COURSE DATA

DATA SUBJECT

Code: 34199
Name: Inorganic Chemistry II
Cycle: Undergraduate Studies
ECTS Credits: 4.5
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1110 - Degree in Chemistry	Facultat de Química	2	Second quarter
1929 - Double Degree Program in Physics and Chemistry	Facultat de Física	2	Second quarter
1934 - Double Degree Program in Chemistry-Chemical Engineering	Facultat de Química	3	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1110 - Degree in Chemistry	Inorganic Chemistry	COMPULSORY
1929 - Double Degree Program in Physics and Chemistry	Segundo Curso (Obligatorio)	COMPULSORY
1934 - Double Degree Program in Chemistry-Chemical Engineering	Tercer curso	COMPULSORY

COORDINATION

GIMENEZ SAIZ CARLOS

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.

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 theirimpact on the environment (SDG 14 and 15), take advantage of alternative raw materials and generate less waste (SDG 11).

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 / LEARNING OUTCOMES

1108 -

Ability to recognise chemical elements and their compounds: preparation, structure, reactivity, properties and applications.

Acquire a permanent sensitivity to quality, the environment, sustainable development and the prevention of occupational hazards.

Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as appropriate.

Demonstrate ability to work in teams both in interdisciplinary teams and in an international context.

Demonstrate a commitment to ethics, equality values and social responsibility as a citizen and as a professional.

Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the areas of chemistry.

Demonstrate knowledge of the main aspects of chemical terminology, nomenclature, conventions and units.

Demonstrate knowledge of the main types of chemical reaction and their main characteristics.

Demonstrate knowledge of the principles, procedures and techniques for the determination, separation, identification and characterisation of chemical compounds.

Demonstrate knowledge of the principles of thermodynamics and kinetics and their applications in chemistry.

Demonstrate leadership and management skills, entrepreneurship, initiative, creativity, organization, planning, control, leadership, decision making and negotiation.

Demonstrate the ability to adapt to new situations.

Develop capacity for analysis, synthesis and critical thinking.

Develop sustainable and environmentally friendly methods.

Evaluate, interpret and synthesise chemical data and information.

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.

Interpret the variation of the characteristic properties of chemical elements according to the periodic table.

Learn autonomously.

Recognise and analyse new problems and plan strategies to solve them.

Recognise and evaluate chemical processes in daily life.

Relate the macroscopic properties and the properties of individual atoms and molecules, including macromolecules (natural and synthetic), polymers, colloids and other materials.

Relate theory and experimentation.

Show inductive and deductive reasoning ability.

Solve problems effectively.

Solve qualitative and quantitative problems following previously developed models.

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 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.

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.

Understand the qualitative and quantitative aspects of chemical problems.

1110 - Degree in Chemistry

Act autonomously in learning, making informed decisions in different contexts, forming judgements based on experimentation and analysis, and transferring knowledge to new situations.

At the end of the course, the student will be able to address new problems and develop strategies to solve them.

At the end of the course, the student will be able to assess risks in the use of chemical substances and laboratory procedures.

At the end of the course, the student will be able to distinguish between qualitative and quantitative aspects of chemical problems.

At the end of the course, the student will be able to distinguish the principles, procedures and techniques used for the determination, separation, identification and characterisation of chemical compounds.

At the end of the course, the student will be able to identify chemical elements and compounds, including their production, structure, reactivity, properties and applications.

At the end of the course, the student will be able to identify chemical processes in everyday life.

At the end of the course, the student will be able to identify the main types of chemical reactions and their key characteristics.

At the end of the course, the student will be able to implement sustainable and environmentally friendly methodologies.

At the end of the course, the student will be able to relate theory and experimentation.

At the end of the course, the student will be able to solve problems effectively.

At the end of the course, the student will be able to state the principles of thermodynamics and kinetics and apply them in chemistry.

At the end of the course, the student will correctly use chemical terminology, nomenclature, conventions and units.

At the end of the course, the student will demonstrate inductive and deductive reasoning skills.

At the end of the course, the student will demonstrate the ability to analyse, synthesise and apply critical reasoning.

At the end of the course, the student will interpret the relationship between the variation of the characteristic properties of chemical elements and the periodic table.

Collaborate effectively in teams, assuming responsibilities and leadership roles and contributing to collective improvement and development.

Communicate effectively, both orally and in writing, adapting to the characteristics of the situation and the audience.

Contribute to the design, development and implementation of solutions that address social needs, taking the Sustainable Development Goals as a reference.

Demonstrate critical and self-critical reasoning within the field of study, considering aspects such as professional ethics, moral values and the social implications of the different activities undertaken.

Express oneself correctly, both orally and in writing, in any of the official languages of the Valencian Community.

Propose creative and innovative solutions to complex situations or problems within the field of study, in order to respond to diverse professional and social needs.

Understand and recognise, from within the discipline, inequalities based on sex and gender in society; integrate different needs and preferences related to sex and gender into problem-solving and solution design.

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

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

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	7,00
Theory	38,00
Total hours	**45,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	32,50
Preparation of lessons	19,00
Preparation for assessment activities	16,00
Resolution of case studies	0,00
Total hours	**67,50**

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

The knowledge acquired will be assessed through a final written exam on the date established by the Faculty, which will account for 80 % 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 20% 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 classes, 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 written exam 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 written exam and the weighted average must be equal to or greater than 5.

SECOND CALL

In the second call, the same conditions and percentages described for the first call will be maintained. The students 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.

Final warning

Copying or plagiarism of any assignment that is part of the evaluation will make it impossible to pass the course, and the student will be subject to the appropriate disciplinary procedures.

Please note that, according to Article 13 d) of the University Student Statute (RD 1791/2010, December 30), "*it is the duty of a student to refrain from using or cooperating in fraudulent procedures in evaluation tests, in the work performed or in official University documents*".

REFERENCES

- Housecroft, C. E.; Sharpe,A. G.; Inorganic Chemistry, ed. Pearson Prentice-Hall, 3ª edició, 2008. ISBN: 978-0-13-175553-6. (In a separate format, the answer manual for the exercises has been published. There is a Spanish translation of the 2nd edition and the answer manual. Ed. Pearson Prentice-Hall, 2006.)
- 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. (There is a Spanish translation of the fourth edition by Ed. McGraw-Hill, 2008).
- Rayner-Canham,G.; Overton,T.; ¿Descriptive Inorganic Chemistry¿ y ¿Student solutions manual for descriptive inorganic chemistry¿, ed. W.H. Freeman, 4ª edición, 2006. ISBN 10: 1-4292-1814-2. (There is a Spanish translation of the 2nd edition by G. Rayner-Canham, Química Inorgánica Descriptiva, ed. Prentice Hall, 2000)
- Cotton,F.A.; Wilkinson,G.; Murillo; C.A.; Bochmann, M.; ¿Advanced Inorganic Chemistry¿, ed. Wiley-Interscience, 6ª edición, 1999. ISBN: 978-0-471-19957-1 There is a Spanish translation of the 4th edition, F.A. Cotton y G. Wilkinson, ¿Química Inorgánica Avanzada¿, ed. Limusa, 1987.
- Greenwood, N. N.; Earnshaw, A.; Chemistry of the Elements, ed. Elsevier Science, 2ª edición, 1997 (corregida en 1998, con reimpresiones en 2001 y 2002). ISBN: 0-7506-3365-4.
- Wells,F.; "Química Inorgánica Estructural", 4ª ed. Reverté, Barcelona, 1994. ISBN-13: 978-8429175240; ISBN-10: 8429175245