Chemical Bonding and Structure of Matter

Code: 106799
ECTS Credits: 6

2025/2026

Degree	Type	Year
Nanoscience and Nanotechnology	FB	1

Contact

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Teachers

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Teaching groups languages

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

Prerequisites

There are no official prerequisites, however it is recommended that students review the basic knowledge of Chemistry, Physics (Electricity and Electromagnetic Waves) and Calculation of Integral and Derivatives (High School level).

Objectives and Contextualisation

The general objective of the subject is that students get to know and know how to apply the concepts, principles and theories about the structure of the atom and matter, since it is that what determines their properties. The understanding of the fundamentals of chemical bonding, intermolecular forces and states of aggregation of matter is essential to be able to manipulate and design chemical entities and their reactions/interactions and is, therefore, a basic knowledge for Nanoscience and Nanotechnology.

We also want to make students work on their ability to identify, analyze and solve chemical, physical and biological problems in the field of Nanoscience and Nanotechnology. Critical reasoning, autonomous work (individual and/or group), conceptual synthesis and the use of computer and bibliographic resources will be enhanced. On the other hand, students will also be introduced to safety standards and good laboratory practices and practices will be carried out in order to favor the understanding of the concepts seen in theory.

Learning Outcomes

1. CM04 (Competence) Work collaboratively in teams to solve problems and practical cases in general chemistry.
2. CM05 (Competence) Work autonomously to plan the work involved in supervised activities.
3. KM05 (Knowledge) Describe chemical bonding, intermolecular forces and states of matter aggregation.
4. KM06 (Knowledge) Identify the concepts, principles and theories on the structure of the atom and matter, and relate them to their properties.
5. SM05 (Skill) Gather, analyse and adequately represent data and observations in the field of general chemistry, using magnitudes, units and terminology associated with basic chemical concepts.
6. SM06 (Skill) Determine the properties of elements and simple molecules by applying Lewis theory, valence bond theory and molecular orbital theory.
7. SM08 (Skill) Safely handle instruments and materials typically found in a general chemistry laboratory.

Content

The main sections of the subject are:

- Atomic nature of matter
- Atomic structure: quantum mechanics and electronic configuration of atoms
- The periodic table of the elements
- Chemical bond and molecular structure
- Intermolecular forces and states of the matter

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory practices	8	0.32	
Problems class	14	0.56	
Theory class	30	1.2	
Type: Supervised			
Support for doing problems and the assimilation of theoretical concepts	10	0.4	
Type: Autonomous			
Bibliographical work	15	0.6	
Completion of practical reports	8	0.32	
Reading the practical guides	2	0.08	
Solving the exercices	24	0.96	
Studying	31	1.24	

The teaching methodology includes different types of activities that are:

Theory classes: will be carried out combining the use of digital material (e.g. slides) and the realization of developments on the board. It is recommended to take notes and expand or complete them by consulting the books and materials recommended in the bibliography and in class. It will try to boost student participation during classes. The teaching staff will solve some practical cases in order to exemplify the theory.

Classes of problems: they are essential for the correct understanding of the subject and for the application of the concepts studied in the resolution of real problems. Students will have a collection of problems that must be solved and that (a part) will be corrected throughout the course to the classes of problems. When the teaching staff determines it, the delivery of solved problems will be mandatory.

Laboratory practices: practices will be carried out in the laboratory (experimental and / or computational) so that the students get to know the work in the laboratory and can work in a more practical and applied way the concepts seen to theory.

Autonomous work: the students must work autonomously on the theoretical contents and the questions raised by the lecturerin the directed sessions or through the Moodle classroom, in the realization of the practices, and in the elaboration of the works of the subject that will involve a part of bibliographic research.

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
Evaluation of practical lab	15%	1	0.04	CM05, SM05, SM08
Other evidences	15%	1	0.04	CM04, KM05, KM06, SM06
Performing two partial exams	70%	6	0.24	KM05, KM06, SM05, SM06

The evaluation will be carried out throughout the course and will be done through different evaluation activities, each of them with the weight in the final grade indicated in the table (Continuous evaluation, AC). The evaluation method will also be subject to the guidelines set by the Faculty of Sciences. Class attendance will be part of the continuous assessment, in accordance with the criteria established by the teaching staff.

Partial exams (70% of the total grade): Two tests (35% weight each) will be done to evaluate the scientific-technical knowledge of the subject achieved by the students, as well as their capacity for analysis and synthesis, and critical reasoning. The contents evaluated will be those of the theory and problem classes, as well as some questions about the practices carried out. The minimum grade required in each partial is 4.5 out of 10.

