COURSE OF STUDY: Bachelor's Degree in Science and Management of Maritime Activities
ACADEMIC YEAR: 2023/2024
ACADEMIC SUBJECT: General and Inorganic chemistry – 6 credits

General information	
Year of the course	*1st*
Academic calendar (starting and ending date)	*26/02/24 – 15/06/24*
Credits (CFU/ETCS):	6
SSD	*CHIM 03*
Language	*Italian*
Mode of attendance	*Mandatory*

Professor/ Lecturer	
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Department and address	
Virtual room	*https://teams.microsoft.com/l/channel/19%3ArwQlFyCdJonPWxHeFF5iUWQ_ve0nd6zemn2_lPr9t881%40thread.tacv2/?groupId=f965cedf-1976-405c-ada3-656479ab2698&tenantId=*
Office Hours (and modalities: e.g., by appointment, on line, etc.)	To be defined by mail

Work schedule			
Hours			
Total	Lectures	Hands-on (laboratory, workshops, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Es. 150	*48*	*0*	*102*
CFU/ETCS			
Es. 6	*6*	*0*	

Learning Objectives	*The course contributes to the transmission of methods and contents specific to General and Inorganic Chemistry, both of a theoretical-general nature and more specific and applied in various technological or environmental fields. From this point of view, the course constitutes an essential basis for the correct understanding of subsequent teachings, either chemical or more generally scientific.* *Students will develop a natural awareness of the fundamental role played by this discipline in the scientific and technological world, and will acquire familiarity with the fundamental principles underlying the scientific method.* *They will learn the typical terminology of the discipline and will be able to recognize the most common inorganic compounds by formula or name.* *The necessary concepts to understand the nature of matter and materials, the concept of chemical equilibrium, and the kinetic and thermodynamic characteristics of chemical reactions, especially in the gaseous phase and in aqueous solution, will be provided.*

Course prerequisites	*Basic knowledge of Physics and Mathematics*

Teaching strategies	*The course is conducted through frontal lessons with the aid of slides and other multimedia materials.*
Expected learning outcomes in terms of	
Knowledge and understanding on:	o Understanding the fundamentals of the scientific method and the main characteristics of an experimental measurement; o Capacity for inductive and deductive reasoning; o Acquisition of reference theoretical models and in-depth knowledge of modern chemistry; o Ability to schematize a chemical reaction in qualitative and quantitative terms.
Applying knowledge and understanding on:	o Acquisition of the reasoning skills necessary to translate observable phenomena into chemical reactions and processes.
Soft skills	***Critical and judgmental skills.*** o Autonomy of judgment o Critical reasoning skills; o Development of the ability to describe a chemical-physical system qualitatively and quantitatively and to formulate hypotheses on how to alter the system itself in a targeted manner; o Acquisition of the ability to critically interpret experimental data. ***Communication skills.*** o Communication skills o Acquisition of scientific vocabulary, and in detail of chemical language; o Development of the ability to present scientific content rigorously and comprehensively, and to express an experimental measurement appropriately. **Ability to continue studying autonomously throughout life.** o Capacity for autonomous learning o Development of the ability to identify key concepts of each topic and to make connections between them; o Development of chemical intuition, understood as the ability to translate everyday phenomena into chemical-physical language.
Syllabus	
Content knowledge	*Introductory notions: Matter and substances - Chemical elements and compounds - Mixtures and solutions - States of aggregation of matter - Chemical properties and physical properties.* *Atomic Structure: Fundamental subatomic particles - Rutherford atomic model - Atomic number - Mass number - Isotopes - Bohr atomic model: Heisenberg uncertainty principle - The electron and its associated wave (De Broglie) - Wave treatment of electrons in an atom (standing waves) Quantum numbers - Pauli exclusion principle - Hund's maximum multiplicity rule - Electronic configuration of the elements of the periodic table - Electronic structure and Periodic table of elements: elements from hydrogen to neon - elements from sodium to argon.* *Chemical Bond: Ionization energy - Electron affinity - Bond energy - Pure ionic bond - Pure covalent bond (Lewis theory) - Octet rule and its overcoming - Polar covalent bond - Electronegativity of atoms - Coordination covalent bond - Valence bond theory (VB) - Orbital hybridization: hybrid bonds - sp, sp2, sp3, dsp3, d2sp3 hybridizations and associated geometries - Bonding with delocalized electrons (benzene) - Weak bonds and interactions (polarizability) - Hydrogen bond and its importance - Chemical bonds and state of aggregation.*

	Chemical Reactions: Stoichiometry - Valence and oxidation number - Nomenclature of chemical compounds - Oxides, peroxides, superoxides, hydroxides, oxyacids, thioacids, hydrides, and non-oxygenated acids, salts - Setting up chemical reactions - Reactions without change in oxidation number - Redox reactions and their balancing. *The gaseous state: The ideal gas - Pressure - Volume - Temperature - Boyle's Law - Charles's Law - Gay-Lussac's Law - Ideal gas state equation - Partial pressures - Real gases - Van der Waals equation.* *The liquid state: Physical properties of liquids: Surface tension - Liquid-vapor system - Heat of vaporization - Vapor pressure - Boiling of liquids - Solutions - Solubility - Concentration - % by weight - % by volume - Molarity - Normality - Molality - Molar fraction - Ideal solutions and real solutions - Raoult's law for volatile solutes - Phase diagram of water and carbon dioxide - Colligative properties of solutions - Raoult's law for non-volatile solutes and lowering of vapor pressure - Elevation of boiling point - Depression of freezing point - Phase diagram of aqueous solutions - Boiling constant, freezing constant - Determination of the molecular weight of a solute - Osmosis and osmotic pressure - Laws of osmosis - Solubility of gases in liquids: Henry's law.* *Chemical Equilibria: Generalities - Homogeneous chemical equilibria - Exothermic and endothermic reactions - Law of mass action - Principle of mobile equilibrium (Le Chatelier) - Effect of temperature - Effect of pressure - Effect of concentration - Heterogeneous equilibria - Relationship between Kp and Kc. Chemical equilibria in solution.* *Chemical Equilibria (2): Acid-base theories: Arrhenius, Bronsted and Lowry, Lewis - Strength of acids and bases - Ionic product of water - pH - Hydrogen ion concentration and pH of solutions: solutions of a strong acid or base; solutions of a weak acid or base; polyprotic acids; buffer solutions; solutions of salts that hydrolyze.*
Texts and readings	*Fondamenti di Chimica", seconda edizione, 2006 - A.M. Manotti Lanfredi, A. Tiripicchio - Casa editrice: CEA (Casa Editrice Ambrosiana)*
Notes, additional materials	*Slides*
Repository	

Assessment	
Assessment methods	
Assessment criteria	• Knowledge and understanding: - Candidates must have acquired the fundamentals of the scientific method and the main characteristics of an experimental measure, the theoretical models to describe the structure of matter, bonds, and chemical transformations. • Applied knowledge and understanding: - Candidates must be able to express a chemical quantity with the correct units of measurement and to apply the studied concepts in proposed practical cases. • Judgment autonomy: - Candidates must be able to describe qualitatively and quantitatively a chemical-physical system, to formulate hypotheses on how to alter the system itself in a targeted way, to interpret a given experimental data critically. • Communicative skills: - Candidates must be able to express themselves with a relevant and appropriate scientific vocabulary and language, and be able to discuss rigorously on the topics under examination.

	- They must also have developed the ability to describe a chemical system accurately, identifying the fundamental quantities and relationships underlying it. • Learning ability: - Candidates must have developed the ability to identify the key concepts of each topic and to make connections between them.
Final exam and grading criteria	*The final evaluation takes into account all the aforementioned criteria, and it consists of the score obtained in the oral exam, in thirtieths.* *In the case of written exams, the assessment tests are conducted in the form of multiple-choice questionnaires.*
Further information	
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