UAB
Universitat Autònoma de Barcelona

Chemistry of Elements

Code: 106808
ECTS Credits: 6

2025/2026

Degree	Type	Year
Nanoscience and Nanotechnology	OB	2

Contact

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Teaching groups languages

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

Prerequisites

There are no prerequisites, but it is recommended to have passed the subjects 'Chemical link and structure of matter' and 'Chemical reactivity' of 1st year.

Objectives and Contextualisation

The subject Chemistry of the elements is taught in the second semester of the 2nd year of the Degree in Nanoscience and Nanotechnology and is a compulsory subject.

The training objectives are included in the following sections:

a) Predict the properties of the elements and their compounds by applying the different binding theories and models of Inorganic Chemistry.

b) Establish the reactivity and general tendencies of the elements according to their position in the periodic table.

c) Identify the main most representative inorganic compounds, their properties, synthesis and applications.

d) Introduction to the complexes of transition metals: classification of the type of ligands and isomerism.

Learning Outcomes

1. CM13 (Competence) Apply chemical knowledge to solve quantitative and qualitative problems, using bibliographic sources when necessary.
2. CM14 (Competence) Work collaboratively to plan and organise the basic tasks carried out in a physicochemical analysis laboratory.
3. CM15 (Competence) Handle chemical products and wastes while taking their impact on safety and the environment into account.
4. KM20 (Knowledge) Describe the electronic structure of atoms and their ions in the periodic table.

5. SM22 (Skill) Explain the variation in properties of the chemical elements and their compounds, based on the periodic table groups and crystal structure.

Content

THEORY

1. General perspective of the Periodic Table. Origin and abundance of the elements. Radii, IP, EA, electronegativity. Metallic character. Oxidation state. The three types of bonding. Fajans rules.

2. Hydrogen. Properties and uses, reactivity and obtaining of hydrogen. Covalent, ionic and metal hydrides: classification and general properties.

3. Alkali and alkaline earth metals. General properties. Abundance, applications and obtaining. Hydration and solubility of halides. Oxides and derivatives, hydroxides, carbonates and sulfates. General reactivity.

4. Elements of group 13. General properties. Tl and the inert pair. Abundance, applications and obtaining. Elemental B. Oxides, acids and derivatives of B. Boranes and halides of B. Reactivity of Al. Al oxide and halides.

5. Elements of group 14. Abundance, applications and properties. Allotropes of C, Si, Ge and Sn. Semiconductors. Carbides. Hydrides. Methane. Halides. C monoxide and dioxide. Carbonate and hydrogen carbonate. Uses of Si and SiO_2. Glasses. Cements. Ge, Sn, Pb oxides. Silicates and aluminosilicates. Hydrogen cyanide and derivatives. Organosilanes and silicones.

6. Elements of group 15. Abundance, applications and properties. Nitrogen. Phosphorus, allotropes of phosphorus. Nitrides and phosphides. Ammonia, hydrazine, hydrazoic acid. P, As, Sb hydrides. Halides of N, P, As, Sb. Oxides and oxoanions of N. Oxides and oxoanions of P, As, Sb, Bi. Phosphates and polyphosphates.

7. Group 16 elements. Abundance, applications and properties. Characteristics and allotropic forms of the elements. Oxygen and ozone. Hydrides. Hydrogen peroxide. Halides. Oxides. Oxoacids and oxoanions of sulfur. Sulfides and polysulfides.

8. Halogens. Abundance, applications, properties and production. Hydrogen halides. Pseudohalogens and pseudohalides. Interhalogens. Oxides. Oxoacids and oxoanions.

9. Noble gases. Properties, abundance and applications. Clathrates. Xe fluorides. Xe oxides and oxoanions.

10. Metals of block ***d***. Classification of the elements of block *d*. Discovery, abundance and importance. Orbital energy. Electronic configurations. Magnetic properties. Oxidation states. Concept of metal-ligand bond and common geometries. Types of bonds. Compounds with metal-metal bonds. Noble character. Halides, cyanides and oxides. Oxocations, oxoanions and polyoxoanions. Hydrolysis of cations.

