



UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Organic Chemistry II (blended)

2021-2-E2702Q094-E2702Q095M

Aims

Intermediate Organic Chemistry (aromatic and heteroaromatic compounds).

Knowledge and understanding

At the end of the course the student knows:

- The concept of aromaticity and the main scientific approaches
- The main classes of aromatic and heteroaromatic substances
- The main structural, chemical and electronic properties of aromatic and heteroaromatic substances
- The main reactivity of aromatic and heteroaromatic substances
- The main synthesis methods of aromatic and heteroaromatic substances

Applying knowledge and understanding

At the end of the course the student is able to:

- Recognize and interpret the main properties of aromatic and heteroaromatic substances
- Synthesize and apply the main reactions of aromatic and heteroaromatic substances

Making judgments

At the end of the course the student is able to:

- Select the main classes of aromatic and heteroaromatic substances based on their use and properties
- Select the main reactions and synthesis of aromatic and heteroaromatic substances based on the products to be obtained

Communication

Knowing how to describe in a clear and concise way in writing and orally with the language properties the main concepts of aromaticity and the properties and reactivity of aromatic and heteroaromatic substances

Lifelong learning skills

Being able to apply the acquired knowledge to different classes and compounds of aromatic and heteroaromatic organic substances, even in contexts different from those presented during the course. Being able to extend knowledge independently through the study and analysis of advanced texts in Organic Chemistry, scientific literature, patents and scientific-technical reports.

Contents

Molecular orbitals. Huckel molecular orbital method. Aromaticity. Mono- and polycyclic aromatic and heteroaromatic systems: properties, synthesis, reactions.

Detailed program

Main topics.

a) Monocomponent carbocyclic aromatic systems (28 hours). Molecular orbitals and Huckel method (HMO). Benzene: aromaticity, resonance, resonance and delocalization energy. Hückel's Rule. Definition of aromaticity. Nomenclature. Reactions in the side chain. Reductions and oxidations. Electrophilic aromatic substitution reactions on benzene and benzene derivatives. Effect of substituents and orientation theory. Nitro derivatives. Aromatic amines: synthesis and reactivity. Diazonium salts: preparation, reactivity and synthetic usefulness. Arylsulphonic acids: mechanism of sulphonation and synthetic utility. Aromatic halogen derivatives: synthesis. Aromatic nucleophilic substitution. Cross-coupling reactions catalyzed by transition metals. Phenols and phenol ethers. Synthesis of Kolbe, reactions with formaldehyde, of ReimerTiemann, of coupling with diazonium salts. Quinones: synthesis and reactivity, oxidation-reduction equilibria.

b) Polynuclear carbocyclic aromatic systems (2 hours). Biaryls. Naphthalene: synthesis and electrophilic substitution reactions. Anthracene and phenanthrene.

c) Heteroaromatic systems (5 hours). Nomenclature and main properties. Klopman-Salem relationship. Regiochemistry of the electrophilic substitution reaction through the theory of molecular orbitals. Pentatomic monohetero systems: nomenclature, properties, synthesis and reactivity. Hexatomic mono- and polyethero

systems: nomenclature, properties, synthesis and reactivity. Pentatomic polyethero systems: overview. Natural derivatives of biological importance.

Prerequisites

General Chemistry (1st year). Organic Chemistry I (1st year).

Teaching form

Lectures and exercises in the classroom and in e-learning mode (complementary teaching material, videolectures, online exercises)

Textbook and teaching resource

P. Y. Bruice, Organic Chemistry, Edises

A. Abbotto, G. Pagani - Heterocyclic Chemistry, Piccin (available only in italian)

Semester

Second year, first (fall) semester

Assessment method

The student can attend the exam following one of the two options:

a) Two partial written tests during the course + final oral exam. The written tests focuses on the topics covered in the lesson up to the date of the test (the detailed list of topics is described by the teacher in classroom). As a rule: First partial test. Carbocyclic aromatic systems (up to substituents effect); Second partial test: remaining part of the program. The distribution of the contents of the two partial tests may vary from year to year.

Each partial test give a vote (from 0 to 30). The arithmetic average of the written tests is the admission score to the oral test, which consists in an exam lasting about 15 minutes focused on the shortcomings presented at the level of the written partial tests.

This procedure is allowed only for students who pass the written tests with at least 15/30 and attend the oral exam at the first exam following the end of the lessons. The dates of the partial written tests are communicated well in advance both in the classroom and in the e-learning page of the course. The first partial test takes place approximately halfway through the course. The second test immediately after the end of the semester.

b) Single oral exam. The single oral exam can be taken in any of the calls during the year. There are no limitations in the event of not passing the exam (however, in the case of largely insufficient preparation the teacher can

request to skip 1 appeal when the following exam is scheduled a few days after the insufficient test). The single oral exam covers some questions covering all the topics covered in the course. The duration is about 1 hour.

The oral exam can contain written parts (blackboard, paper) in front of the examining committee.

It is mandatory to register for the partial written tests and the oral tests on the official appeals board. Non-enrolled students will not be admitted to the exams.

DATA

Data collected since academic year 2005-06

Average for the 1st written test: 20.6/30

Average for the 2nd written test: 22.3/30

Average for the written test (average of I and II test): 22.1/30

Average of the final exam (written + oral): 25.0/30

Office hours

All days from Monday to Friday upon e-mail request
