Bari CdS DENTISTRY AND DENTAL PROSTHETICS
FIRST YEAR – A.Y. 2024-2025
CHEMISTRY

General information	
Course name	Chemistry
Year of the course Academic	First year
calendar	Second semester
Credits (CFU/ETCS)	6 CFU
SSD	Biochemistry BIO/10
Language	Italian
Mode of attendance	Attendance is governed by the Course Teaching Regulation

Professor/ Lecturer	
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Department and address	Department of Translational Biomedicine and Neuroscience (DiBraiN) Nuovo Complesso delle Scienze Biomediche Policlinico, Piazza G. Cesare, 11 - Bari
Virtual room	Teams platform, code v44ry3j
Reception	Every day by email appointment or Teams platform, code v44ry3j

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Work schedule			
Hours			
Total	**Lectures**	**Hands-on (laboratory, workshops, working groups, seminars, field trips)**	**Out-of-class study hours/ Self-study**
150	60		90

Syllabus	
Learning Objectives	***Objective 1*** Knowledge of the structure and transformations of matter and molecular phenomena that find direct or indirect confirmation in clinical-medical applications, with particular regard to acid-base equilibria, physiological buffers, laws and solubility of gases, osmotic phenomena, properties of solutions, electrochemical potential. ***Objective 2*** Knowledge of the functional groups of the main organic molecules and their reactivity from the perspective of metabolic

	mechanisms and understanding the function of the macro-molecules of the human body. ***Objective 3*** Knowledge of the main classes of macromolecules (carbohydrates, lipids, proteins, nucleic acids, vitamins and coenzymes) present in the human body, with particular attention to the structure-function relationship and their possible involvement in physiopathological processes. ***Objective 4*** *Knowledge of the general characteristics of catalysts.*
Course prerequisites	Knowledge of the basics of chemistry, physics and mathematics necessary to pass the entrance test to the CdL in Medicine and Surgery.

Teaching strategies	The training activity is carried out through frontal lessons in the classroom with the use of audio-visual systems with interactive methodology based on the interaction between teacher and student.

Expected learning outcomes	
Knowledge and understanding ability	The student will have to acquire a good knowledge and understanding of the general principles of inorganic chemistry, knowledge of the structure of the main carbon compounds and their reaction mechanisms. Furthermore, the student will have to acquire a good knowledge of biological macromolecules, the structure and function of oxygen transporters.
Application of knowledge and understanding ability	The student will have to acquire skills and competences aimed at being able to translate the theoretical information acquired during the course to scientific contexts specific to the dental profession.
Soft skills	*Autonomy of judgement* *At the end of the course the student must be able to independently discuss and critically analyze the chemical-physical properties of the inorganic, organic and biochemically interesting molecules that have been studied during the course.* *Autonomy of judgment will be stimulated during the delivery of frontal lessons by involving students in solving questions and exercises proposed by the teacher in the classroom.* *Communication skills* *At the end of the course the student must be able to expose and explain one's chemical knowledge with logical rigor, correct language and scientific terminology. Furthermore, the student must be able to reproduce the main structures of inorganic molecules, organic and of biochemical interest.* *Ability to learn* *At the end of the course the student must be able to evaluate*

