DEPARTMENT OF ELECTRICAL, ELECTRONIC AND COMPUTER ENGINEERING
Bachelor's Degree in Industrial Engineering
Academic Year 2019/2020 - 1° Year - Ingegneria Industriale Curriculum

CHIMICA A - E

CHIM/07 - 9 CFU - 1° Semester

Teaching Staff

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LEARNING OBJECTIVES

The course aims to provide the knowledge of Chemistry necessary to understand the behavior of the most common substances in order to deal with the interpretation of chemical and chemical physical phenomena and to establish the appropriate property-structure correlations of materials of engineering use.

COURSE STRUCTURE

Lectures and exercises.

DETAILED COURSE CONTENT

STRUCTURE OF MATTER: Thomson's model; Rutherford's model; atomic number and mass number; atomic mass unit; atomic spectra; quantum theory, Bohr's theory, the Pauli principle, the uncertainty principle, wave-particle duality, wave mechanics, the equation of Schroedinger; quantum numbers and energy levels; ideal construction of the atoms, the periodic system: potential ionization, electronegativity and electronic affinity.
CHEMICAL BOND: Valence Bond Theory; covalent, metallic and ionic bonds, p and s covalent; hybridization; resonance; relationships between structure and bonding; intermolecular bonds; Molecular Orbital theory.

TYPE OF MATERIAL: Aggregation states; chemical elements and compounds, atoms and molecules, atomic and molecular weight, gram atom, gram-mole; Avogadro's number.
NOMENCLATURAL OF CHEMICAL COMPOUNDS: Brute and structural formulas; chemical equations and stoichiometry with exercises, oxidation, reduction, dismutation; equivalent weight and gram equivalent.
GASEOUS STATE: Ideal gas, the laws of Boyle, Gay Lussac, Charles, Avogadro; ideal gas equation of

state and numerical exercises; Avogadro's law; partial pressures, Dalton's law, equation of Van der Waals; critical state of real gases; Andrew diagram.
CHEMICAL THERMODYNAMICS: General concepts of thermodynamics, internal energy, the first law of thermodynamics, enthalpy, Hess's law, entropy and second law of thermodynamics, III law of thermodynamics, free energy and spontaneous processes.
CONDENSED STATES: Solid state, covalent solids, ionic, molecular, metallic; point, line and surface defects ; vapor pressure, boiling and solidification temperature.
STATE OF SOLUTION: Types of solution; solubility of a species; concentration units; solute-solvent interactions; ideal and real solutions; Raoult's law: the relationship between the composition of a mixture of two liquids and that of its vapor; systems with azeotrope of maximum and minimum; industrial applications, dilute solutions of non-volatile solutes, colligative properties, freezing point depression; boiling point elevation; osmotic pressure; numerical exercises.
CHEMICAL EQUILIBRIUM: Law of mass action, Le Chatelier's principle; derivation of thermodynamic equilibrium constant (Kp, Kc, Kx), the relationship between the equilibrium constants, homogeneous and heterogeneous equilibria, influence of pressure, temperature and concentration on the conditions of equilibrium, free energy and equilibrium constant.
HETEROGENEOUS EQUILIBRIA: Change of state; melting, evaporation, sublimation, Clausius-Clapeyron variance; phase diagrams, one-component systems: water, sulfur, carbon dioxide; systems with eutectic point.

CHEMICAL KINETICS: Rates of reaction, activation energy, rate constants, molecularity and order reaction; influence of temperature; homogeneous and heterogeneous catalysis.
ELECTROLYTE SOLUTIONS: Electrolytic dissociation, strong and weak electrolytes, degree of dissociation; Van't Hoff coefficient, specific and equivalent conductivity; Arrhenius, Bronsted and Lewis theories; ionic product of water ; definition of pH; calculating the pH of solutions of strong acids and bases; calculating the pH of solutions of weak acids and bases.
MULTIPLE EQUILIBRIA IN SOLUTION OF ELECTROLYTES: Salt hydrolysis, buffer solution, acid-base titration, solubility product and common ion effect; numerical exercises.
ELECTROCHEMISTRY: Oxidation-reduction reactions, electrode potentials, Nernst equation and numerical exercises, galvanic batteries; electrochemical series of the elements, electrolysis; Faraday's laws and numerical exercises; electrolysis of molten sodium chloride, electrolysis of an aqueous sodium chloride solution; the electrolysis of water; corrosion.
INORGANIC CHEMISTRY

TEXTBOOK INFORMATION

Theory and exercises

B.B.Laird, Chemistry, McGraw-Hill
