UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

General and Inorganic Chemistry

2122-1-E2701Q034-E2701Q036M

Aims

General Objectives

The course of General and Inorganic Chemistry (6 CFU) is devoted to the students enrolled to Materials Science university course. The aim of the course is to present the basic concepts of the chemistry in order to realize the macroscopic properties of the pure substances and of the matter.

Knowledge and understanding.

Students, by the end of the course, will learn the basic principles of stoichiometry and of the chemical reactions of inorganic compounds. Moreover, students will learn to know and exploit general chemistry lab equipment and glassware as well as the basic safety rules.

Applying knowledge and understanding.

By the end of the course, students will be able to solve simple problems of stoichiometry and to perform simple chemistry lab experiments.

Making judgments.

By the end of the course, students will become able to choose the methodology to study the chemistry of a selected system and to individuate proper compounds and techniques to carry out simple chemical reactions.

Communication skills.

By the end of the course, students will be able to describe the arguments of the course and to participate in stimulating discussions.

Learning skills.

By the end of the course, students will have developed the ability to solve and face with more complex exercises, arguments and experiments.

Contents

The course aims at providing an in depth knowledge about general chemistry principles, which represent the basis for the understanding of the properties of chemical compounds and of the chemical phenomena (e.g. reactions, equilibria, pH, colligative properties). The study of theoretical principles will always be accompanied by the application to exercises resolution so he or she will be able to learn better the theoretical concepts and to solve stoichiometry questions.

Detailed program

Atoms, electronic configurations and periodic properties of the elements. Atomic structure, fundamental particles, atomic dimensions. Elements and isotopes. The concept of mole and the Avogadro number, atomic weights. Electronic Configurations of Elements and Nomenclature. Quantization of the electron-nucleous system, wave functions. Atomic orbitals, relevant energy contents, geometry and electronic radial distributions for hydrogen-like and poly-electronic elements. Electronic configurations of elements and periodic properties: volume and atomic radius, ionization potentials and electronic affinity. Hybrid orbitals “sp” “sp2” e “sp3”.

Molecules, compounds, chemical bonds and molecular interactions. Molecules and molecular weights, molecules and chemical formula. Oxidation numbers. Nomenclature of inorganic compounds, general properties and chemical reactivity. Ionic solids and theory of the ionic bond. Valence bond theory, covalent bonds and dative bonds. Multiple bonds. Electronegativity. Structure of polyatomic molecules. Biatomic molecules and molecular orbitals. Intermolecular interactions, weak intermolecular forces, dipole-dipole interactions.

Physical States of Matter (laws and properties). Systems, phases, components, degree of freedom. Gas state, the perfect gas model, vapours. Solids and liquids, phase and equilibrium. Measurements of solution concentration.

Chemical Reactions, thermodynamics, chemical equilibrium. Chemical reactions and reaction balance, weight calculations and stoichiometry. Brief recall of thermodynamics and kinetic results in the study of energy balance and of spontaneous course of a chemical reaction; equilibrium constants.

Chemical equilibrium in solution. Dissolution of molecular and ionic solids in liquid solvent. Acids and bases. Proton transfer reactions. Acid and base strengths and dissociation constants. Self dissociation of water. Definitions of pH and pOH and relevant intervals. Calculation of pH in acid and basic solutions. Redox Reactions, Electrodes, Chemical Cells. Redox couples, reaction with electron transfer, oxidation and reduction half-reactions. Electrodic potential, standard reduction potentials, Nernst’s equation. Chemical electrodes. Cells and their electromotive force.

Prerequisites

The basic knowledge concerning the numerical, algebra and analytical geometry calculations are required, such as

typically given in the high school.

Teaching form

The course is organized in frontal lessons in Italian language in which syllabus arguments are presented on the blackboard or by slides. The slides of the lessons will be supplied to the students on the e-learning platform. Besides the theoretical aspects, step by step, representative examples and exercises will be shown in order to practice. The student can verify its learning through other exercise texts and written questions, which will be proposed as didactical material at the end of each paragraph. The regular attendance of the lessons is recommended for an easier learning, although it is not more compulsory.

Textbook and teaching resource

Martin S. Silberberg, Chimica, la natura molecolare della materia e delle sue trasformazioni, Mc Graw Hill

Michelin Lausarot, G.A. Vaglio, Stechiometria per la chimica generale, Piccin

Slides in the e-learning website

Semester

first

Assessment method

The student acquires the CFU of the course passing a final written and oral examination. The written exam is constituted of numerical exercises, of the same type and difficulty of those shown during the lectures; the oral part consists in some questions on the main topics of the course. The admission to the oral exams requires the positive pass of the written part (mark equal or higher than 18/30).

Office hours

Monday from 2 to 3.30 p.m., or by appointment.