UCL Université catholique de Louvain

LFSAB1301

2014-2015

Chemistry and Physical Chemistry 1

6.0 credits	30.0 h + 30.0 h	2q

Teacher(s) :	Nysten Bernard ; Demoustier Sophie ; Jonas Alain ;
Language :	Français
Place of the course	Louvain-la-Neuve
Inline resources:	http://icampus.uclouvain.be/claroline/course/index.php?cid=LFSAB1301
Main themes :	Three general topics are presented ' An introduction to the understanding of matter structure and properties which leads to study the structure of atoms, the periodicity of atomic properties, intra- and inter-molecular bonds and how they control the structure of materials. ' An introduction to thermodynamics within the frame of physical and chemical equilibrium, in a rigorous way but without necessarily using the complete formalism of thermodynamics. This includes state variables, the first principle of thermodynamics (energy conservation, internal energy, enthalpy, heat and enthalpy of reaction), the second principle of thermodynamics (spontaneous and non-spontaneous processes, entropy), free energy (including its interest to describe equilibrated reactions and its link to equilibrium constants). The notion of perfect gas will also be briefly introduced. ' How these notions are of interest to understand one-component phase transformations and chemical equilibria in aqueous solutions, such as acid/base reactions and solubility equilibria. Learning outcomes:
Aims :	Contribution of the course to the program objectives Regarding the learning outcomes of the program of Bachelor in Engineering Sciences, this course contributes to the development and the acquisition of the following learning outcomes: LO 1.1 : Apply concepts, laws, reasoning to disciplinary reduced problems. LO 4.2 : Work in team: manage disputes, make decisions, share tasks. LO 5.2 : Communicate with schemes and graphics, interpret schemes, present the results of a work, structure information. LO 5.4 : Write synthetic documents complying with the imposed standard and rules in the framework of the given missions (projects or problems). Specific learning outcomes of the course At the end of the course, the student will be able ' to write the equation corresponding to simple reactions, to use the concepts of mole, atomic or molar mass, mass or molar yield to predict the reaction products; ' to identify, define, explain and use the concepts of atom, molecule, compound, mole, atomic or molar mass, atomic or molecular orbitals, electronic configuration, ionisation and ionisation energy,electroaffinity, ionic, metallic, covalent and intermolecular bindings, molecular structure, binding energy; ' to use the above mentioned conseptes to predict the electron configuration of an atom, an anion or a cation, to predict and explain the variation of ionisation energy or electroaffinity between elements, to predict the Lewis and the spatial structure of a molecule, to explain the formation of interatomic binding on the basis of the concepts of ionisation and hybridation, to predict the evolution of properties such as boiling temperature on the basis of intermolecular forces; ' to apply the Hess law, to use tables and calculate reaction enthalpies of simple chemical reactions or of phase transformations from formation enthalpies, binding energies or atomisation energies, calorimetric data; ' to calculate reaction entropies of simple chemical reactions from tables of absolute entropies; ' to calculate equilibrium concentrations of simple reactions from equilibrium constants and initial concentrations or vice-versa; ' to identify the type of solutions (acid, base, salt, buffers), the main species present in solution and to calculate the concentration of these species, the pH, the pOH and to make the link with acidity or basicity constants; ' to interpret the characteristics of acid-base titration curves and to calculate the pH on every point of the curve; ' to predict the relative forces of acids and bases in relationship with the strength of chemical bindings and with the acidity or basicity constants; ' to organise himself to, in group, to prepare and solve simple chemistry problems or to realise basic chemistry laboratories, interpret the results and write short reports(4.2, 5.2, 5.4). *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Evaluation methods :	Written examination during the session following the semester. For this examination, the students receive a Mendeleev table mentioning the atomic and mass numbers of the elements and a formular established by the teachers.
Teaching methods :	Lectures (CM) Exercices (APE) and laboratories (LABO)1 solved in groups. 1 In 2013-2014 and 2014-2015, laboratories will not be organised due to the absence of infrastucture.

Content :	Generalities: matter, compounds, molecules, atoms ; measurement units ; energy. -- Atoms: Discovery of electrons, protons, neutrons ; periodic table of elements ; light as a wave and emission spectra ; Bohr model, orbitals, quantum numbers, atomic radius ; energy of ionization. -- Chemical bonds: types, Lewis structure, electronegativity, bond energy. Thermochemistry: work, energy, first principle, enthalpy, heat of reaction, of formation, of phase change, Hess' law, mass balances. -- Second principle of thermodynamics: spontaneous and equilibrated reactions, heat transfer, Boltzmann principle, reaction entropy, Gibbs' free energy, phase changes. -- Reaction equilibrium and free energy: Equilibrium constant. -- Acid and bases: equilibrium, pH (weak and strong acids, salts, buffers, bases). pH computation, titration. -- Equilibrium in aqueous solutions
Bibliography :	Reference book: « Principes de Chimie », 2nd edition, Atkins et Jones (de boeck). The slides presented during the lectures, the exercice and laboratory statements and solutions are available on iCampus.
Cycle and year of study :	> Master [120] in Environmental Science and Management > Master [60] in Environmental Science and Management > Bachelor in Engineering
Faculty or entity in charge:	BTCI