Universitat Autònoma de Barcelona

2022/2023

Structure of Matter

Code: 106224
ECTS Credits: 6

Degree	Type	Year	Semester
2504235 Science, Technology and Humanities	OB	2	2

Contact

Name: Xavier Roque Rodriguez
Email: xavier.roque@uab.cat

Use of Languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

External teachers

Ana Isabel Ruiz García
Rosario García Giménez
Sergio Díaz-Tendero Victoria

Prerequisites

There are none.

Objectives and Contextualisation

The general objective of this subject is to offer students a basic knowledge to understand the structure of the matter and its relationship with its physical and chemical properties, and settle the knowledge that allow them understanding the fundamental role of Chemistry as basic science and the benefits that the advances in this discipline have provided to society. Specifically, students will study concepts related to atomic structure, periodical properties of elements, chemical bond theories, molecular structure and molecular interactions resulting in different forms of matter aggregation. Next, they will study the concept of chemical reactivity and the ability of substances to transform. Finally, those concepts will be contextualized concerning some key aspects of the 21st century Chemistry and the challenges it faces.

Competences

- Describe the fundamental forces of nature in relation to the configuration of the universe and the structure of matter.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.

Learning Outcomes

1. Apply the theoretical and practical knowledge acquired to problem solving in chemistry and physical chemistry.
2. Describe the structure of the atom and know the periodic table of the elements.
3. Distinguish between the typed of chemical bonding and intermolecular interactions and understand the concept of molecule.
4. Identify and understand some of the present-day challenges facing chemistry, such as advanced materials, nanotechnology, environmental chemistry and molecular recognition in biological processes.
5. Identify the principles and theories of chemistry of the atom, molecule, solid and chemical reaction, understanding the physical and mathematical bases they require.
6. Understand the concept of chemical reactivity and understand the principal factors that influence the principal types of reactions.
7. Understand the fundamental relationship between electronic structure and chemical bonding, and the physicochemical properties of the different states of aggregation of matter, including metals, glass, ceramics, semiconductors, polymers and biomaterials.

Content

I - Atomic structure and properties
-Atomic models: from Dalton to Quantum Mechanics.
-Periodic table of elements and electronic structure.
-Nucleus structure and nuclear processes.

II - Molecules and molecular compounds
-Chemical bond, intermolecular forces and aggregation states.
-Physicochemical properties of the matter.
- Symmetry of molecules and solids. Tridimensional structure. Coordination compounds. Biomolecules.

III - Structure of solids
- Defects and crystal growth.
-Materials and their properties.
-Description and structural determination by conventional and advanced methods.

IV - Chemical reactions
-Introduction to chemical reactivity-types of reactions.
-Energy and velocity of chemical processes.
-Catalysis - Industrial, environmental and biological processes relevance.

V - Current challenges of Chemistry
-Introduction to self-assembly and self-organization.
-Current applications of advanced materials in nanotechnology.
-Climate change and sustainability. Environmental aspects of Chemistry.

Methodology

Lectures.
Practical exercises.
Project preparation and oral presentation.

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			

Learning exercises	16	0.64	1
Lectures	33	1.32	6, 2, 3, 7, 5
Type: Supervised			
Essay supervision	4.25	0.17	1, 4
Type: Autonomous			
Personal study	75	3	1, 6, 2, 3, 7, 5
Project preparation	17.75	0.71	4

Assessment

During the course, four practices will be carried out: (1) Scientific bibliographic search; (2) Molecular structure and chemical bonding; (3) Structure in crystalline solids; (4) Analysis of air pollution in cities. Each student will deliver a report after each practice. 15% of the final grade in the subject will correspond to the work done during the practices and the reports delivered.
In the middle of the semester a written test will take place, intermediate exam, in which the knowledge of the part of the contents seen up to that moment will be evaluated - blocks I and II. 25% of the final grade in the subject will correspond to the evaluation of these contents. To weight the final qualification, the grade in this test must be greater than 4/10.
At the end of the semester a second written test will be carried out by the students, final exam, in which the knowledge of the second part of the subject will be evaluated - blocks III, IV and V. 35% of the final grade in the subject will correspond to the evaluation of these contents.
Those students who have not passed the intermediate exam, with a grade lower than 4/10, will have the opportunity in the final exam to make up for this part of the subject. The evaluation percentages are maintained: 25% for the first part -blocks I and II- and 35% for the second part -blocks III, IV and V-.
Throughout the semester, the students will develop a project on a topical issue related to the subject, which will correspond mainly to block V. At the end of the semester, they will carry out a presentation followed by a debate with the whole group about their project. 25% of the final grade in the subject will correspond to the manuscript, presentation and discussion in the debate of the project.
Students will have the opportunity to make up for any of the parts of the evaluation that they have failed (with a grade lower than 5/10) in the extraordinary call.
In the event of a student committing any irregularity that may leadto a significant variation in the grade awarded to an assessment activity, the student will be given a zero for this activity, regardless of any disciplinary process that may take place. In the event of several irregularities in assessment activities of the same subject, the student will be given a zero as the final grade for this subject.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final exam	35%	2	0.08	6, 2, 3, 7, 5
Intermediate test	25%	2	0.08	6, 2, 3, 7, 5
Practices	15%	0	0	1, 6, 3, 4
Project	25%	0	0	1, 4

Bibliography

R. Chang, J. Overby. *Química*. 13ª edición en inglés, 8ª en español. México: McGraw-Hill, 2020.
R. H. Petrucci. *Química general: principios y aplicaciones modernas*. Madrid: Pearson Educación, 2017.
O. Mó Romero y M. Yáñez Montero. *Enlace químico y estructura molecular*. Palencia: Ediciones Cálamo, 2002.
H. Birch. *50 cosas que hay que saber sobre Química*. Madrid: Planeta, 2016.
H. Baker. *50 cosas que hay que saber sobre Física Cuántica*. Madrid: Planeta, 2016.J. L. Amoros. *El Cristal*. 4ª ed. Madrid: Atlas, 1990.
R. I. D. Tilley. *Crystals and crystal structures*. Oxford: Wiley-Blackwell, 2006.
J. F. Shackelford. *Introducción a la ciencia de materiales para ingenieros*. 6ª edición. Londres: Pearson. 2005.
C. Pico Marín, M. Luisa López García y M. L. Veiga Blanco. *Cristaloquímica de materiales: de la estructura a las propiedades de los sólidos inorgánicos*. Madrid: Síntesis, 2007.
A. R. West. *Solid State Chemistry and Its Applications*. 2nd. ed. Chichester: Wiley, 2014.

Software

None required.