Teaching Guide				
Identifying Data				2015/16
Subject (*)	Química Inorgánica Avanzada		Code	610G01025
Study programme	Grao en Química			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	Fourth	Obligatoria	6
Language	SpanishEnglish			
Teaching method	Face-to-face			
Prerequisites				
Department	Química Fundamental			
Coordinador	Fernandez Sanchez, Jesus Jose	E-mail	jesus.fernandezs@udc.es	
Lecturers	Fernandez Lopez, Alberto A. Fernandez Sanchez, Jesus Jose	E-mail	alberto.fernandez@udc.es jesus.fernandezs@udc.es	
Web				
General description	The Organometallic Chemistry is one of the wide fields of study in which the Inorganic Chemistry is divided. The Organometallic Chemistry studies the experimental research, the structure, bonding, reactivity and applications of those compounds with M-C bond. The importance of these go further than the mere academic interest, as many of the organometallic compounds are presently used in synthetic reactions, in stoichiometric or catalytic conditions, for both, laboratory or industrial and technological processes. The subject ?Advanced Inorganic Chemistry? is taught in the first term of the fourth year in the Chemistry Degree at de UDC. This subject, dedicated to the study of Organometallic Compounds consists of four theoretical and two laboratory credits.			

Study programme competences	
Code	Study programme competences
A1	Ability to use chemistry terminology, nomenclature, conventions and units
A4	Knowledge of main types of chemical reaction and characteristics of each
A6	Knowledge of chemical elements and their compounds, synthesis, structure, properties and reactivity
A9	Knowledge of structural characteristics of chemical and stereochemical compounds, and basic methods of structural analysis and research
A10	Knowledge of chemical kinetics, catalysis and reaction mechanisms
A14	Ability to demonstrate knowledge and understanding of concepts, principles and theories in chemistry
A16	Ability to source, assess and apply technical bibliographical information and data relating to chemistry
A17	Ability to work safely in a chemistry laboratory (handling of materials, disposal of waste)
A18	Risk management in relation to use of chemical substances and laboratory procedures
A20	Ability to interpret data resulting from laboratory observation and measurement
A22	Ability to plan, design and develop projects and experiments
A23	Critical standards of excellence in experimental technique and analysis
A26	Ability to follow standard laboratory procedures in relation to analysis and synthesis of organic and inorganic systems
B1	Learning to learn
B2	Effective problem solving
B3	Application of logical, critical, creative thinking
B4	Working independently on own initiative
C1	Ability to express oneself accurately in the official languages of Galicia (oral and in written)
C2	Oral and written proficiency in a foreign language

Learning outcomes	
Learning outcomes	Study programme competences

Students should know the structure, nature of bonding, reactivity and properties of organometallic complexes and apply this knowledge to the solution of chemical problems.	A1 A4 A6 A9 A10 A14 A16	B1 B2 B3 B4	C1 C2
Students should be able to apply the theoretical knowledge and practical skills necessary to carry out the synthesis and characterization of organometallic compounds.	A1 A9 A14 A16 A17 A18 A20 A22 A23 A26	B1 B2 B3 B4	C1 C2

Contents	
Topic	**Sub-topic**
I. Organometallic chemistry.	I.I. General characteristics of organometallic compounds. I.II. Organometallic compounds in the main groups. I.III. Reaction mechanisms of inorganic species.
II. Organometallic compounds with monohapto lygands.	II.I. Metal carbonyls. II.II. Organometallic compounds with monohapto ligands: sigma M-C bond. II.III. Metal carbenes and carbines.
III. Organometallic compounds with polyhapto ligands.	III.I: Organometallic compounds with dihapto ligands: akenes and alkynes. III.II: Organometallic compounds with trihapto ligands: allyls. III.III. Organometallic compounds with tetrahapto ligands: conjugated diolefins. III.IV. Organometallic compounds with pentahapto ligands: cyclopentadienyls. III.V. Organometallic compounds with hexahapto ligands: arenes.
IV. Experimental organometalllic chemistry.	IV.I. Syntheses of organometallic compounds. IV.II. Structural determination applied to organometallic compounds.

Planning				
Methodologies / tests	**Competencies / Results**	**Teaching hours (in-person & virtual)**	**Student?s personal work hours**	**Total hours**
Guest lecture / keynote speech	A14 B3 C1 C2	21	42	63
Problem solving	A1 A4 A6 A9 A10 A14 A16 B1 B2 B3 C1 C2	7	14	21
Laboratory practice	A1 A4 A6 A9 A16 A17 A18 A20 A22 A23 A26 B1 B4	20	20	40
Mixed objective/subjective test	A1 A4 A6 A9 A10 A14 B3 B2 C1 C2	4	22	26
Events academic / information	B1	0	0	0
Personalized attention		0	0	0
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies

Methodologies	Description
Guest lecture / keynote speech	Lectures dedicated to introduce the most relevant contents of the course. Active participation of students are encouraged as an important part of the lectures methodology. Prior to each lecture students are supposed to have read the suggested readings related to the topics of the lecture. If necessary the students are expected to prepare by themselves part of the course contents in the student?s personal work hours.
Problem solving	Classes given in small groups of students, which must participate actively. Problem-solving classes are dedicated to solve the doubts arisen during lectures and the preparatory readings. They are also dedicated to the resolution of problems and questions previously given to the students or to the intensive study of a particular topic trough the active discussion methodology. If necessary, practical cases may also be solved using the university Moodle.
Laboratory practice	Laboratory classes which are dedicated to the synthesis, isolation and characterization of organometallic compounds. Prior to the lab class, the student study the theoretical and synthetic aspects of each laboratory experiment using the recommended bibliographic sources. Before starting the laboratory work, the student have to show, in a personal tutorial with the professor, that has reached the necessary level of knowledge and skills necessary to understand and carry out the experiment safely. During the laboratory work, the student must work carefully paying special attention to the safety rules and showing the rigor and efficiency characteristic of the scientific method. The preparatory work, the experimental description (laboratory diary) and the conclusions drawn must be recorded in the laboratory notebook, which must be given to the professor before the deadline.
Mixed objective/subjective test	The mixed test is a written exam, which consists of assay-type questions in which the student must find the answer to a more or less complex problem, which may be of logic or numeric nature. It may also contain objective test questions.
Events academic / information	The students are encouraged to attend invited lectures and other academic or scientific events related to the subject, which might take place during the course.

