



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## SYLLABUS DEL CORSO

### Chimica Organica II (blended)

2223-2-E2702Q094-E2702Q095M

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#### 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

Oral exam. The single oral exam can be taken in any of the calls during the year. The single oral exam contains questions covering all the topics presented in the course. The duration is about 1 hour.

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

The oral test (including the written part) are aimed at verifying: the level of the acquired knowledge; autonomy of analysis and judgment; exposition skills; the correctness and clarity of the exposition and description of the concepts and knowledge both orally and in writing.

It is mandatory to register for 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**

Monday to Friday upon e-mail request

## **Sustainable Development Goals**

QUALITY EDUCATION

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