Chemistry of the Earth

Code: 101060
ECTS Credits: 10

2024/2025

Degree	Type	Year
2500254 Geology	FB	1

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

This subject does not have official prerequisites, but students must know the fundamental concepts corresponding to the subjects of Baccalaureate Chemistry: formulation, stoichiometry, atomic structure and bond, thermodynamics and ionic equilibria (acid-base, precipitation and redox).

The Universitat Autònoma de Barcelona offers a propedéutic chemistry course for those students who consider that they have not achieved these concepts. This intensive course provides the student with a review of the fundamental concepts for a good follow-up of this subject.
The secretary of the Faculty of Sciences has information (enrollment, dates, etc ...) on this propedéutico course.

Objectives and Contextualisation

"Química de la Terra" in the degree:
This is a first-cycle subject, basic training, which develops the foundations of chemistry at a theoretical, practical and laboratory level. This subject gives tools and knowledge to be used in other subjects of the Degree in Geology.

Training objectives:
The objective of this subject is that the student is able to master the following topics:
1) The atoms, the elements, the periodic table.
2) Important elements in geology and isotopes.
3) Introduction to chemical thermodynamics and kinetic.
4) Introduction to chemical thermodynamics and kinetic.
5) Chemical bonding and bonding in solids.
6) Balance in aqueous solution: acid-base, dissolution-precipitation reactions and oxidation-reduction equilibrium.
7) Chemical Kinetics.
8) Geological origin of the main ones

Competences

- Learn and apply the knowledge acquired, and use it to solve problems.
- Show an interest in quality and incorporate it into practice.
- Suitably transmit information, verbally, graphically and in writing, using modern information and communication technologies.
- Use chemistry concepts when solving problems in geology.
- Work independently.

Learning Outcomes

1. Learn and apply the knowledge acquired, and use it to solve problems.
2. Show an interest in quality and incorporate it into practice.
3. Suitably transmit information, verbally, graphically and in writing, using modern information and communication technologies.
4. Use and discern the basics of chemistry in order to understand geology.
5. Work independently.

Content

Block I

Unit 0. Introduction

Inorganic formulation. Chemical reactions: stoichiometry. Chemical balance.

Unit 1. Atomic structure

Historical background. First atomic models. Waves and particles. Electromagnetic radiation. The hydrogen atom: Bohr's atomic model. Quantum mechanics. Hydrogenoid atomic orbital: quantum numbers. Representation of orbitals. Electronic spin. Polyelectronic atoms: atomic orbitals and energy levels. Electron shielding and effective nuclear charge. Pauli exclusion principle. Electronic configuration: Aufbau rule.

Unit 2. The periodic table

Ordering of the elements according to the atomic number. Classification of elements in groups, periods and blocks. Periodic properties of atoms. Atomic radius and ionic radius. Ionization potential. Electronic affinity. electronegativity

Unit 3. Chemical bond (I)

States of aggregation and discrete molecules. Link type. Structural and energy parameters. Bond polarity and dipole moment. Covalent Bonding: Lewis Structures. Concepts of resonance, bond order, formal charge and oxidation state. Molecular geometry: electron pair repulsion theory (VSEPR).

Unit 4. Chemical bond (II)

Types of solids. Crystal structures. Ionic solids. Lattice energy: Born-Haber cycle. Covalent solids and molecular solids. Metal link. Intermolecular forces: hydrogen bonding and van der Waals forces.

Unit 5. Chemical Kinetics

Reaction speed. Elementary reactions and molecularity. Reaction order. Speed constant. Arrhenius equation. Integrated velocity equations.

Block II

Unit 6. Chemical balance

Concept of chemical balance. Equilibrium constant: Kp and Kc. Influence of temperature: van't Hoff equation. Displacement of equilibrium: Le Chatelier's principle.

Unit 7. Acids and bases (I)

Acid-base theories. Autoionization of water and pH scale. Strong acids and bases. Weak acids and bases.

Unit 8. Acids and bases (II)

Polyprotic acids and bases. Ions as acids and bases: hydrolysis and pH of salts. Problems of mixtures of acids and bases. Buffer solutions Acid-base ratings.

Unit 9. Solubility and complexation equilibria

Solubility and solubility product (Kps). Common ion effect. Solubility and pH. Complexation equilibria.

