COURSE DATA

DATA SUBJECT

Code: 34220
Name: Industrial and Ceramic Inorganic 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

TATAY AGUILAR SERGIO

SUMMARY

Industrial inorganic chemistry is an important branch of industry with a wide variety of finished products, among which the following stand out: mineral fertilizers, construction materials, glass, enamels, etc., as well as basic products for the chemical industry such as: mineral acids, alkalis, oxidizing agents, and halogens. It is worth noting that more modern developments in the industry, such as microelectronic chips, CDs, and optical fibers, have become a reality thanks to the significant progress made in the field of inorganic chemistry.

The course places special emphasis on manufacturing processes and the applications of products, taking into account aspects such as raw materials, environmental preservation, and other ecological, economic, and energy consumption considerations. Additionally, it aims to introduce students to techniques for the preparation and characterization of both traditional and advanced ceramic materials ¿ that is, materials with interesting physical and chemical properties that are used both independently and as components of devices. Thermodynamic and kinetic aspects of solid reactivity, which are very important in the preparation and manufacturing of ceramic materials, will also be covered.

By the end of the course, students should be able to develop awareness of the sustainable management and availability of water (SDG 3), become familiar with the economic and environmental implications of inorganic industrial processes, and understand the necessary adaptations to minimize their environmental impact (SDGs 9 and 12).

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 advisable that students have successfully completed all the subjects in previous academic years.

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.

Carry out standard experimental procedures involved in synthetic and analytical work, in relation to organic and inorganic systems.

Demonstrate knowledge of the characteristics and behaviour of the different states of matter and the theories used to describe them.

Demonstrate knowledge of the principles of quantum mechanics and their application to the description of the structure and properties of atoms and molecules.

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

Handle chemicals safely.

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

Relate chemistry with other disciplines.

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

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.

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. Introduction.

Introduction. Inorganic chemicals industry. Historical perspective. Chemicals: classification. Economic aspects of the chemical industry. Raw Materials. Industrial processes (batch and continuous). Main differences between a chemical process at the laboratory level and at the industrial scale. Ecology and sustainability.

2. Primary inorganic materials.

Water. Drinking water. Disinfection of water. Separation of insoluble contaminants (mechanical separation). Separation of soluble contaminants (physical-chemical and biological treatment). Production of drinking water from sea water (desalination). Composition of the air. Oxygen. Noble gases. Hydrogen. Hydrogen peroxide and inorganic peroxides. Production, uses and economic importance.

3. Nitrogen and its compounds.

Fertilizers (composition). Ammonia. Nitric acid. Emissions of nitrogen oxides. Ammonium derivatives. Hydrogen cyanide. Hydrazine. Hydroxylamine. Urea. Production, uses and economic importance.

4. Phosphorus and its compounds.

Phosphorus. Phosphoric acid. Phosphates. Eutrophication. Phosphorus halides and their derivatives. Esters. Production, uses and economic importance.

5. Sulfur and its compounds.

Sulfur. Claus's method. Sulfur dioxide. Exploitation of pyrite. Sulfuric acid: industrial importance. Lead chamber method. contact method. Sulfur oxide emissions. Other sulfur derivatives.

6. Halogens and their compounds.

Hydrogen fluoride. Sodium chloride. Chlor-alkali industry. Hydrogen chloride. Oxygen compounds of chlorine. Production, uses and economic importance.

7. Carbon and its compounds.

Sodium carbonate. Solvay method. Coal minerals. carbon black Carbon dioxide emissions (separation and treatment). Synthetic Diamond production, uses and economic importance.

8. Titanium and Titanium dioxide

Titanium dioxide. Titanium minerals. Alternatives to rutile. Sulphate process and chloride process. Metallic Titanium: Hunter process and Kroll process.

9. Silicon and its oxides.

Silicates. Cements. Gasses. Silicones. Ultrapure silicon (obtaining, purification and crystallization). Production, uses and economic importance.

10. Introduction to the ceramic materials and the ceramic industry.

Concept of ceramic material and ceramic. Historical perspective. The ceramic industry. Ceramic processes.

11. Chemical crystallography

Description of crystal structures. Compact packaging. Polyhedra model. common structures. Other structures.

12. Phase diagrams of ceramic materials.

Definitions. one-component systems. two-component systems. Simple eutectic systems. Binary systems with compounds. Binary systems with immiscibility of liquids. solid solutions. Binary systems with solid solutions. phase transitions. Binary systems with solid-solid phase transitions. ternary systems. Examples of binary and ternary systems in traditional and advanced ceramic materials. CaOSiO2 system. MgO-Al2O3-SiO2 system.

13. Processing of ceramic materials.

Raw Materials. Molding and firing. Fusion and solidification. Special processes. Ceramic products. Traditional pottery.

14. Advanced ceramics.

Technical ceramics. Gels. Preparation of monocrystals.

15. Characterization techniques for ceramic materials.

Types of techniques used. diffraction techniques. X-ray powder diffraction. Powder diffractometry. microscopic techniques. Optical microscopy. Scanning electron microscopy. Transmission electron microscopy. Spectroscopic techniques. Thermal analysis. Applications of differential and thermogravimetric thermal analysis.

16. Applications.

Properties of ceramic materials. Electrical, optical and magnetic properties. Medical applications. Other apps.

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	75,00
Preparation of lessons	0,00
Preparation for assessment activities	15,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

La parte de cerámica está planteada para que el estudiante sea el protagonista de su propio aprendizaje y se estructura de la siguiente manera:

Clases expositivas, en las que el profesor dará una visión general del tema objeto de estudio, haciendo especial insistencia en aspectos nuevos o de especial complejidad. También se trabajará la aplicación específica de los conocimientos que el estudiante vaya adquiriendo, proponiendo y resolviendo cuestiones y problemas prácticos que los estudiantes deben traer trabajados a clase. Lógicamente estas clases se complementan con el tiempo de estudio personal del estudiante.

Tutorías grupales, en las que los alumnos en grupos reducidos resolverán cuestiones o problemas

propuestos por el profesor. Además, se resolverán dudas y se iniciarán discusiones de temas que puedan ser de interés para la asignatura.

La parte dedicada a química industrial, por ser una química descriptiva, se basará fundamentalmente en clases expositivas durante las cuáles serán explicados todos los epígrafes de cada uno de los temas. También se incluirán actividades de evaluación: ejercicios comparativos, entrega de artículos discutidos, pequeños cuestionarios ... Se pretende que las clases sean dinámicas por lo que se iniciarán debates o discusiones de temas que puedan ser de interés para la asignatura.

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EVALUATION

Los conocimientos adquiridos se evaluarán mediante un examen en las fechas indicadas por la Facultad y que determinará la calificación de la asignatura. El examen consistirá en preguntas objetivas, referidas a aquellos conocimientos considerados básicos, de problemas numéricos y de cuestiones que impliquen la utilización de diferentes conceptos presentados en los distintos temas de cada una de las dos partes de la asignatura. Además, se incluirán actividades evaluables durante el trascurso de la docencia de la asignatura.

Para aprobar la asignatura es necesario alcanzar 5 puntos sobre 10 en cada una de las dos partes de la asignatura.

La nota final se corresponderá a la media obtenida a partir de las notas de cada parte. La nota de cada una de las partes estará compuesta por: la nota obtenida en el examen (85%) participación y actividades evaluables (15%).

Los alumnos que no aprueben en la primera convocatoria habrán de presentarse al examen de la segunda que tiene idéntica estructura y puntuación que la primera convocatoria.

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*".

University documents".

REFERENCES

- Büchel, K.H.; Moretto,H.H.; Woditsch, P. Industrial Inorganic Chemistry, 2ª Ed., Wheinheim: Wiley-

VCH,2000. ISBN:978-3-527-29849-5

- Ángel Vian Ortuño, Curso de introducción a la química industrial, Alhambra, 1979 (act. 2012)
- James A. Kent (Ed.), Riegels handbook of industrial chemistry, Chapman & Hall, 1992
- Ceramic Materials: Science and Engineering Carter, C. Barry; Norton, M. Grant; New York, NY: Springer New York, 2013 2nd ed. 2013.
- Introducción a la cristalografía, Sands, Donald E.; Barcelona; Reverté, 1971
- Philippe Boch, Jean-Claude Niepce, Ceramic Materials Processes, Properties and Applications; ISTE; 2007
- Anna E. McHale; Phase Diagrams and Ceramic Processes; Springer 1998