



UNIVERSITÀ
degli STUDI
di CATANIA

DEPARTMENT OF BIOLOGICAL, GEOLOGICAL AND
ENVIRONMENTAL SCIENCES
Bachelor's Degree in Biology
Academic Year 2021/2022 - 1° Year

GENERAL AND INORGANIC CHEMISTRY A - L

CHIM/03 - 9 CFU - 1° Semester

Teaching Staff

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LEARNING OBJECTIVES

The course aims to provide the basics of General and Inorganic Chemistry as a cultural basis essential for the understanding of the courses later encountered by the students, sequentially, organic chemistry, biochemistry and molecular biology.

The course of General Chemistry will also give the student an idea of the role of chemistry in society and in everyday life. In particular, the student, through the study of chemistry will not only be aware of the fundamental role carried out by this discipline in different scientific and technological fields, particularly in the chemistry of bio-systems, but will also learn the fundamental principles behind the scientific method.

The student must acquire, through the study of the fundamental laws that govern them, basic knowledge on the various states of aggregation structure with particular reference to the study of the electronic configuration of atoms and molecules and the chemical dynamics (chemical reactions especially in their stoichiometric, thermodynamic and kinetic aspects). The student will be able to correlate the structure to the chemical reactivity and to perform stoichiometric calculations at the base of chemical measurements.

COURSE STRUCTURE

The course includes 42 hours of lectures + 36 hours of exercises. The latter are useful for the final written exam. Students will also be taken once in the laboratory to carry out an experience useful for the understanding of some basic concepts of the course.

If the teaching course is given in a mixed or remote mode, the necessary changes with respect to what was previously stated may be introduced, in order to respect the program envisaged and reported in the syllabus.

DETAILED COURSE CONTENT

- 1 - STRUCTURE OF - Subatomic particles: Electron, proton, neutron - atomic number, mass number - isotopes - atomic mass unit - Atomic model of Bohr / Rutherford - Quantum Mechanical Description of the atom - Atomic orbitals - Quantum Numbers - the Pauli exclusion principle - Principle of maximum multiplicity
- 2 - PERIODIC SYSTEM OF ELEMENTS - electronic configuration and periodic classification of the elements - Periodic properties: atomic and ionic radii, ionization energy, electron affinity, electronegativity.
- 3 - CHEMICAL BOND - Ionic bond - covalent bond - valence bond theory - Electronegativity of atoms and polarity of bonds - Oxidation number - Dative bond - VSEPR Theory: molecular geometry hybrid -Orbitals - Resonance - Chemical bonding and structural formulas of the most common inorganic compounds.
- 4 - INTERMOLECULAR FORCES - Van der Waals and London Forces - hydrogen bond.
- 5 - GASEOUS STATE - General characteristics of gaseous state - ideal or perfect Gas - ideal gas laws - Gas Equation - Gas Diffusion - Real Gas. Numerical applications.
- 6 - STOICHIOMETRY - The concept of mole - stoichiometry law- Determination of the formula of a compound - The chemical equation and its equilibrium- Identification of redox reactions - Balancing of redox reactions - Stoichiometry: Quantitative relationships in chemical reactions - limiting reagent, numerical applications
- 7 - CONDENSED PHASES AND STATE CHANGES - Outline of solid state properties as a function of the chemical bond - the liquid state Features - State changes - Vapor Pressure - State diagram of the water and carbon dioxide- Le Chatelier's principle -.
- 8 - WATER SOLUTIONS - Types of solutions - Concentration units - Solubility (with particular reference to the solubility of ionic compounds) and heterogeneous equilibria - Henry's Law - colligative properties of solutions: Lowering of vapor pressure and Raoult's Law - Cryoscopy and ebullioscopy - Osmosis and osmotic pressure - electrolyte solutions. Colligative properties of electrolytes - Dissociation Grade, Numerical applications
- 9 - KINETICS - Factors affecting the rate of reaction - kinetic equation and reaction order - Graphical Treatment of 1st order reaction - elementary reactions: the reaction rate-limiting step - Activation energy - Catalysts
- 10 - CHEMICAL BALANCE - The balance in homogeneous systems - chemical equilibrium Law - Factors affecting the balance - Ionic equilibria in aqueous solution - Dissociation of water and pH -Theory of acids and bases: Acids and Bases according to Arrhenius, Bronsted and Lewis - ampholytes - pH of salt solutions (hydrolysis) - Buffer solutions - Calculation of pH in solution of acids, bases, salts and buffers - pH indicators. Numerical applications and titrations.
- 11 - ELECTROCHEMISTRY - Galvanic cells - Nernst equation - Series of potential standards and its importance - - Electrolysis - Faraday law.

12 - ELEMENTS OF THERMODYNAMICS - Enthalpy - Hess's Law - Entropy - Free Energy - Temperature Role in the spontaneity of chemical reactions

13 - INORGANIC CHEMISTRY - metals and non-metals: general information on the chemical and physical properties, natural and biological relevance. General characteristics of each group of the periodic Table. Main oxidation states and compounds of hydrogen, alkali metals and alkaline earth metals, Carbon, Nitrogen, Phosphorus, Oxygen, Sulfur and Chlorine. Transition elements: general information. Coordination compounds of biological relevance.

The underlined parts, and everything else that is necessary to pass the test for the programmed number (see the site of Biological Sciences), are discussed in depth at the basic courses to be held in the afternoons of the first two weeks of the course.

TEXTBOOK INFORMATION

1. CHEMICAL PRINCIPLES - Atkins, Jones, Laverman

2. Stoichiometry- B I Bhatt-S B Thakore

3. Chemical Reactions and Stoichiometry, R. K. Dave

4. Chemistry: A Molecular Approach (5th edition) Nivaldo J. Tro, Global Edition

5. Chemistry & Chemical Reactivity. Kotz/Treichel/Townsend

Lecture notes
