COURSE DATA

DATA SUBJECT

Code: 34200
Name: Inorganic Chemistry III
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1110 - Degree in Chemistry	Facultat de Química	3	First quarter
1929 - Double Degree Program in Physics and Chemistry	Facultat de Física	4	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1110 - Degree in Chemistry	Inorganic Chemistry	COMPULSORY
1929 - Double Degree Program in Physics and Chemistry	Cuarto Curso (Obligatorio)	COMPULSORY

COORDINATION

GARCIA-ESPAÑA MONSONIS ENRIQUE

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SUMMARY

The compulsory subject Inorganic Chemistry III of 6 credits is included in the field Inorganic Chemistry of the fundamental chemistry module and is taught in the sixth semester of the degree in Chemistry

After the study of Inorganic Chemistry I and II, where they have acquired the basic knowledge of the subject matter and we have studied the properties of chemical elements and their compounds, inorganic chemistry III focuses on the study of the coordination and organometallic compounds.

The coordination and organometallic compounds play an important role in Inorganic Chemistry and represent a way of approaching the study of this subject matter applicable to a wide variety of systems. Its study has an integrator character, it brings together concepts and theories with experimental facts and covers from the electronic structure and molecular synthesis and reactivity of the substances, thermodynamics and kinetics, basic studies and applications. By its nature, extends from the theoretical chemistry to Biochemistry and organometallic chemistry are blurring the boundaries between the conventional Inorganic Chemistry and Organic Chemistry. The subject Coordination Chemistry, 6 credits,

and Organometallic Chemistry, 4.5 credits, will complete these topics. Currently, the area of new materials is progressing very quickly and there is a marked interest in the synthesis and properties of new inorganic solids. The items included in the subject Inorganic Chemistry III that will enable the student to understand basic concepts of solids and will complemented with the compulsory subject Science of Materials, 6 credits.

The subject Inorganic Chemistry III contains a theme of symmetry and group theory, useful tool in chemistry, which is needed to address with rigor, some aspects of the coordination compounds of transition metals.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

1110 - Degree in Chemistry

Obligation to have previously passed the subject(s)	34183 - General Chemistry I 34184 - General Chemistry II

1929 - Double Degree Program in Physics and Chemistry

Obligation to have previously passed the subject(s)	34183 - General Chemistry I 34184 - General Chemistry II

OTHER REQUIREMENTS

Students should have completed and passed the subjects I Inorganic Chemistry and Inorganic Chemistry II.

COMPETENCES / LEARNING OUTCOMES

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Act autonomously in learning, making well-founded decisions in various contexts, forming judgements based on experimentation and analysis, and applying knowledge to new situations.

Address new problems and propose strategies to solve them.

Collaborate effectively in work teams, assume responsibilities and leadership roles, and contribute to collective improvement and development.

Communicate effectively both orally and in writing, adapting to the context and audience.

Contribute to the design, development and implementation of solutions that respond to social demands, using the Sustainable Development Goals as a reference.

Demonstrate both inductive and deductive reasoning skills.

Demonstrate critical and self-critical thinking, considering professional ethics, moral values and social implications of the different activities carried out throughout the degree.

Demonstrate the ability to analyse, synthesise and reason critically.

Distinguish between the qualitative and quantitative aspects of chemical problems.

Distinguish the principles, procedures and techniques used in the determination, separation, identification and characterisation of chemical compounds.

Evaluate the risks involved in the use of chemical substances and laboratory procedures.

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

Identify chemical elements and their compounds, including their extraction, structure, reactivity, properties and applications.

Identify chemical processes in everyday life.

Identify the main types of chemical reactions and their associated key characteristics.

Implement sustainable and environmentally friendly methodologies.

Interpret the relationship between the variation in the characteristic properties of chemical elements and the Periodic Table.

Propose creative and innovative solutions to complex situations or problems in the field, addressing diverse professional and social needs.

Relate theory to experimentation.

Solve problems effectively.

State the principles of thermodynamics and kinetics and their application in chemistry.

Understand and analyse, from the perspective of the degree programme, social inequalities based on sex and gender; integrate gender-sensitive approaches into problem-solving and solution design.

Use chemical terminology, nomenclature, conventions and units correctly.

DESCRIPTION OF CONTENTS

1. Molecular symmetry

1.1 Symmetry elements and operations.
1.2. Point groups of symmetry. Determination of the point group symmetry of a molecule. C4v, D3h, D4h Td and O point groups.
1.4 Character tables. Species of symmetry. Symmetry of atomic orbitals.
1.4.-Application of symmetry. Chirality, molecular vibrations. IR and RAMAN spectra: H2O molecule, stretching vibrations of carbonyl groups in metal carbonyls. Determination of group orbitals in octahedral

complexes.

