VNIVERSITAT DE VALÈNCIA

Course Guide
34199 Inorganic Chemistry II

COURSE DATA

Data Subject	
Code	34199
Name	Inorganic Chemistry II
Cycle	Grade
ECTS Credits	4.5
Academic year	2020 - 2021

Study (s)

Degree	Center	Acad. year	Period
1110 - Degree in Chemistry	Faculty of Chemistry	2	Second term

Subject-matter

Degree	Subject-matter	Character
1110 - Degree in Chemistry	8 - Inorganic Chemistry	Obligatory

Coordination

Name	Department
JULVE OLCINA, MIGUEL	320 - Inorganic Chemistry

SUMMARY

T. Moeller defines Inorganic Chemistry as the discipline which deals with experimental research and theoretical interpretation of the properties and reactions of all the elements and all their compounds except for hydrocarbons and most of their derivatives. Therefore, its study covers the behaviour of more than 100 elements, with thousands of compounds with very different properties, which is one of its most attractive characteristics: to locate such a large number of very different facts in a similar vein.

The Inorganic Chemistry I subject is focused on the study of the structural, thermodynamic and reactivity basic principles of Inorganic Chemistry, and on the systematic study of selected non-metals and semimetallic and their compounds. The Inorganic Chemistry II subject arises, in part, as a complement of Inorganic Chemistry I, being focused on a systematic study of metallic elements, transition, d and f blocks, as well as s and p blocks, and their most important compounds, while introducing students to the most basic aspects of the coordination chemistry, which are needed to address the above systematic study.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

This subject completes the subject Inorganic Chemistry I with the systematic study of the metallic elements of the periodic table. In the subject Inorganic Chemistry I the non-metallic elements were studied and now the metallic ones will be studied in a similar way.

OUTCOMES

1108 - Degree in Chemistry

- Develop capacity for analysis, synthesis and critical thinking.
- Show inductive and deductive reasoning ability.
- Demonstrate leadership and management skills, entrepreneurship, initiative, creativity, organization, planning, control, leadership, decision making and negotiation.
- Solve problems effectively.
- Demonstrate ability to work in teams both in interdisciplinary teams and in an international context.
- Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as appropriate.
- Demonstrate a commitment to ethics, equality values and social responsibility as a citizen and as a professional.
- Learn autonomously.
- Demonstrate the ability to adapt to new situations.
- Acquire a permanent sensitivity to quality, the environment, sustainable development and the prevention of occupational hazards.
- Demonstrate knowledge of the main aspects of chemical terminology, nomenclature, conventions and units.
- Interpret the variation of the characteristic properties of chemical elements according to the periodic table.
- Demonstrate knowledge of the main types of chemical reaction and their main characteristics.
- Demonstrate knowledge of the principles of thermodynamics and kinetics and their applications in chemistry.
- Ability to recognise chemical elements and their compounds: preparation, structure, reactivity, properties and applications.

- Demonstrate knowledge of the principles, procedures and techniques for the determination, separation, identification and characterisation of chemical compounds.
- Relate the macroscopic properties and the properties of individual atoms and molecules, including macromolecules (natural and synthetic), polymers, colloids and other materials.
- Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the areas of chemistry.
- Solve qualitative and quantitative problems following previously developed models.
- Recognise and analyse new problems and plan strategies to solve them.
- Evaluate, interpret and synthesise chemical data and information.
- Relate theory and experimentation.
- Recognise and evaluate chemical processes in daily life.
- Understand the qualitative and quantitative aspects of chemical problems.
- Develop sustainable and environmentally friendly methods.
- 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 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.
- 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.
- Express oneself correctly, both orally and in writing, in any of the official languages of the Valencian Community.
- Have basic skills in the use of information and communication technology and properly manage the information obtained.

LEARNING OUTCOMES

The previous section includes the competences contained in the document VERIFICA. This subject addresses part of the learning results of the matter Inorganic Chemistry that allow to acquirespecific knowledge of chemistry, cognitive skills and general skills recommended by the EUROPEAN CHEMISTRY THEMATIC NETWORK (ECTN) for the Chemistry Eurobachelor® Label. The following table lists the learning outcomes acquired in the subject Inorganic Chemistry I related to the competences of the degree in Chemistry.

