Universitat Autònoma de Barcelona

2020/2021

Chemistry of the Earth

Code: 101060
ECTS Credits: 10

Degree	Type	Year	Semester
2500254 Geology	FB	1	A

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

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

Gumer Galán García

Juan Francisco Piniella Febrer

Maria Jesús Sánchez Martín

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

1. Atomic structure
Historical background. First atomic models. Waves and particles. Electromagnetic radiation. The hydrogen atom: Bohr's atomic model. Quantum mechanics. Hydrogen 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.

2. The periodic table
Ordering of elements according to atomic number. Classification of elements into groups, periods and blocks. Periodic properties of atoms. Atomic radius and ionic radius. Ionization potential. Electronic affinity. Electronegativity.

3. Chemical bond (I)
Aggregation states and discrete molecules. Type of link. Structural and energy parameters. Polarity of the bond and dipole moment. Covalent bond: Lewis structures. Concepts of resonance, bond order, formal charge and oxidation state. Molecular geometry: theory of electron pair repulsion (VSEPR).

4. Chemical bond (II)
Types of solids. Crystalline structures. Ionic solids. Reticular energy: Born-Haber cycle. Covalent solids and molecular solids. Metallic link. Intermolecular forces: hydrogen bonding and van der Waals forces.

5. Chemical Kinetics
Inorganic formulation. Chemical reactions: stoichiometry. Chemical equilibrium. Reaction rate. Elemental reactions and molecularity. Reaction order. Speed constant. Arrhenius equation. Integrated velocity equations.

Block II

6. Thermochemistry
Introduction.- Heat and work.- Reversible and irreversible processes.- First Principle. Internal energy.- Enthalpy.- Applications.- Thermochemistry.- Enthalpy of standard formation and enthalpy of standard reaction.-

Hess's law.- Kirchoff's law.- The problem of energy: fuels.
Reversibility and spontaneity.- Second Principle. Entropy.- Applications.- Gibbs and Helmholtz energies.- Spontaneity and equilibrium criteria.- Third Principle.

7. Solutions
Introduction.- Clapeyron and Clausius-Clapeyron equations.- Ideal solutions. Raoult's law.- Diluted solutions. Henry's law.- Collective properties.

Block III

8. Phase balance and phase rule (I)
Concept of phase, component, degree of freedom. Phase balance. Phase rule. Graphic representation of chemical composition (chemography).

9. Phase balance and phase rule (II)
Phase diagrams as a graphical expression of phase rules. Unary systems. Binary systems.

Block IV

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

11. Acids and bases (I)
Acid-base theories. Self-ionization of water and pH scale. Strong acids and bases. Weak acids and bases.

12. Acids and bases (II)
Polyprotic acids and bases. Ions as acids and bases: hydrolysis and pH of salts. Problems of mixing acids and bases. Buffer solutions. Acid-base titrations.

13. Solubility and complexation equilibria
Solubility and solubility product Kps. Common ion effect. Solubility and pH. Complexation equilibria.

14. Electrochemistry
Concept of oxidation and reduction. Equalization of redox reactions. Electrode potential and standard electrode potential.- Electromotive force. Nernst equation. Batteries. Corrosion. Electrolysis.

Methodology

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.

Activities

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

Assessment

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
At the end of the first semester, a partial exam of the subject is scheduled, which includes topics 1 to 7 (block I and block II).
At the end of the second semester, a partial exam of the subject is scheduled, which includes topics 8 to 14 (block III and block IV).

At the end of the course there is a resit exam for the first semester and the second semester.

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 justifiably attending one of the internship sessions, and not having the option of doing it in a group other than the assigned one, this session will not be considered in the calculation of the internship grade. The justification will require the presentation of a medical certificate or equivalent (the overlap

with other subjects, travel, work ...) is not valid.
Laboratory reports will be evaluated and attitude and work in the laboratory (NPLab) will also be taken into account.

First semester grade (N1s)
They will evaluate subjects 1 to 7 with the following weighting:
- Note block I: the examination of topics 1-5 will have a weight of 70% and the learning evidence of topics 1-5 will have a weight of 30%.
- Note block II: the examination of subjects 6-7 will have a weight of 70% and the learning evidence of subjects 6-7 a weight of 30%.
- The grade for the first semester is obtained: N1s = (Note block I) x 0.65 + (Note block II) x 0.35

- If the GRADE OF THE FIRST SEMESTER (N1s) is inferior to 3,5 the student has toappear to the examination of recovery of the subjects 1 to 7.

Second semester grade (N2s)
They will evaluate subjects 8 to 14 with the following weighting:
- Note block III: the examination of subjects 8-9 will have a weight of 70% and the learning evidence of subjects 8-9 a weight of 30%.
- Note block IV: the examination of the subjects 10-14 will have a weight of 70% and the learning evidences of the subjects 10-14 a weight of 30%.
- The second semester grade is obtained: N2s = (Note block III) x 0.35 + (Note block IV) x 0.65

- If the GRADE OF THE FIRST SEMESTER (N2s) is inferior to 3,5 the student has to appear to the examination of recovery of the subjects 8 to 14.

Final grade of the subject (NF)

To participate in the recovery the students must have been previously evaluated in a set of activities whose weight is equivalent to a minimum of 2/3 parts of the total qualification of the subject.

The final grade is obtained from the following weighting: NF = (N1s x 0.45) + (N2s x 0.45) + (NPLab x 0.10)

You must have a minimum of 5.0 in the final grade (NF) to pass the course.

Improve grade on the resit exam. Students who have passed the subject per course but who want to improve their grade under the following conditions may take the one-year (or both) resit exam:

1) if the student improves the grade, the best grade will be used.
2) if the student does not improve the mark, the two marks will be averaged.

Rating as "not rated"
A student will be considered "Not evaluated" if the weight of the assessment activities performed is less than 30% of the total scheduled in the subject.

Assessment Activities

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

Second Partial Exam	31,5%	2	0.08	1, 2, 5, 4

Bibliography

R.H. Petrucci, W.S. Harwood, F.G. Herring: Química general. Enlace químico y estructura de la materia, Vol.1, Ed. Prentice Hall, 2003

R. Chang: Química General, 9ª edició, Ed. McGraw-Hill, 2007

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

American Chemical Society, Química, un proyecto de la American Chemical Society. Ed. Reverté, 2005

P. Atkins, L. Jones: Principios de Química, 3ª edició, Ed. Panamericana, 2006

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.