

Approval date: 20/06/2022
COURSE GUIDE
Inorganic Chemistry (2041119)

Grado (Bachelor's Degree)	Grado en Farmacia	Branch	Health Sciences
Module	Formación Básica	Subject	Química
Year of study	1 ^o	Semester	2 ^o
		ECTS Credits	6
		Course type	Core course

PREREQUISITES AND RECOMMENDATIONS

- It is highly recommended basic chemical knowledge, at least High School level.
- It is highly recommended to have completed (and passed) the Course 'Basic Chemical Principles' (Principios Básicos de Química), which is also offered in the first year (first semester) within the degree in Pharmacy.

BRIEF DESCRIPTION OF COURSE CONTENT (According to the programme's verification report)

- Inorganic Chemistry
- Non-metallic elements, metals and its compounds
- Pharmaceutical applications of inorganic elements and compounds

SKILLS
GENERAL SKILLS

- CG01 - Identificar, diseñar, obtener, analizar, controlar y producir fármacos y medicamentos, así como otros productos y materias primas de interés sanitario de uso humano o veterinario.
- CG03 - Saber aplicar el método científico y adquirir habilidades en el manejo de la legislación, fuentes de información, bibliografía, elaboración de protocolos y demás aspectos que se consideran necesarios para el diseño y evaluación crítica de ensayos preclínicos y clínicos.
- CG10 - Diseñar, aplicar y evaluar reactivos, métodos y técnicas analíticas clínicas, conociendo los fundamentos básicos de los análisis clínicos y las características y contenidos de los dictámenes de diagnóstico de laboratorio.
- CG12 - Desarrollar análisis higiénico-sanitarios, especialmente los relacionados con los alimentos y medioambiente.
- CG13 - Desarrollar habilidades de comunicación e información, tanto orales como escritas, para tratar con pacientes y usuarios del centro donde desempeñe su actividad profesional. Promover las capacidades de trabajo y colaboración en equipos



multidisciplinares y las relacionadas con otros profesionales sanitarios.

- CG15 - Reconocer las propias limitaciones y la necesidad de mantener y actualizar la competencia profesional, prestando especial importancia al autoaprendizaje de nuevos conocimientos basándose en la evidencia científica disponible.
- CG16 - El trabajo de Fin de Grado está orientado a la evaluación de las competencias genéricas asociadas a la Titulación, por lo que incluye la totalidad de las citadas competencias.

SUBJECT-SPECIFIC SKILLS

- CE01 - Identificar, diseñar, obtener, analizar y producir principios activos, fármacos y otros productos y materiales de interés sanitario
- CE02 - Seleccionar las técnicas y procedimientos apropiados en el diseño, aplicación y evaluación de reactivos, métodos y técnicas analíticas.
- CE03 - Llevar a cabo procesos de laboratorio estándar incluyendo el uso de equipos científicos de síntesis y análisis, instrumentación apropiada incluida.
- CE04 - Estimar los riesgos asociados a la utilización de sustancias químicas y procesos de laboratorio.
- CE05 - Conocer las características físico-químicas de las sustancias utilizadas para la fabricación de los medicamentos.
- CE06 - Conocer y comprender las características de las reacciones en disolución, los diferentes estados de la materia y los principios de la termodinámica y su aplicación a las ciencias farmacéuticas.
- CE07 - Conocer y comprender las propiedades características de los elementos y sus compuestos, así como su aplicación en el ámbito farmacéutico.
- CE09 - Conocer el origen, naturaleza, diseño, obtención, análisis y control de medicamentos y productos sanitarios.
- CE10 - Conocer los principios y procedimientos para la determinación analítica de compuestos: técnicas analíticas aplicadas al análisis de agua, alimentos y medio ambiente.

TRANSFERABLE SKILLS

- CT02 - Capacidad de utilizar con desenvoltura las TICs

LEARNING OUTCOMES

- Knowing the chemical elements and their compounds with special focus on those chemical aspects that are important in the pharmaceutical practice.
- Knowing and understanding the role of chemical elements and their inorganic compounds in biological systems, both in normal and altered state.
- Knowing the important role of the transition elements and coordination compounds in fundamental metabolic processes for life.

PLANNED LEARNING ACTIVITIES

THEORY SYLLABUS

Unit 1. Noble Gases and Chemistry of hydrogen.



