COURSE DATA

DATA SUBJECT

Code: 36468
Name: Bioinorganic Chemistry
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1110 - Degree in Chemistry	Facultat de Química	4	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1110 - Degree in Chemistry	Inorganic Chemistry Applied	ELECTIVES

COORDINATION

GARCIA-ESPAÑA MONSONIS ENRIQUE

SUMMARY

Bioinorganic Chemistry (6 credits) is included in the applied inorganic chemistry subject area and is given in the seventh four-month term of the Degree in Chemistry. The main aim is to introduce students to the complex and interesting world of inorganic biochemistry. After analysing the concepts of biocoordination, students study the functions performed in living organisms by inorganic compounds and metalloproteins ¿ as well as the physicochemical aspects that regulate them. This implies understanding the role of the essential elements and the various action mechanisms of proteins and enzymes in relation to their structural characteristics. An understanding the role of electron transfer metalloproteins and their structures and action mechanisms. Become aware of the importance of sustainable water management (SDG6). An awareness of how to use knowledge of the action mechanisms of metal ions in living organisms as a source of inspiration for the preparation of molecules with pharmacological applications: therapeutic uses and diagnosis, with the aim of ensuring healthy lives and promote well-being for all at all ages (SDG3).

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PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

It is important to understand the basic concepts of coordination chemistry included in the syllabuses of Inorganic Chemistry II and III.

COMPETENCES / LEARNING OUTCOMES

1110 - Degree in Chemistry

At the end of the course, the student will be able to describe the characteristics and behaviour of the different states of matter and the theories used to explain them.

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 the structure and reactivity of the main classes of biomolecules and the chemistry of key biological processes.

At the end of the course, the student will be able to state the principles of quantum mechanics and apply them to the description of the structure and properties of atoms and molecules.

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.

At the end of the course, the student will relate chemistry to other disciplines.

Capacidad de análisis, síntesis y razonamiento crítico en la aplicación del método científico.

Comprender las particularidades contables que presenta la regulación jurídico-mercantil de las empresas, relacionando la legislación mercantil aplicable a los distintos tipos operaciones societarias con la contabilidad de los hechos económicos que se regulan. Aprender a relacionar las leyes mercantiles que se ocupan de los concursos de acreedores con la contabilidad, adquiriendo práctica en el manejo de determinados textos legales vigentes.

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

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

Ser capaces de analizar la influencia que sobre el diseño del sistema de información de costes, ejercen, tanto la actividad concreta desarrollada por la entidad como la tecnología utilizada, la estructura organizativa y el estilo de dirección. Calcular costes preestablecidos y relacionarlos con la planificación y el control de la actividad interna. Seleccionar aquellos indicadores de gestión que faciliten el desempeño personal, estableciendo la frecuencia y el formato en función del usuario de destino.

DESCRIPTION OF CONTENTS

1. Chemical elements of life

1.1. The essential chemical elements. Abundance and essentiality. Essenciality and toxicity. Absorption, transport and storage. Essential elements: metals and not metals.
1.2. Toxicity of some metallic ions.
1.3. Biocoordinación. The proteins as ligands. Types of metaloproteíns. Biochemical function of the metalloproteíns. Study of the metalloproteíns. Inorganic probes. Model compounds.
1.4. Structural characterization of the metalloproteíns.

2. Bioinorganic Chemistry of iron

2.1. Introduction. Chemistry of the iron of biological importance. Porphyrines of iron. Clusters iron - sulphur. Proteins of iron.
2.2. Proteins hemo. Hemoglobin and mioglobin. Catalases and peroxidases. Cytochrome P-450.
2.3. Cytochrome c. Nitrite reductasa desasimilatoria (cytochrome cd1).
2.4. Iron-sulfur Proteins. Centers 1Fe-0S. Centers 2Fe-2S. Centers 3Fe-4S. Centers 4Fe-4S. Other centers Fe-S.
2.5. Biological functions of the Fe-S proteins.
2.6. Not hemo Proteins without prostetics groups. 2.6.1. Dinuclear Centers. 2.6.2. Active mononuclear Centers.
2.7. Captation, transport and storage of iron. 2.7.1.-Siderophores. 2.7.2.-Transferrin. 2.7.3.-Ferritin.
2.8. Metabolism of the iron in humans.
2.9. Synthetic models for the transport of dioxygen.

3. Biouinorganic chemistry of copper

3.1. Introduction. Chemistry of Cu(II) of biological importance. Classification of proteins of copper.
3.2. Centers of copper of type 1: blue Proteins of electronic transference: biological function, structure and chemical properties.
3.3. Centers of Copper of type 2. 3.3.1.-Superoxide dismutase Cu-Zn. 3.3.2.-Other enzymes of copper of type 2. Not blue Oxidases.
3.4. Centers of copper of type 3. 3.4.1.-Hemocyanin: an alternative for the transport of dioxygen. 3.4.2.-Tirosinasa.
3.5. Multicentral Proteins of copper. 3.5.1.-Nitrite reductase. 3.5.2.-blue Oxidases of copper.

