Inorganic Synthesis Laboratory

Code: 105041
ECTS Credits: 3

2024/2025

Degree	Type	Year
2502444 Chemistry	OB	3

Contact

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

As defined in the objectives, this subject is the experimental continuation of the theoretical subject "Coordination Chemistry and Organometallics". Knowledge acquired in the subject "Structural Determination" will also be put into practice. For this reason, it is highly recommended that the student has passed or taken these subjects during the first semester of the same academic year. On the other hand, as these theoretical subjects of 3rd year are based on the knowledge acquired in the subject of 2nd year "Chemistry of the Elements", it is essential to have also passed this subject to study the "Laboratory of Inorganic Synthesis". It should be noted that the reactions that the student will perform and the compounds that he will synthesize and analyze are part of the contents of the theoretical subjects mentioned and, consequently, both in the laboratory sessions and in the evaluation of this course, these contents are they take for granted.

Objectives and Contextualisation

The aim of this experimental subject is twofold. On the one hand, to reinforce, by means of a series of experiments of synthesis and characterization of compounds, the understanding of the concepts developed in the asignatura "Coordination Chemistry and Organometallics", that the student has cursado in the first semester. On the other hand, being this the last experimental subject focused on chemical synthesis, it complements the laboratories that the student has taken as part of the subjects of 2nd year, "Structure and Reactivity of Organic Compounds" and "Chemistry of the Elements" . In this way, the subject "Inorganic Synthesis Laboratory" provides students with a solid training in a good number of advanced synthetic techniques, more difficult than those that are part of the laboratories linked to the 2nd year subjects.

The subject consists of a set of laboratory practices in which the student will synthesize and characterize a series of compounds. These have been selected with the aim of covering as many synthetic experimental techniques as possible and the widest variety of inorganic compounds, within the time available.

The synthetic training will be complemented by the use of some instrumental techniques (IR, UV and NMR spectroscopy) that students will use in the characterization of the compounds. In this sense, the knowledge obtained in the subject "Structural determination", studied in the first semester of 3rd, will be used. In addition, as in all laboratory courses, learning safety rules and waste treatment is also an essential part of student training. In particular, in this course, the student will have to
become familiar with the handling of hazardous substances.

Competences

- "Interpret data obtained by means of experimental measures, including the use of IT tools; identify their meaning and relate the data with appropriate chemistry, physics or biology theories."
- Adapt to new situations.
- Be ethically committed.
- Communicate orally and in writing in one's own language.
- Develop synthesis and analyses studies in chemistry from previously established procedures.
- Evaluate the health risks and environmental and socioeconomic impact associated to chemical substances and the chemistry industry.
- Handle chemical products safely.
- Handle standard instruments and material in analytic and synthetic chemical laboratories.
- Manage the organisation and planning of tasks.
- Manage, analyse and synthesise information.
- Obtain information, including by digital means.
- Operate with a certain degree of autonomy and integrate quickly in the work setting.
- Propose creative ideas and solutions.
- Reason in a critical manner
- Recognise and analyse chemical problems and propose suitable answers or studies to resolve them.
- Resolve problems and make decisions.
- Show an understanding of the basic concepts, principles, theories and facts of the different areas of chemistry.
- Show initiative and an enterprising spirit.
- Show motivation for quality.
- Show sensitivity for environmental issues.
- Use the English language properly in the field of chemistry.
- Work in a team and show concern for interpersonal relations at work.

Learning Outcomes

1. Adapt to new situations.
2. Analyse situations and problems in the field of organic and inorganic chemistry, and propose answers or experimental studies using bibliographic sources.
3. Apply the acquired theoretical contents to the explanation of experimental phenomena.
4. Be ethically committed.
5. Characterise synthesised compounds using physical and spectroscopic methods.
6. Classify compounds by their most important reactivity characteristics: acid/base and oxidant/reductant.
7. Communicate in English in the laboratory.
8. Communicate orally and in writing in one's own language.
9. Critically evaluate experimental results and deduce their meaning.
10. Deduce the stable electronic configurations of an organometallic compound.
11. Describe basic safety regulations.
12. Determine the performance of a reaction.
13. Develop the habits and skills of a laboratory.
14. Draft a laboratory logbook containing descriptions of the developed procedures, the observations made, the results obtained, the interpretation of the same and the conclusions.
15. Evaluate risks in the use of chemicals and laboratory procedures.
16. Follow safety procedures in the chemistry laboratory.
17. Follow standard laboratory procedures described in English.
18. Follow standard laboratory procedures.
19. Handle instruments to record different types of spectrums.
20. Identify the main reagents in a laboratory and their commercial presentation.
21. Identify the risks of synthetic reagents.
22. Innovate methods for adaptation to the interpretation of a specific molecular structure.
23. Interpret the safety notes on chemistry products.
24. Manage the organisation and planning of tasks.
25. Manage, analyse and synthesise information.

