UNIVERSITÀ DI PAVIA

Anno Accademico 2021/2022

CHEMISTRY	
Enrollment year	2021/2022
Academic year	2021/2022
Regulations	DM270
Academic discipline	CHIM/07 (FOUNDATIONS OF CHEMISTRY FOR TECHNOLOGIES)
Department	DEPARTMENT OF CIVIL ENGINEERING AND ARCHITECTURE
Course	CIVIL AND ENVIRONMENTAL ENGINEERING
Curriculum	PERCORSO COMUNE
Year of study	1°
Period	1st semester (27/09/2021 - 21/01/2022)
ECTS	9
Lesson hours	68 lesson hours
Language	Italian
Activity type	WRITTEN AND ORAL TEST
Teacher	DONDI DANIELE (titolare) - 9 ECTS
Prerequisites	Mathematics (1st course)
Learning outcomes	The course aim to provide the fundamentals of chemistry that are the basis for handling specific arguments on materials technology.
Course contents	Basics of chemical formulas and chemical reactions Qualitative and quantitative aspects of chemical formulas and reactions, stoichiometry, principal reaction types. Radiochemistry Nuclear stability, radioactive decays, kinetic of radioactive decay, natural radioactive families. Chemical and biological effects of radiations. The environmental radioactivity. Radon. Basics of chemical bond theory The hydrogen atom. Electronic configuration of elements and periodic

properties. Ionic, covalent, polarized-covalent, coordination and metallic bonds. Molecular geometries. Dipolar moments of molecules. Intermolecular interactions: hydrogen-bond, van der Waals forces and dispersion forces. Ionic and covalent valences of elements of s, p block and first transition row. Oxides, hydrides, anions and cations, salts.

States of matter
Gaseous state: ideal gases and real gases. The ideal gas equation. Gaseous mixtures, Dalton's law, PVT calculations. Solid state: crystalline systems, Bravais' lattices, compact structures, reference structures for ionic salts. Covalent (diamonds, graphite, silicon, quartz), metallic and molecular crystals. Liquid state: superficial tension, adhesion and cohesion forces, wettability, vapor tension.

Thermodynamics, kinetics and chemical equilibrium
Thermodynamic state functions. Enthalpy of formation of compounds, heats of reaction, thermodynamic cycles (Hess law), reaction isotherm. The equilibrium in gaseous phase, the equilibrium constant, reaction quotient, the effect of temperature. Basics of chemical kinetics.

Solutions
The measuring units of concentration: molarity, molality, w/w and w/v percent. Liquid-vapor equilibrium, the Raoult's law. Freezing-point depression, boiling-point elevation, osmotic pressure. Solubility equilibrium (solubility product). Acid-base equilibrium, definition of pH, pH of strong and weak acids and basis. Hydrolysis of anions and cations. Buffer solutions.

Phase equilibria
Phase state diagram of water. Thermal analysis of alloys. Eutectic diagrams and diagrams with total and partial solubility in the solid phase.

Electrochemistry
Electrode potentials and basics of batteries. Standard electrochemical potentials, Nernst equation. Corrosion phenomena of metals, passivation, corrosion protection. Batteries and accumulators in everyday use. Electrolysis.

Tecnology and materials
Organic and inorganic compounds related to practical applications: Cements, lime, hydraulic lime, plaster, geopolymers.

Basics of Organic Chemistry
Hydrocarbons: alkanes, alkenes, alkynes, cycloalkanes and aromatic compounds. Funcional groups and main properties of alcohols, ethers, aldehydes, ketones, carboxylic acids, amines, amides and amino acids.

Environmental Chemistry
Structure and composition of atmosphere. The pollution due to nitrogen oxides, sulfur, hydrocarbons, halogenated compounds, ozone, solid particles. Pollutants of air, water and soil. In particular VOCs, PAH, PCB, endocrine disruptors, heavy metals. Main degradative pathways of organic pollutants.

Teaching methods	Lectures (hours/year in lecture theatre): 68 Practical class (hours/year in lecture theatre): 0 Practicals / Workshops (hours/year in lecture theatre): 0 During the course slides were projected and additional exercises/explanations are drawn on blackboard. All slides are available for download. E-learning website where students can exercise online with immediate evaluation of results. It's possible also to make challenges between students.
Reccomended or required readings	Slides projected during the course (availables on website). D. Dondi, L.. Vasta. Chimica: principi e applicazioni . Universitas Studiorum. website for self evaluation: http://www-5.unipv.it/dondi/ . website with exercises done: https://sites.google.com/site/dondidaniele/ .
Assessment methods	Written exam consisting of theory (30 quizzes, 1h) and numerical exercises (2h). Oral exam optional.
Further information	Written exam consisting of theory (30 quizzes, 1h) and numerical exercises (2h). Oral exam optional.
Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile