Universitat Autònoma de Barcelona

2019/2020

Chemistry of the Earth

Code: 101060
ECTS Credits: 10

Degree	Type	Year	Semester
2500254 Geology	FB	1	A

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
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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.
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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

ATOMIC STRUCTURE AND CHEMICAL BOND

1. Introduction
Historical antecedents.- Waves and particles.- Principle of uncertainty.- Quantum mechanics. The Schrödinger equation.

2. Atomic structure
The hydrogen atom.- Concept of hydrogenoid orbital.- Representation of the orbitals.- Electronic spin.- Polielectronic atoms.- Atomic orbitals and energy levels.- Explanation of the electrons and effective nuclear charge. Principle of Pauli exclusion.- Electronic configuration. Rule of the Aufbau.

3. The periodic table
Sorting of the elements according to the atomic number.- Classification of the elements in groups, periods and blocks. Periodic properties of the atoms.- Atomic radius and ionic radius.- Potential of ionization.- Electronic affinity. Electronegativity.- Other properties: oxidation state, basicity, metallic character.

4. Introduction to the chemical bond
Aggregation states and discrete molecules.- Type of link.- Structural and energy parameters: experimental determination.- Polarity of the link and dipole moment.

5. Structure and geometry of discrete molecules
Lewis structures.- Resonance concepts, binding order, formal charge and oxidation state.- Molecular Geometry: Theory of Repulsion of Electronic Pairs (VSEPR). Theory of molecular orbitals.

6. The chemical bond in the solids
Types of solids.- Crystalline structures.- Metallic bond. Bands theory. Metals, semiconductors and insulators.- Ionic solids. Reticular energy Born-Haber cycle.- Covalent solids.- Molecular solids. Intermolecular forces: hydrogen bond, van der Waals forces.

CHEMICAL THERMODYNAMICS

7. First Principle. Thermochemistry
Introduction.- Heat and work.- Reversible and irreversible processes.- First Principle. Internal energy.- Enthalpy.- Applications.- Thermochemistry.- Enthalpy of standard training and standard reaction enthalpy.- Law of Hess.- Kirchoff Law.- The problem of energy: fuels.

8. Second and Third Principles. Spontaneity and balance.
Reversibility and spontaneity.- Second Principle. Entropy.- Applications.- Energies of Gibbs and Helmholtz.- Criteria of spontaneity and equilibrium.- Third Principle.

9. Dissolutions
Introduction.- Equations of Clapeyron and Clausius-Clapeyron.- Ideal dissolutions. Law of Raoult.- Dissolutions diluted. Law of Henry.- Collaborative properties.

10. Phase equilibrium. Rule of phases.
Concept of phase, component, degree of freedom. - Stage equilibrium. Phase rule.- Graphical representation of the chemical composition (quimiography) .- Phase diagrams as a graphical expression of the phased rules .- Unary systems.- Binary systems.

11. Chemical equilibrium
General condition of chemical equilibrium.- Balance in gaseous reactions. Constant of equilbri.- Influence of the temperature. Van't Hoff equation.- Balance shift. Principle of Le Chatelier.

12. Introduction to equilibrium in aqueous solution
Introduction.- Reactions of precipitation.- Acid-base reactions.- General principles of redox reactions: equalization of reactions; Oxidizing agents and reducers.- Stoichiometric calculations in aqueous solutions and valuations.

13. Acids and bases
Acid-base theories.- Autoionisation of water and pH scale.- Acids and strong bases.- Acids and weak bases.- Acids and polypropic bases.- The ions as acids and bases: hydrolysis and pH of the salts.- Problems of mixtures of acids and bases .- Solutions buffer.

14. Solubility and complexation balances
Solubility and product of solubility Kps.- Effect of the common ion.- Solubility and pH.- Balances of complexation.

15. Electrochemistry
Basic concepts.- Potential of electrode and standard electrode potential.- Electromotive force E.- Variation of E with concentration: Nernst equation.- Batteries and batteries.- Corrosion.- Electrolysis.

CHEMICAL CINEMATICS

16. Introduction to Chemical Kinetics
Reaction rate.- Elemental reactions. Molecularity.- Order of reaction.- Constantof speed.- Integrated equations of speed.- Dependence with the temperature. Arrhenius Equation.

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 weighting:
a) Written tests (70%)
b) Laboratory practices (15%)
c) Evidence of learning (15%)

Final note of the subject. In order to be able to do the weighted average of the written tests with the mark of the laboratory practices and the learning evidences, it will be necessary to obtain a mark equal or superior to 4.0 in the note of the final exam (ExF) or Have passed the subject for partial (P1 and P2). Otherwise, the subject will be suspended.

a) Evaluation through exams (written tests)

Partial exams. There will be two partial tests (P1, P2), one per semester. The subject evaluated will be the one corresponding to the subjects that will be announced sufficiently in advance.

The student has passed the subject by partial if he has all the partial ones (P1 and P2) with a mark equal to or greater than 4.0, and the weighted average note of the two partials with the note of laboratory practices and

the note of the evidences of learning is equal to or greater than 5.0. In this case they will be released from presenting themselves to the final exam.

Therefore, the students with a partial with a mark less than 4.0 will have to be submitted to the final test (ExF) obligatorily.

Final exam It will consist of a single exam (ExF) that will evaluate the whole subject globally.

Only students who have obtained a minimum grade in the subject's evaluation of a 3.0 will be able to present to the final exam, considering the written notes (partial P1 and P2), the laboratory practices note and the note of the learning evidences.

In order to participate in the recovery the students must have been previously evaluated in a series of activities whose weight equals to a minimum of 2/3 parts of the total grade of the subject.

The students who have not approved by partial will have to present themselves.

b) Evaluation of the laboratory practices.
The laboratory reports will be evaluated and the attitude and work in the laboratory will also be taken into account.
Attendance to laboratory practices is mandatory. Not attending without justification will prevent the approval of the subject. In case you do not justify attending any of the practice sessions, and if you do not have the option to perform it in a group other than the one assigned, this session will not be considered in the calculation of the practice note. The justification will require the presentation of medical justification or equivalent (overlapping with other subjects, trips, work ...) is not valid.

c) Evaluation of the learning evidences
They are individual or group activities (inside or outside the classroom) to work on various aspects of the contents of the subject. They will have a weight of 15% in the final grade of the subject

Improve note to the final exam. The students who have passed the subject by year but who wish to improve their mark under the following conditions may submit to the final exam:

1) If the student improves the grade, the best grade will be used.
2) If the student does not improve the note, the average of the two notes will be made.

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

Others
Any copy action in the assessment activities will imply a zero in the subject, regardless of other disciplinary implications.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final exam	70%	3	0.12	1, 2, 3, 5, 4
First Partial Exam	35%	2	0.08	1, 2, 5, 4
Laboratory Practices	15%	8	0.32	1, 2, 3, 5, 4
Learning evidences	15%	4	0.16	1, 2, 3, 5, 4
Second Partial Exam	35%	2	0.08	1, 2, 5, 4

Bibliography

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

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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.