	their knowledge and skills and, consequently, to implement and/or update them by independently drawing from texts, scientific articles and online platforms.
Content knowledge	*INTRODUCTION* *Identification, classification, composition of matter. Elements, compounds and mixtures. Atoms, molecules, ions. Relative atomic masses. Avogadro's number. Absolute atomic masses. Mole. Chemical formulas. Molecular weight and formula weight. Writing and balancing chemical equations. States of aggregation of matter. Molecular kinetic theory of ideal gas. Real gases: Van der Waals equation. Maxwell-Boltzmann distribution. Nomenclature of inorganic compounds.* *ATOMIC STRUCTURE AND PERIODIC TABLE* *The fundamental particles of the atom. The atomic number. The atomic mass number. Isotopes. The atom according to the wave mechanical theory. Electronic configuration of the elements. The periodic table. Periodic properties of elements: atomic dimensions, ionization energy, electronic affinity, electronegativity.* *CHEMICAL BONDS* *Lewis symbolism. Ionic bond. Factors influencing ionic bond formation. Covalent bond. Lewis structure of molecules. Properties of the covalent bond and bond order. Resonance. The coordinated covalent bond. Polarity of molecules. Geometry of molecules. Theory of repulsion of electron doublets in the valence layer. Valence bond theory. Hybrid orbitals. Molecular orbital theory. Paramagnetism of oxygen. Reactive oxygen species. Metallic bond. Structure and properties of solids. Intermolecular forces.* *CHEMICAL THERMODYNAMICS* *Thermodynamic systems. State functions. The first principle of thermodynamics. Heat of reaction. Enthalpy. Hess's law. Heat of formation. Standard states. Spontaneity of a transformation and entropy. Reversible and irreversible transformations. The second principle of thermodynamics. Free energy and useful work. Free energy and balance. Third law of thermodynamics.* *CHEMICAL KINETICS* *Reaction rate. Rate law. Reaction order. Integrated equation of the rate of a first order reaction.* $t_{1/2}$ *of a first order reaction. Reaction mechanisms. Molecularity. Collision theory. Effective collisions. Transition state theory. Effect of temperature on reaction speed. Arrhenius equation. Catalysis. Chain reactions.* *SOLUTIONS* *Composition of solutions. Effect of temperature on solubilization. Concentration of a solution. Ways of expressing the concentration of a solution. Henry's Law. Ostwald's*

	dilution law. *CHEMICAL EQUILIBRIA* *Law of action of the masses. Equilibrium constant. Thermodynamics and chemical equilibrium. Activity and concentration. Chemical potential. Le Chatelier principle.* *ACIDS AND BASES* *Acids and bases according to Arrhenius. Acids and bases according to Bronsted-Lowry. Acids and bases according to Lewis. Strength of Lewis acids and bases. Octahedral coordination complexes.* *ACID-BASE EQUILIBRIA IN AQUEOUS SOLUTION* *The ionic product of water. pH concept. Calculation of the pH of strong acids and bases. Weak acids and bases: Ka and Kb, pKa and pKb. Calculation of the pH of weak acids and bases: application of Ostwald's dilution law. Buffer systems. Blood and cell buffers. pH indicators. Acid-base titrations. Titration curves. Amino acid titration curve. Dismutation reactions. Metathesis reactions. Solubility product.* *ELECTROCHEMISTRY* *Electrochemical potential of electrode. Redox couplereduction potential. Battery. Battery potential. Measurementof redox potentials. Spontaneity of redox reactions. Nernst's equation. Concentration batteries. Potentiometric pH measurement. Electrolytic conduction. Electrolysis cells: electrolysis of molten salts, electrolysis of water.* *ALKANES* *Normal, branched, cyclic alkanes. Conformation of organic molecules. Nomenclature. Combustion reaction. Carbon oxidation states. Radical substitution: halogenation of methane and higher alkanes.* *ISOMERISM* *Constitutional isomerism. Stereoisomerism. Chiral centers. Enantiomers. Optical activity. Polarized light and polarimeter. Configuration of molecules. R/S and D/L systems. Racemes. Compounds with multiple chiral centers. Meso compounds.* *NUCLEOPHILIC SUBSTITUTIONS* *Inductive and mesomeric effects. Halides. Mono and bimolecular nucleophilic substitutions. Stability and reactivity. Stabilization of carbocations. Mono- and bimolecular elimination reactions.* *ALKENES AND ALKYNES* *Nomenclature of unsaturated hydrocarbons. Structure of alkenes. Hydrogenation reaction. Electrophilic addition Reaction. Markownikoff rule. Chain and step polymerization.*

