UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Advanced Organic Chemistry

2526-1-F5402Q004

Aims

Detailed discussion of the main reaction mechanisms of organic molecules. Advanced reactivity of aromatic and heteroaromatic systems. Cyclization reactions.

Knowledge and understanding skills developed

At the end of the course the student knows

- The main theoretical / practical tools to address the mechanistic study of reactions in organic chemistry
- The subdivision of reactions in organic chemistry through the study of the main mechanistic families
- The application of the concepts learned in the course in an advanced laboratory of organic chemistry.

Knowledge and understanding skills applied

- At the end of the course the student has the tools in order to study the organic reactions from a mechanistic point of view, in order to obtain selective regio and stereo reactions
- At the end of the course the student is able to choose the best reaction conditions to optimize the regio and stereo selection of a reaction
- At the end of the course the student is able to work in an advanced organic chemistry laboratory.

Autonomy of judgment

At the end of the course the student is able to evaluate which is the best mechanistic model to develop the study of an organic reaction

Communication skills

- Knowing how to describe the organic reaction mechanism using the correct terminology
- Knowing how to describe in a laboratory notebook an organic reaction carried out in the laboratory using

the correct terminology

Ability to learn

- Apply the knowledge learned during the course to correctly interpret any organic chemistry article

Contents

Review of the electronic structure of organic molecules. Main reactive species in organic chemistry and their relative stability as a function of the substituent effect. nucleophiles and electrophiles, carbanions, carbon radicals, addition to the carbonyl group. Mechanisms in organic chemistry: thermodynamics and kinetics, thermodynamic and kinetic control, acidity and basicity, electrophilia and nucleophilia, free energy relations, Hammond's postulate, general acid and basic catalysis and specific catalysis. Aromaticity. Aromatic substitution. Pericyclic reactions. Molecular rearrangements. Elements of heteroaromatic chemistry. Selection of reactions under the name of wide use in organic synthesis.

In the part relating to the laboratory, the safety and behavioral rules to be followed in an organic chemistry laboratory will be recalled, and using the main techniques of synthesis, analysis and purification of organic substances, some compounds will be synthesized using multi-step synthetic protocols

Detailed program

Basic mechanistic concepts: Kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammet principle, Principle of microscopic reversibility. Perturbative theory and HSAB: Applications of perturbative theory (Diels-Alder and 1,3 dipolar cycloditions) Applications of HSAB theory Acid-base catalysis; Specific acid catalysis, general acid catalysis. Nucleophilic substitution: the Sn1 and Sn2 borderline cases, borderline mechanisms, Nucleophilicity and solvent effect, Effect of leaving groups on reactivity, Rearrangement of carbocations. Reactions of carbonyl compounds; Hydration and addition of alcohols to aldehydes and ketones, Addition of nucleophilic carbon to aldehydes and ketones, Hydrolysis of esters, hydrolysis of amides. Olefination reactions. Aromaticity: The concept of aromaticity, annulenes, homoaromaticity, Fused ring systems, aromatic heterocyclic rings.

Aromatic Substitutions Electrophilic aromatic substitution reactions, Structure-reactivity relationships, Reactivity of polycyclic and heterocyclic aromatic compounds, Specific mechanisms of electrophilic aromatic substitution. Pericyclic Reactions: Electrocyclic Reactions, Sigmatropic Rearrangements, Cycloaddition Reactions. elements of heteroaromatic chemistry. Systematic heteroaromatic. Synthesis and responsiveness of the main actions. Synthesis and reactivity of azole principles. Representative hetero-hetero systems. Reactions under the name of general utility in organic chemistry In the part referring to the laboratory, the safety and behavioral rules to be followed in an organic chemistry laboratory will be presented, the main techniques for the analysis and purification of organic substances and organic chemistry reactions will be conducted for the synthesis of two main molecules obtained as a result of multistep synthesis.

Prerequisites

Knowledge of Organic and Physical chemistry at bachelor level

Teaching form

24 two-hour lectures, in person. Delivered Didactics

2 two-hour lab lectures, in person. Delivered Didactics
5 four-hour lab activities, in person, Interactive Teaching

Teaching language will be italian.

Textbook and teaching resource

F. A. Carey, R.J. Sundberg "*Advanced Organic Chemistry*", Ed. Plenum Press, New York

integral recording of the lessons

annotated slides.

Semester

1 semester

Assessment method

Oral examination aimed at verifying adequate knowledge of: a) the chemical physical basis of mechanisms in organic chemistry b) the main general mechanisms of reaction in organic chemistry c) the capability to plan the synthetic access to simple organic multifuctional molecules.

For the laboratory part, the activity carried out will be evaluated as well as the compilation of the laboratory notebook. Furthermore, two tests relating to the skills acquired to be done during the course on the e-learning platform will complete the evaluation of the laboratory course.

Evaluation Scale:

18-19: Knowledge of a limited number of topics from the course syllabus, with restricted ability in discussion and analysis, which, in the case of an oral exam, emerge only with the help and questions from the instructor; expository skills and vocabulary are not always accurate, with limited critical thinking ability.
20-23: Knowledge of some topics from the course syllabus, independent analytical skills only on purely practical and procedural issues, use of correct but not entirely precise and clear vocabulary, and an occasionally uncertain expository ability.
24-27: Knowledge of a broad range of topics covered in the course syllabus, ability to conduct argumentation and critical analysis independently, ability to apply knowledge to different contexts and connect topics to real cases, use of correct vocabulary and proficiency in disciplinary language.
28-30/30L: Comprehensive and thorough knowledge of the exam topics, independent ability to discuss and critically analyze themes, capacity for reflection and self-reflect

ion, as well as for connecting topics to real cases and various contexts, excellent critical and independent thinking skills, full command of disciplinary vocabulary, and a structured, rigorous expository ability, with strong argumentative, reflective, and interdisciplinary connections skills.

Office hours

upon request, generally 8:30-18:00

Sustainable Development Goals

QUALITY EDUCATION