



UNIVERSITÀ
CATTOLICA
del Sacro Cuore

Chemistry

PROF. NICOLETA ALINA SUCIU

Course aims and intended learning outcomes

The objective of the course is to provide the fundamental concepts of inorganic and organic chemistry for future progressive study in biochemistry and allied subjects. During the course the students will (i) gain an understanding of matter, its classification and chemical bonding; (ii) learn to write chemical equations and make calculations using the chemical equations; (iii) study the differences between solids, liquids and gases, based on their properties; (iv) acquire principal concepts of colligative properties of chemical solutions and of chemical equilibrium; (v) study the functional groups of the organic molecules and their properties; (vi) increase the understanding of organic (aliphatic and aromatic) molecules reactivity through a survey of basic reactions.

Furthermore, students will have the possibility to increase their understanding through practical examples and facilitated discussions during seminars and experiments conducted in laboratory.

At the end of the course the students will be able to (i) define and employ the vocabulary of inorganic and organic chemistry; (ii) write down the electronic configuration of chemical elements; (iii) identify ionic, covalent inorganic and covalent organic compounds; (iv) calculate masses of products/reactants and yield of a chemical reaction; (v) define liquids, gases and solids, based on their behaviour; (vi) determine the energy changes in chemical inorganic and organic reactions; (vii) prepare a buffer solution in laboratory; (viii) identify classes of organic compound based on functional groups and reactivity; (ix) apply their knowledge, understanding and skills in solving problems related to the behaviour of organic substances; (x) explain and understand "daily life" events, using scientific language and knowledge.

Course content

Module I: Inorganic Chemistry	CFU
The matter. The structure of the Atom and the periodic Table	0.20
The classification of Matter. Atomic orbitals. Electronic configuration of the atoms. Atomic properties and periodic table.	
Structure and Properties of Ionic and Covalent Compounds	0.20
Chemical Bonding. Properties of ionic and covalent compounds. Lewis Structures of molecules and ions. Formal charge	
Chemical Equations and Chemical changes	0.9
The mole concept and atoms. The chemical formula and equation. Precipitation, acid-base and oxidation-reduction reactions.	
The states of matter	0.4
Gases, liquids and solids. The ideal gases law. Partial pressure. Gas solubility. Diffusion and effusion. Intermolecular forces. Liquids and solids properties. Phase changes. Phase diagrams.	
Chemical equilibrium of solutions	1.8
Equilibrium constant. Le Chatelier principle. Brønsted-Lowry acids and bases. Water ionization and pH scale. Lewis acids and bases. pH of saline solutions. Buffer solutions. Titrations. Solubility. Colligative properties.	
Practical Laboratory experiences	1.0



UNIVERSITÀ
CATTOLICA
del Sacro Cuore

Seminars	0.5
Module II: Organic Chemistry	
Introduction	0.20
Functional groups as a substrate for organic reactions. Classification of organic reactions: addition, elimination, substitution. Nucleophilic and electrophilic reagents. Inductive and resonance effects.	
Saturated and unsaturated hydrocarbons	1.2
ALKANES AND CYCLOALKANES. Nomenclature. Physical properties. Conformations of alkanes and cycloalkanes. Cis-trans isomerism in cycloalkanes. Reactions: combustion and halogenation. Energy changes in reactions. Reaction mechanism. ALKENES and ALKYNES. Nomenclature. Geometric isomers. Physical properties and acidity. Electrophilic addition. Main electrophilic addition reactions. Alkenes and alkynes in nature. BENZENE AND ITS DERIVATIVES. Structure of benzene. Aromaticity (Hückel rule). Nomenclature and physical properties. Electrophilic aromatic substitution and types of reactions.	
Stereochemistry	0.20
Chirality and stereocenters. Enantiomers. R and S absolute configuration. Optical activity. Molecules with >1 stereocenter. Fisher formulas and their use.	
Organic compounds containing halogen, oxygen and sulfur	0.6
ALCOHOLS, PHENOLS, ALKYL HALIDES, THIOLS and ETHERS. Nomenclature and physical properties. Chemical properties: acidity and basicity. Reactivity: dehydration of alcohols, oxidation. Interesting alkyl halides.	
Compounds containing the carbonyl group	1.1
ALDEHYDES AND KETONES. Nomenclature and physical properties. Nucleophilic addition reactions. Redox reactions. Aldol condensation. CARBOXYLIC ACIDS AND THEIR DERIVATIVES. Carboxylic acids: nomenclature, physical properties and acidity. Addition-elimination mechanism. Esters and Amides: nomenclature and properties. Saponification. Fatty acids. Polyfunctional compounds of biochemical interest.	
Amines	0.20
Nomenclature and physical properties. Chemical properties: basicity. Principal reactions with carboxylic acids and carbonyl compounds.	
Practical Laboratory experiences	1.0
Seminars	0.5

Reading list

DENNISTON K., TOPPING J., QUIRK DORR D., CARET R. General, Organic, and Biochemistry, ninth Edition, McGraw-Hill Education International Edition, New York, USA, 2017.

SMITH J.G. General, Organic and Biological Chemistry, third Edition, McGraw-Hill Education International Edition, New York, USA, 2017.

Lecture slides and additional study material will be uploaded on teacher's web page (<http://blackboard.unicatt.it>).

Teaching method

28 hours of frontal lectures for each of the two modules (3 sessions/week; 2 hours/session and 1hour/session). Each module has associated 12 hours of practical laboratory experiences and 6 hours of seminars (practice problems and tackling exam-like questions). It is also an opportunity for students to discuss any issues pertaining to the lecture course.



UNIVERSITÀ
CATTOLICA
del Sacro Cuore

Assessment method and criteria

For each module, the exam is based on 1.5 hours classroom testing, consisting of thirty closed-ended (25) and open (5) questions, designed to verify the student's preparation throughout the proposed content. The activity of the students during the seminars and the practical laboratory, for each module, will be taken into consideration in the final score, for a maximum of two extra points. For each module, a mock exam (examination taken as practice before an official examination) will be available. At the end of the Inorganic Chemistry module, an early exam session is planned. During the official exam dates, the students will have the possibility to be assessed for the content of a module or both modules. The final mark will be the average of the scores obtained for the two modules.

Notes and prerequisites

Attendance at hands-on laboratory activity and seminars is mandatory.

Since the current course has a medium-basic level, a minimum knowledge in the field of Chemistry is required. However, in order to facilitate students' understanding during the course, a Preparatory course will be available (10 hours) before the course starts.

Prof. Nicoleta Alina Suciu will be available in her office for consultations by appointment