereoselectivity)
   3.3 Phospholipids modification: industrial relevance, classical and biotransformation approaches. Case study: phospholipases (reaction mechanism, substrate specificity, stereoselectivity)

4. Design of experiment (DoE): DoE approaches in the optimization of industrial processes and quality by design

Prerequisites

Background. Basics of organic chemistry (organic compound classes and their reactivity)
Prerequisites. none

Teaching form

21 x 2 hours-lectures composed by:

- a section of delivered didactics (Didattica erogativa, DE, 38 h) focused on the presentation-illustration of contents by the lecturer.
- a section of interactive teaching (Didattica Interattiva, DI, 4h) including teaching interventions supplementary to delivered didactic activities, short interventions by trainees, case studies, live forum, wooclap.
  Didactic activities are conveyed by means of face-to-face lectures

20 hours of Tutorial activities aimed at guiding and assisting students throughout their studies in view of the exam preparation delivered by interactive teaching (Didattica Interattiva, DI) through
12 h in-person tutorials
8 h asynchronous learning activity (e-tivity)

Practical applications of the software JMP Statistical Discovery (https://www.unimib.it/servizi/studenti-e-laureati/service-desk/software-campus) will be outlined.

Teaching language: italian.
Lectures in the classroom will be recorded and made available in the e-learning page of the course.

Textbook and teaching resource

Slides available at the e-learning platform of the course
Lectures in the classroom will be recorded and made available in the e-learning page of the course.
Textbooks
David Van Vranken, Gregory Weiss Introduction to Bioorganic Chemistry and Chemical Biology Ed. Garland Science

Semester

First semester

Assessment method

Oral examination. One general question focussed on one wide topic described during the course.
The student shall demonstrate to be skilled in connections among the topics of the course, in scientific vocabulary, comprehension and communication.

Office hours

On demand by mail to the lecturer (laura.cipolla@unimib.it)

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | QUALITY EDUCATION | INDUSTRY, INNOVATION AND INFRASTRUCTURE | RESPONSIBLE CONSUMPTION AND PRODUCTION