26. Manipulate the main reagents and dissolvents in a chemistry laboratory.
27. Observe the physical and chemical properties of different substances.
28. Observe the reactivity and behaviour of representative compounds in the laboratory.
29. Obtain information, including by digital means.
30. Operate with a certain degree of autonomy and integrate quickly in the work setting.
31. Order the most common ligands (or the ligands chosen as representative examples) by their properties (donor and/or accepter capacity, spectrochemical series).
32. Perform a synthetic and analytic study to determine chemical and physical properties using instructions supplied for a detailed procedure.
33. Perform correct evaluations of the health risks and environmental impact of magnetic fields.
34. Perform standard tests on which the results obtained are based.
35. Prepare an inorganic chemistry laboratory or experiment as described in English.
36. Prepare inorganic compounds with coordination bonds.
37. Prepare inorganic compounds with metal-carbon bonds.
38. Prepare solid state inorganic compounds.
39. Propose creative ideas and solutions.
40. Reason in a critical manner
41. Recognise potential risks in the laboratory before they are produced.
42. Recognise potentially dangerous reagents and dissolvents.
43. Recognise the electronic spectrums of coordination compounds.
44. Recognise the specific terminology of inorganic chemistry to communicate professionally.
45. Recognise the use of each reagent in the laboratory and take appropriate safety precautions in each case (special goggles and/or gloves, extractor hood, gas mask, etc.).
46. Relate bond theory and the models of inorganic chemistry with the reactivity of elements and their compounds.
47. Relate knowledge about the structure and reactivity of the elements and chemical compounds with their method or methods of obtainment and/or purification.
48. Resolve problems and make decisions.
49. Safely dispose of waste from chemical reactions.
50. Safely handle inflammable, toxic and/or corrosive reagents.
51. Selectively distinguish the rejection of reagents and chemical products.
52. Show initiative and an enterprising spirit.
53. Show motivation for quality.
54. Show sensitivity for environmental issues.
55. Summarise a report or article on inorganic chemistry in English.
56. Synthesise and purify a compound chemical.
57. Understand the labelling of chemical reagents in English.
58. Use graphic design programs to draw chemical formulas and their reactions.
59. Use safety equipment properly.
60. Use spectroscopy devices to confirm experimental results.
61. Use standard instruments and material in chemical laboratories for analysis and synthesis in the field of inorganic chemistry.
62. Use suitable strategies for the safe elimination of reagents.
63. Use the basic materials of a chemical laboratory.
64. Use the most common English chemistry terms.
65. Work in a team and show concern for interpersonal relations at work.
66. Work safely in the laboratory while following the adequate procedure.
67. Write simple laboratory reports in English

Content

P1. Co(III) complexes. UV spectroscopy. Isomerization of coordination. IR spectra.
P2. Co(salen) preparation. Reaction with O2
P3. Preparation of phenylmagnese bromide and triphenylphosphine
P4. Preparation of ferrocene
P5. Preparation of metal-carbonyl complexes. IR and NMR spectroscopy

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory presentation	1	0.04	11, 49, 33, 23, 50, 4, 42, 45, 41, 14, 16, 59, 15
Laboratory sessions	48	1.92	1, 2, 3, 9, 5, 6, 7, 8, 10, 52, 53, 11, 13, 12, 49, 51, 57, 33, 67, 24, 25, 20, 21, 22, 23, 64, 19, 50, 26, 4, 54, 28, 27, 29, 30, 31, 37, 36, 38, 39, 40, 34, 32, 35, 43, 42, 45, 44, 41, 14, 47, 46, 48, 55, 16, 18, 17, 56, 66, 65, 60, 63, 61, 62, 59, 58, 15
Type: Autonomous			
Preparation of experiments	23	0.92	3, 6, 10, 12, 24, 25, 20, 21, 23, 64, 4, 29, 40, 32, 43, 42, 45, 44, 41, 14, 46, 55, 16, 18, 17, 62, 59, 15

This course is structured in 12 laboratory sessions of 4 hours each.
Prior to the start of the laboratory sessions, there will be an information session (compulsory attendance) in which students will be explained how the laboratories work, the safety measures they must follow and some fundamental aspects of the practices they have. to perform.

There will be written tests to assess the degree of comprehension and knowledge that the student has achieved by reading the script of the practice, and / or the related theoretical aspects that accompany the practice (all available as material on the virtual platform Moodle), and / or carrying out the experiments. These tests will be the most important element in the qualification of the student.

