COURSE DATA

Data Subject	
Code	34199
Name	Inorganic Chemistry II
Cycle	Grade
ECTS Credits	4.5
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1110 - Degree in Chemistry	Faculty of Chemistry	2	Second term
1929 - Double Degree Program in Physics and Chemistry	Double Degree Program Physics and Chemistry	2	Second term

Subject-matter

Degree	Subject-matter	Character
1110 - Degree in Chemistry	8 - Inorganic Chemistry	Obligatory
1929 - Double Degree Program in Physics and Chemistry	2 - Segundo Curso (Obligatorio)	Obligatory

Coordination

Name	Department
JULVE OLCINA, MIGUEL	320 - Inorganic Chemistry

SUMMARY

T. Moeller defines Inorganic Chemistry as the discipline which deals with experimental research and theoretical interpretation of the properties and reactions of all the elements and all their compounds except for hydrocarbons and most of their derivatives. Therefore, its study covers the behaviour of more than 100 elements, with thousands of compounds with very different properties, which is one of its most attractive characteristics: to locate such a large number of very different facts in a similar vein.

The Inorganic Chemistry I subject is focused on the study of the structural, thermodynamic and reactivity basic principles of Inorganic Chemistry, and on the systematic study of selected non-metals and semimetallic and their compounds. The Inorganic Chemistry II subject arises, in part, as a complement of Inorganic Chemistry I, being focused on a systematic study of metallic elements, transition, d and f blocks, as well as s and p blocks, and their most important compounds, while introducing students to the most basic aspects of the coordination chemistry, which are needed to address the above systematic study.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

This subject completes the subject Inorganic Chemistry I with the systematic study of the metallic elements of the periodic table. In the subject Inorganic Chemistry I the non-metallic elements were studied and now the metallic ones will be studied in a similar way.

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

1108 - Degree in Chemistry

- Develop capacity for analysis, synthesis and critical thinking.
- Show inductive and deductive reasoning ability.
- Demonstrate leadership and management skills, entrepreneurship, initiative, creativity, organization, planning, control, leadership, decision making and negotiation.
- Solve problems effectively.
- Demonstrate ability to work in teams both in interdisciplinary teams and in an international context.
- Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as appropriate.
- Demonstrate a commitment to ethics, equality values and social responsibility as a citizen and as a professional.
- Learn autonomously.
- Demonstrate the ability to adapt to new situations.
- Acquire a permanent sensitivity to quality, the environment, sustainable development and the prevention of occupational hazards.
- Demonstrate knowledge of the main aspects of chemical terminology, nomenclature, conventions and units.
- Interpret the variation of the characteristic properties of chemical elements according to the periodic table.
- Demonstrate knowledge of the main types of chemical reaction and their main characteristics.
- Demonstrate knowledge of the principles of thermodynamics and kinetics and their applications in chemistry.
- Ability to recognise chemical elements and their compounds: preparation, structure, reactivity, properties and applications.

- Demonstrate knowledge of the principles, procedures and techniques for the determination, separation, identification and characterisation of chemical compounds.
- Relate the macroscopic properties and the properties of individual atoms and molecules, including macromolecules (natural and synthetic), polymers, colloids and other materials.
- Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the areas of chemistry.
- Solve qualitative and quantitative problems following previously developed models.
- Recognise and analyse new problems and plan strategies to solve them.
- Evaluate, interpret and synthesise chemical data and information.
- Relate theory and experimentation.
- Recognise and evaluate chemical processes in daily life.
- Understand the qualitative and quantitative aspects of chemical problems.
- Develop sustainable and environmentally friendly methods.
- Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.
- Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.
- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.
- Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.
- Express oneself correctly, both orally and in writing, in any of the official languages of the Valencian Community.
- Have basic skills in the use of information and communication technology and properly manage the information obtained.

LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)

The previous section includes the competences contained in the document VERIFICA. This subject addresses part of the learning results of the matter Inorganic Chemistry that allow to acquirespecific knowledge of chemistry, cognitive skills and general skills recommended by the EUROPEAN CHEMISTRY THEMATIC NETWORK (ECTN) for the Chemistry Eurobachelor® Label. The following table lists the learning outcomes acquired in the subject Inorganic Chemistry II related to the competences of the degree in Chemistry.

SPECIFIC KNOWLEDGE OF CHEMISTRY	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject Inorganic Chemistry II that contemplate the learning outcomes EUROBACHELOR®
Major aspects of chemical terminology, nomenclature, conventions and units.	CE1: Demonstrate knowledge of the main aspects of chemical terminology, nomenclature, conventions and units.
The principal techniques of structural investigations, including spectroscopy	CE7: Ability to recognise chemical elements and their compounds: preparation, structure, reactivity, properties and applications. CE8: Demonstrate knowledge of the principles, procedures and techniques for the determination, separation, identification and characterisation of chemical compounds.
The principles of thermodynamics and their applications to chemistry	CE6: Demonstrate knowledge of the principles of thermodynamics and kinetics and their applications in chemistry.
The characteristic properties of elements and their compounds, including group relationships and trends within the Periodic Table	CE2: Interpret the variation of the characteristic properties of chemical elements according to the periodic table. CE7: Ability to recognise chemical elements and their compounds: preparation, structure, reactivity, properties and applications.
The structural features of chemical elements and their compounds, including stereochemistry.	CE7: Ability to recognise chemical elements and their compounds: preparation, structure, reactivity, properties and applications.