Unit 10. Oxidation and reduction

Concept of oxidation and reduction. Equalization of redox reactions. Electrode potential and standard electrode potential.

Block III

Unit 11. Dissolutions

Introduction Clapeyron and Clausius-Clapeyron equations. Ideal solutions. Raoult's law. Dilute solutions. Henry's Law Colligative properties.

Unit 12. Thermochemistry (I)

Calorimetry Heat and work. Reversible and irreversible processes. First Principle Internal energy and enthalpy. applications thermochemistry Standard enthalpy of formation and standard enthalpy of reaction. Hess's Law Kirchoff's law. The energy problem: fuels.

Unit 13. Thermochemistry (II)

Reversibility and spontaneity. Second Principle entropy applications Gibbs and Helmholtz energies. Criteria of spontaneity and balance. Third Principle

Block IV

Unit 14. Phase balance and phase rule (I)

Concept of phase, component, degree of freedom. Phase balance. Rule of phases. Graphic representation of the chemical composition (chemography).

Unit 15. Phase balance and phase rule (II)

Phase diagrams as a graphical expression of phase rules. Unary systems Binary systems.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Classes of problems	24	0.96	1, 2, 4, 5
Expositive classes (theory)	51	2.04	1, 2, 4
Laboratory Practices	8	0.32	1, 2, 3, 4, 5
Seminars	2	0.08	1, 2, 4, 5
Type: Autonomous			
Preparation of Work and Study	146	5.84	1, 2, 3, 4, 5

The center of the learning process is the work of the student. The student learns working, being the mission of the teaching staff to help him / her in this task (1) providing information or showing the sources where it can be obtained and (2) directing his / her steps so that the learning process can be done effectively.

In line with these ideas, and in accordance with the objectives of the subject, the development of the course is based on the following activities:

1) Expositive classes (theory)

The student acquires the scientific-technical knowledge of the course by attending lectures and complementing them with the personal study of the topics explained. These classes are the activities in which less student interactivity is required: they are conceived as a fundamentally unidirectional method of transmitting knowledge from the teacher to the student.

2) Classes of problems and seminars

The classes of problems and seminars are sessions with a small number of students. The scientific knowledge is worked on by solving problems and / or practical cases. In these classes there must be a strong interaction between students and teachers in order to complete and deepen the understanding of the knowledge worked in the theoretical classes.

In the seminar classes the student works individually or in a group solving exercises and / or questions raised in the same class or previously. The sessions of problems and seminars should also serve as a solution to doubts and deepen certain key concepts of the subject.

Some of these activities will count for the continuous evaluation note.

3) Laboratory practices

Practices were carried out during the course in the chemistry laboratories. There will be two sessions, of 4 hours each.

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.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
First Partial Exam	33,5%	2	0.08	1, 2, 4, 5
Laboratory Practices	10%	8	0.32	1, 2, 3, 4, 5
Learning evidences	27%	4	0.16	1, 2, 3, 4, 5
Recovery exam	63%	3	0.12	1, 2, 3, 4, 5
Second Partial Exam	31,5%	2	0.08	1, 2, 4, 5

CONTINUOUS EVALUATION

The evaluation of the subject will be carried out through the following activities:

a. Written tests (exams)

b. Evidence of learning

c. Laboratory practices

a. Written tests

- During the first semester, two partial exams of the subject will be carried out, which will cover all the topics of block I and part of the topics of block II.

- During the second semester, two partial exams of the subject will be carried out, which will cover part of the topics of block II, and all the topics of block III and block IV.

- At the end of the course (June/July), there is a make-up exam for each of the blocks.

b. Evidence of learning

These are individual or group activities (inside or outside the classroom) to work on various aspects of the contents of the subject.

c. Laboratory practices

Attendance at laboratory practices is MANDATORY. Failure to attend without justification will prevent passing the subject.

In the event of not attending any of the practical sessions with justification, and not having the option of doing it in a group other than the one assigned, this session will not be considered in the calculation of the practical grade. The justification will require the presentation of a medical certificate or equivalent (overlapping with other subjects, trips, work, etc. is not valid).

Evaluation. Laboratory reports will be evaluated and attitude and work in the laboratory (NPLab) will also be taken into account.

Block grade:

- Block I grade (Nbloc-1). The exams will have a weight of 80% and the evidence of learning a weight of20%.

- Block II grade (Nbloc-2). The exams will have a weight of 80% and the evidence of learning a weight of 20%.

