SSD: CHIM/06
Academic year: **2016/17**
Faculty: **Department of Biology**
Study courses: **Organic Chemistry**
Study plans/Curricula: **Biological Sciences 1st level degree**
Type: **Basic activities of the class (type a)**
Total Credits: **7**
Didactic Methods: **Lectures and exercises**
Language of the course: **Italian**
Didactic Period: **1° year - 2° semester (March – June)**
Exam type: **Oral**
Professor in charge: **ANGELO NACCI**

Training objectives: **To complete knowledge of the behaviour of the various organic functional groups, with particular reference to stereochemical aspects and their reactivity.**

Prerequisites: **Basic concepts of organic chemistry and biochemistry of bachelor degree**

Didactic Methods: **Classroom lectures at the blackboard**

Course programme
Hybridizations of carbon atom. Alkanes: Nomenclature. Structural and conformational isomerism. Sources: oil. Halogenation and combustion reactions. Cycloalkanes. Theory of Bayer. Cyclohexane. Conformational and geometric isomerism in cycloalkanes. The concept of spontaneous reactions. Activation energy. The reaction mechanisms. The concept of electrophile and nucleophile. Carbocations and carbanions. Brønsted and Lewis acids and bases. Scale of pKa. Alkenes and alkynes. Nomenclature. Geometric isomerism. Electrophilic addition to alkenes: general mechanism. Addition reactions: hydracids, water, halogens, hydroboration. Regiochemistry of addition: Markovnikov rule. Oxidation reactions with peracids and permanganate. Stereochemistry of oxidation reactions. Polymerization of alkenes.
Aromatic hydrocarbons. Benzene: structure, aromatic and stabilization energy. Naphthalene and anthracene. Mechanism of electrophilic aromatic substitution reactions. Halogenation, nitration, Friedel-Crafts alkylations and acylations. Optical isomerism: Chirality and symmetry of elements. Optical activity, polarized light and optical rotation. Enantiomers: racemic mixtures and diastereomers. Meso compounds and epimers. Absolute configuration of chiral carbons. Alkyl halides: Nomenclature. aliphatic nucleophilic substitution reactions SN1 and SN2: Stereochemistry. Eliminations. Competition between substitution and elimination mechanisms. Alcohols and glycols: nmenclature. Acidity of alcohols. Alcoholates. Dehydration of alcohols to alkenes (mechanism E1). Williamson synthesis of ethers. Alkyl halides from alcohols. Oxidation of alcohols to carbonyl compounds. Glycols and glycerol: synthesis and properties. Ethers, Epoxides, and phenols: Nomenclature and synthesis. Aldehydes and ketones: nomenclature. Structure of the carbonyl. Nucleophilic addition. Acetals, hemiacetals, and aldimine (Schiff bases). Reduction and oxidation. Enols and enolates: keto-enol equilibrium and its importance in metabolic processes. Carboxylic acids: nomenclature and structure. Acidity. Methods of synthesis. Derivatives: esters, amides, nitriles, acyl halides and anhydrides. Reduction reactions. Fatty acids and their salts. Fisher esterification. Saponification. Soaps. Lipids, phospholipids and their biological importance.
Amides. Structure and Synthesis. biological importance of amides. Carbon-carbon bond forming reactions: aldol condensations and Claisen reactions. Amines: Nomenclature, basicity and

synthesis: ammonolysis of alkyl halides. Biogenic amines. Carbohydrates: aldohexoses. Fructose. Anomers. Epimers. Glycosides and their biological importance. Pentose: ribose, 2-deoxyribose, xylose, arabinose and ribulose. N-ribosides. Glucosamine. Disaccharides: maltose, cellobiose, lactose, sucrose. Polysaccharides: starch, cellulose, glycogen and their structure. Amino acids. Chemical and physical properties: solubility and Isoelectric point.
Stereochemistry. Synthesis of amino acids. Volhard method. Peptide bond. Proteins: primary, secondary, tertiary and quaternary structures. Denaturation. ATP and hints on energy metabolism and biochemistry. Aromatic heterocycles: Pyrrole, Furan, Thiophene, Imidazole, thiazole, pyridine, Pyrimidine and Purine.
Purine and pyrimidine bases. The keto-enol in the purine and pyrimidine bases. Basic knowledge on Nucleic acids and nucleotides.

Reference Texts: 1) "Organic Chemistry" A biological approach - J. McMurry – Zanichelli; 2) "Organic Chemistry" Brown - Foote - Iverson - Anslyn - EdiSES. Handouts and lecture notes