I year (1st semester) **A.Y. 2021-22**	Scientific Field	**CHEMISTRY AND INTRODUCTORY BIOCHEMISTRY**	TUTOR	ECTS
	BIO/10	Chemistry and Introductory Biochemistry	Marini Stefano	6
MARINI S. **COORDINATOR**	BIO/10	Chemistry and Introductory Biochemistry	Ciaccio Chiara	1
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SPECIFIC AIMS	To understand and to learn the chemical and physical principles of the molecular mechanisms that underlie life processes. To learn about the chemical compounds involved in biological processes and to understand some of the chemical reactions that take place during the life processes.

PROGRAM **CHEMISTRY**	INTRODUCTORY REMARKS. Periodic table of elements and inorganic nomenclature. Atom: atom models, atomic particles: proton, neutron, electron. Isotopes. Electrons and atom electronic configuration. The quantum-mechanical model of the atom. Quantum numbers and orbitals. Auf-bau. Chemical bonds. MATTER STATES. Gas: ideal gas law. Absolute temperature and its relation with mean molecular speed. Mixture of gases; Dalton law. LIQUIDS: vapor pressure of a liquid. Solids: structural characteristics of covalent, ionic, molecular and metallic solids. THERMODYNAMICS. Thermodynamic potentials; enthalpy, Hess law, entropy. Free energy: relationship with enthalpy and entropy. SOLUTIONS. Concentrations of solutions: dilution and mixing of solutions. Vapor pressure of a solution (Raoult law). Solubility of gases in liquids: Henry law. CHEMICAL EQUILIBRIUM. Equilibrium in gaseous phase. Expression of equilibrium constant. Kp and Kc relationship. Equilibrium influencing factors. Homogeneous and heterogeneous equilibrium. SOLUTIONS OF ELECTROLYTES. Strong and weak electrolytes: dissociation grade. Colligative properties of electrolyte solutions. Van't Hoff binomial. Acid and bases following Arrhenius, Bronsted and Lowry definitions. Strong and weak acid and bases. Dilution law of Ostwald. pH in strong and weak acid and base solutions. Buffers. Dissociation of polyprotic acids and bases. Acid-base titrations. HETEROGENEOUS SYSTEMS. Equilibria of slightly soluble ionic compounds. The solubility-product constant. The effect of a common ion. KINETIC. Kinetic introduction, activated complex theory, activation energy. Kinetic equations and reaction order. Relationship between kinetic constant and activation energy (Arrhenius energy). Relationship between kinetic constants and equilibrium constants. ELECTROCHEMISTRY. Redox reactions and chemical potentials. Oxidation number. Redox reactions and their balance. Redox standard potentials. Nernst equation. Electromotive force potential of a cell. Half-cell. Chemical and concentration cells.

PROGRAM **INTRODUCTORY BIOCHEMISTRY**	CARBON ATOM HYBRIDIZATION. Sp3, sp2, sp hybridization and their geometry. HYDROCARBONS. Saturated hydrocarbons (arenes): alkanes, cycloalkanes. Nomenclature. Conformational isomerism and geometric isomerism (cis-trans). Alkanes reactions: halogenation ant its mechanism. Unsaturated hydrocarbons: alkenes and alkynes. Nomenclature. Addiction reactions to alkenes. Markovnikov rule. Alkynes addiction. AROMATIC COMPOUNDS. Benzene structure: resonance model. Aromatic compounds nomenclature. Electrophilic aromatic substitution and its mechanism. Activating/deactivating groups in electrophilic aromatic substitution. Ortho-para and meta directing group. Polycyclic aromatic hydrocarbons. ALCOHOLS, PHENOLS, THIOLS. Nomenclature. Acidity and alkalinity of alcohols and phenols. Alcohols' reactions. Alcohol with more than a unique alcoholic group. Alcohols and phenols in comparison. Aromatic substitution in phenols. Thiols. Aldehydes and KETONES. Nomenclature. Aldehydes and ketones preparation. Carbonylic group. Nucleophilic addition at carbonylic groups. Acetals and hemiacetals formation. Oxidation of carbonylic compounds. Keto-enol tautomerism. Alfa hydrogen acidity. Aldol condensation. CARBOXYLIC ACIDS AND THEIR DERIVATIVES. Nomenclature. Carboxylate ion resonance. Effects of acid structure: inductive effect. Acids preparation. Carboxylic acid derivatives: esters, anhydrides, amides. DIFUNCTIONAL ACIDS. DICARBOXYLIC ACIDS. Unsaturated acids. Ketoacids. Esterification mechanisms (Fisher). Glycerol triesters. Ammines and OTHER NITROGEN COMPOUNDS. Classification and nomenclature of ammines. Ammines preparation. Ammine alkalinity. Comparison between ammines and amides. Ammines reactions: heterocycles, pyrrole, pyridine, imidazole, pyrimidine, purines. STEREOISOMERISM. Chirality. Enantiomers. Polarized light. Diastereoisomers. Meso compounds. Racemic mixtures. CARBOHYDRATES. Definition, classification and nomenclature. Monosaccharides. Monosaccharides chirality. Fisher projections.

