Universidad Zaragoza

Academic Year/course: 2023/24

60451 - Molecular Design in Inorganic and Organometallic Chemistry

Syllabus Information

Academic year: 2023/24
Subject: 60451 - Molecular Design in Inorganic and Organometallic Chemistry
Faculty / School: 100 - Facultad de Ciencias
Degree: 543 - Master's in Molecular Chemistry and Homogeneous Catalysis
ECTS: 6.0
Year: 1
Semester: First semester
Subject type: Compulsory
Module:

1. General information

This subject is one of the basic pillars of the Master's Degree in Molecular Chemistry and Homogeneous Catalysis, as it provides the necessary knowledge of the synthesis, bonding models, properties, reactivity and current applications of coordination and organometallic compounds. It also covers clusters and nanoparticles. Other subjects of the master´s degree, such as Catalysis, Asymmetric Catalysis, Sustainable Chemistry and Catalysis etc. will deal with the catalytic processes based on these clusters and nanoparticles.

These approaches and objectives are aligned with the Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/es/); specifically, the planned learning activities will contribute to the achievement of goals 3, 5, 7, 8, 9 and 10.

2. Learning results

- To apply basic concepts of coordination chemistry to the synthesis of complexes that incorporate small molecules.

-To assess possible coordination modes, bonding, properties, reactivity and possible applications.

- To know and apply concepts about metal-metal bonding to dinuclear, polynuclear and cluster compounds.

-To identify the methods of synthesis, usefulness and applications of nanoparticles.

-To know the fundamentals and characteristics of the different M-C bonds and to recognize the different families of organometallic compounds.

-To know the usual processes in the synthesis of organometallic complexes and their general properties.

- To predict the stability and reactivity of different types of organometallic compounds of transition metals and be able to propose synthesis methods.

-To apply information from analytical and characterization spectroscopic techniques to the analysis of organometallic compounds.

-To solve and critically discuss problems and questions on structure and reactivity of organometallic compounds.

- To recognize the usefulness of organometallic compounds for the synthesis of organic molecules and as catalysts in chemical processes.

-To know the applications of coordination and organometallic compounds in medical therapies and in the preparation of luminescent species.

3. Syllabus

Topic 1. Fundamental concepts in coordination chemistry.

Topic 2. Activation of small molecules by coordination to metal centres.

Metal-metal bonds in coordination compounds.

Topic 4. Cluster Compounds.

Topic 5. Giant clusters and nanoparticles.

Topic 6. Classification of organic groups as ligands. Organometallic compounds with sigma-giving ligands.

Item 7. Transition metal complexes with multiple M-C bonding.

Item 8. Transition metal complexes with sigma-pi M-C bonding (open and cyclic non-aromatic systems).

Item 9. Transition metal complexes with sigma-pi M-C bonding (aromatic systems).

Item 10. Medical therapies with metal complexes.

4. Academic activities

Master classes: 40 hours

Theoretical-practical sessions in which the contents of the subject will be explained.

Problem solving and case studies: 15 hours

Problem solving and seminar questions

Special laboratory practices: 5 hours

Preparation and characterization of a complex that can act as a homogeneous catalyst in organic processes. Isolation and identification of the organic products of catalysis.

Oral presentation of research papers: 10 hours

Selection of a current research article, presentation and defence.

Personal study: 73 hours

Assessment tests: 7 hours.

5. Assessment system

Continuous assessment is based on the following activities and weighting:

1. Control of theoretical questions, theoretical-practical questions and problem solving of topics 1 to 5**(P1**).

2. Preparation and oral presentation, individually or in pairs, of a scientific article related to the contents of the subject**(T1**).

3. The laboratory report**(IL**) of the integrated practices.

4. A written test within the period of global tests consisting of the solving of problems and theoretical and/or theoretical-practical questions of topics 6-10, which may include questions related to the practices**(P2**). Students who did not take the P1 test or did not achieve a grade of 4 out of 10, will have an additional test on subjects 1 to 5**(P1')**.

In order to **averag**e any of the grades with the rest ,it is necessary to obtain a minimum grade of 4 out of 10 in any of the**P1, P1'** or**P2** tests.

The final grade will be the best of the following grades:

NOTE 1= 0.40***(P1 orP1')**+ 0.**10*T1**+ 0.**45*P2**+ 0.**05*IL**

NOTE 2= 0.45*P1**'**+ 0.**55*P2**

The grade in the second annual call will be that of a single written test structured in two parts that will include all the topics of theory, problems and practice defined as programmed learning activities.