-Block III grade + Block IV grade (Nbloc-3+4). The exams will be worth 80% and the learning evidence will be worth 20% (each blog counts for 50%).

To pass the course it is necessary:

- Have a minimum grade of 3.5 in NBloc-1

- Have a minimum grade of 3.5 in NBloc-2

- Have a minimum grade of 3.5 in NBloc-3+4

If the minimum grade of 3.5 is not reached in NBloc-1 or NBloc-2, the student must take the recovery exam for the corresponding block.

If the minimum grade of 3.5 is not reached in NBloc-3+4, the student must take the recovery exam for block III or block IV (or both if deemed appropriate).

Final grade for the course (NF)

- To participate in the retake, students must have been previously assessed in a set of activities whose weight is equivalent to a minimum of 2/3 of the total grade for the course.

- The final grade is obtained from the following weighting: NF = (0.30 x NBloc-1) + (0.30 x NBloc-2) + (0.30 x NBloc-3+4) + (0.10 x NPLab)

- To pass the course, it is necessary to have a minimum of 5.0 in the final grade for the course (NF).

- If a student does not reach 3.5 in the NBloc-1, NBloc-2 or NBloc-3+4 grade, his final grade (NF) will be a maximum of 4.5.

Improving the grade (in the make-up exam):

Students who have passed the course for the course, but who want to improve their grade, may take the make-up exam for one or more blogs. The conditions will be:

- if the student improves the grade, the best grade will be used.

- if the student does not improve the grade, the average of the two grades will be taken.

Evaluation as "Not Evaluated"

A student will be considered "Not Evaluated" if the weight of the evaluation activities carried out is less than30% of the total scheduled for the course.

SINGLE EVALUATION

Within the regulatory period established by the University, students may request a single evaluation, waiving the continuous evaluation. Laboratory practices are not included in the single evaluation.

The evaluation of the subject will be carried out through the following activities:

a. Written tests (exams)

b. Laboratory practices

a. Written tests

The single evaluation will consist of ONE SINGLE synthesis test, which will be carried out at the end of the course (same date as the second partial of the second semester), and will have three parts:

- Part 1. An exam on the syllabus of block I (NBloc-1). Minimum passing mark: 3.5 points

- Part 2. An exam on the syllabus of block II (NBloque-1). Minimum passing mark: 3.5 points

- Part 3. An exam on the syllabus of block III and block IV (NBloc-3+4). Each blog counts for 50%. Minimum passing mark: 3.5 points.

b. Laboratory practices

These are compulsory and are not included in the single assessment. Students must complete them on the dates set by the Faculty, and they will be assessed during the same practice sessions.

If students do not attend any of the practice sessions with justification, and donot have the option of doing it in a group other than the one assigned, this session will not be considered in the calculation of the practice mark. The justification will require the presentation of a medical certificate or equivalent (overlap with other subjects, travel, work, etc. is not valid).

Assessment. Laboratory reports will be assessed, and attitude and work in the laboratory (NPLab) will also betaken into account.

Final grade for the course(NF):

NF = (0.30 x NBloc-1) + (0.30 x NBloc-2) + (0.30 x NBloc-3+4) + (0.10 x NPLab)

- A minimum grade of 5.0 must be obtained to pass the course.

- If the student fails the synthesis test, he/she has the right to take the make-up exam (same structure and conditions as the synthesis test).

Bibliography

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

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F. D. Ferguson y T. K. Jones La regla de las fases. Editorial Alhambra, 1968

M.D. Reboiras, Química, la ciencia bàsica, Ed. Thomson, 2006

Fernando Bastida Geología, una visión moderna de las Ciencias de la Tierra Ediciones Trea, Volumen 1, p. 257-350, 2005.

Ernest G. Ehlers The Interpretation of Geological Phase Diagrams Dover Publications, Inc. 1987.

Problems book:

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

Software

There is not.

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan/Spanish	annual	morning-mixed
(PLAB) Practical laboratories	1	Catalan/Spanish	annual	afternoon
(PLAB) Practical laboratories	2	Catalan/Spanish	annual	afternoon
(SEM) Seminars	1	Catalan/Spanish	annual	morning-mixed
(SEM) Seminars	2	Catalan/Spanish	annual	morning-mixed
(TE) Theory	1	Catalan/Spanish	annual	morning-mixed