UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Organic Chemistry for Life Science

2627-1-F5402Q017

Aims

The main objective of the course is to provide a general overview of the role of bio-organic chemistry, in the creation of effective molecular tools in the study and monitoring of biochemical, physio-pathological and productive processes. This knowledge is fundamental in the chemical-diagnostic and chemical-biotechnological fields and is complementary to the vast sector of pharmaceutical, nutraceutical and food chemistry.

Knowledge and understanding skills.

At the end of the course the student will know the general strategies of synthesis and characterization of bio-conjugates, with reference to:

- the synthetic strategies and the use of protective groups;
- the methods of analysis and purification (where necessary) of these classes of molecules;
- the application and research contexts in which to synthesize and use these compounds as molecular tools.

Ability to apply knowledge and understanding.

At the end of the course the student will be able to read and understand a scientific article in which bio-conjugates, oligosaccharides, oligonucleotides and derivatives, peptides and derivatives are designed, synthesized and used.

Making judgements.

The student must be able to elaborate what has been learned and be able to recognize the technical and experimental problems in which the learned chemical methodologies can be applied in an innovative way.

Communication skills.

At the end of the course, the student will be able to express himself appropriately in the description of the issues addressed with language properties and exposure security. He will also be able to describe in a technical report in

a clear and concise way and orally explain the objectives, the procedure and the results of the elaboration of a scientific article.

Learning skills.

At the end of the course, the student will be able to consult the literature on the topics covered and will be able to analyze, apply, integrate and connect the knowledge acquired with what he has learned in courses related to the application of bio-organic chemistry to the synthesis and analysis of compounds of interest to the diagnostic, pharmaceutical and nutraceutical industries.

Contents

The course will illustrate the main synthesis and analysis techniques of bioconjugates, including oligonucleotides and derivatives, peptides and derivatives, oligosaccharides and derivatives, as well as their most significant applications as molecular tools in different application areas aimed at the study and qualitative and quantitative characterization of (bio) chemical, physio-pathological and production processes (e.g. pharmaceutical, nutraceutical, food industry):

1. assay and quantification;
2. detection, tracking, and imaging in vitro and in vivo;
3. purification, capture and scavenging;
4. catalysis and chemical modification;
5. therapeutics and in vivo diagnostics;
6. vaccines and immune modulation.

Some examples of applications will be treated with a flipped learning approach through the critical presentation of research articles by students.

Detailed program

The course will describe the main methods for:

- the chemical functionalization of peptides and proteins;
- the chemical functionalization of sugars, oligosaccharides and glycoconjugates;
- the chemical functionalization of nucleic acids and oligosaccharides,

describing the most important bioconjugation reactions and the principles of "chemoselective ligation" and the use of bioorthogonal strategies and reagents.

Emphasis will be given to the applications of the molecular tools in the diagnostic field, for the preparation of vaccines and for the bioconjugation of antibodies.

Prerequisites

Knowledge of basic organic chemistry.

Teaching form

Classes will be delivered in frontal mode (20 two-hour lectures, in person, Delivered Didactics) and in flipped learning (8 two-hour lectures, in person, seminars), the latter with presentation and discussion of scientific papers by students.

Bioconjugate applications will be discussed during the lectures held by the teacher and during the students seminars when they will briefly and critically present some research articles related to the different topics.

Textbook and teaching resource

Slides. Available on the e-learning platform of teaching.
Handouts. Available on the e-learning platform of teaching.

Recommended books:

- Bioconjugate Techniques, Book • 3rd Edition • 2013, https://www.sciencedirect.com/book/9780123822390/bioconjugate-techniques
- David Van Vranken and Gregory A. Weiss. Introduction to bioorganic chemistry and chemical biology

Semester

Second semester

Assessment method

Examination Methods and Grading Criteria
The final exam consists of a single oral exam at the end of the course, with a score ranging from 18/30 to 30/30 with honors (lode). The interview goes beyond a simple verification of notions; it assesses the student's ability to connect different concepts and topics.
Evaluation Criteria
The final score is based on a comprehensive assessment taking into account four core pillars:

1. Conceptual knowledge and depth of understanding.
2. Ability to practically apply knowledge and understanding.
3. Communication and argumentation skills during the discussion.
4. Learning, self-assessment, and self-regulation skills.

Grading Tiers

18–21 (Sufficient)
The student demonstrates an essential and sometimes superficial knowledge of the course topics. Understanding of core concepts is mainly rote-based, with a limited ability to independently elaborate or establish connections between topics. Scientific language and discipline-specific terminology are used acceptably, though some

inaccuracies or conceptual uncertainties may be present.

22–24 (Satisfactory–Fair)
Knowledge of the content is adequate, and the understanding of basic concepts is consolidated. The student is able to present the material correctly and attempts to make logical connections between different processes, though they require guidance for a truly critical integration of information. Specific terminology is used with fair precision and accuracy.

25–27 (Good)
The student demonstrates a good command of the curriculum and a solid understanding of the underlying concepts. They show the ability to effectively apply theoretical knowledge to practical contexts and can establish fluid, coherent connections between the various macro-themes of the course. Scientific language is appropriate, precise, and well-mastered.

28–30 with Honors (Very Good–Excellent)
Knowledge of the subject is comprehensive, deep, and supported by a strong aptitude for critical reflection and personal synthesis. The presentation is fluid, rigorous, and flawlessly structured, with a masterful and natural command of scientific terminology. The maximum score (30/30 with potential honors) certifies absolute excellence in terms of a holistic vision, propriety of language, and advanced argumentative skills.

Office hours

On demand by mail to the lecture

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING