UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Laboratory of Organic Chemistry III

2425-3-E2702Q101-E2702Q103M

Aims

Acquire elements and techniques for functional groups transformations and their appplcation to organic synthesis

The objective of the course is to learn the elements of the main techniques for the transformation of functional groups and their application in organic synthesis.

- Knowledge and understanding

  Students will acquire a solid understanding of the tecnhniques adopted for functional group transformation in organic synthesis, including reaction mechanisms, the chemical properties of organic compounds, and the theoretical basics of the analytical techniques used in the laboratory (TLC, melting point), as well as the principles underlying the techniques for isolating and purifying synthetic products. They will gain a solid knowledge of the procedures and experimental setups adopted, understanding the physicochemical principles behind their selection.

- Applied knowledge and understanding

  Students will apply the theoretical knowledge acquired to design and conduct organic chemistry experiments. They will be able to select the appropriate techniques for the synthesis and analysis of compounds, interpreting the results obtained with a view process optimization. They will be able to appropriately describe the procedures and experimental setups adopted and follow the correct safety procedures.

- Judgment autonomy

  Students will develop the ability to critically evaluate experimental results, formulating hypotheses and interpreting data independently. They will be able to identify any experimental errors and propose solutions to improve the quality of the results obtained.

- Communication skills

  Students will learn to communicate the results of their research clearly and concisely. They will be able to write detailed laboratory reports and present their findings to an audience, using appropriate technical language and supporting their claims with experimental data.

- Learning skills

  Students will develop skills that promote autonomous and continuous learning in the field of organic chemistry. They will be able to use bibliographic resources and digital tools to deepen their knowledge and stay updated on developments and technical innovations in the field.

These objectives aim to provide students not only with the technical skills necessary to operate in an organic chemistry laboratory but also with the critical and communicative abilities essential for their future professional careers.

Contents

Examples of single and/or multi step organic reactions involving functional group transformations (dehydration, reduction, oxidation, substitution), diazocopulation reaction (synthesis of acid orange 7 dye), an aldol consensation and a simple multistep synthesis.

Detailed program

- reduction of a ketone
- Friedel Crafts Alkylation
- Oxidation under green conditions
- dehydration of an alchool
- synthesis of an azo dye
- cyclohexene oxidation to adipic acid
- aldol condensation
- multistep synthesis of an amide (imine formation - reduction - acylation)

Prerequisites

Sound knowledge of basic organic chemistry, common glassware, basic lab techniques and physicochemical principles of purification techniques and qualitative analysis (i.e. simple and fractional distillation, steam distillation, melting point). Such knowledge is summarized in the recommended books.

Teaching form

Lab experiences about the reactions and processes described in the detailed program

In detail, the students will be assigned to groups according to the maximum lab capacity (number of fume hoods). Whenever possible, shorts introductory videos aimed to highlight key aspects of the lab activities will be made available on the e-learning (LMS) platform. A short lesson (15-20 min) will also take place before each lab activity to further highlight key aspects.

Teaching language will be italian.

Teaching strategy:

12 four-hour lab activities, in person, Interactive Teaching

Textbook and teaching resource

Suggested books:

Understanding the Principles of Organic Chemistry: A Laboratory Course, Reprint, 1st Edition Steven F. Pedersen, Arlyn M. Myers ISBN 9781111428167 link

A Small Scale Approach to Organic Laboratory Techniques, 4th Edition Donald L. Pavia, George S. Kriz, Gary M. Lampman, Randall G. Engel ISBN 9781305253926 link

Semester

third year first semester. Start on september 23rd 2024

Assessment method

The student will be evaluated based on their ability to adhere to safety measures and good practices in the chemistry laboratory. The ability to work in a team will be assessed, along with the quality of the experimental results obtained. Finally, the clarity and completeness of the individual laboratory reports will be evaluated under the following aspects:

- Ability to manage the theory of errors
- Understanding of the principles underlying the adopted procedures
- Correct presentation of experimental observations and results, along with their critical analysis

A description of the structure of the report will be provided, including a brief description of the various parts.

