Universitat Autònoma de Barcelona

2022/2023

Chemistry

Code: 102828
ECTS Credits: 9

Degree	Type	Year	Semester
2501915 Environmental Sciences	FB	1	2

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

Teachers

Maria Jesús Sánchez Martín
Maria del Mar Marquès Bueno

Prerequisites

Students must hold the basic knowledge of high school chemistry courses:

1. Expression of the concentration

Mol concept, Molarity (M), molality (m), normality (N),% by weight or volume, etc.

2. Stoichiometry of chemical reactions

Stoichiometric calculations.

3. Basic concepts of chemical equilibrium.

Chemical equilibrium and constant equilibrium. Expressions of the equilibrium constant. Factors that affect balance.

4. Chemical formulation

Inorganic compounds and organic compounds.

5. Balance of Chemical reactions

No redox reactions. Basics of redox reactions. Balance of redox Equations.

6. Ideal gases

General concepts Law of ideal gases.

Objectives and Contextualisation

The general objective is to contact, for the first time in the undergraduate studies, with the fundamental concepts of Chemistry. It is intended to become aware of the importance of chemistry in everyday life and, in a special way, in the environment.

The most specific objectives of the subject are:

1) Structural and molecular study of matter and the world around us.

2) Introduction to the properties of organic compounds and biomolecules.

3) Macroscopic interpretation of chemical phenomena:

a. Chemical thermodynamics: chemical systems in equilibrium.

b. Chemical kinetics: how chemical changes take place and at what velocity.

Competences

- Adequately convey information verbally, written and graphic, including the use of new communication and information technologies.
- Analyze and use information critically.
- Collect, analyze and represent data and observations, both qualitative and quantitative, using secure adequate classroom, field and laboratory techniques
- Demonstrate adequate knowledge and use the most relevant environmental tools and concepts of biology, geology, chemistry, physics and chemical engineering.
- Demonstrate concern for quality and praxis.
- Demonstrate initiative and adapt to new situations and problems.
- Learn and apply in practice the knowledge acquired and to solve problems.
- Quickly apply the knowledge and skills in the various fields involved in environmental issues, providing innovative proposals.
- Teaming developing personal values regarding social skills and teamwork.
- Work autonomously

Learning Outcomes

1. Adequately convey information verbally, written and graphic, including the use of new communication and information technologies.
2. Analyze and use information critically.
3. Call and make organic and inorganic chemicals.
4. Demonstrate concern for quality and praxis.
5. Demonstrate initiative and adapt to new situations and problems.
6. Describe the concept of chemical equilibrium and factors that can be modified.
7. Describe the concept of complex ion, the formulation and nomenclature.
8. Describe the concept of solubility and the variables that affect it.
9. Describe the properties of different states of matter and relate to chemical bonds and intermolecular forces.
10. Describe the three principles of thermodynamics and the associated thermodynamic functions.
11. Differentiate between different types of chemical bonds and intermolecular interactions.
12. Identify the character of acid or base * * nsted BRO of chemicals in solution.
13. Identify the chemical processes in the surrounding environment and evaluate them properly and originally.
14. Identify the kinetic parameters of a chemical reaction, relate the reaction mechanism and describe the temperature dependence.

15. Identify the main organic functional groups and describe the most relevant physicochemical properties.
16. Identify the main sources and bibliographic databases in the field of chemistry.
17. Identify the oxidation and reduction processes in a redox reaction and match the corresponding chemical equation.
18. Learn and apply in practice the knowledge acquired and to solve problems.
19. Observe, recognize, analyze, measure and properly and safely perform chemical processes.
20. Teaming developing personal values regarding social skills and teamwork.
21. Work autonomously

Content

PART I - BOND AND STRUCTURE OF THE MATTER

1. Atoms and the atomic theory

The first discoveries of chemistry. The electrons and other discoveries of atomic physics. The nuclear atom. Electromagnetic radiation. Quantum theory. The Bohr atom. Atomic spectra. Duality corpuscle wave and uncertainty principle. Wave mechanics: wave function.

2. Hydrogen atom and polyelectronic atoms

The hydrogen atom. Hydrogenide orbital concept. Representation of the orbitals. Electronic spin. Polyelectronic atoms. Electronic configurations: rules for the distribution of electrons in orbitals.

3. The periodic table

Introduction to the periodic table. Historical introduction. Electronic configuration and periodic table. Metals, not metals and their ions. Periodic properties of the atoms: atomic radius and ionic radius. Ionization potential. Electronic affinity. Electronegativity. Other properties

4. Chemical bond

Lewis structures. Concepts of resonance, bond order, formal charge and oxidation state. Molecular geometry: theory of the repulsion of electronic pairs (VSEPR). Bond: order and energy. Theory of the valence bond: hybrid orbitals. Theory of molecular orbitals. Metallic bond: theory of bands, metals, semiconductors and insulators.

