UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Integrated Laboratory of Chemistry and Biology

2627-3-E1301Q084

Aims

The Integrated Chemical-Biological Laboratory aims to provide students with practical training in the main experimental methodologies used in chemistry and life sciences, integrating competencies in organic chemistry, biochemistry, microbiology, molecular biology, and physiology. Students will develop practical skills in carrying out experimental protocols, analysing and interpreting experimental data, and communicating scientific results, while applying good laboratory practices and safety regulations.

1. Knowledge and understanding
   Acquire the fundamental knowledge of the main experimental techniques used in chemical and biological laboratories and understand their theoretical principles.

2. Applying knowledge and understanding
   Apply the acquired knowledge to perform experimental protocols and to collect, process, and interpret experimental data.

3. Making judgements
   Critically evaluate experimental results, identify the key aspects of experimental protocols, and perform laboratory activities with increasing autonomy.

4. Communication skills
   Describe the experimental methodologies used and present experimental results using appropriate scientific language.

5. Learning skills
   Apply the acquired competencies to similar and more advanced experimental contexts and develop independent learning skills in laboratory methodologies.

Contents

The laboratory integrates practical activities in chemistry and life sciences aimed at developing the main experimental skills. The course includes analytical and organic chemistry techniques, chromatography and organic transformations, quantitative analysis of aqueous solutions, isolation and characterization of microorganisms, cell culture and functional analysis of neuronal differentiation, purification and characterization of proteins and enzymes, as well as basic molecular biology techniques for recombinant plasmid DNA cloning and screening. Experimental data will be processed, interpreted, and discussed in the light of the underlying theoretical principles and good laboratory practice.

Detailed program

The laboratory is organized into practical modules covering the main experimental methodologies used in chemistry and the life sciences.

The General Chemistry module includes quantitative analytical techniques based on acid-base, redox, iodometric, and potentiometric titrations, determination of the isoelectric point of an amino acid, and colorimetric analyses.

The Organic Chemistry module includes practical training in the main chromatographic techniques (thin-layer chromatography and column chromatography), purification of compounds by liquid-liquid extraction, and functional group transformations to investigate the reactivity of organic compounds.

The Molecular Biology module includes recombinant plasmid DNA cloning, bacterial transformation, screening by colony PCR, plasmid DNA extraction, restriction enzyme digestion, and agarose gel electrophoresis.

The Microbiology module covers the isolation, cultivation, and characterization of bacteria, determination of microbial growth, and assessment of antimicrobial activity.

The Biological Chemistry module focuses on the preparation of cell extracts, protein purification by chromatography, protein characterization by SDS-PAGE and Western blotting, protein and enzyme activity assays, and enzyme kinetics, including quantitative analysis of the experimental results.

The Physiology module includes cell culture and differentiation of neuroblastoma cells, evaluation of cell proliferation and morphology, functional analyses based on intracellular calcium measurements and electrical activity recordings, as well as data processing and discussion.

In all modules, the experimental activities are complemented by the processing, interpretation, and discussion of the experimental data, including the use of basic statistical tools, promoting the integration of theoretical knowledge with practical laboratory skills.

Prerequisites

Students are expected to have a basic background in chemistry and the biological sciences, together with familiarity with fundamental laboratory techniques and good laboratory practice.

Teaching form

The course includes practical laboratory activities carried out in dedicated and appropriately equipped laboratories through an interactive teaching approach. The laboratory sessions, organized into multiple practical activities for a total of approximately 20 hours, will be performed in small groups of students and will be preceded by a theoretical introduction covering the objectives, methodologies, and experimental design.

The activities will be supported by teaching materials (slides, experimental protocols, and handouts) provided through the course e-learning platform, aimed at preparing students before the laboratory sessions and reinforcing the acquired knowledge. Attendance to laboratory activities is mandatory according to the course regulations.

Textbook and teaching resource

The teaching materials for the course include handouts and experimental protocols used during the practical laboratory activities. All teaching materials supporting the theoretical and/or technical aspects of the laboratory experiences will be accessible through the course e-learning platform. The teaching materials will mainly consist of protocols and handouts prepared by the instructors, which will be provided to students at the beginning of the teaching activities and made available on the e-learning platform. Additional materials, including illustrative videos and self-assessment tests, will also be made available through the e-learning platform.

Semester

The course will be delivered in the first semester.

Assessment method

For the Biochemistry module, as for all other modules of the LIB course, students are not allowed to take partial exams or assessments relating to individual modules, and no in-course assessments are scheduled for any module.
The assessment of the entire course consists of a single written examination aimed at evaluating the competencies acquired by students in relation to each of the six modules that make up the course. The written examination lasts 2 hours and is carried out in a computer lab, using a PC through a dedicated online platform.
The examination consists of closed-ended questions (exercises and multiple-choice questions) covering the subject content of all modules, as well as a single open-ended question on the subject content of one of the modules. The closed-ended questions for each module allow students to obtain a maximum of 10 points. The overall score obtained from the closed-ended questions of the six modules is converted into a maximum score of 29 points (automatically assigned by the system at the end of the examination). The open-ended question is worth 0 to 2 points, awarded following evaluation by one of the lecturers.
The open-ended question is assessed only if a minimum score has been achieved in the closed-ended questions. The final grade is expressed out of 30 and is obtained by adding the two scores (for the closed-ended and open-ended questions). A total score ?30.5 allows students to obtain honours (cum laude).

Office hours

The teachers will receive by appointment requested by e-mail.

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING