

MODULE	SUBJECT	COURSE	SEMESTER	CREDITS	TYPE
Chemistry	Inorganic Chemistry	1º	2º	6	Basic
<b>PROFESSOR</b>			<b>FULL CONTACT ADDRESS FOR TUTORIALS</b>		
<ul style="list-style-type: none"> <li>Alicia Domínguez Martín. <b>Group A</b> (<a href="mailto:adominguez@ugr.es">adominguez@ugr.es</a>) PHONE: 958248589</li> <li>Josefa M<sup>a</sup> González Pérez. <b>Group B</b> (<a href="mailto:jmgp@ugr.es">jmgp@ugr.es</a>) PHONE: 958243855</li> <li>Alicia Domínguez Martín. <b>Group C (English)</b> (<a href="mailto:adominguez@ugr.es">adominguez@ugr.es</a>) PHONE: 958248589</li> <li>Miguel Ángel Galindo Cuesta. <b>Group D</b> (<a href="mailto:magalindo@ugr.es">magalindo@ugr.es</a>) PHONE: 958248525</li> <li>Carmen Rodríguez Maldonado. <b>Group E</b> (<a href="mailto:crmaldonado@ugr.es">crmaldonado@ugr.es</a>) PHONE: 958248592</li> <li>Sergio Morales Torres. <b>Group F</b> (<a href="mailto:semoto@ugr.es">semoto@ugr.es</a>) PHONE: 958240443</li> </ul> <p>Practical Course: Available in <a href="http://inorganica.ugr.es">http://inorganica.ugr.es</a></p>			<p>CAMPUS CARTUJA S.N. FACULTY OF PHARMACY INORGANIC DEPARTMENT. THIRD FLOOR. POSTAL CODE E-18071. GRANADA. PHONE: 958-243851</p> <p>CAMPUS FUENTENUEVA S.N. FACULTY OF SCIENCE INORGANIC DEPARTMENT. CHEMISTRY BUILDING, 2<sup>ND</sup> FLOOR POSTAL CODE E-18071. GRANADA. PHONE: 958-243851</p>		
			<b>TUTORING HOURS</b>		
			Available at the Department website: <a href="http://inorganica.ugr.es/">http://inorganica.ugr.es/</a>		
<b>BELONGS TO UNDERGRADUATE DEGREE PROGRAMME</b>			<b>OTHER DEGREES IN WHICH THE SUBJECT COULD BE TAUGHT</b>		
Pharmacy Degree					
<b>PREREQUISITES AND / OR RECOMMENDATIONS (if applicable)</b>					

- 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, which is also offered in the first year (first semester) within the degree in Pharmacy.

#### BRIEF DESCRIPTION OF CONTENTS

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

#### GENERAL AND SPECIFIC COMPETENCIES

##### A. General skills

- To identify, design, collect, analyze, control and produce drugs and medicines, and other products and raw materials of medical interest for human or veterinary use.
- To learn to apply the scientific method and acquire skills in handling legislation, sources of information, literature, protocol development and other aspects that are necessary considered for the design and critical assessment of preclinical and clinical trials.
- To design, implement and evaluate reagents, clinical analytical methods and techniques, knowing the basics of clinical analyzes, and the characteristics and contents of the reports of laboratory diagnosis.
- To develop health and hygiene analysis, especially those related to food and the environment.
- To develop information and communication skills, both oral and written, to deal with patients and users of the center where you are working. Promote and collaboration capabilities in multidisciplinary teams and

##### B. Specific skills

- To identify, design, collect, analyze and produce active ingredients, drugs and another products and materials of sanitary interest.
- To select appropriate techniques and procedures in the design, implementation and evaluation of reagents, methods and analytical techniques.
- To perform standard laboratory procedures including the use of scientific equipment for synthesis and analysis, including appropriate instrumentation.
- Estimating the risks associated with the use of chemical and laboratory procedures.
- To know the physical and chemical characteristics of the substances used for the manufacture of medicines.
- To know and understand the characteristics of reactions in solution, the different states of matter and the principles of thermodynamics and its application to pharmaceutical sciences.
- Understanding the properties of the elements and their compounds, and their application in the pharmaceutical field.



## OBJECTIVES (EXPRESSED AS EXPECTED RESULTS OF EDUCATION)

- 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.