	CE11: Relate the macroscopic properties and the properties of individual atoms and molecules, including macromolecules (natural and synthetic), polymers, colloids and other materials.
The relation between bulk properties and the properties of individual atoms and molecules, including macromolecules (both natural and manmade), polymers and other related materials.	CE11: Relate the macroscopic properties and the properties of individual atoms and molecules, including macromolecules (natural and synthetic), polymers, colloids and other materials.
COMPETENCES AND COGNITIVE SKILLS	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject Inorganic Chemistry II that contemplate the learning outcomes EUROBACHELOR®
Ability to demonstrate knowledge and understanding of the facts, concepts, principles and fundamental theories related to the topics mentioned above.	CE13: Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the areas of chemistry.
Ability to apply this knowledge and understanding to the solution of common qualitative and quantitative problems	CE14: Solve qualitative and quantitative problems following previously developed models. CE15: Recognise and analyse new problems and plan strategies to solve them. CE24: Understand the qualitative and quantitative aspects of chemical problems.
Competences for the evaluation, interpretation and synthesis of information and chemical data.	CE16: Evaluate, interpret and synthesise chemical data and information.
Competences to present and argue scientific issues orally and in writing to a specialized	CG6: Demonstrate ability to communicate information, ideas, problems and solutions

audience.	to both specialist and non-specialist audiences and using information technology, as appropriate. CB4: Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences
Ability to calculate and process data, related to information and chemistry data.	CE14: Solve qualitative and quantitative problems following previously developed models. CE15: Recognise and analyse new problems and plan strategies to solve them.
GENERAL COMPETENCES	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject Inorganic Chemistry II that contemplate the learning outcomes EUROBACHELOR®
Ability to apply practical knowledge to solve problems related to qualitative and quantitative information.	CG4: Solve problems effectively. CE14: Solve qualitative and quantitative problems following previously developed models. CE22: Relate theory and experimentation. CE23: Recognise and evaluate chemical processes in daily life. CE24: Understand the qualitative and quantitative aspects of chemical problems.
Calculation and arithmetic capabilities, including aspects such as analysis error, estimates of orders of magnitude, and correct use of the units	CG1: Develop capacity for analysis, synthesis and critical thinking. CG2: Show inductive and deductive reasoning ability.

	CG4: Solve problems effectively.
Interpersonal skills to interact with other people and get involved in team work.	CG5: Demonstrate ability to work in teams both in interdisciplinary teams and in an international context. CG7: Demonstrate a commitment to ethics, equality values and social responsibility as a citizen and as a professional. CG9: Demonstrate the ability to adapt to new situations.

Acquire a special awareness for the sustainable management of raw materials and for sustainable development compatible with the environment (SDGs 11, 12, 13, 14 and 15).

Design, select and/or develop efficient chemical products and processes (SDG 7) that minimize their impact on the environment (SDG 14 and 15), take advantage of alternative raw materials and generate less waste (SDG 11).

DESCRIPTION OF CONTENTS

1. General methods of obtention of metals

General methods of obtention of metals. Ellingham diagrams. Metallurgical, hydrometallurgical and electrochemical methods.

2. Alkali metals

Alkali earth metals. General characteristics of group 1. Singularity of Li. Obtention and application of alkali and alkaline earth metals. Most important binary compounds: hydrides, halides, oxides, peroxides and superoxides. Hydroxides: sodium hydroxide. Chemistry in liquid ammonia. Organometallic compounds. Biological aspects of the elements in group 1.

3. Group 2 metals

General characteristics of group 2. Singularity of Be. Extraction and applications of group 2 metals. Most important binary compounds: hydrides, halides, oxides, peroxides and superoxides. Chemistry in liquid ammonia. Organometallic compounds. Biological aspects of the elements of group 2.

4. Group 13 metals: Al, Ga, In, and Tl

Group 13 metals: Al, Ga, In, and Tl. General characteristics of the group. Obtention and application of the elements. Reactivity of aluminium: Chemistry in aqueous solution. Halides, oxide and hydroxide aluminium. Chemistry of gallium, indium, and thallium. Biological aspects.

5. Metals of groups 14 and 15: Sn, Pb and Bi

Metals of groups 14 and 15: Sn, Pb and Bi. Characteristics of the elements. Obtention and applications. Chemistry in aqueous solution. Most important compounds. Biological aspects.