TEXTBOOKS	Chemistry by M.S. Silderberg, McGraw-Hill International Edition. Introduction to General, Organic and Biochemistry by F.A. Bettelheim, W.H. Brown, M.K. Campbell, S.O. Farrell, Brooks/Cole.
EXAM METHOD	The course provides two different final tests: a written and an oral exam. The written part will deal with the whole program as reported above and will consist in 5 stoichiometry exercises, which must be solved; each exercise will range from 0 to 5 points as a function of the exercise progresses and solution quality. Moreover, a further exercise of organic nomenclature (ranging from 0 to 5 points) must also be solved. To be admitted to the oral part, the written part of the exam must be passed with a whole mark higher than 15. Oral test, which is usually held one week after the written, consists of an oral examination on the whole program. It is important to stress that admission to the oral part is valid only for the same examination.

EXAM COMMISSION	The Coordinator, full Professors of the disciplines, Professors of similar disciplines, Specialists of the subject, compose the exam Commission of the Integrated Course.

Marini Stefano, President
Ciaccio Chiara

CONTACTS

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PREREQUISITES: Previous knowledge and competence in Basic Chemistry.

The specific learning outcomes of the program are coherent with the general provisions of the Bologna Process and the specific provisions of EC Directive 2005/36/EC. They lie within the European Qualifications Framework (Dublin Descriptors) as follows:

1. **Knowledge and Understanding**

- Demonstrate a comprehensive theoretical knowledge of the main molecular chemical and biochemical principles, rules and structures.
- Identify the structural components of inorganic and organic compound present in nature.
- Understand the importance of these structures, focusing the attention on their natural interaction and their possible alterations.

- Understand the bases of aqueous-electrolytic and acid-base rules and their role on the human body homeostasis.
- Understand the importance of chemical bonds and how they stabilize a chemical structure.

2. **Applying Knowledge and Understanding**

- Determine the core consequences of chemical abnormalities and the influence of chemical compounds in the human body.
- Apply the theoretical knowledge to the clinical setting, being able to recognize the general diagnostic aspects of chemical and metabolic abnormalities.
- Identify and recognize the proper molecular diagnostic techniques to use for any particular topic of examination. Provide a comprehensive description of all the available possibilities.
- Assess the major metabolic values and cut-offs used in the clinical scenario.
- Solve main problems of bioinorganic chemistry based on learning fundamental principles.
- Learn to interpret the results of simple experiments and demonstrations of chemical principles.

3. **Making Judgements**

- Recognize the importance of an in-depth knowledge of the topics consistent with a proper medical education.
- Identify the fundamental application of the theoretical studies to clinical practice.

4. **Communication Skills**

- Present the topics orally in an organized and consistent manner.
- Use of proper scientific language coherent with the topic of discussion.

5. **Learning Skills**

- Identify the possible use of the acknowledged skills in future career.
- Assess the importance of the acquired knowledge in the overall medical education process.