


5.00 credits

30.0 h + 30.0 h

Q2

Teacher(s)	. SOMEBODY ;Contino Francesco ;Demoustier Sophie ;Nysten Bernard ;
Language :	French
Place of the course	Louvain-la-Neuve
Main themes	<p>Three general topics are presented:</p> <ul style="list-style-type: none"> • 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.
Learning outcomes	<p>At the end of this learning unit, the student is able to :</p> <p>Contribution of the course to the program objectives:</p> <p>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:</p> <ul style="list-style-type: none"> • LO 1.1 • LO 3.2 • LO 4.2, 4.4 <p>Specific learning outcomes of the course:</p> <p>At the end of the course, the student will be able</p> <ul style="list-style-type: none"> • 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 concepts 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).

Evaluation methods	<p>At the end of each part, depending on the possibilities left by the timetable, a possible short online test is organised (each teacher will confirm whether and how these tests will be held). If they are organised, the online tests will cover the learning, lectures, PBLs of each part. If the student is successful, these tests will give a maximum bonus of 2 points for the part concerned.</p> <p>The in-session written examination covers the entire semester material. For the examination, students receive, together with the questionnaire, a copy of the periodic table of elements and a copy of the forms established by the teachers, previously available on the Moodle site of the course. All the data needed to solve the problems numerically are provided with the questionnaire. The examination is organised in the form of a multiple choice questionnaire.</p> <p>In order to ensure that the final grade for the course reflects a minimum level of competence acquired in each of the three parts of the course, the overall examination grade will be calculated on the basis of the geometric mean of the grades obtained for the three parts (a possible zero in one part is converted into a non-zero grade in order to calculate this mean). It will be established as follows</p> <ul style="list-style-type: none"> • the mark for each part will be the examination mark plus the possible "bonus" of the online test (max 2 points), limited to 20/20 ; • the overall examination mark will be calculated on the basis of the geometric average of the marks obtained for the three parts and will be rounded to the nearest whole number.
Teaching methods	<p>The teaching consists of lectures and group-based learning through exercises (APE) and problems (APP). The PBL sessions are conducted in the presence of tutors who ensure that the students are encouraged to think through and solve the problem or exercise and through this work learn the concepts involved. Some parts of the course are given in a flipped classroom format.</p>
Content	<p>The course LEPL1301 Chemistry and Physical Chemistry 1 is the first course of chemistry and physical chemistry in the civil engineering curriculum.</p> <p>The first part of the course focuses on the introduction to chemistry and the basic concepts that allow the solution of "chemical problems" (notions of atom, molecule, chemical notation, mole, concentration, reaction energy, reaction yield, limiting reactant, etc.). It continues with an understanding of matter from the microscopic to the macroscopic. This first leads to the study of the structure and properties of atoms and ions. The chemical bonds between atoms to form molecules and the associated energies are then presented.</p> <p>On this basis, the second part of the course focuses on the thermodynamic description of phase and chemical equilibria. To do this, after a description of the properties of perfect gases, it develops the concepts of work, heat, enthalpy, statistical entropy, thermodynamic entropy and free enthalpy. From the criteria of spontaneous evolution based on these notions, it establishes the formalism describing equilibria (equilibrium constants, free enthalpies of reaction) and applies it to the study of equilibria involving pure solids, pure liquids and gases.</p> <p>Based on the notions of chemical equilibrium and equilibrium constant, the third part of the course deals with the concepts of acids and bases. Thermodynamics, in particular equilibrium constants, is used to study quantitatively the strength of acids and bases. Chemical equilibria in the aqueous phase are then discussed and illustrated through the study of acid-base titrations and solubility equilibria.</p>
Inline resources	<p>Moodle site : https://moodle.uclouvain.be/course/view.php?id=1892</p>
Bibliography	<p>Ouvrage de référence : « Principes de Chimie », Atkins, Jones, Laverman (de boeck) (disponible au SICI).</p> <p>Certaines diapos présentées au cours, les énoncés et les solutions des exercices sont disponibles sur Moodle. Pour certaines parties, des notes de cours sont aussi disponibles sur Moodle. Des vidéos et podcasts sont aussi mis à disposition sur Moodle ainsi que les correctifs des examens des années précédentes.</p> <p>Reference book: "Principles of Chemistry", Atkins, Jones, Laverman (de boeck) (available at SICI).</p> <p>Some of the slides presented in the course, the statements and the solutions of the exercises are available on Moodle. For some parts of the course, lecture notes are also available on Moodle. Videos and podcasts are also available on Moodle, as well as exam papers from previous years.</p>
Faculty or entity in charge	BTCI

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