Additionally, the teacher will allocate approximately 15 minutes of a class to allow the students to answer the evaluation surveys of the teaching performance and the evaluation of the subject.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Assessment of the student's skills and attitude in the laboratory. Correction of the laboratory book.	35%	0	0	1, 2, 3, 9, 5, 6, 7, 8, 53, 13, 12, 49, 51, 57, 33, 67, 24, 25, 20, 21, 22, 23, 64, 19, 50, 26, 28, 27, 29, 30, 37, 36, 38, 34, 32, 35, 42, 45, 44, 41, 14, 48, 55, 16, 18, 17, 56, 66, 65, 60, 63, 61, 62, 59, 58, 15
Final exam	50%	2	0.08	3, 9, 6, 8, 10, 52, 53, 11, 33, 25, 20, 21, 22, 23, 64,

				54, 31, 39, 40, 35, 43, 42, 45, 44, 41, 47, 46, 48, 55, 62, 59, 15
Prelabs	15%	1	0.04	2, 3, 6, 10, 52, 11, 12, 49, 57, 33, 24, 25, 20, 21, 22, 23, 64, 50, 26, 4, 29, 30, 31, 37, 36, 38, 39, 40, 35, 43, 42, 45, 44, 41, 14, 47, 46, 48, 55, 16, 66, 65, 63, 62, 59, 58, 15

The note of the subject consists of 3 parts:

1) Final Exam (Contribution to the final grade of the subject = 40%). It consists of a written evaluation test. A second test will be scheduled exclusively to retrieve this part or raise a grade.

2) Prelabs (Contribution to the final grade of the subject = 30%). It consists of a set of written tests that will be done at the beginning of each practice where the preparation of the practice and the understanding of the different phases and / or strategies and techniques that will be used will be evaluated. The average of the tests performed will be the final grade of the prelabs. This note is not recoverable.

3) Experimental mark (Contribution to the final mark of the subject = 30%). In this part different aspects will be valued: results of the experiments, the notebook performed and the attitude in the laboratory). This part will not be recoverable.

The final marks of the students who pass the subject may be distributed between 5 and 10, always maintaining the order of the students according to the NF mark obtained, in order to achieve the distribution between approved, notable, excel · lenses and MHs, which teachers consider ideal.

RATINGS:
Student who PASSES the subject:
Student who meets all the following requirements:
a) In the final exam you have obtained a grade equal to or higher than 5.
b) Student with an overall grade of the subject equal to or higher than 5.

c) In case of lack of attendance due to illness or other serious circumstance, that this has been duly justified with a medical certificate or adequate document. In no case may absences exceed one session (4 hours).

Student who DOES NOT PASS THE SUBJECT:
Student who does not meet any of the requirements indicated in the "Students that passes the subject".
OUTSTANDING MENTION:
The Outstanding Mention may be awarded to students who have obtained a grade equal to orgreater than 9.00. Their number may not exceed 5% of the students enrolled in a subject (groups of morning + afternoon) in the same corresponding academic course.

NOT ASSESSABLE Student:

Any student who has one or morelack of assistance without justification. In no case, the lack of assistance may exceed more than one session (4h) per Bloc. Any lack of assistance must always be duly justified immediately to the responsible Professor.
RETAKE:
To retake this subject, the students must have been previously evaluated in a set of activities whose weight equals to a minimum of two thirds of the total grade of the subject.
The retake of all assessment activities carried out in the Laboratory sessions is not contemplated.
The retake exam will be retrieved also through a written test.
IRREGULARITIES IN EVALUATION TESTS
Without prejudice to other disciplinary measures deemed appropriate, the irregularities committed by the student that can lead to a variation in the qualification of any assessment activity will be qualified with a zero.

Therefore, copying, plagiarizing, cheating, etc. In any of the assessment activities it will imply failing it with a mark equal to zero.
SECURITY WARNING IN THE LABORATORY
Any student involved in an incident that could have serious consequences of security may be expelled from the laboratory and fail the subject.

Bibliography

Theoretical Concepts:
Shriver-Atkins, Química Inorgànica, 4ª edició, Ed. McGraw-Hill, 2008
C. E. Housecroft, A. G. Sharpe, Química Inorgánica, 2ª edició, Ed. Pearson, 2006 (capítols 19, 20, 23, 25 i 26)
D. Astruc, Química Organometàl·lica, Ed. Reverté, 2003

Experimental Part:
G.M. Williams, J. Olmsted III, A. Breksa III, J. Chem. Educ. 1989, 66, 1043.
R.B. Penland, T.J. Lane, J.V. Quagliano, J.Am. Chem. Soc. 1956, 78, 88.
T.G. Appleton, J. Chem. Educ.1997, 54, 443.
P. Simpson, Compuestos organometálicos de elementos de grupos principales, Ed. Alhambra, 1973, 120-123.
F.R. Hartley, G. Temple-Nidd, Educ. Chem. 1975, 12, 6.
P.W. Wiggins, Educ. Chem. 1973, 10, 52.
R.J. Angelici, J. Chem. Edu. 1968, 45, 119.

Software

Being a practical subject does not contemplate the use of specific software. It is probable that at some point use will be made of the UAB Virtual Campus and some of its Moodle tools.

However, some of the activities may require the use of basic office automation tools (word processor and graphics, etc.).

Language list

Name	Group	Language	Semester	Turn
(PLAB) Practical laboratories	1	Catalan/Spanish	second semester	morning-mixed
(PLAB) Practical laboratories	2	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	3	Catalan	second semester	afternoon
(PLAB) Practical laboratories	4	Catalan/Spanish	second semester	afternoon
(SEM) Seminars	1	Catalan	second semester	morning-mixed
(SEM) Seminars	2	Catalan	second semester	afternoon