ORGANIC CHEMISTRY - channel 2

CHIM/06 - 9 CFU - 1° Semester

Teaching Staff

ANDREA PAPPALARDO

Email: andrea.pappalardo@unict.it
Office: Dipartimento di Scienze Chimiche/ Viale A. Doria, 6
Phone: 095/7385010
Office Hours: Martedi 9.00-10.00; Giovedi 9.00-10.00

LEARNING OBJECTIVES

Major objectives of this course are to enlighten the principles of Organic Chemistry, their applications in practical situations and their relevance to our lives, and in general in the world around us.

COURSE STRUCTURE

classroom lessons and laboratory exercises

DETAILED COURSE CONTENT

1. Introduction - Structure and Bonding in carbon compounds. Covalent Bonds. Single and multiple bonds. Hybridization. Polar and nonpolar molecules. Intermolecular interactions. Structure formulae and their representation Constitutional isomers. Three dimensional shape of organic compounds. Resonance. Functional groups and classification of organic compounds. Nomenclature. Molecular structure and physical properties.

2. Introduction to organic reactions and mechanisms - Homolytic and heterolytic covalent bond cleavage. The use of curly arrows. Acids and Bases. Acid strength (Ka e pKa). Effects of structure on the strength of acids and bases. Acid-base reactions. Nucleophiles and electrophiles. Relationship between standard Gibbs energy and equilibrium constant. Rates of reactions and equilibrium constant. Energy profile diagram. Transition states and intermediates.

3. Alkanes and Cycloalkanes – Structure and nomenclature. Sources. Physical properties. Conformational isomers. Pyrolysis. Combustion. Halogenation. Ring strain and axial/equatorial, cis/trans isomerism in cyclic compounds.

4. Stereochemistry – Chirality. Stereoisomers: enantiomers, diastereoisomers. Asimmetric carbons and other stereogenic centres. Optical activity. Polarimeter. R-S configurations. Absolute configuration.

Fischer projections. Resolution of racemic misture. The stereoisomers of tartaric acid. Chirality in Nature.

5. Alkenes: Structure and Nomenclature. Cis-trans and (E)-(Z) nomenclature system. Reactivity. Reactions of electrophifilic addition (addition of H2, X2, HX, water). Markovnikov's rule. Regioselettivity. Stereospecificity. Polymerization.

6. Alkynes – Structure and Nomenclature. Reactivity. Addition of hydrogen, HX and water.

7. Aromatic compounds - Structure and stability of benzene and its derivatives, aromaticity, Huckel's rule, nomenclature of aromatic compounds. Electrophilic aromatic substitution . reactivity in substituted benzene rings, directing effect of substituents Nitration, halogenation sulfonation Friedel-Crafts alkylation and acylation. Aromatic heterocyclic (furan, thiophene, pyrrole, pyridine): structure and reactivity.

8. Alkyl Halides - Nucleophilic Substitution. The SN1 and SN2 mechanisms. Stereochemistry of Nucleophilic Substitution. Elimination reactions. The E2 and El mechanisms. Organochlorine pesticides (outlines).

9. Alcohols, Phenols, ethers, thiols - Structure and nomenclature. Physical properties. Hydrogen bonding, Acidity and basicity. Review of synthesis. Reactivity (substitution reactions, oxidation, esterification). Cyclic ethers.

10. Aldehydes and Ketons - Structure. Nomenclature. Physical properties. Review of synthesis. Reactivity: nucleophilic addition of organometallic reagents (Grignard reagents), HCN, alcohols (acetal, hemiacetal), amines (imine, enamine). Oxidation. Reduction. Acidity of □-hydrogens. Aldol condensation

11. Carboxylic acids and their derivatives - Structure. Nomenclature. Physical properties. Acidity. Review of synthesis. Reactivity: Nucleophilic acyl substitution. Esters. Anhydrides. Amides. Halogenures. Nitriles. Hydrolysis of esters. Saponification. Claisen condensation. Keto acids and keto esters. Hydroxyacids.

12. Amines - Structure and basicity. Nomenclature. Physical properties. Stereochemistry. Reactivity: alkilation, amide formation, reaction with nitrous acid. Arendiazonium salts and their reactions. Diazo coupling.

13. Carbohydrates – Structure. Nomenclature. Classification. Common names. Absolute configurations. Fischer projections. Cyclic structure and conformations of hexoses. Epimers, anomers. Mutarotation. Oxidation. Reduction. Disaccharides and polysaccharides: sucrose, maltose, lactose, cellulose, starch, glycogen.

14. Aminoacids and proteins – Natural and essential amino acids. Absolute configuration. Dipolar ions. Acid and basic properties. Important reactions. Peptide linkage. Hydrolysis. 1°, 2°, 3° and 4° structure of proteins.

15. Lipids – Structure. Fats and oils. Free fatty acids. Triacyl glycerols. Terpenes. Steroids. Prostaglandins. Phospholipids and cell membrane. Wax.

16. Nucleic acids (outlines)

TEXTBOOK INFORMATION

1. W. H. Brown "Chimica Organica", Edises

2. T W Graham Solomons, Craig B Fryhle “Chimica organica”, Zanichelli