UCLouvain

lepl1301

2018

5 credits	30.0 h + 30.0 h	Q2

Teacher(s)	Demoustier Sophie ;Jonas Alain ;Nysten Bernard ;SOMEBODY ;
Language :	French
Place of the course	Louvain-la-Neuve
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; the approach is based on the atomic structure of matter and ideas derived from statistical physics. 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 ideal 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.
Aims	**Contribution of the course to the program objectives**: Regarding the learning outcomes of the program of Bachelor in Engineering, this course contributes to the development and the acquisition of the following learning outcomes: • LO 1.1 • LO 3.2 • LO 4.2, 4.4 **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 first principle of thermodynamics to analyze energy exchanges of an ideal gas, and to use tables and calculate reaction enthalpies of simple chemical reactions or of phase transformations from formation enthalpies; • to apply the second principle of thermodynamics to predict the evolution of simple systems, to compute entropy variations, and more specifically to calculate reaction entropies of simple chemical reactions from tables of absolute entropies; • to calculate equilibrium concentrations of simple reactions involving ideal gases and pure solids and liquids, from equilibrium constants and initial concentrations or vice-versa; to compute equilibrium constants from tables of thermodynamic data; to compute equilibrium vapour pressures of pure liquids from their enthalpies of vaporisation; • 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).

1

	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'. - - - - *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); sometimes in flipped classes Exercices (APE) in groups.
Content	**Generalities:** measurement units, matter, compounds, molecules, atoms, chemical symbols and equation, 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. **First principle of thermodynamics:** work, energy, first principle, enthalpy, heat of reaction, of formation, of phase change, Hess' law. **Second principle of thermodynamics:** entropy, spontaneous and equilibrated reactions, heat transfer, Boltzmann law, reaction entropy, Gibbs' free energy, phase changes. **Reaction equilibrium and free energy:** Equilibrium constant, equilibrium vapour pressure. **Acid and bases:** equilibrium, pH (weak and strong acids, salts, buffers, bases). pH computation, titration. **Equilibrium in aqueous solutions**
Inline resources	https://moodleucl.uclouvain.be/course/view.php?id=8983
Bibliography	• « Principes de Chimie », Atkins, Jones, Laverman (de boeck) Ouvrage de référence : « Principes de Chimie », Atkins, Jones, Laverman (de boeck). Les slides présentées au cours, les énoncés et les solutions des exercices sont disponibles sur Moodle. Pour le second thème (thermodynamique), un syllabus adapté au format des cours est disponible sur Moodle (il n'y a pas de copie des dias présentées au cours); des podcasts sont également disponibles pour certains cours.
Faculty or entity in charge	BTCI

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Aims
Bachelor in Engineering	FSA1BA	5		
Bachelor in Engineering : Architecture	ARCH1BA	5		