Laboratory practicals (15% of the total): Practicals in the laboratory are mandatory. Immediately contact the teaching staff responsible for the subject and the practices in case there is any problem for its realization. The evaluation of the practices is carried out through the reports and will represent 15% of the total grade. The average of the reports, which are normally written during the practice and delivered at the end of it, must be a minimum of 5.0 out of 10. Students who are involved in an incident that may have serious safety consequences may be expelled from the laboratory and thus suspend the subject.

Other evidence (15% of the total): In order to motivate the work of the subject and to monitor the progress of the students, the teaching staff will require that the students autonomously carry out tests in Moodle (or in

other online platforms), problem solving to deliver, preparation of materials or presentations, visualization of videos and / or bibliographic works, that will be evaluated. They shall represent a maximum of 15 % of the total notice.

Those not presented: A student will be considered evaluated if he/she performs any of the following activities: (a) completion of a partial exam or (b) realization of two practical laboratory sessions.

Recovery exam: If the minimum requested is not reached, at the end of the course one or both partial exams can be repeated. The grade obtained will replace the one obtained in the first attempt. To participate in these second exams it is necessary to have been previously evaluated in a set of activities whose weight is equivalent to a minimum of two thirds of the total grade of the subject.

Review: Students will have the opportunity to review all assessment activities as set out in UAB regulations.

Single Assessment (UA):

Students who have taken advantage of the single evaluation modality must take a final test that will consist of: (1) a theory exam where they must answer a series of questions related to the theory classes and laboratory practices carried out; (2) a problem test where a series of exercises similar to those that have been worked on in the Classroom Practices sessions and laboratory practices must be solved. These tests will be carried out on the day that the students of the continuous evaluation take the exam of the second partial. In addition, and given that the practices are mandatory, the reports of the practices must be presented on the same day as the continuous evaluation students, which, normally, will be tried to be the same day of the realization of the practice.

The student's grade will be calculated from the different evaluation activities according tothe following weights: the theory exam will account for 45% of the grade, the problem exam 40% and the grade of the practice reports will count 15%.

If the final grade does not reach 5.0, students will have another opportunity to pass the subject throughanew exam (similar to the final test one) that will be held on the date set by the coordination of the degree. The weight of this test will be 85%. The laboratory practices part (reports mark) is not recoverable.

The students will be able to review the different tests evaluated on the day of the review of the second partial by the rest of the students or, if necessary, on a day agreed with the teaching staff responsible for the subject.

In all acts and modalities of evaluation, any irregularity that may lead to a significant variation of the rating, will be rated with 0. Students may fail the course.

If the course is failed but the laboratory grade is higher than 6.0, it will not be mandatory to repeat the laboratory sessions the following academic year, and the laboratory grade will be retained, provided that 75% of the same lab sessions are maintained as in the previous year in which the course was failed.

Bibliography

Bibliography includes books on General Chemistry and other more specialized on the Chemical Bond.

- R. H. Petrucci, F.G. Herring, J. D. Madura, C. Bissonnette, Química General: principios y aplicaciones modernas, Pearson Prentrice Hall (11ª Ed.) 2017 ISBN: 9788490355336, eISBN: 9788490355343. https://bibcercador.uab.cat/permalink/34CSUC_UAB/avjcib/alma991010080899706709
- D. A. McQuarrie, P. A. Rock, E. B. Gallogly: *General Chemistry: Atoms First*, 4ª edition, Ed. University Science Books, 2011. ISBN: 9781891389603, eISBN: 9781891389900
- J. Casabó i Gispert: *Estructura atómica y enlace químico*. Editorial Reverte, 1996. ISBN: 9788429171891, eISBN: 9788429193343
- J.M.Costa, J.M.Lluch, J.J.Pérez: *Química. Estructura de la materia.* Biblioteca Universitària. Enciclopèdia Catalana, 1993. ISBN: 9788477395164

Physical Chemistry General Books:

- D. A. McQuarrie, J. D. Simon: *Physical Chemistry: a molecular approach*, Ed. University Science Books, 2011. ISBN: 9780935702996, eISBN: 9781891389962
- P.W. Atkins, J. De Paula, *Química Física*, Editorial Panamericana, 8ª edition, 2008. eISBN: 9789500694988

Software

In the computational lab, the GAUSSIAN program (v16 or later) and the associated viewer GaussView (v6 or later) will be used for quantum mechanical calculations.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan	first semester	morning-mixed
(PAUL) Classroom practices	2	Catalan	first semester	morning-mixed
(TE) Theory	1	Spanish	first semester	afternoon