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| Course Unit | Organic Chemistry I | Field of study | Chemistry |
| Bachelor in | Chemical Engineering | School | School of Technology and Management |
| Academic Year | 2023/2024 | Year of study | 1 |
| Type | Semestral | Semester | 2 |
| Level | 1-1 | ECTS credits | 6.0 |
| Code | 9125-755-1205-00-23 | | |
| Workload (hours) | 162 | Contact hours | T 30 TP - PL 30 TC - S - E - OT - O - |

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) Maria Olga de Amorim Sá Ferreira

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. Know about atomic and molecular structure, chemical bonding and molecular properties. Know how to use the different types of organic molecular representation.
2. Recognise the different functional groups and to use the nomenclature of organic compounds.
3. Explain physical properties of organic compounds based on intermolecular forces.
4. Understand the concept of conformation and to perform conformational analysis of compounds using Newman projections.
5. Understand the concepts of isomery, stereoisomery and chirality. Recognise stereoisomers and know how to represent them.
6. Acquire fundamental concepts of the main general types of organic reactions.
7. Know the main reactions of alkenes, alkynes and alkyl halides and explain the respective mechanisms.
8. Understand the main reactions of hydrocarbons derived from benzene, of the different families of organic compounds containing the carbonyl group and of amines.

Prerequisites

Before the course unit the learner is expected to be able to:
Know the fundamental concepts of chemistry taught in high school.

Course contents

This subject concerns the basic concepts of Organic Chemistry, namely: structure of organic molecules, functional groups and families of organic compounds, intermolecular forces, molecular conformations, stereochemistry and main reactions of organic compounds and their reaction mechanisms.

Course contents (extended version)

1. Introduction.
 - Importance of organic compounds and their applications.
2. Organic Molecules Structure.
 - Covalent and ionic bonds.
 - Different orbital hybridizations.
 - Valences of the most common elements in Organic Chemistry.
 - Lewis structures, octet rule and its exceptions.
 - Representation of organic molecules using lines, condensed and 3-D structural formulas.
 - General principles of resonance and representation of resonance structures.
3. Functional Groups and Families of Organic Compounds.
 - Hydrocarbons, alkyl and aryl halides, alcohols and ethers.
 - Amines, aldehydes, ketones, carboxylic acids, amides and esters.
 - Structure, nomenclature and physical-chemical properties of the families of organic compounds.
 - Origin, classification, physical properties and industrial uses of hydrocarbons.
4. Fundamental Concepts of Intermolecular Forces.
 - Different types of intermolecular forces.
 - Intermolecular forces and physical properties of the substances.
5. Molecular Conformations.
 - Conformations of open chain alkanes.
 - Conformations of cyclohexane and its disubstituted derivatives.
 - Conformational analysis of compounds.
 - Newman projections.
6. Stereochemistry.
 - Concept of isomery; constitutional isomers and stereoisomers; diastereomers and enantiomers.
 - Chirality and optical activity.
 - Meso compounds and racemic mixtures.
 - R/S configuration of a chiral center; Cahn-Ingold-Prelog system.
 - Fisher projections.
 - E/Z nomenclature system.
 - Stereoisomery of disubstituted cycloalkanes.
 - Separation methods of chiral compounds.
7. Reactions of Organic Compounds.
 - General types of organic reactions: addition, substitution, elimination and rearrangement reactions.
 - Main concepts of reaction mechanism.
 - Reactions of nucleophilic substitution SN1 and SN2.
 - Elimination reactions E1 and E2; Zaitsev's rule.
 - Main reactions of alkanes.
 - Main alkenes reactions and respective mechanisms. Markovnikov rule.
 - Stability and rearrangement of carbocations.
 - Main reactions of alkynes and respective mechanisms.
 - Main reactions of alcohols, amines and aromatic hydrocarbons.
 - Main reactions of carboxylic acids, esters, amides, aldehydes and ketones.

Recommended reading

1. T. W. Graham Solomons, C. B. Fryhle, S. A. Snyder, Organic Chemistry, 12th edition, Wiley, 2017.
2. T. W. Graham Solomons, C. B. Fryhle, S. A. Snyder, Organic Chemistry - Study guide and solutions manual, 12th edition, Wiley, 2016.
3. J. McMurry, Organic Chemistry, 9th Edition, Thomson, 2016.

Teaching and learning methods

Theoretical classes of the syllabus and discussion and analysis of application examples. Practical classes for the resolution of application exercises. Independent

Teaching and learning methods

study including homework exercises for further analysis at the practical classes.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final)
 - Intermediate Written Test - 30% (Chapters 2 to 4.)
 - Intermediate Written Test - 30% (Chapters 5 and 6.)
 - Intermediate Written Test - 20% (Chapter 7.)
 - Case Studies - 20% (Chapter 7.)
2. Alternative 2 - (Regular) (Supplementary, Special)
 - Final Written Exam - 100%
3. Alternative 3 - (Student Worker) (Final, Supplementary, Special)
 - Final Written Exam - 100%

Language of instruction

English

Electronic validation

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|----------------------------------|-----------------------|--------------------------------|--------------------------|
| Maria Olga de Amorim Sá Ferreira | Hélder Teixeira Gomes | António Manuel Esteves Ribeiro | José Carlos Rufino Amaro |
| 28-02-2024 | 13-03-2024 | 13-03-2024 | 16-03-2024 |