UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Industrial Biotechnologies for Chemicals and Bioenergies

2526-2-F5401Q055

Aims

The course aims to introduce topics and problems related to basic and applied research related to the use of microorganisms and enzymes for biotechnologies.

1. Knowledge and understanding.

At the end of the course the student will have to know the principles and concepts of microbial bioprocesses, biorefinery, comparison of generations, the use of enzymes as biocatalysts in various sectors of biotechnological interest, such as pharmaceuticals and food. The course includes practical teachings.

2. Applying knowledge and understanding.

At the end of the course the student will be able to apply the acquired knowledge above described to biosynthetic methodologies for basic research and industrial processes.

3. Making judgments.

The student must be able to process what learned and be able to recognize the processes and problems of the industrial biotransformations.

4. Communication skills.

Use of an appropriate scientific vocabulary and ability in written and oral reports.

5. Learning skills.

At the end of the course the student will be able to read the literature on the topics covered and will be able to analyse, use and integrate the knowledge acquired with what will be learned in lessons related to the production of chemical products of interest for the biotechnology industry.

Contents

The course will be divided into two parts. The first part will deal with the topics related to the classic fermentation processes and microbial biorefinery. The second part will be devoted to the biocatalytic applications of enzymes and examples from the pharmaceutical and food sectors will be illustrated.

1. Microbial biodiversity and its importance for biotechnological applications

2. The Bioreactor. Monitoring and control of the parameters

3. Biotechnology of classic fermentations

4. Enzymes as biocatalysts

5. Enzyme immobilazation

Detailed program

Part I

1. Microbial cell, isolation, growth media, sterilization, cultivation
2. Microbial diversity and its importance in biotechnology
3. Primary and secondary metabolites
4. The bioreactor: batch, fed-batch and continuous fermentations
5. Microbial biorefinery, type of biomasses, pretreatments and fermentation strategies
6. Examples of industrial fermentations: ethanol, citric acid

Part II

1. Classification of enzymes and their use as biocatalysts for production of fine chemicals
2. Enzyme immobilization
3. Biocatalysis in the pharma industry. Case studies: production of semi-synthetic antibiotics, modified nucleosides and nucleotides
4. Chemo-enzymatic production of oligosaccharides and their applications
5. Application of enzymes for plastic and bioplastic degradation
6. Biocatalytic process intensification: flow chemistry with enzymes and cells

Prerequisites

To have acquired the contents and passed the teachings of General Biochemistry.

Teaching form

The educational activities will take the form of:

- 15 two-hour lectures, in person, **delivered didactics**
- 1 two-hour lecture, in person, of discussion of a scientific article on the topics discussed during the lectures, **interactive teaching**
- 24 hours of lab activities (**MANDATORY**), in person, on the topics discussed during the lectures, **interactive teaching**

Textbook and teaching resource

The course will be carried out with the aid of powerpoint presentations and videos. Group discussions will be also carried out. All the teaching materials presented will be made available to the students.
In addition, scientific articles and literature reviews related to the various topics covered in the lectures will be provided.

Semester

Second semester, II year course

Assessment method

The assessment of the acquired knowledge will be carried out through a written exam, with an optional oral exam for grades above 18 (upon the student's request), at the end of the course. During the exam, the student will be required to answer at least two open-ended questions involving an in-depth discussion of the topic, as well as at least 11 multiple-choice questions related to both the topics covered in lectures and the practical activities carried out in the laboratory. The exam will last 2 hours.
In itinere exams will not be held.

Office hours

Contact: on demand, upon request by e-mail to lecturer.

Sustainable Development Goals

QUALITY EDUCATION | AFFORDABLE AND CLEAN ENERGY | INDUSTRY, INNOVATION AND INFRASTRUCTURE | RESPONSIBLE CONSUMPTION AND PRODUCTION | CLIMATE ACTION