SPECIFIC KNOWLEDGE OF CHEMISTRY	
The learning process should allow the degree graduates to demonstrate:	
	Competencias de la asignatura Química Inorgánica I que contemplan los resultados de aprendizaje EUROBACHELOR®
Major aspects of chemical terminology, nomenclature, conventions and units.	Demonstrate knowledge of the main aspects of chemical terminology, nomenclature, conventions and units..(CE1)
The major types of chemical reaction and the main characteristics associated with them.	Demonstrate knowledge of the main types of chemical reaction and their main characteristics.(CE4)
The principles of thermodynamics and their applications to chemistry	Demonstrate knowledge of the principles of thermodynamics and kinetics and their applications in chemistry..(CE6).
The characteristic properties of elements and their compounds, including group relationships and trends within the Periodic Table	Interpret the variation of the characteristic properties of chemical elements according to the periodic table..(CE2). Ability to recognise chemical elements and their compounds: preparation, structure, reactivity, properties and applications..(CE7).
The structural features of chemical elements and their compounds, including stereochemistry.	Ability to recognise chemical elements and their compounds: preparation, structure, reactivity, properties and applications..(CE7). Relate the macroscopic properties and the properties of individual atoms and molecules, including macromolecules (natural and synthetic), polymers, colloids and other materials.CE11). Show knowledge of the structure and reactivity of the main classes of biomolecules and the chemistry of the main biological processes..(CE12).

The relation between bulk properties and the properties of individual atoms and molecules, including macromolecules (both natural and man-made), polymers and other related materials.	Relate the macroscopic properties and the properties of individual atoms and molecules, including macromolecules (natural and synthetic), polymers, colloids and other materials.CE11).

COMPETENCES AND COGNITIVE SKILLS	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject Inorganic Chemistry I that contemplate the learning outcomes EUROBACHELOR®
Ability to demonstrate knowledge and understanding of the facts, concepts, principles and fundamental theories related to the topics mentioned above.	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the areas of chemistry..(CE13).
Competences for the evaluation, interpretation and synthesis of information and chemical data.	Evaluate, interpret and synthesise chemical data and information..(CE16). Interpret data from observations and measurements in the laboratory in terms of their significance and the theories that underpin them..(CE20).
Competences to present and argue scientific issues orally and in writing to a specialized audience.	Relate chemistry with other disciplines.(CE26). Prepare reports, surveys and industrial and environmental projects in the field of chemistry..(CE27). Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as appropriate. (CG6). Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences..(CB4).

Competences to present and argue scientific issues orally and in writing to a specialized audience.	Relate chemistry with other disciplines.(CE26). Prepare reports, surveys and industrial and environmental projects in the field of chemistry..(CE27).

GENERAL COMPETENCES	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject Inorganic Chemistry I that contemplate the learning outcomes EUROBACHELOR®
Ability to apply practical knowledge to solve problems related to qualitative and quantitative information.	Solve problems effectively..(CG4). Solve qualitative and quantitative problems following previously developed models..(CE14). Relate theory and experimentation..(CE22). Recognise and evaluate chemical processes in daily life..(CE23). Understand the qualitative and quantitative aspects of chemical problems..(CE24).
Calculation and arithmetic capabilities, including aspects such as analysis error, estimates of orders of magnitude, and correct use of the units.	Develop capacity for analysis, synthesis and critical thinking.. (CG1). Show inductive and deductive reasoning ability..(CG2). Solve problems effectively..CG4). Demonstrate ability to work in teams both in interdisciplinary teams and in an international context.(CG5).
Interpersonal skills to interact with other people and get involved in team work.	Demonstrate ability to work in teams both in interdisciplinary teams and in an international context.(CG5).

	Demonstrate a commitment to ethics, equality values and social responsibility as a citizen and as a professional. (CG7) Demonstrate the ability to adapt to new situations..(CG9).

DESCRIPTION OF CONTENTS

1. General methods of obtention of metals

General methods of obtention of metals. Ellingham diagrams. Metallurgical, hydrometallurgical and electrochemical methods.

2. Alkali and alkali earth metals

Alkali and alkali earth metals. General characteristics of groups 1 and 2. Singularity of Li and Be. Obtention and application of alkali and alkaline earth metals. Most important binary compounds: hydrides, halides, oxides, peroxides and superoxides. Hydroxides: sodium hydroxide. Chemistry in liquid ammonia. Organometallic compounds. Biological aspects of the elements in groups 1 and 2.

3. Group 13 metals: Al, Ga, In, and Tl

Group 13 metals: Al, Ga, In, and Tl. General characteristics of the group. Obtention and application of the elements. Reactivity of aluminium: Chemistry in aqueous solution. Halides, oxide and hydroxide aluminium. Chemistry of gallium, indium, and thallium. Biological aspects.