Group 18 elements: molecular species; physical properties; chemical behavior (reactivity); collection methods; applications. Major compounds. Hydrogen introduction. Isotopes. Molecular hydrogen. Physical Properties. Chemical behavior. Preparation methods. Applications. Biological aspects. Major compounds. Hydrides.

Unit 2. Elements in Group 17.

Introduction. Isotopes. Molecular species. Physical Properties. Chemical behavior. Preparation methods. Applications. Biological aspects. Lead compounds: halides, oxides (binary oxides, oxyacids and oxysalts).

Unit 3. Group 16: Oxygen

Introduction. Molecular species. Physical Properties. Chemical behavior. Preparation methods. Applications. Biological aspects. Major compounds. The water and hydrogen peroxide. The water in the chemicals. Inorganic aspects of water treatment and water purification.

Unit 4. Other elements in Group 16

Introduction. Molecular species. Allotropy and solid phases. Physical Properties. Chemical behavior. Preparation methods. Applications. Biological aspects. Major compounds: hydrides: general aspects. Binary oxides (carbon dioxide and sulfur trioxide); oxyacids (sulfuric acid); oxysalts and other compounds.

Unit 5. Group 15: Nitrogen

Introduction. Physical Properties. Chemical behavior. Preparation methods. Applications. Biological aspects. Major compounds: hydrides (general, ammonia and hydrazine); binary oxides; oxyacids; oxysalts (nitrates and nitrites).

Unit 6. Other elements in Group 15

Introduction. Molecular species. Allotropy and solid phases. Physical Properties. Chemical behavior. Preparation methods. Applications. Biological aspects. Major compounds: hydrides; halides; oxides; oxyacids (phosphoric acid); oxysalts (phosphate and polyphosphate).

Unit 7. Group 14: Carbon.

Introduction. Molecular species. Allotropy. Physical Properties. Chemical resistance (reactivity of molecular and atomic species). Preparation methods. Applications. Biological aspects. Major compounds: halides; binary oxides (carbon monoxide and carbon dioxide); oxyacids and oxysalts (carbonates and bicarbonates, silicates).

Unit 8. Other elements in Group 14.

Introduction. Molecular species. Allotropy. Physical Properties. Chemical resistance (reactivity of molecular and atomic species). Preparation methods. Applications. Biological aspects. Major compounds: hydrides; halides; oxides (silica); oxyacids and oxysalts (silicates).

Unit 9. Elements in Group 13.

Introduction. Molecular species and solid phases. Boro: B12 Unit. Metallic character of the other elements. Physical Properties. Chemical behavior. Preparation methods. Applications. Biological aspects. Major compounds: hydrides (boron hydrides); halides; binary oxides and hydroxides (oxides of boron and aluminum, aluminum hydroxide); oxyacids and oxysalts (borates).

Unit 10. S-block elements.

Introduction: Electronic configuration . Physical Properties . Chemical behavior. Preparation methods. Biological function of these elements in relation to their chemical properties. Importance of calcium in pharmaceutical preparations. Major compounds : hydrides (ionic or saline hydrides); halides ; oxides , peroxides , superoxides ; hydroxides ; coordination compounds and organometallic compounds. Interesting applications of these compounds.



Unit 11. D-block elements: First-row transition elements.

Introduction: Electronic configuration. Physical Properties. Chemical behavior. Preparation methods. Applications. Role in biological systems. Major compounds: hydrides; halides (simple and metal-metal); oxides (binary and mixed); hydroxides, oxyhydroxides, and hydroxy salts; oxyacids and oxyanions; sulfides, interstitial phases. Coordination compounds.

Unit 12. D-block elements: Second and third-row transition elements.

Introduction: Electronic configuration. Physical Properties. Chemical behavior. Preparation methods. Applications. Role in biological systems. Major compounds: hydrides; halides (simple and metal-metal); oxides (binary and mixed); hydroxides, oxyhydroxides, and hydroxy salts; oxyacids and oxyanions; sulfides, interstitial phases. Coordination compounds and biological systems.

Unit 13. F-block elements.

Introduction. Electronic configuration. Physical Properties. Characteristic chemical behavior related to their electronic configurations. Preparation methods. Applications. Major compounds. Coordination compounds. Biohealth applications of these compounds in particular gadolinium complexes used as NMR contrast

PRACTICAL SYLLABUS**First session.**

- Preparation of a crystallization gel. Study of the chemical properties of the halogens: reactivity and study the variation of the oxidizing capacity. Solubility of halogens and polyiodides formation.

Second session.

- Study of the chemical properties of compounds formed by metallic elements belonging to the first transition series: chromium, cobalt and copper.

Third session.

- Study of the coordination complex: $[\text{Ni}(\text{en})_3]\text{SO}_4$
- Synthesis of the complex. Observation of the different reaction steps.
- Crystallization of the compound.
- Calculating the yield of the synthesized product.

Fourth session.

- Determination of the amount of nickel(II) in the complex tris(ethylenediamine)nickel(II) sulfate by a complexometric titration using the hexadentate ethylenediaminetetraacetate anion $[\text{EDTA}(4^-)]$.

RECOMMENDED READING**ESSENTIAL READING**

- C. Housecroft, A. G. Sharpe, "Química Inorgánica (2ª Edición, 2006) & "Inorganic



- Chemistry” (4th Edition, 2012), Ed. Pearson, Prentice Hall.
- M. Weller, T. Overton, J. Rourke, F. Armstrong, “Inorganic Chemistry” (7th Edition), Ed. Oxford University Press, 2018.
 - N. N. Greenwood, A. Earnshaw, “Chemistry of the Elements” (2nd Edition), Ed. Butterworth-Heinemann, 1997.
 - D. F. Shriver, P. W. Atkins, J. Rourke, “Inorganic Chemistry” (5th Edition), Oxford University Press, 2009.
 - W. Henderson, “Main Group Chemistry”, Tutorial Chemistry Texts, Vol. 3, Royal Society of Chemistry, 2000.
 - L. Beyer, V. Fernández-Herrero “Química Inorgánica” Editorial Ariel Ciencia, Barcelona, 2000.
 - C. Valenzuela Calahorro, “Química General e Inorgánica para estudiantes de Farmacia”, Ed. Universidad de Granada, 2002.
 - W. R. Peterson, “Nomenclatura de las sustancias químicas” (4ª Edición), Ed. Reverté, 2016.

COMPLEMENTARY READING

- B. W. Pfennig, “Principles of Inorganic Chemistry” (1st Edition), Ed. John Wiley & Sons, 2015.
- R. H. Petrucci, W. S. Harwood, F. G. Herring, “General Chemistry” (11th Edition), Ed. Prentice-Hall, 2017.
- R. Chang, K. A. Goldsby, “Chemistry” (12th Edition), Ed. Mc Graw Hill, 2017
- J. Barrett, “Atomic Structure and Periodicity”. The Royal Society of Chemistry, 2002.
- N. C. Norman, “Periodicity and the s- and p-block elements”, Ed. Oxford Chemistry Primers-Series Zeneca- Oxford Science Publication, Vol. 51, 1997.
- Katja A. Strohfeltdt, “Essentials of inorganic chemistry: for students of pharmacy, pharmaceutical sciences and medicinal chemistry, Ed. John Wiley & Sons, 2015.

RECOMMENDED LEARNING RESOURCES/TOOLS

- Periodic system (information about elements): <https://iupac.org/what-we-do/periodic-table-of-elements/> y [Periodic Table – Royal Society of Chemistry \(rsc.org\)](https://www.rsc.org/periodic-table/)
- Periodic system (videos regarding reactivity): <http://www.periodicvideos.com/>
- Orbital Viewer: Free software for visualizing atomic and molecular orbitals: <https://www.orbitals.com/orb/index.html>
- Inorganic Department web site: [Departamento de Química Inorgánica > Presentación | Universidad de Granada \(ugr.es\)](https://www.ugr.es/~quimica/)
- Faculty of Pharmacy web site: [Facultad de Farmacia de la Universidad de Granada: Facultad de farmaciaInicio \(ugr.es\)](https://www.ugr.es/~farmacia/)
- Degree in Pharmacy, University of Granada: [Grado en Farmacia > Presentación | Universidad de Granada \(ugr.es\)](https://www.ugr.es/~prado/)
- PRADO online platform: <https://prado.ugr.es/>

TEACHING METHODS

- MD01 - Lección magistral/expositiva
- MD03 - Resolución de problemas y estudio de casos prácticos
- MD04 - Prácticas de laboratorio y/o clínicas y/o oficinas de Farmacia



- MD07 - Seminarios
- MD09 - Realización de trabajos en grupo
- MD10 - Realización de trabajos individuales
- MD12 - Tutorías

ASSESSMENT METHODS (Instruments, criteria and percentages)

ORDINARY EXAMINATION DIET

EVALUATION INSTRUMENTS

Besides the different **complementary tasks developed throughout the Course** (activities and/or tests), there will be three kind of exams:

- **Mid-term exam (check the date in the official website <https://farmacia.ugr.es/docencia/pod/pod2023>):** mandatory. One exam carried out during the scheduled classes, unless an alternative date is agreed with the students. This exam aims to (a) get students familiar with exams; (b) encourage continuous learning process in students; (c) prepare students to the final exam. This exam will NOT exclude content from the final exam.
- **Practicum Exam:** mandatory. Once the practical sessions are finished, a written exam about the Practicum will be performed. This exam will be scheduled by the teachers involved in the Practical Course and communicated to students accordingly.
- **Final exam, at the end of the Course (check the date in the official website <https://farmacia.ugr.es/docencia/pod/pod2023>):** mandatory. Each teacher will provide the rules of the exam prior to it. Any case, it can include:
 - MULTIPLE CHOICE QUESTIONS
 - THEORY QUESTIONS, SHORT OR LONG VERSION
 - INORGANIC CHEMISTRY NOMENCLATURE
 - PERIODIC TABLE

EVALUATION AND QUALIFICATION CRITERIA

1. It is mandatory to carry out the Practicum Course to pass the subject within the ordinary call.
2. The final grade will be calculated according to the percentages detailed as follows. The evaluation will be based on different items in which students must demonstrate an uniform and balanced understanding of all the subject, according to the following percentages:
 - Mid-term exam: 20% grade.
 - Activities and/or tests along the Course: 10% grade.
 - Practicum Exam (written): 20% grade.
 - Final exam: 45% grade.
 - Class attendance: 5% grade

EXTRAORDINARY EXAMINATION DIET

EVALUATION INSTRUMENTS

Besides the different **complementary tasks assigned by the teacher**, there will be two kind of



exams:

- **Practicum Exam:** mandatory. A written or practical exam for the assessment of the learning objectives of the Practicum will be performed. The teacher will communicate the nature of the exam (written or practical) in advance to the student. If the exam is written, it will be carried out along with the Theoretical exam. Otherwise, a date, close to the final exam, will be agreed to perform the practical exam in the laboratories of the Inorganic chemistry department at the Faculty of Pharmacy.
- **Theoretical exam (check the date in the official website <https://farmacia.ugr.es/docencia/pod/pod2023>):** mandatory. Each teacher will provide the rules of the exam prior to it. Any case, it can include:
 - MULTIPLE CHOICE QUESTIONS
 - THEORY QUESTIONS, SHORT OR LONG VERSION
 - INORGANIC CHEMISTRY NOMENCLATURE
 - PERIODIC TABLE

EVALUATION AND QUALIFICATION CRITERIA

1. **The final grade will be calculated according to the percentages** detailed as follows. The evaluation will be based on different items in which students must demonstrate an uniform and balanced understanding of all the subject, according to the following percentages:

- Activities, and/or tests: 15% grade.
- Practicum Exam (written or practical): 15% grade.
- Theoretical exam: 70% grade.

SINGLE FINAL ASSESSMENT (evaluación única final)

Those students who, according to those reasons specified at the University of Granada regulation (see Normativa de Evaluación y de Calificación de los Estudiantes de la Universidad de Granada), cannot attend regularly to the classes, and therefore cannot follow the continuous assessment plan, they can ask for a final single final assessment. This request must be addressed to the Head of the Department within the first two weeks of the subject, explaining their motivation. For further information, please visit <https://www.ugr.es/sites/default/files/2017-09/examenes.pdf>

This assessment consists in a single academic event, the same day as the ordinary and extraordinary calls. Students should show a balanced knowledge of the subject and the acquisition of the competencies described in the Learning Guide to pass the Inorganic Chemistry Course. In this Single final assessment, two exams will be carried out:

- Theoretical exam: 85% of the final grade
- Practicum Exam (written or practical): 15% of the final grade

The teacher will communicate the nature of the Practicum exam (written or practical) in advance to the student. If the exam is written, it will be carried out along with the Theoretical exam. Otherwise, a date, close to the final exam, will be agreed to perform the practical exam in the laboratories of the Inorganic chemistry department at the Faculty of Pharmacy.

ADDITIONAL INFORMATION

This learning guide has been prepared according to all teaching recommendations delivered by





“CRUE” and “Secretariado de Inclusión y Diversidad de la UGR”.

