

8.00 credits

45.0 h + 60.0 h

Q2

Teacher(s)	Garcia Yann ;Leyssens Tom ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	It is recommended to have acquired the knowledge and skills developed in the teaching units: LCHM1111 Chimie générale LPHY1101 Physique 1 LPHY1102 Physique 2
Main themes	0. INTRODUCTION TO PHYSICAL CHEMISTRY. Chemical equilibrium and partition coefficients. Applications. 1. THERMODYNAMICS. First principle of thermodynamics. Thermochemistry. Second principle of thermodynamics. Free Enthalpy. 2. PHASE EQUILIBRIA. Generalities. One-component systems: state diagram of a pure body. Thermodynamics and phase transition temperature. Phase rule. Two-component systems: binary phase diagrams. 3. CHEMICAL EQUILIBRIA IN SOLUTION. Solubility and complexation. Complex reaction networks. Quantitative study of some cases. 4. COMPLEMENTS OF ELECTROCHEMISTRY. Electrolysis. Conductivity of solutions. Batteries.
Learning outcomes	At the end of this learning unit, the student is able to : Quantitative interpretation of chemical phenomena based on physicochemical laws. Introduction to the use of data tables. 1 <i>The contribution of this course to the development and mastery of the skills and knowledge of the program(s) is available at the end of this sheet, in the section "Programs/training courses offering this course".</i>
Evaluation methods	Written exam at the end of the year, supplemented by continuous assessment during the year (preparation of lab sessions and reports, seminars). This part of the grade from the continuous assessment will be used for each session and may not be repeated. Practical training is an integral and inseparable part of the general chemistry course. Participation in all practical sessions is therefore MANDATORY . The laboratories are taken into account in the final grade of LCHM1211 taken into account in the deliberation. Any REASONED absence (justified by a medical certificate or by any other official document) will result in the recovery of the missed session during the last week of the term. Any NON-MOTIVATED absence will be sanctioned by a NEGATIVE mark on the final mark of LCHM1211 taken into account in the deliberation, and may, depending on the degree of recurrence and the assessment of the situation by the teaching staff. Should the number of unjustified and/or justified absences become significant, the teaching staff reserves the right to activate the articles of the RGEE allowing the jury to prohibit the student from registering for the corresponding exam. The written exam contains two parts (Prof. T. Leyssens and Y. Garcia), and the overall note takes into account the number of hours of each course (proportional to the relative importance of both parts).
Content	Tom Leyssens Part I : Thermodynamics 1. 1. <u>Work and heat</u>

1. 1. System and surroundings
2. Pressure
3. Temperature
4. Energy Transfer

1. Work and expansion work
2. Heat

1. 1. Energy of a system and first law of thermodynamics
2. 1. Energy of a system, molecular point of view
2. First law of thermodynamics
3. What about constant p – enthalpy

1. 1. Entropy and second law of thermodynamics
- 3.1 Entropy a measure for disorder
- 3.2 Determine entropy change
- 3.3 2nd Law of thermodynamics
- 3.4 3rd Law of thermodynamics

1. 1. Gibbs' free energy/ Free enthalpy
- 4.1 A revised criteria for spontaneous change
- 4.2 what about chemical reactions
- 4.3 Chemical equilibrium (

Part II : How to use thermodynamics: Phase equilibria

1. One component system s
 1. Single component Phase diagram
 2. Gibbs Phase rule
 3. Relation to free energy
 4. Along the liquid-gaz curve

1. Two component systems
- 2.1 Liquid-Liquid Phase diagrams
- 2.2 Liquid-Vapour Equilibria

Part III : Some equilibria in more detail

1. Acid-base equilibria
 1. Reminder
 2. pH of weak acids and salts/ simple cases
 3. pH of weak acids and bases (bifunctional acids and bases)

1. Solubility product s
 1. Solubility Product
 2. Common ion effect
 3. Selective precipitation
 4. Solubility vs. pH
 5. Limitations

1. Combining equilibria
- 3.1 Solubility vs pH
- 3.2 Complexation and solubility

Yann Garcia

IV. Complements of electrochemistry

Reminder on electrochemical cells: electrolysis and batteries. Notions of electricity. Electrolysis

1. General principle. Faraday's laws. Reactions at electrodes and industrial applications. Conductivity of solutions
2. Principles and definitions. Mobility of ions. Experimental aspects. Transport numbers and balance of an electrolysis. Applications: Degree of dissociation of a weak electrolyte. Ionic product of water. Determination of a solubility product. Conductimetric titrations. Batteries, or galvanic cells
3. Reminders: electromotive force of a battery, standard electrode potential and Nernst relation, energy balance of the battery. Main types of electrodes: metal-ion electrodes, insoluble metal-salt electrodes, gas electrodes, redox electrodes. Analytical applications: pH measurement, potentiometric titrations, commercial batteries, etc

V. Cross-disciplinary techniques.

1. Basic principles and introduction to experimental techniques.
2. Applications to thermal methods (experimental determination of the heat of reaction, determination of the melting point), Mössbauer spectroscopy (influence of the electron density or electronegativity on the isomeric shift, of the local electric or magnetic field on several examples), solid state NMR, etc.


Laboratory sessions (4x3h + 4x3h30) :

Each student individually prepares and performs an experiment illustrating a theme of the course. They write a report. A laboratory manual allows the student to prepare each laboratory session. A verification of this preparation takes place at the beginning of each session.

Exercise sessions (13 x 2h) :

Solving theoretical problems and numerical exercises in the presence of assistants.

	<p><i>Part LCHM1211A and LCHM1211B only includes 4 laboratory sessions of 3 hours and 7 exercise sessions of 2 hours.</i></p> <p>Supervision: weekly individualized contacts in order to answer specific questions.</p>
Inline resources	Moodle UCLouvain
Bibliography	Livre de P. Atkins, L. Jones et L. Laverman : "Principes de Chimie", Trad. Française de A. Pousse (De Boeck), ou édition anglaise originale correspondante, complété par des notes de cours. Manuel de travaux pratiques et fascicule d'exercices. Documents fournis sur Moodle.
Faculty or entity in charge	CHIM

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Bachelor in Chemistry	CHIM1BA	8		
Minor in Chemistry	MINCHIM	8		