4. Metals of groups 14 and 15: Sn, Pb and Bi

Metals of groups 14 and 15: Sn, Pb and Bi. Characteristics of the elements. Obtention and applications. Chemistry in aqueous solution. Most important compounds. Biological aspects.

5. Basic concepts of coordination chemistry

Basic concepts of coordination chemistry. Basic structural aspects and bond. Nomenclature and formulation of coordination compounds

6. Characteristics of transition metals

Characteristics of transition metals. Structural aspects. Electronic structure and chemical behavior. Trend in the stability of the oxidation states. Hydrated metal ions, oxocationes and oxoanions. Redox properties

7. Elements in groups 3 to 7

Elements in groups 3 to 7. Obtaining of the elements. Particular study of scandium, titanium, vanadium, chromium, and manganese. Applications. Chemistry in aqueous solution. Complexes. Binary compounds: halides, oxides, sulfides. Complex. Compounds with metal-metal bonds. Clusters. Polioxometalates. Biological aspects

8.

Iron, cobalt and nickel. Obtaining of the elements. Particular study of iron. Most relevant applications. Chemistry of II and III States. Complexes. Other oxidation States. Binary compounds: halides, oxides, sulfides. Organometallic compounds. Biological aspects

9. The platinum group metals: Ru, Rh, Pd, Os, Ir and Pt

The platinum group metals: Ru, Rh, Pd, Os, Ir and Pt. separation of metals. Applications. Most important oxidation States. Pd (II) and Pt (II) chemistry. Binary compounds. Complex. Organometallic compounds. Biological aspects.

10. Coinage metals: Cu, Ag and Au

Coinage metals: Cu, Ag and Au. Extraction of metals. Applications. States of oxidation and stability. Binary compounds. Chemistry of Cu (II). Complexes. Biological aspects.

11. Group 12 metals: Zn, Cd and Hg

Group 12 metals: Zn, Cd and Hg. General characteristics of the elements. Obtaining and applications: batteries. Binary compounds. Chemistry in aqueous solution. Coordination compounds. Biological aspects

12. Lanthanoids and actinoids

Lanthanoids and actinoids. General characteristics of the lanthanoids and actinoids. Oxidation States. Variation of properties throughout the series. Isolation and natural state. Applications of elements and their compounds. Radioactivity and nuclear reactions of the actinoids. Particular study of uranium: Chemistry in aqueous solution. Most important binary compounds

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	38,00	100
Tutorials	7,00	100
Study and independent work	32,50	0
Preparation of evaluation activities	16,00	0
Preparing lectures	6,00	0
Preparation of practical classes and problem	13,00	0
TOTAL	**112,50**	

TEACHING METHODOLOGY

The subject is raised so that the student is the protagonist of their own learning and is structured in the following way:

Lectures. In these classes, the teacher will give an overview of the topic object of study with special emphasis on the new aspects or particular complexity. It also will carry out the specific application of the knowledge that students have acquired via the resolution of issues and practical problems that students have previously worked. Logically, these classes will be complemented with the of personal study time referred to section III.

Group tutoring. Students attend them in smaller groups. In them, the teacher can propose activities, as resolution of issues or problems, resolution of doubts, approach to discussions, etc., which will contribute to the final score, as it considers the teacher.

Seminars. Seminars will be also included, with the aim to complement the lectures.

EVALUATION

FIRST SUMMONS

- Mode A

The acquired knowledge will be assessed through a final examination, in the periods established by the faculty, which will weight an 70 % of the final note. The examination will consist of objective questions dedicated to the knowledge considered as basic (see list of the learning outcomes), and numerical problems and relationship that force the student to consider aspects of the subject appearing on various topics.

Professor will evaluate with a 30 % of the final note the participation of the student in any activity that may arise, related to the matter, including:

- Delivery of solved problems and exercises.

- The troubleshooting by the student will also be taken in account.
- Attendance and participation in discussions also will be considered positively.
- Preparation and oral presentations
- Performance of written tests.
- Class attendance.
- Any other complementary training activities determined by the professor.

The overall rating of examination will be obtained from all the planned activities, with the weight indicated. To pass the course, students must achieve a minimum score of 4 in the exam and the final average must be equal or larger than 5

- Mode B

The student who justified reasons unable to regularly attend class can accommodate, at most within one month from the beginning of the course, to be evaluated only by means of a written examination on the date set by the faculty, and the final grade of the student will be the exam note. To pass the course the student must obtain a note equal or higher than 5 on this exam.