The evaluation of the laboratory (Organic Chemistry III Laboratory) consists of an overall score published on the e-learning page, which will then be averaged with the assessment of the lecture module (Organic Chemistry III).

The score for the laboratory component consists of an overall judgment on the achievement of minimum objectives (18 points), to which an assessment of the attitude demonstrated during the experimental activity (0-2 points) is added. This score is supplemented by a score based on the correction of the reports (0-12 points). Additionally, a penalty of 3 points will be applied for failing to meet the deadline for submitting the reports.

The **deadline for submitting the reports is set for February 1, 2025**. It will still be possible to submit the reports after this date, but a penalty of up to 3 points will be applied to the final score due to the failure to meet the submission deadline.

The grading is based on the following criteria:

18-20:

- Knowledge and understanding: Sufficient but limited understanding of transformation techniques and reaction mechanisms, with noticeable fundamental gaps.
- Applied knowledge and understanding: Limited ability to conduct experiments adequately and/or select appropriate techniques.
- Judgment autonomy: Just sufficient critical evaluation of results, with difficulties in identifying errors and offering solutions.
- Communication skills: Laboratory reports are unclear and presentations are confusing, with sufficient but at times inadequate use of technical language and lack of support with experimental data.
- Learning ability: Limited autonomy in learning and restricted use of available resources, with reduced mastery of software and bibliographic databases.

21-23:

- Knowledge and understanding: Good understanding of transformation techniques and reaction mechanisms, with significant gaps.
- Applied knowledge and understanding: Significant difficulties in conducting experiments and selecting appropriate techniques.
- Judgment autonomy: Very limited evaluation ability, with difficulties in identifying errors and proposing solutions.
- Communication skills: Laboratory reports are unclear and presentations are confusing, with some inadequate use of technical language.
- Learning ability: Limited autonomy in learning and restricted use of available resources.

24-26:

- Knowledge and understanding: Good understanding of transformation techniques and reaction mechanisms, with some gaps.
- Applied knowledge and understanding: Conducts experiments with some difficulties in selecting techniques and interpreting results.
- Judgment autonomy: Demonstrates some evaluation ability, but with difficulties in identifying errors and proposing solutions.
- Communication skills: Writes laboratory reports with good presentation, but with some shortcomings in technical language and result presentation.
- Learning ability: Shows good ability in autonomous learning and uses resources sufficiently.

27-29:

- Knowledge and understanding: Good or excellent understanding of transformation techniques and reaction mechanisms. Knows analytical techniques and the underlying physicochemical principles, with some minor gaps.
- Applied knowledge and understanding: Conducts experiments competently, selecting appropriate techniques and adequately interpreting results.
- Judgment autonomy: Critically evaluates results, identifying errors and proposing solutions, although with some uncertainty.
- Communication skills: Writes clear laboratory reports and presents results adequately, although with some inaccuracies in technical language.
- Learning ability: Shows autonomy in learning, using bibliographic resources and digital tools, but with room

for improvement.

30 - 30 with Honors:

- Knowledge and understanding: Excellent understanding of the fundamental principles of transformation techniques and reaction mechanisms. Demonstrates mastery of analytical techniques and the physicochemical principles underlying experimental procedures.
- Applied knowledge and understanding: Demonstrates the ability to design and conduct experiments autonomously, selecting the most appropriate techniques and optimizing processes. Interprets results with great competence.
- Judgment autonomy: Critically evaluates results, formulating hypotheses and identifying errors with innovative solutions to improve the quality of results.
- Communication skills: Writes detailed laboratory reports and presents results clearly and convincingly, using appropriate technical language and supporting claims with experimental data.
- Learning ability: Demonstrates autonomy in learning, effectively using bibliographic resources and digital tools

Office hours

upon request

Sustainable Development Goals

CLEAN WATER AND SANITATION