## DETAILED SYLLABUS

### THEORETICAL 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 of 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. Elements of 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. Orders Group 16 elements**

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. Elements of 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. Others group 15 elements**

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. Elements of 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. Orders Group 14 elements.**

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 of 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 transition series**

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 transition series.**

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. Chemistry 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.

## **PRACTICUM 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.**

- $[\text{Ni}(\text{en})_3]\text{SO}_4$  Studio System
- Synthesis of the complex. Observation of the different reaction steps
- Crystallization of the compound



- Calculating yield of the synthesized product.

#### **Fourth session.**

- Determination of the sulfate nickel tris (ethylenediamine) nickel (II) cation complexometric titration by Ni (II) with the anion ethylenediaminetetraacetate (EDTA<sup>4-</sup>).

#### **BIBLIOGRAPHY**

1. C. Housecroft, A. G. Sharpe, "Química Inorgánica (2ª Edición, 2006), "Inorganic Chemistry" (4<sup>th</sup> Edition, 2012), Ed. Pearson, Prentice Hall.
2. M. Weller, T. Overton, J. Rourke, F. Armstrong, "Inorganic Chemistry" (7<sup>th</sup> Edition), Ed. Oxford University Press, 2018.
3. B. W. Pfennig, "Principles of Inorganic Chemistry" (1<sup>st</sup> Edition), Ed. John Wiley & Sons, 2015.
4. N. N. Greenwood, A. Earnshaw, "Chemistry of the Elements" (2<sup>nd</sup> Edition), Ed. Butterworth-Heinemann, 1997.
5. D. F. Shriver, P. W. Atkins, C. H. Langford, "Química Inorgánica" (2ª Edición), Ed. Reverté, 1998.
6. R. H. Petrucci, W. S. Harwood, F. G. Herring, "Química General" (11ª Edición), Ed. Prentice-Hall, 2017.
7. R. Chang, K. A. Goldsby, "Química" (12ª Edición), Ed. Mc Graw Hill, 2017.
8. J. Barrett, "Atomic Structure and Periodicity". The Royal Society of Chemistry, 2002.
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10. N. C. Norman, "Periodicity and the s- and p-block elements", Ed. Oxford Chemistry. Primers-Series Zeneca- Oxford Science Publication, Vol. 51, 1997.
11. C. Valenzuela Calahorro, "Química General e Inorgánica para estudiantes de Farmacia", Ed. Universidad de Granada, 2002.
12. W. R. Peterson, "Nomenclatura de las sustancias químicas" (4ª Edición), Ed. Reverté, 2016.
13. Katja A. Strohfeltdt, "Essentials of inorganic chemistry: for students of pharmacy, pharmaceutical sciences and medicinal chemistry, Ed. John Wiley & Sons, 2015.

#### **RECOMMENDED LINKS**

- Periodic system: [http://www.mcgraw-hill.es/bcv/tabla\\_periodica/element/elemento1.html](http://www.mcgraw-hill.es/bcv/tabla_periodica/element/elemento1.html)
- Orbital Viewer: Free software for visualizing atomic and molecular orbitals: <http://www.orbitals.com/orb/ov.html>
- Inorganic Department web site: <http://farmacia.ugr.es/cont.php?sec=5&pag=1#26>
- <http://prado.ugr.es/moodle/>



## TEACHING METHODOLOGY

- **Expositive classes:** They will develop according to the schedule for the Academic Course 2020-21, further details can be found at <https://farmacia.ugr.es/pod/2021/>. In the expositive classes both the blackboard and digital presentations will be used and the teacher will promote the active participation of students with questions, comments, etc. This includes the possibility of carrying out self-evaluation tests or activities in order to encourage autonomous work and critical thinking skill on students. Such tests can be performed using online platforms such as Kahoot or PRADO to which students will access by means of their own smartphones, tables or laptops. Such innovative teaching methodology has a positive impact on students who learn by gaming.
- **Practicum:** It is mandatory and it will take place in groups with a reduced number of students. Each group will perform 4 practical sessions along 5 working days, with duration of 3hours/day. Each student will personally be called, in advance; specifying date and hour, any time between February and May and the Practicum will take place at the Department of Inorganic Chemistry at the Faculty of Pharmacy. It is MANDATORY to attend all practical sessions. Moreover, each student must bring to the Practicum their own lab coat, safety goggles and lab journal. During these sessions, the students will apply the gained theoretical concepts from expositive classes.
- **Tutorials:** They will be carried out individually or in reduced groups if requested by students. The aim of tutorials is solving doubts, fixing concepts and discussing any aspect related to the subject. Tutorials will develop according to the information displayed at the Department website (<http://inorganica.ugr.es/>). Eventually, tutorials can also take place using virtual tools such as PRADO platform, email, etc.
- **Communication with students:** it will be established by the official online platform at the University of Granada: PLATAFORMA DE RECURSOS DE APOYO A LA DOCENCIA (PRADO). All enrolled students have guaranteed access to PRADO. Each theoretical Groups will have an specific module in PRADO, where the teacher will upload all the relevant information about the subject, including all materials needed for the development of the Course and the learning process, such as the learning guide, exams qualifications, slides of the class presentations, links to videos, self-evaluation tests, etc. Likewise, they can be included activities and online resources with deadlines to guide students in their learning process.

