



CHEMISTRY Ps - Z

CHIM/07 - 9 CFU - 1° Semester

Teaching Staff

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Office Hours: Lunedì 8-10, mercoledì 8-10. Il docente è disponibile anche a incontri di ricevimento in modalità telematica, previo appuntamento.

LEARNING OBJECTIVES

The course aims to provide the tools and the basic chemistry skills needed to address the interpretation of chemical, physical-chemical and of the most common materials phenomena in engineering.

COURSE STRUCTURE

Frontal lessons.

DETAILED COURSE CONTENT

- 1. *Nature of Matter.** Matter and its states of aggregation. Homogeneous and heterogeneous systems. Phases and their separations. Elements and compounds. Atoms and molecules. Law of conservation of mass. Law of definite proportions. Law of multiple proportions. Avogadro's law. Avogadro's number. Mole.
- 2. *Structure of matter.** Atom. Protons, neutrons and electrons. Atomic number and mass number. Atomic mass unit. Isotopes. Mass defect. Thomson's experiment and his atomic model. Millikan's experiment. Rutherford experiment and his atomic model di Rutherford. Electromagnetic radiation. Black-body radiation. Photoelectric effect. Emission Spectrum of Hydrogen. Bohr's theory. De Broglie's equation. Heisenberg's uncertainty principle. Quantum mechanics. Schrödinger equation. Quantum numbers. Orbitals. Polyelectronic atoms. Pauli exclusion principle. Hund's rule. Aufbau principle. Periodic table. Periodic properties of elements.
- 3. *Chemical bond.** Binding energy. Ionic bond. Covalent bond. Dative bond. Lewis structures. Valence. Valence bond theory. Hybridization. Resonance. MO-LCAO method. Metallic bond. Hydrogen bonding.
- 4. *Chemical compounds and nomenclature.** Valence and oxidation number. Oxidation and reduction. Hydrides. Hydracids. Oxides. Peroxides. Hydroxides. Oxyacids. Salts. Chemical equations. Chemical

reactions. Redox reactions. Balancing of reactions. Limiting reagent. Chemical formula (empirical, molecular, structural formula). Elemental analysis.

5. *Thermodynamics. Thermodynamic system. Extensive and intensive properties. State variables. State functions. Work. Heat. Energy. Heat capacity. Law's of thermodynamics.

6. *States of aggregation of matter. Gaseous state. Ideal gas. Boyle's law. Gay-Lussac's law. Charles's law. Avogadro's law. Ideal gas law. Gaseous diffusion. Dalton's law. Partial pressure. Real gases. Van der Waals' equation. Liquefaction of gases. Liquid state. Surface tension. Vapor pressure. Clausius–Clapeyron relation. Solid state. Crystalline and amorphous solids. Anisotropy and isotropy. Unit cells. Bravais Lattices. X-ray diffraction and Bragg's law. Classification of solids.

7. *Changing States of Matter and heterogeneous equilibriums. Types of phase transition. Clausius–Clapeyron relation. Gibbs' phase rule. Phase diagrams (water, carbon dioxide, sulphur).

8. *Solutions. Solubility. Concentration. Ideal solutions. Raoult's law. Azeotropes. Colligative properties. Relative lowering of vapor pressure. Depression of freezing point. Elevation of boiling point. Osmotic pressure.

9. *Chemical equilibrium. Law of mass action. Le Chatelier's principle. Thermodynamics and chemical equilibrium. Equilibrium constant (K_p e K_c). Homogeneous and heterogeneous equilibriums. Gaseous equilibriums. Effect of temperature, pressure and concentration on equilibriums.

10. *Electrolytic solutions. Electrolytic dissociation. Strong and weak electrolytes. Degree of dissociation. Van 't Hoff factor. Electrical resistance and conductance. Equivalent conductance. Kohlrausch's law. Acids and bases. Theories of acids and bases. Strength of acids and bases. Ionic product for water. Relationship between K_a and K_b . pH. pH of acids, bases and salts. Buffer solutions. pH indicators. pH titrations. Solubility equilibriums. Solubility product. Common ion effect.

11. *Electrochemistry. Redox reactions. Electrode potentials. Nernst equation. Standard half-cell reduction potential. Galvanic cells. Concentration cells. Prediction of redox reactions. Equilibrium constant of redox reactions. Determining pH, K_{sp} e degree of dissociation. Free energy and redox reactions.

12. *Electrolysis. Decomposition potential. Overpotential. Faraday's laws. Electrochemical equivalent. Electrolysis of melts. Electrolysis of water. Electrolysis of water solutions. Industrial applications. Accumulators. Corrosion. Passivation.

13. *Chemical kinetics. Reaction rate. Rate law. Molecularity. Order of reaction. First and second order reactions. Arrhenius' equation. Effect of temperature. Activation energy. Catalysts. Chain reactions.

TEXTBOOK INFORMATION

1. Pietro Tagliatesta, CHIMICA GENERALE E INORGANICA, edi-ermes.
2. Maurizio Speranza; CHIMICA GENERALE E INORGANICA, edi-ermes.
3. P. Michelin Lausarot, G. A. Vaglio, STECHIOMETRIA, Piccin.