11. ***f***-block metals. Discovery and stability. Abundance. Uses of lanthanides. Oxidation states and chemistry of lanthanides. The *f*-orbitals. Oxidation states of actinides and uses of uranium.

PROBLEMS

The content of this section, which will be delivered in the form of a dossier, consists of a certain number of statements of problems related to the topics developed in theory.

LABORATORY PRACTICES

There will be three laboratory sessions of four hours each.

Practice 1: Synthesis of Pb(II) nitrate. Practice 2: Synthesis of Pb(II) chloride. Practice 3: Synthesis of Sn(II) chloride.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
learning results	140	5.6	

The training activities are divided into three sections: theory sessions, problem solving sessions and laboratory practices, each with its specific methodology.

Theory sessions:

The teacher will explain the content of the syllabus. These expository sessions will be the most important part of the theory section. In the hands of the teacher and through communication through the Virtual Campus, the knowledge of some selected parts of the syllabus should be sought and studied through autonomous learning by the students. To facilitate this task, information on locations in textbooks, web pages, etc. will be provided. Also to reinforce learning, cooperative activities to be carried out in a group within the classroom will be proposed. These will be directed by the teacher, both during theory lessons and during problem solving sessions, and will consist in the discussion and sharing of the knowledge acquired by each member of the group.

Problem solving sessions:

The theory group will be divided into two subgroups of problems. Students will attend the sessions scheduled by their subgroup of problems. At the beginning of the semester a dossier of statements of problems of the subject will be delivered through the Virtual Campus that will be resolved throughout the sessions. In these sessions, distributed throughout the semester, the problem solving session teacher will expose the experimental and calculation principles necessary to work on the problems, explaining the guidelines for the resolution and reinforcing at the same time the knowledge of different parts of knowledge of the theory sessions.

Laboratory practices:

The group will be subdivided into two subgroups. It is necessary to assist to the practices with laboratory coat, and with the protocol of practices (available in the Virtual Campus) printed, and previously read. Students also need to bring a notebook to record the observations made and the data obtained. On the days established in the calendar, the students will be summoned in the Chemistry of the Elements laboratory to carry out basic experiences. The practices will be carried out in pairs and will be evaluated individually. Attendance at practices is mandatory.

Material available in the Virtual Campus of the subject:

Teaching guide. Presentations used by teachers to theory sessions. Dossier of problem solving sessions. Protocols of practical sessions. Links to educational web addresses. Calendar of teaching activities (classroom sessions, laboratory sessions, evaluations).

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.

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Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Laboratory resultats	15%	1	0.04	CM13, CM14, CM15
Theory&problems sessions	85%	9	0.36	CM13, KM20, SM22

Exams
For assessment purposes, the subject can be considered divided into two parts.
Two partial exams will be held throughout the semester, one for each part (ExP1 and ExP2), a laboratory practice exam (ExL) and a global recovery exam (ExR), all of which will have a grade between 0 and 10.

Monitoring work (S)
A certain number of student monitoring tests will be collected throughout the semester (problems solved individually or in groups, short classroom tests, etc.). Each student will therefore obtain a monitoring grade (S), which will be the average of the grades obtained in the subject.

Laboratory Practices
Students will do three mandatory laboratory practices throughout the course. These practices will be assessed with a practice exam (ExL) and laboratory monitoring (booklet, performance, attitude) (SL).

Grades
The final grade (NF) of the subject will be obtained as follows:
NF = 0.70 x (ExP1 + ExP2)/2 + 0.15 x S + 0.15 x NL
Where NL is the laboratory practice grade, with NL = 0.60 x ExL + 0.40 x SL

To pass the subject by partials, the following two conditions must be met:
1) The final grade of the subject (NF) must be $\geq$ 5.0
2) To be able to make an average, ExP1, ExP2 and ExL must be $\geq$ 4.0.