4. Bioinorganic chemistruy of zinc

4.1. Introduction. Importance and biological functions of zinc.
4.2. Study of the carbonic anhydrase.
4.3. Study of the carboxypeptidase.
4.4. Study of the alkaline phosfatase.
4.5. Study of the alcohol deshydrogenase.
4.6. The Zn(II) with structural function and genetic regulation: fingers and clusters of zinc.
4.7. Model Compounds of hydrolitic enzymes of zinc.

5. Bioinorgànic chemistry of alkaline and alkaline earths

5.1. Introduction. Chemistry of coordination of alkaline and alkaline earths ions of biological importance. Antibiotics as ligands. Synthetic Ligands. Crowns ethers and criptands.
5.2. Processes of transport across membrane. 5.2.1.-Sodium potassium bomb. 5.2.2.-Transport across membrane by means of ionóforos mobile. 5.2.3.-Processes of transport across channels or pores. 5.3. Calcium. Proteins of calcium: classification and chemical characteristics. 5.4. Intracelular Proteins of calcium. Calmodulines. Troponin C and the muscular contraction. Extracelular Proteins of calcium. 5.5. Magnesium in biology. Enzymes of magnesium. 5.6. Magnesium and polynucleotides.

6. Bioinorgànic chemistry of molybdenum and tunsgten

6.1. Introduction. Biological importance of the molybdenum. Classification of proteins of molybdenum.
6.2. Structure of the active center of molybdenum enzymes. 6.3. Tungsten enzymes.

7. Bioinorganic chemistry of cobalt and nickel

7.1. Introduction.
7.2. Bioinorganic chemistry of cobalt. 7.2.1.-Cobalamines, Vitamin B12 and coenzime B12. 7.2.2.-Proteins B12.
7.3. Biochemistry of nickel of biological interest. 7.3.1.-Urease. 7.3.2.-Hydrogenases.

8. Bioinorganic chemistry of vanadium, chrome and manganese

8.1. Introduction.
8.2. Vanadium. 8.2.1.-The vanadium in the tunicades. 8.2.2.-Amavadine. 8.2.3.-Haloperoxidases of vanadium.
8.3. Chrome.
8.4. Manganese. 8.4.1.-Biological Importance of manganese. 8.5. Enzymes of manganese.

9. Fixation of dinitrogen

9.1. Introduction. 9.1.1.- Chemical Fixation of N2. 9.1.2.-Biological fixation of N2.
9.2. Structure and properties of the nitrogenase. Mechanism of nitrogenase

10. Metal ions in medicine

10.1. Introduction. Chelatotherapy.
10.2. Anticancer drugs. Arthritic drugs.
10.3. Anti-infective agents. Antimicrobial Agents. Antivirals.
10.4. Radiopharmaceuticals. MRI contrast agents. Drugs with antiulcer activity. Neurological agents

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	12,00
Independent study and work	60,00
Preparation of lessons	0,00
Preparation for assessment activities	18,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

The subject is organised to ensure that the student independently learns around three main axes:

Classroom presentations. In these classes the lecturer will provide a general overview of the topic with special emphasis on key concepts or concepts of particular complexity. The lecturer will indicate the most relevant information sources for personal study. The lecturer will motivate the student to participate in the various discussions that will arise during the course.

Seminars are provided between four and six one-hour sessions. This seminars will look for a specific application of the knowledge students have acquired in the theory lessons. Students should have prepared previously proposed topics. The presentation of the work will be carried out by students, on an individual or group basis.

Tutorials. Students will attend in groups with sessions lasting one hour. In these sessions, the lecturer will guide the student on the elements to be learned and the evaluation. Students will receive a list of questions and issues that will help in the study of each of the aspects covered in the theoretical lessons.

Tutorials will be also used to resolve doubts that may have arisen in classes and provide guidance on working methods for the resolution of questions.

tions.

EVALUATION

The knowledge acquired will be assessed through an exam in the periods established by the Faculty, which will represent the greatest contribution to the final grade (70 %). The exam will consist of questions and issues dedicated to knowledge considered as basic and also related to other topics that may require considering aspects that appear in other subjects. Students who do not pass the first call will have to take the second exam.

Class attendance may be positively assessed, as well as the student's participation in any proposed acivity related to the subject, among which we must highlight::

- Performing the proposed exercises.
- Attendance and reasoned and clear participation in the discussions raised.
- Preparation and presentation of works on the proposed topics.

The overall grade will be that of the exam (70 %) plus that obtained in all the proposed activities (30 %), with the weight established for each of these. To pass the subject, the student will have to achieve a minimum grade of 5 in each of the sections of the evaluation.

SECOND CALL

In the second call, students will take an exam on the contents of the subject covered in the theory classes, tutorials and seminars, so that the teacher will be able to evaluate whether the student has acquired the skills and knowledge related to the subject. Students will maintain the marks 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

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