Personalized attention	
Methodologies	Description
Guest lecture / keynote speech Problem solving Laboratory practice Mixed objective/subjective test	Personalized attention is aimed to give support to the students in the process of autonomous learning. It is organized in the scheduled tutorials.

Assessment			
Methodologies	Competencies / Results	Description	**Qualification**
Guest lecture / keynote speech	A14 B3 C1 C2	During the lectures the professor assess the active participation of students as well as their reasoning and oratory skills. If necessary, the students might take a brief test consisting of short answer or multiple election questions, during the lecture hours. The solution and presentation of a study case using Moodle are also possible. The marks corresponding to these activities will be added to the ?problem solution? marks.	0
Problem solving	A1 A4 A6 A9 A10 A14 A16 B1 B2 B3 C1 C2	During the problem-solving classes the professor assess the active participation of students as well as their reasoning and oratory skills. If necessary, the students might take a brief test consisting of short answer or multiple election questions, during the lecture hours. The solution and presentation of a study case using Moodle are also possible. The marks corresponding to these activities will be added to the ?lecture? marks.	15

Laboratory practice	A1 A4 A6 A9 A16 A17 A18 A20 A22 A23 A26 B1 B4	During the pre-lab tutorial, the professor assess the rigorous preparation of the theoretical and experimental parts of the laboratory experiment which concerns both the synthetic and the characterization methodology. The professor also assess the laboratory work particularly: the organization, safety work, knowledge of the material and technical procedures, the manual skill and, specially, the ability to find relationships between the experimental procedure carried out and the theoretical background acquired during the previous work. The laboratory notebook will also be marked. It consists of four parts: preparatory work, exact description of laboratory work (laboratory diary), characterization of the products synthesized and results and conclusions drawn from the experiment.	20
Mixed objective/subjective test	A1 A4 A6 A9 A10 A14 B3 B2 C1 C2	Students will take the mixed test in the hours designed by the Faculty. The assessment criteria will be given before the exam.	65
Events academic / information	B1	The participation of students in these activities will be added to the overall marks	0

Assessment comments
In order to pass the subject, the students must attend to all the laboratory classes and to the 80% of the remaining activities. In the ?first opportunity?, the contribution of the different methodologies to the final assessment is as follows: C1 Mixed text, 6.5 points. C2 Laboratory practice, 2.0 points C3 Keynote speech + problem solving, 1,5 points. C4 Student progression, 1 point. In order to pass the subject have to attain a minimum mark of 5 points corresponding to the sum of (C1 + C2+ C3) and comply the following requirements: The student must attain a minimum of the 45% of the maximum mark in contributions C1 and C2. The contribution C4 ?Student progression? will be added to the final marks only if the sum C1 + C2+ C3 is 5 or more points. (In any case, the maximum mark is 10 points) The condition of ?no presentado? will be granted to those students who have participated in activities summing less than the 20% of the total mark. In the ?second opportunity?, the student repeat only of the mixed test. The grades corresponding to laboratory practise, and keynote speech + problem solving are those attained during the normal period of classes (first opportunity). The contribution of each methodology and the conditions to pass the subject are the defined for the first opportunity. The mark ?matricula de honor? will be granted preferably to the students that have passed the subject in the first opportunity.

Sources of information	
Basic	- A.F. Hill (2002). Organotransition metal chemistry. Cambridge, Royal Soc. of Chem. - R.H. Crabtree (2009). The organometallic chemistry of the transition metals. New Jersey, Wiley - C. Elschenbroich (2006). Organometallics. Weinheim, Wiley-VCH Bibliografía de prácticas de laboratorio, síntese e determinación estrutural enfocada cara á Química Inorgánica en xeral e a Química Organometálica en particular, a disposición pública na Biblioteca da Facultade de Ciencias da UDC.

Complementary	- G.O. Spessard y G.L. Miessler (2010). Organometallic Chemistry. New York, Oxford Univ. Press - D. Astruc (2003). Química organometálica. Barcelona, Reverté - R.H. Crabtree y E. Peris Fajarnés (1997). Química organometálica de los metales de transición. Castellon, Pub. Univ. Jaume I - G.A. Carriedo Ule y D. Miguel Sanjosé (1995). Iniciación a la química organometálica. Oviedo, Pub. Univ. Oviedo Bibliografía de Química Organometálica, a disposición pública na Biblioteca da Facultade de Ciencias da UDC. "Organometallic Hypertext Book", R. Toreki (ILPI, Interactive Learning Paradigms Incorporated), http://www.ilpi.com/organomet/

Recommendations
Subjects that it is recommended to have taken before
Química Inorgánica 1/610G01021 Química Inorgánica 2/610G01022 Química Inorgánica 3/610G01023 Química Inorgánica 4/610G01024
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Other comments
The subject ?Advanced Inorganic Chemistry? is the last compulsory subject corresponding to Inorganic Chemistry in the Chemistry Degree therefore, is highly recommendable to have passed the previous ?Inorganic Chemistries 1-4?.Complementary material will be given to the students through the Moodle.Is highly advisable to attend all classes and the active participation in all activities.