5. Gases, liquids and solids

Gases. Formation of condensed phases. Intermolecular forces: hydrogen bonding, van der Waals forces. The chemical bond as an intermolecular force.

PART II - ORGANIC COMPOUNDS AND BIOMOLECULES

1. Biomolecules

Chemical elements present in living beings. Biomolecules Levels of structural organization of biomolecules. Proteins: sequence, secondary and three-dimensional structure. Importance of weak interactions in aqueous medium. Nucleotides and nucleic acids: structure of DNA and organization of genetic material. Sugars and lipids as structural, reserve and functional compounds

2. Proteins

General characteristics. Aminoacids. Peptide bond.

3. Enzymes and enzymatic catalysis

Nature and function of enzymes. Effects of catalysts in chemical reactions. Enzymatic activity: concept of initial velocity. Enzymatic kinetics: Michaelis-Menten model. Regulation of enzimatic activity. Biomedical and biotechnological applications.

4. Glucides

General characteristics. Mono, di and polysacarides.

5. Lipids

General characteristics. Functions of lipids.

6. Biomolecules

Purifications and characterization of proteines. DNA recombinant.

PART III - THERMODYNAMICS, KINETICS AND EQUILIBRIUM

1. Thermochemistry, spontaneity and equilibrium

Basic concepts: heat, heat capacity and specific heat. Reaction heat. First principle of thermodynamics: internal energy, work and state function. Enthalpy: Hess's law, enthalpy of standard formation and standard reaction enthalpy. The problem of energy: fuels. Spontaneity. Entropy Second principle of thermodynamics: Gibbs energy, standard Gibbs energy. Energy changes in theformation of ionic crystals: reticular energy, Born-Fajans-Haber cycle.

2. Dissolutions

Solubility of gases. Vapor pressure of the solutions. Condition of phase balance. Rule of the phases. Phase diagram of a pure substance. Ideal solutions Law of Raoult. Diluted solutions Henry's Law. Colligative properties.

3. Principles of chemical equilibrium

Dissolution processes. Concept of balance, expressions and relationships between equilibrium constants. The reaction quotient Q. Modifications of equilibrium conditions: Le Châtelier principle. Balance calculations: examples. Relationship between the Gibbs energy and the equilibrium constant; prediction of the direction of a chemical change.

4. Reactions in aqueous solution

Stoichiometric calculations in aqueous solutions. Acid-base reactions. Precipitation reactions. General principles of redox reactions.

5. Introductionto chemical kinetics

Velocity of a chemical reaction. Equation of velocity and reaction order. Reaction velocity and temperature. Catalysis.

Methodology

Master classes:

The teacher imparts the basic knowledge of the subject in the lectures, trying to make clear its applicability to solving problems related to the environment. Although apparently, the students do not have a very active participation in this type of teaching, we must promote their participation by putting questions in class,

encouraging students to express their doubts and their ideas, both in the same class, and after the study. staff of the subjects taught.

Classes of problems:

They are fundamental to put into practice the knowledge acquired and know how to apply it to solve problems. Here it is essential that the students have a very active participation, solving (or, at least, trying to solve) the problems proposed before the face-to-face class. In this way, students can interact with the teacher proposing methods to solve problems, consulting the possibility of solving them by alternative methods and realizing the knowledge they had not acquired correctly. The fact of dividing the classes of problems into two subgroups, less numerous than the master classes, favors this interaction.

The teacher may also require the delivery of problems solved by the students for correction and evaluation. In some cases, the teacher may also require that the students make an oral presentation of the problem they have solved.

Laboratory practices:

Laboratory practices are very important from a double perspective. On the one hand allow students to see the application of knowledge acquired in the real world. On the other hand, they will allow them to acquire the experimental methodology and learn techniques that will be useful in their future professional life. They are mandatory and a lack of attendance implies the non pass of the course.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Exercises	11	0.44	2, 18, 5, 4, 16, 19, 1, 21, 20
Laboratory	15	0.6	2, 18, 5, 4, 16, 19, 1, 21, 20
Lectures	52	2.08	2, 3, 4, 6, 7, 8, 10, 9, 11, 12, 14, 17, 13, 16, 19, 1, 21, 20
Type: Autonomous			
Exercises	4	0.16	2, 18, 5, 19, 21, 20
Personal Work	135	5.4	18, 16, 21

Assessment

The global grade of the course will be obtained by:

Written tests (60%)
Exercises (20%)
Laboratory practices (20%)

To consider the course approved, the overall grade must be equal to or greater than 5.0

Written tests:

There are two types of written tests:

Partial exams: There will be two partial tests but three exams will be done, one for each part of the course and with the weights: Part I 20%, Part II 30% and Part III 50%.

