



UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2023/2024
BACHELOR'S DEGREE (BSC)	ENVIRONMENTAL ENGINEERING FOR SUSTAINABLE DEVELOPMENT
SUBJECT	GENERAL AND INORGANIC CHEMISTRY WITH ELEMENTS OF ORGANIC CHEMISTRY
TYPE OF EDUCATIONAL ACTIVITY	A
AMBIT	50280-Fisica e chimica
CODE	07844
SCIENTIFIC SECTOR(S)	CHIM/07
HEAD PROFESSOR(S)	GARCIA LOPEZ ELISA Professore Associato Univ. di PALERMO ISABEL
OTHER PROFESSOR(S)	
CREDITS	9
INDIVIDUAL STUDY (Hrs)	144
COURSE ACTIVITY (Hrs)	81
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	GARCIA LOPEZ ELISA ISABEL Friday 10:00 13:00 Stanza S06P1004. Primo piano. Edificio 6.

DOCENTE: Prof.ssa ELISA ISABEL GARCIA LOPEZ

PREREQUISITES	Basic concepts on calculus and trigonometry
LEARNING OUTCOMES	<p>-Knowledge and understanding: Knowledge of issues concerning the structure of matter and the principles that regulate its chemical-physical transformations (phase transformations, chemical reactions, etc ..). In particular, the student will be able to understand the basic principles of atomic structure and chemical bonding. The student will also be able to evaluate the influence of the operating parameters (such as temperature and pressure) on chemical reactions. These abilities will be verified by the written and oral examinations.</p> <p>-Applying knowledge and understanding: Ability to independently evaluate both the validity and the accuracy limits of the structure of matter models and the principles of thermodynamics and kinetics of chemical reactions. These abilities will be verified by the written and oral examinations.</p> <p>-Making judgments The student will have acquired the capacity to independently assess both the validity and the approximate models limits of the matter structure, as well as the use of the thermodynamics principles and the kinetics of chemical reactions. This ability will be verified by the written and oral examinations.</p> <p>-Communication skills: Ability to communicate and express issues concerning the fundamental aspects of the discipline (atomic structure, thermodynamics and kinetics chemical reactions). This ability will be verified by the written and oral examinations.</p> <p>-Learning ability: The student will learn the basic aspects of the structure of matter and of the chemical reactions. This knowledge will contribute to the student formation in the phenomenological disciplines (physical and chemical) and it will allow him to continue his engineering studies with greater autonomy and discernment. This ability will be verified by the written and oral examinations.</p>
ASSESSMENT METHODS	<p>Two exams: a first written test lasting two hours consisting in at least 10 theoretical and numerical questions which require a short answer. This text will be evaluated on the basis of thirtieths. Students who get a vote in the writing test not lower than eighteen/thirtieths will be admitted to the oral exam. The exam will be not passed if the student will show a not acceptable knowledge of the topics.</p> <p>The oral exam will consist of an interview, based on the written test and on the general program, in order to check that the student possess the skills and disciplinary knowledge in all of the main topics described in the program. The oral questions could have also an open nature and hence the answers could be discursive. The final assessment will be formulated taking into account both the written exam and the interview.</p> <p>The final assessment is on a 30 basis according to the following criteria: 30-30+: excellent knowledge of the topics, excellent language and vocabulary, good analytical capability, the student is able to apply knowledge to solve the proposed problems 26-29: Good management of the topics, nice language and vocabulary, the student is able to apply knowledge to solve the proposed problems 24-25: basic knowledge of the topics, fair language and vocabulary, limited capability to apply autonomously knowledge to solve the proposed problems 21-23: the student does not show full management of the main topics while possessing the knowledge, satisfactorily language and vocabulary, poor capability to apply autonomously the acquired knowledge 18-20: minimal basic knowledge of the main topics and of the technical language and vocabulary, poor or no capability to apply autonomously the acquired knowledge.</p>
EDUCATIONAL OBJECTIVES	The aim is the learning of the fundamental principles of chemistry, highlighting the importance of the methodological criteria that may be useful for the continuation of engineering studies.
TEACHING METHODS	Lectures and classroom exercises
SUGGESTED BIBLIOGRAPHY	<p>Testo principale in italiano: "Elementi di chimica" di L. Palmisano, G. Marci, A. Costantini, EDISES, 2° Edizione Agosto 2020. ISBN: 8836230237 Tavola periodica degli elementi con proprietà. Versione avanzata. ISBN: 8836230725</p> <p>Main text in English: "Chemistry: The Molecular Nature of Matter and Change" By M. Silberberg and P. Amateis. McGraw-Hill. 9th Edition 2021. ISBN10: 1260240215; ISBN13: 9781260240214</p>

	<p>Testi di approfondimento: "Chimica ambientale" Colin Baird, Michael Cann. Zanichelli, 3° Edizione, ISBN: 880817378X</p> <p>Testo facoltativo per esercitazione numerica: "Stechiometria" G. Marci, L. Palmisano, F. Ruffo, EDISES, 1° Edizione, ISBN: 9788836231058</p>
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SYLLABUS