In the event that the previous requirement is not met, the student must take the global retake exam, where he or she will be able to recover one or both of the two partials and/or the laboratory practice exam, given that the subjects of each partial will be separated and identified as such (ExR1, ExR2 and ExRL). The NF will be calculated by replacing the values of ExP1 and/or ExP2 and/or ExL with those obtained in the remedial exam ExR1 and/or ExR2 and/or ExRL.

In order to be able to take the global remedial exam, it is mandatory that students have previously taken the 1st and 2nd partial exams (ExP1, ExP2).

To pass the subject in the global remedial exam, the following conditions must be met:

Prerequisite: To participate in the remedial exam, students must have previously been evaluated in a set of activities whose weight is equivalent to a minimum of two thirds of the total grade for the subject (therefore, having previously taken the partial exams ExP1 and ExP2).

1) The final grade (NF) of the subject must be $\geq$ 5.0
2) In order to be able to make an average, in cases where it applies, ExR1, ExR2 and ExRL must be $\geq$ 4.0, analogous to the conditions imposed to pass the subject by partials.

Students who pass the course by partials but wish to improve their grade may take the global exam but must do it in full; that is, the two subtests corresponding to each partial. The grade of the retake exam will replace the grade that was obtained for the two partials together ((Exp1+Exp2)/2) and, therefore, will have a weight of 70% in the new NF of the subject (the grade of the follow-up work S cannot be recovered).

Single Assessment
Students who have opted for the single assessment modality (and who therefore have not taken the follow-up tests S) must take a final test (ExF) which will consist of an exam of the entire subject syllabus to be taken on the day that the continuous assessment students take the second partial exam, and which will be averaged with the laboratory grade as follows:

Final Grade (NF) = Exam Grade (85%) + Laboratory Grade (15%) = 0.85 x ExF + 0.15 x NL

If the final grade does not reach 5.0, the student has another opportunity to pass the subject through the remedial exam (ExFR) which will be held on the date set by the degree coordination (same day as the global remedial exam for the entire group). The grade of the retake exam (ExFR) will replace that of the previous exam (ExF)to calculate the final grade for the subject.

Bibliography

Textbook:

"Química Inorgànica" Shriver & Atkins, McGraw Hill, 4a Ed, 2008. ISBN-13: 978-970-10-6531-0

Original version:"*Inorganic Chemistry*" Shriver & Atkins, Oxford UP, 5th Ed, 2010. ISBN-13. 978-0199236176

Some other descriptive books recommended:

"*Descriptive Inorganic Chemistry*" G. Rayner-Canham, Freeman. 2009, Fifth Edition. ISBN-13: 978-1-4292-2434-5

"*Química Inorgànica Descriptiva*" G. Rayner-Canham, Prentice-Hall. 2000, 2a ed. ISBN 13: 9789684443853

Obres de referència de consulta general:

"Química Inorgánica" (2a ed.) C.H. Housecroft, A.G. Sharpe, Pearson Educación, 2006. ISBN 13: 978-84-205-4847-0

"*Chemistry of the Elements*" by N.N. Greenwood & A. Earnshaw, Pergamon, 1984. ISBN 13: 9780080220574

https://cv2008.uab.cat

http://www.webelements.com/

http://tablaperiodica.analesdequimica.es/

http://www.periodicvideos.com/

Software

In case the lectures are online: Teams

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/Spanish	second semester	afternoon
(PAUL) Classroom practices	2	Catalan/Spanish	second semester	afternoon
(PLAB) Practical laboratories	1	Catalan/Spanish	second semester	morning-mixed
(PLAB) Practical laboratories	2	Catalan/Spanish	second semester	morning-mixed
(TE) Theory	1	Catalan/Spanish	second semester	afternoon