To be able to weight the partial tests the grade of each exam must be equal to or greater than 3.5. Students with exams with a grade lower than 3.5 must be submitted to the Final Test of the exam (s), as they will not be able to weigh with another part.

To be able to weigh with the Evidence and Laboratory note, the weighted grade of the Partial Exams must be equal to or greater than 4.0. Otherwise, students must submit to the final test of that exam with a lower grade.

Final test (exam recovery): To participate in the recovery, the students must have been previously evaluated in a set of activities the weight of which equals a minimum of two thirds of the total grade of the subject (therefore it has been of having presented to Evidencies, Laboratory and a minimum of a partial examination).

It will be necessary for students who have partial / s with a grade lower than 3.5, or those who have not been submitted to any examination, to be present at least one of the three exams.

Improve note: students who have a grade of 3.5 or higher and who wish to improve a partial grade, prior communication to the faculty responsible for the subject, can be presented to the final exam for recovery. The grade you get in the final exam will replace the one you had in the partial, either superior or inferior.

In order to weigh with the Evidence and Laboratory note, the weighted grade of the exams must be equal to or greater than 4.0. Otherwise, the subject will be suspended and the exam grades will be the one that appears on your academic record.

Exercises:

May include work, problems solved in class or at home, written tests in class with or without material, etc. They can be done in theory or problem class and can be without previous notice (only in the class of problems). Minimum grade of 4.0 to be able to weigh with the Written Tests. If the grade is lower than 4.0 there will be no possibility of passing the subject as they are not recoverable. Evidence not presented will have a grade of 0.

Laboratory practices:

Presentation of the results obtained during the practices and responses to the proposed questionnaire. The attitude and way of working in the laboratory will also be taken into account. In the notebook a scheme of the practice to be carried out must be prepared (work prior to the practice) and the laboratory data. There will be a written test at the end of the practices that will consist of a test type test to evaluate the knowledge acquired during the same. Reports 60%, notebook 10% and exam 30%. Non-recoverable activity.

Attendance at laboratory practices is mandatory. Not attending without justification will lead to a non-pass in the subject, even if the partial exams are approved. If you can not attend, justifiably, any of the practice sessions, students must notify the faculty responsible for the practices in order to assist a different group to recover it (can not assist in retrieving it without having previously communicated it to the teaching staff of practices or in the last case of theory). If there is no option to do it in a group different from the one assigned, after agreement with the responsible professor, the professor will evaluate the justification and decide what to do. The justification will require the presentation of medical proof or equivalent (there is no valid overlap with other courses, travel, work ...).

Not respecting the laboratory rules will imply a suspension of the practices and therefore the impossibility of passing the course.

There will be a session prior to the practices to explain the operation and that will be mandatory. Your attendance will be controlled and the non-attendance will imply lowering the final grade of practice 3 points.

The note to be able to weigh with the note of Evidence and Written Tests must be higher than 5.

Not Evaluated:

It will be considered Not Evaluated if the number of evaluation activities carried out is less than 30% of the total programmed in the subject.

Others:

Any copy action in any of the evaluation activities will suppose a zero to the course, independently of other disciplinary implications.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exercises	20%	2	0.08	18, 5, 19, 21, 20
Practical Lab	20%	1	0.04	2, 18, 5, 4, 16, 19, 1, 21, 20
Test Part I	12%	1.5	0.06	3, 9, 11, 13
Test Part II	18%	1.5	0.06	15
Test Part III	30%	2	0.08	6, 7, 8, 10, 12, 14, 17, 13

Bibliography

Basic Bibliography:

H. Petrucci, Wiliam S. Harwood, F. Geoffrei Herring, *Química General*, 10a Edició, Editorial: Prentice-Hall (Pearson), 2011.

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J.Casabò: Estructura atómica y enlace, Ed. Reverté, 1996

D.L.Nelson, M.M. Cox: Lehninger-Principios de Bioquímica, 5ª ed., Ed. Omega, 2009

Stryer, L., Berg, J.M., Timoczko, T.: Bioquímica, 6ª ed., Ed. Reverté, 2007

ON-LINE Bibliography:

QUÍMICA GENERAL. Principios y aplicacions modernas. 11ed

Ralph H. Petrucci, F. Geoffrey Herring, Jeffry D. Maduray, Carey Bissonnette. Ed. Pearson, 11 ed., Madrid, 2017.

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Books of exercices:

J.A. López Cancio. Problemas de Química. Cuestiones y ejercicios. Prentice Hall, 2000

A. Navarrete, A. Garcia. La resolución de los problemas en química. Anaya, 2004

Formulation:

SALES; VILARRASA. Introducció a la nomenclatura química. 5a ed. Reverté SA, 2003

Software

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