- SECOND SUMMONS

In second summons, the student will perform a written exam, on the date set by the faculty, and the final grade of the student will be the obtained note in this exam. To pass the course the student must obtain a note equal or higher than 5 on this exam.

REFERENCES

Basic

- Housecroft, C. E.; Sharpe,A. G.; Inorganic Chemistry, ed. Pearson Prentice-Hall, 3ª edició, 2008. ISBN: 978-0-13-175553-6.
  (En format separat, s'ha publicat el manual de respostes als exercicis plantejats. Existeix una traducció a l'espanyol de la 2ª edició i del manual de respostes d'Ed. Pearson Prentice-Hall, 2006.)
- Atkins,P. W.; Overton,T. L.; Rourke, J.P.; Weller, M.T. y Armstrong, F. A.; Shriver & Atkins: Inorganic Chemistry, ed. Oxford, 5ª edición, 2010. ISBN: 978-0-19-923617-6.
  (Existe una traducción al español de la cuarta edición de Ed. McGraw-Hill, 2008).
- Rayner-Canham,G.; Overton,T.; Descriptive Inorganic Chemistry y Student solutions manual for descriptive inorganic chemistry, ed. W.H. Freeman, 4ª edición, 2006. ISBN 10: 1-4292-1814-2.
  (Existeix una traducció al espanyol de la 2ª edició de G. Rayner-Canham, Química Inorgánica Descriptiva, ed. Prentice Hall, 2000)

Additional

- Cotton,F.A.; Wilkinson,G.; Murillo; C.A.; Bochmann, M.; Advanced Inorganic Chemistry, ed. Wiley-Interscience, 6ª edición, 1999. ISBN: 978-0-471-19957-1
  Existe una traducción al español de la 4ª edición, F.A. Cotton y G. Wilkinson, Química Inorgánica Avanzada, ed. Limusa, 1987.
- Greenwood, N. N.; Earnshaw, A.; Chemistry of the Elements, ed. Elsevier Science, 2ª edición, 1997 (corregida en 1998, con reimpresiones en 2001 y 2002). ISBN: 0-7506-3365-4.
- Wells,F.; "Química Inorgánica Estructural", 4ª ed. Reverté, Barcelona, 1994. ISBN-13: 978-8429175240; ISBN-10: 8429175245

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

Contents

1.-The contents initially indicated in the teaching guide are kept.

2.- The teaching distribution and the relationship between face-to-face and no presential activities could be modified during the academic year if health emergency conditions were caused by the Covid-19.

Workload and temporary teaching planning

Regarding the workload:

1.- The different activities which are detailed in the teaching guide with the planned dedication are maintained.

Regarding the temporary teaching planning

2.- The material to follow the theory/tutoring/classroom-seminar classes allows to continue with the teaching time planning, both in days and schedule, whether the teaching is face-to-face or no presential.

Teaching metodology

Theory subjects:

Situation of minimal attendance: In theory classes and tutorials the occupation will be, at most, 30% of their usual occupation. Teaching will be online. Students who have a laboratory session before or after theory classes, and the time to travel is longer than the time established in the schedules, will be able to follow the class in person in the classroom assigned in the schedules. When there are students in this situation, classes will be taught by synchronous videoconference in the group classroom.

Maximum face-to-face situation: In theory classes and tutorials, the occupation will respect the sanitary restrictions that limit the capacity of the classrooms. Depending on the capacity of the classroom and the number of students enrolled, it may be necessary that part of the students have to follow the classes synchronously. If this situation arises, the students will attend the group classroom in weekly rotating shifts (preferably in alphabetical order), so as to ensure that the percentage of attendance of all the students enrolled in the subject is the same.

Confinement situation: If for health reasons it is not possible to continue with hybrid teaching, totally or partially affecting the classes of the subject, these will be replaced by synchronous non-face-to-face sessions following the established schedules and using the virtual classroom tools.

Evaluation

The evaluation system described in the teaching guide of the subject in which the various evaluable activities have been specified as well as their contribution to final grade of the subject is kept. Only in duly justified exceptional cases will the examination be considered as the sole evaluation method.

If there is a closure of the facilities for health reasons that could preclude any of the face-to-face activity of the subject, this onelwould be replaced by another similar one that would be performed under a virtual mode through the tools of the virtual classroom of the University of València. The contribution of each evaluable activity to the final mark of the subject will remain invariable, as it has been specified in this teaching guide .

Bibliography

1.- The literature recommended in the teaching guide is maintained since it is accessible, and it is complemented by notes, slides and excercises uploaded to the Virtual Classroom *as material of the subject.*