2. Coordination and Organometallic transition metal compounds

2.1.- Historical aspects: Alfred Wërner and his time. Definition of coordination compound.
2.2.- General characteristics: oxidation state. Index and coordination geometry. Square, tetrahedral and octahedral complexes. Geometry and coordination symmetry. Idealization of coordination symmetry.
2.3.- Types of ligands. Classification: nature of the donor atom, denticity, nature of the metal-ligand bond, ligands in organometallic chemistry.
2.4.-Isomery in coordination compounds

3. The bond nature and electronic structure

3.1- Introduction. Valence bond theory: high and low spin complexes.
3.2.-Crystal field theory. Factors that affect the crystalline field stabilization energy. Octahedral complexes, weak and strong field complexes. Tetrahedral complexes. Jahn-Teller effect. Square complexes
3.3.- Molecular orbital theory. Diagram of molecular orbitals and electronic configuration of octahedral, tetrahedral, square complexes. Angular overlap model. Energy splitting diaframs of d orbitals in complexes of other symmetries.
3.4.- Terms and energy levels. d-d Transitions in coordination compounds. Tanabe-Sugano diagrams.

4. Reactions of the metal complexes: Thermodynamic and kinetic aspects of the coordination compounds.

4.1. Stability of coordination compounds. Stability constants: global and successive constants. Determination of stability constants. Stability correlations Statistical effect. Chelate effect. Macrocyclic effect. Cryptate effect. Selectivity.
4.2.- Reactions and mechanisms in coordination chemistry. Introduction. Ligand substitution reactions. Metal ions in aqueous solution; water exchange reactions: labile and inert metal complexes. Mechanisms of ligand substitution reactions: dissociation, exchange and association. Reactions of ligand substitution in octahedral complexes. Experimental evidence for dissociative mechanisms in octahedral complexes. Associative mechanisms in octahedral complexes. The conjugate base mechanism. Kinetic aspects of the chelate effect. Stereochemistry of the reactions. Reactions of ligand substitution in square complexes. Trans effect. Redox reactions: mechanisms of external sphere and internal sphere.
4.3.- Reactions in organometallic chemistry and catalysis. Types of reactions: Dissociation reactions and ligand substitution. Reactions of oxidative addition and reductive elimination. Insertion reactions. Hydride elimination reactions. Cyclometalation Principles of catalysis. Examples of catalytic processes in the chemical industry.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	9,00
Theory	51,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	70,00
Preparation of lessons	0,00
Preparation for assessment activities	20,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

The subject is raised so that the student is the protagonist of their own learning and vertebrará around four axes:

Participatory lectures-in those classes the teacher give an overview of the topic object of study with special emphasis on the key concepts or of particular complexity. Indicate those most recommended resources that complement the topic on personal study time. The teacher will induce the student to participate in the discussions that arise through exposure of the subject.

Practical classes and seminars-these classes are carried out the specific application of the knowledge that students have acquired in theory classes. Students must previously have worked the problems will be resolved. The resolution of these problems is carried out on some occasions by the teacher and in another case by the students well in group, either on an individual basis.

Tutoring-students attend them in groups and will be one hour. In them, teacher will guide the student on the elements that make up the learning process, at the same time which will evaluate their process of learning in a global way. The student will receive a list of questions and problems that you will exercise on each of the aspects dealt with in class sessions. Also, tutorials will serve to resolve all questions that have been able to arise during classes and guide students on the methods of work more useful to the resolution of problems that may arise.

Seminars and Conference: Seminars and Conference will focus on complementary aspects of their training in Inorganic Chemistry. For this task, students attending the event and answer a questionnaire prepared by

the instructor.

EVALUATION

FIRST CALL

The knowledge acquired will be evaluated through a final test on the date established by the Faculty and will account for 80% of the final score. The exam will consist of objective questions about the knowledge that is considered basic (see the list of learning outcomes) as well as of numerical exercises necessary to evaluate the aspects of the subject that appear in the different topics.

A 20% of the final score will be attributed to the student's participation in any of the activities proposed along the course related to the subject, among which it is worth highlighting:

- Presentation of problems and exercises.
- Attendance and participation in the discussions.
- Resolution of problems and raising doubts.
- Realization of works and/or oral presentations.
- Realization of written tests.
- Any other complementary training activity determined by the teacher.

The final mark will be that of the final test plus the one obtained in all the activities that are proposed, with the percentages 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.

SECOND CALL

In the second call, the marks obtained in the activities proposed during the course (continuous assessment) can be maintained, if the student agrees, with the same conditions and percentages described for the first call. The written exam of the second call 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*".

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