Hrs	Frontal teaching
5	-Classification of matter. Homogeneous and heterogeneous systems. State of aggregation and phase. - Atomic theory of matter. Atomic and molecular weight. Amount. Chemical element and compound. Empirical and molecular formulas. -Atomic structure: Electrons, protons, neutrons. Elements of quantum theory: Bohr's atom. wave theory. Orbital concept. Orbitals: their energy and graphical representation. The quantum numbers. Electronic configuration of the elements. - Periodic system of elements: Metals, non-metals, semi-metals. Periods and groups. Group properties.
5	-Oxidation number and hints of inorganic chemical nomenclature. -Chemical bond. Ionization energy, electron affinity. Homeopolar and heteropolar ionic and covalent bond. Electronegativity. Hybridization of atomic orbitals. Symmetry of hybrid orbitals: sp, sp ² , sp ³ . Double and triple bonds. Bonds with delocalized electrons. Dative link. Intermolecular bond: Hydrogen bond, van der Waals forces. Notes on metallic bonding and band theory.
5	-Basics of organic chemical nomenclature: Hydrocarbons: alkanes, alkenes, alkynes, aromatic hydrocarbons. Alcohols, phenols and ethers. Aldehydes and ketones. Carboxylic acids, esters. Amines and amides. The petroleum. - Basics of biochemistry: the cell: types, structure and main functions. Carbohydrates, lipids, amino acids and proteins. Enzymes. The nucleic acids. The energy of the cell: the ATP molecule.
3	-Stoichiometry, redox balance, combustion. Complete and incomplete combustions. Solid, liquid and gaseous fuels. Combustion fumes.
4	-Biogeochemical cycles: water, carbon, oxygen, nitrogen and phosphorus. Airborne contaminants. Acid rain, greenhouse effect, notes on the chemistry of ozone.
2	-The gaseous state. Gas laws: General equation of state for ideal gases. Gaseous mixtures: partial pressures: Dalton's law. Thermal dissociation of gases. Real gases. Critical temperature and pressure. Andrews diagram.
4	-The solid state: General properties. Concept of structure in solids. Types of solids: Ionic, covalent, molecular, metallic solids and their properties. -The liquid state: General properties. Vapor pressure. Clausius and Clapeyron law. -Phase changes in single component systems: The state diagram of water and CO ₂
4	- Basics of thermodynamics: 1st Law of thermodynamics. Enthalpy. Hess' law. 2nd principle. Entropy. Criterion of spontaneity of the chemical reaction. Free energy. Gibbs report. -Basics of chemical kinetics. Collision theory. Factors affecting the rate of reaction. reaction mechanisms. Speed constants. Activation energy. Arrhenius law. Catalysts.
4	-Two component systems. Aqueous solutions: the phenomenon of dissolution, nature and concentration of solutions. Ideal and non-ideal solutions. colligative properties. Weak and strong electrolytes, degree of dissociation. Effect of dissociation on colligative properties: the van't Hoff binomial. Phase changes in two-component systems. Vapor-liquid equilibria. Distillation, Azeotropes. Solid-liquid equilibria. Eutectic.
4	-Chemical equilibrium: Characteristics of the chemical reaction at equilibrium. Law of mass action. Equilibrium constants. Reaction quotient. Principle of le Chatelier. Balance shift. Dependence of the equilibrium constant on temperature: van't Hoff's law. Heterogeneous balances.
6	-Chemical equilibrium in aqueous solution: Acids and bases according to Arrhenius, Brönsted and Lewis. Autoprotolysis equilibrium of water. Definition of pH and pOH. Solutions of strong and weak monoprotic and polyprotic acids and bases. Acid-base balance in saline solutions. Buffer solutions. Neutralization of weak acids or bases with strong bases or acids. Solubility equilibria: solubility product. Solubility of low soluble salts in solutions with common ions. Fractional precipitation.
3	-Pollutants in water: metallic elements and polluting inorganic species. Organic pollutants (pesticides, halogenated compounds, polycyclic aromatic hydrocarbons, dioxins).
3	-Electrochemistry. Redox reactions, semi-elements and their representation, batteries. Normal reduction potentials under standard conditions. Calculation of the electromotive force of a galvanic cell in non-standard conditions: Nernst equation. Concentration cells. Electrolysis. Faraday's laws.
Hrs	Practice
7	Structure and geometry of molecules. Numerical applications: Stoichiometry. Number of moles. Balancing of chemical reactions
2	Numerical applications: gases and gaseous mixtures.
3	Numerical applications thermochemistry
3	Numerical applications colligative properties
4	Numerical applications gaseous and heterogeneous chemical equilibrium
5	Numerical applications of equilibrium in aqueous solution: acid base and solubility
5	Numerical applications electrochemistry