## EVALUATION (EVALUATION INSTRUMENTS, EVALUATION CRITERIA AND PERCENTAGE ON THE FINAL QUALIFICATION).

There will be three different kind of exams:

- **Mid-term exam (check the date in the official website (<https://farmacia.ugr.es/pod/2021/>):** 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:** 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.
- **One final exam at the end of the Course (check the date in the official website (<https://farmacia.ugr.es/pod/2021/>):** This exam is MANDATORY. Each teacher will provide the rules of the exam prior to it. Any case, it can include:
  - TEST QUESTIONS (MULTIPLE CHOICE OR TRUE/FALSE)
  - THEORY QUESTIONS, SHORT OR LONG VERSION
  - INORGANIC CHEMISTRY NOMENCLATURE AND 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 below.**

### ORDINARY CALL

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: 15% grade.
- Practical Course (written): 15% grade.
- Final exam: 50% grade.

### EXTRAORDINARY CALL

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: 15% grade.
- Practical Course (written or practical): 15% grade.
- Exam: 70% grade.

## DESCRIPTION OF THE EVIDENCE THAT WILL BE PART OF THE FINAL UNIQUE EVALUATION ESTABLISHED IN THE "REGULATIONS OF EVALUATION AND GRADING OF THE STUDENTS OF THE UNIVERSITY OF GRANADA"

- 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 evaluation process. 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 about the process, please visit <https://www.ugr.es/sites/default/files/2017-09/examenes.pdf>
- This evaluation will consist in a single academic event, the same day of the ordinary calls, which will evaluate the knowledge on the subject, with its qualification being considered as the final grade of the subject. 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 Final Unique evaluation two exams will be carried out:
  - One Exam of theoretical contents: 85% of the final grade
  - One exam (written or practical) assessing the practicum: 15% of the final grade.

## 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".



## SCENARIO A (ON-CAMPUS AND REMOTE TEACHING AND LEARNING COMBINED)

### TUTORIALS

#### TIMETABLE

(According to Official Academic Organization Plan)

#### TOOLS FOR TUTORIALS

(Indicate which digital tools will be used for tutorials)

Available at: <http://inorganica.ugr.es/>

Official UGR Email, PRADO Platform and Google Meet video conference

### MEASURES TAKEN TO ADAPT TEACHING METHODOLOGY

- The percentage of face-to-face and online classes will depend on the number of students enrolled in the Course and the security measures dictated by the corresponding health authorities. If possible, teaching will be preferentially developed face-to-face, keeping at least a 1.5 m distance among students. Theoretical classes with a high number of students will be splitted, with alternative groups that would receive teaching half face-to-face and half online. All students will receive the same number of face-to-face and virtual practicum sessions per week.
- The number of students will never exceed the maximum capacity of the given rooms/labs according to COVID restrictions.
- If online scenario is applied, synchronous virtual sessions will be preferred, although certain personal circumstances, such as sickness of the teacher (or any close relative), work/life balance, etc., might promote the asynchronous scenario, which would be complemented by monitoring and specific students' follow-up activities.
- Currently, the recommended online platforms at the University of Granada are Prado, Consigna UGR, Google Meet and Google Drive by means of the official account @go.ugr and also the official @correo.ugr.es email account. If any additional platform is required, instructions will be given to students.
- Teaching materials regarding online teaching will be given to students by any the aforementioned platforms.
- Practicum will be face-to-face in small groups to guaranty the mandatory social distance and other safety rules in the laboratory. Theoretical explanations regarding the practicum might be given online through explicative videos provided by the virtual platform PRADO.

### MEASURES TAKEN TO ADAPT EVALUATION (Instruments, criteria and percentage of final overall mark)

#### Ordinary Call

- The evaluation will be carried out according to the criteria indicated in the corresponding general section, keeping the same percentage no matter the student attendance is on-site or on-line.
- The exams will be face-to-face provided the number of students enrolled allows it according to the safety regulations indicated by the authorities. If this is not possible, the evaluation will be online and will be carried out using the PRADO EXAMEN platform and / or the Google Meet video conference service.

#### Extraordinary Call

- The evaluation will be carried out according to the criteria indicated in the corresponding general section, keeping the same percentage no matter the student attendance is on-site or on-line.
- The exams will be face-to-face provided the number of students enrolled allows it according to the safety regulations indicated by the authorities. If this is not possible, the evaluation will be online and will be carried out using the PRADO EXAMEN platform and / or the Google Meet video conference service.





<b>Single final Call</b>	
<ul style="list-style-type: none"> <li>The evaluation will be carried out according to the corresponding general section with face-to-face exams provided the number of enrolled students allows it according to the safety regulations indicated by the authorities. If this is not possible, the evaluation will be carried out virtually by using the PRADO EXAMEN platform and / or the Google Meet video conferencing service, according to UGR rules.</li> </ul>	
<b>SCENARIO B (ON-CAMPUS ACTIVITY SUSPENDED)</b>	
<b>TUTORIALS</b>	
<b>TIMETABLE</b> (According to Official Academic Organization Plan)	<b>TOOLS FOR TUTORIALS</b> (Indicate which digital tools will be used for tutorials)
Available at: <a href="http://inorganica.ugr.es/">http://inorganica.ugr.es/</a>	Official UGR Email, PRADO Platform and Google Meet video conference
<b>MEASURES TAKEN TO ADAPT TEACHING METHODOLOGY</b>	
<ul style="list-style-type: none"> <li>All theoretical classes, seminars and practicum will be virtual. They will be carried out via the Google Meet platform or any other online platform officially recommended by the University of Granada. Synchronous sessions will be preferred, although certain personal circumstances, such as sickness of the teacher (or any close relative), work/life balance, etc., might promote the asynchronous scenario, which would be complemented by monitoring and specific students' follow-up activities.</li> <li>Currently, the recommended online platforms at the University of Granada are Prado, Consigna UGR, Google Meet and Google Drive by means of the official account @go.ugr and also the official @correo.ugr.es email account. If any additional platform is required, instructions will be given to students.</li> <li>Teaching materials regarding online teaching will be given to students by any the aforementioned platforms.</li> </ul>	
<b>MEASURES TAKEN TO ADAPT EVALUATION</b> (Instruments, criteria and percentage of final overall mark)	
<b>Ordinary Call</b>	
<ul style="list-style-type: none"> <li>The evaluation will be carried out according to the criteria indicated in the corresponding general section, keeping the same percentage no matter the student attendance is on-site or on-line.</li> <li>The exams will be face-to-face provided the number of students enrolled allows it according to the safety regulations indicated by the authorities. If this is not possible, the evaluation will be online and will be carried out using the PRADO EXAMEN platform and / or the Google Meet video conference service.</li> </ul>	
<b>Extraordinary Call</b>	
<ul style="list-style-type: none"> <li>The evaluation will be carried out according to the criteria indicated in the corresponding general section, keeping the same percentage no matter the student attendance is on-site or on-line.</li> <li>The exams will be face-to-face provided the number of students enrolled allows it according to the safety regulations indicated by the authorities. If this is not possible, the evaluation will be online and will be carried out using the PRADO EXAMEN platform and / or the Google Meet video conference service.</li> </ul>	
<b>Single final Assessment</b>	
<ul style="list-style-type: none"> <li>The evaluation criteria will follow that indicated in the corresponding general section.</li> </ul>	



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- The exams will be face-to-face provided the number of students enrolled allows it according to the safety regulations indicated by the authorities. If this is not possible, the evaluation will be online and will be carried out using the PRADO EXAMEN platform and / or the Google Meet video conference service.