6. Basic concepts of coordination chemistry

Basic concepts of coordination chemistry. Basic structural aspects and bond. Nomenclature and formulation of coordination compounds

7. Characteristics of transition metals

Characteristics of transition metals. Structural aspects. Electronic structure and chemical behavior. Trend in the stability of the oxidation states. Hydrated metal ions, oxocationes and oxoanions. Redox properties

8. Elements in groups 3 to 7

Elements in groups 3 to 7. Obtaining of the elements. Particular study of scandium, titanium, vanadium, chromium, and manganese. Applications. Chemistry in aqueous solution. Complexes. Binary compounds: halides, oxides, sulfides. Complex. Compounds with metal-metal bonds. Clusters. Polioxometalates. Biological aspects

9.

Iron, cobalt and nickel. Obtaining of the elements. Particular study of iron. Most relevant applications. Chemistry of II and III States. Complexes. Other oxidation States. Binary compounds: halides, oxides, sulfides. Organometallic compounds. Biological aspects

10. The platinum group metals: Ru, Rh, Pd, Os, Ir and Pt

The platinum group metals: Ru, Rh, Pd, Os, Ir and Pt. separation of metals. Applications. Most important oxidation States. Pd (II) and Pt (II) chemistry. Binary compounds. Complex. Organometallic compounds. Biological aspects.

11. Coinage metals: Cu, Ag and Au

Coinage metals: Cu, Ag and Au. Extraction of metals. Applications. States of oxidation and stability. Binary compounds. Chemistry of Cu (II). Complexes. Biological aspects.

12. Group 12 metals: Zn, Cd and Hg

Group 12 metals: Zn, Cd and Hg. General characteristics of the elements. Obtaining and applications: batteries. Binary compounds. Chemistry in aqueous solution. Coordination compounds. Biological aspects

13. Lanthanoids and actinoids

Lanthanoids and actinoids. General characteristics of the lanthanoids and actinoids. Oxidation States. Variation of properties throughout the series. Isolation and natural state. Applications of elements and their compounds. Radioactivity and nuclear reactions of the actinoids. Particular study of uranium: Chemistry in aqueous solution. Most important binary compounds

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	38,00	100
Tutorials	7,00	100
Study and independent work	32,50	0
Preparation of evaluation activities	16,00	0
Preparing lectures	6,00	0
Preparation of practical classes and problem	13,00	0
TOTAL	**112,50**	

TEACHING METHODOLOGY

The subject is raised so that the student is the protagonist of their own learning and is structured in the following way:

Lectures. In these classes, the teacher will give an overview of the topic object of study with special emphasis on the new aspects or particular complexity. It also will carry out the specific application of the knowledge that students have acquired via the resolution of issues and practical problems that students have previously worked. Logically, these classes will be complemented with the of personal study time referred to section III.

Group tutoring. Students attend them in smaller groups. In them, the teacher can propose activities, as resolution of issues or problems, resolution of doubts, approach to discussions, etc., which will contribute to the final score, as it considers the teacher.

Seminars. Seminars will be also included, with the aim to complement the lectures.

EVALUATION

FIRST CALL

Modality A

The knowledge acquired will be assessed through a final exam on the date established by the faculty, which will account for 70 % of the final note. The exam will consist of objective questions about the knowledge considered basic (see the list of learning outcomes), and numerical and relationship problems that require the students to consider aspects of the subject appearing on various topics.

The student's participation in any of the activities proposed during the academic period that are related to the subject will be valued with 30% of the final grade, among which the teacher can choose one or more of the following:

- Delivery of solved problems and exercises.
- Attendance to the group tutoring clases, and reasoned and clear participation in discussions.
- Troubleshooting and raising doubts.
- Carrying out tasks and/or oral presentations.
- Carrying out written tests.
- Class attendance.
- Any other complementary training activity determined by the professor.

The final mark will be that of the final test plus the one obtained in all the activities that are proposed, with the percentage indicated for each one of them. To pass the subject, the student must obtain a minimum grade of 4.5 in the final test and the weighted average must be equal to or greater than 5.

Modality B

Those students who for justified reasons cannot attend class regularly can request, at most within one month from the beginning of the course, to be evaluated only by means of a written exam on the date set by the Faculty, and the final grade of the student will be that of the exam. To pass the subject, the student must obtain a grade equal to or greater than 5 in this exam.

SECOND CALL

In the second call, modalities A and B will be maintained, with the same conditions and percentages described for the first call. Students enrolled in modality A will maintain the grade obtained in the activities proposed during the course for this second call. The second call written exam will be held on the

date set by the Faculty.

REFERENCES

Basic

- Housecroft, C. E.; Sharpe,A. G.; Inorganic Chemistry, ed. Pearson Prentice-Hall, 3ª edició, 2008. ISBN: 978-0-13-175553-6.
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- Atkins,P. W.; Overton,T. L.; Rourke, J.P.; Weller, M.T. y Armstrong, F. A.; Shriver & Atkins: Inorganic Chemistry, ed. Oxford, 5ª edición, 2010. ISBN: 978-0-19-923617-6.
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Additional

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