UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Biochemistry for Biotechnologies

2526-3-E0201Q059

Aims

The course aims to provide students with biochemical aspects useful for the understanding of advanced biotechnological methodologies in different fields of application of biotechnology. The topics will be dealt with at an intermediate level, with emphasis on one side on approaches to the expansion of molecular and system knowledge and on the other end the application of consolidated methodologies that are closer to more markedly industrial problems with emphasis on the engineering of proteins and on drug discovery.

Knowledge and understanding.
At the end of the course the student must know and understand:
the principles underlying intracellular protein trafficking, some advanced concepts of enzymology, of the engineering of proteins and enzymes and the basic principles of the application of enzymes in industry; the basic principles of signal transduction and cell cycle in eukaryotes; the basic principles of protein-protein interaction and related study methods; the basic principles of systems biology (post-genomic techniques, reductionist approach vs systemic approach)

Ability to apply knowledge and understanding.
At the end of the course the student must be able to apply the acquired knowledge to the scientific, methodological and applicative problems studied in class and in contiguous areas not directly treated in the lessons.

Making judgments
The student must be able to identify the privileged areas of use of the methodologies addressed. The critical and judgment skills are implemented at different levels that include: exercises and computer demonstrations carried out in the classroom; presentation and discussion of one or more case studies that start from the analysis of the biochemical properties of proteins, pass through their structure-guided and/or evolution-guided engineering up to the implementation of pharmacologically active molecules or derivatives thereof usable in the clinic or enzymes usable in the industrial field.

Communication skills.
At the end of the course the student will be able to express himself appropriately in the description of the topics

addressed with proper language.

Learning skills
At the end of the course the student will be able to read and understand at a basic level, literature pure and applied biochemistry, also in view of the choice of the literature to be studied for the thesis preparation.

Contents

Maturation and post-translational modifications of proteins.
Signal transduction.
Molecular enzymology.
Experimental and computational approaches to the determination of protein three-dimensional structure; Protein Engineering.
Post-genomic technologies.
Systems Biology.

Detailed program

CHAPTER 1
Post-translational maturation and modification of proteins: structural characterization, main pathways in vivo and their application valence (for example, effects of glycosylation on the antigenicity and stability of the recombinant proteins)

CHAPTER 2
Signal transduction: definition, examples and potential applications

CHAPTER 3
Enzymes: reaction mechanisms, specificity, regulation, parameters of relevance in biocatalysis. Engineering, immobilization and applications of recombinant proteins for industrial use; basic concepts of protein 3D structure determination including artificial intelligence methods explored through classroom exercises using online software

CHAPTER 4
Introductory aspects to "omics" technologies, their role in the molecular dissection of pathways and in drug discovery. Topics will be introduced through examples, focusing on the limits and possibilities of the various methodologies. In particular, it will be highlighted how the context of application dramatically varies the purpose and methods of analyzing the "omics" data.

CHAPTER 5
Elements of systems biology: generalities and potential uses (in particular in the drug discovery process and in the development of resposable production chains using enginereed enzymes or microrganisms.

Prerequisites

Background: concepts and methodologies of biochemistry, basics of molecular biology, biomolecular and biochemical methods.
Specific prerequisites: Biochemistry.

General prerequisites: Students can take the exams of the third year after having passed all the exams of the first year of the course.

Teaching form

59 total hours divided into twenty-nine 2-hour lessons and one 1-hour lesson consisting of:
• 24 lessons in delivery mode (delivery teaching, DE) focused on the presentation-illustration of contents, concepts, scientific principles;
• the remaining part (5 lessons) in interactive mode (interactive teaching, DI), which includes the presentation and use of bioinformatics tools aimed at studying the three-dimensional structure of proteins also in a protein engineering context;
• up to a maximum of 5 lessons can be held remotely in asynchronous mode.

Teaching language: italian.

Textbook and teaching resource

Learning material (slides of the lessons, scientific articles) is available at the e-learning platform of the course. Book chapters will be suggested in class.
Video recording of the lessons will be made available

Semester

First semester

Assessment method

Written + Oral
The written exam takes place in a computer lab. It consists of:
Part A = 30 multiple choice questions (total max score = 150, threshold score A = 75);
Part B = 2 definitions, 2 problems, 3 open answers, total max score = 180, threshold score B = 90).
The oral exam will be open to:
students who reached or exceeded both thresholds in the written exam
or
the students who, despite having reached or exceeded only one of the two thresholds, reached a total score greater than or equal to 180

The exam will verify the acquisition of the basic concepts and methodologies exposed, evaluating the student's ability to apply them to different problems, not necessarily addressed in class

Office hours

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

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | RESPONSIBLE CONSUMPTION AND PRODUCTION