	Alkynes: structure and reactivity. Conjugated dienes:structure and reactivity. *ALCOHOLS* *Acidity and basicity. Dehydration reaction of alcohols: Zaitsev's rule. Alkoxides. Thiols. Synthesis of ethers.* *ALDEHYDES AND KETONES* *Carbonyl carbon. Nucleophilic additions. Semiacetals and acetals. Amines. Schiff Bases. Keto-enol tautomerism. Basic and acid-catalyzed aldol condensation.* *CARBOXYLIC ACIDS AND DERIVATIVES* *The carboxyl group. Structure and acidity. Fischer esterification. Saponification reaction. Claisen condensation. Thioesters. Amides. Anhydrides. Phosphoanhydrides and ATP. Dicarboxylic acids. Keto acids.* *ARENAS* *Structure of benzene according to valence bond and molecular orbitals. Resonance energy. Aromaticity. Huckel's rule. Electrophilic aromatic substitution. Nomenclature of substituted benzenes. Mesomeric and inductive effects on disubstitution: activating and deactivating groups. Phenols and quinones. Heterocyclic aromatic compounds.* *CARBOHYDRATES* *Monosaccharides: trioses, pentoses, hexoses, epimers, cyclization, anomers, mutarotation. Monosaccharide derivatives. Disaccharides: Maltose, Cellobiose, Lactose, Sucrose. Polysaccharides: Starch, Glycogen, Cellulose. Heteropolysaccharides: Mucopolysaccharides, Proteoglycans.* *LIPIDS* *Classification. Fatty acids. Triacylglycerols. Basic hydrolysis of triglycerides. Phosphoglycerides. Sphingolipids. Terpenes. Steroids. Lipid composition of biological membranes.* *PROTEINS* *Amino acids: classification based on the lateral group R. Acid-base properties of amino acids. The peptide bond. Polypeptides. Primary structure of proteins. Angles ϕ and Ψ. Secondary structure of proteins: α-helical and β-sheet structures. Tertiary structure and quaternary structure of proteins. Fibrous proteins: fibroin, α-keratin, collagen. Globular proteins. Protein denaturation and folding. Myoglobin and hemoglobin: structures and functions. Molecular mechanism of O_2 transport. Factors that modify the affinity of hemoglobin for O_2.* *NUCLEIC ACIDS* *Structure of nitrogenous bases. Nucleosides. Nucleotides.*

	Structure of DNA: A, B, Z. Structure of RNA. *WATER SOLUBLE VITAMINS AND COENZYMES* *Classification of vitamins. Vitamins: B2, B3. Coenzymes FAD and NAD^+.*
Texts and readings	*Recommended texts* *GENERAL CHEMISTRY:* *Petrucci et al. – Chimica Generale (Ed. Piccin)* *Kotz et al. – Chimica (Ed. EdiSES)* *Whitten et al. Chimica (Ed. Piccin)* *ORGANIC CHEMISTRY AND PROPAEDEUTIC BIOCHEMISTRY:* *Brown-Poon – Introduzione alla Chimica Organica (Ed. EdiSES)* *Russo et al. – Chimica Organica (Casa Editrice Ambrosiana)*
Notes, additional materials	*Additional material to the reference texts, where not available online through bibliographic reference, will be made available on the dedicated Teams platform.*
Repository	Course Teams channel

Assessment	
Assessment methods	The exam includes an oral interview during which the acquisition of the expected knowledge will be verified. The student will also be asked to represent the schemes of the main molecules and reactions on the blackboard (or on a sheet of paper).
Assessment criteria	The oral exam includes questions on the topics covered during the lessons; each answer will be evaluated based on the correctness, completeness and clarity of the topic covered by the question. Honors can be awarded when the student has demonstrated full mastery of the subject and excellent presentation skills during the interview.
Final exam and grading criteria	The commission will express the evaluation out of thirty. The exam is considered passed when the grade is greater than or equal to 18. The maximum grades with honors (30 cum laude) will be assigned.
Altro	