

Academic Year/course: 2021/22

27210 - Chemistry Laboratory

Syllabus Information

Academic Year: 2021/22

Subject: 27210 - Laboratorio de química

Faculty / School: 100 - Facultad de Ciencias

Degree: 452 - Degree in Chemistry

ECTS: 12.0

Year: 2

Semester: Annual

Subject Type: Compulsory

Module:

1. General information

1.1. Aims of the course

The fundamental objective of the Chemistry Laboratory course is to enable the student to carry out the basic work in the chemical laboratory rigorously, safely and efficiently and to apply different concepts, theories, procedures, reactions, etc. in a practical way in the fields of Analytical Chemistry, Physical Chemistry, Inorganic Chemistry and Organic Chemistry. The subject has been planned to include all the areas of Chemistry so that the student acquires a global vision of it and, at the same time, is aware of the different working methods and objectives of each one of them.

2. Learning goals

3. Assessment (1st and 2nd call)

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The learning process designed for this course is based on the following points:

This is a practical course, therefore students should participate actively in all the activities of the laboratory sessions. The main part of teaching and learning tasks will be done in the laboratory sessions, in small groups of students supervised by a teacher. Each laboratory session will last between 3 and 4 hours. Additionally, the explanation of the basic concepts about the experimental work will be done in classroom seminars, generally in large groups. Seminars will last between 1 and 2 hours.

Classroom materials will be available via Moodle. These include the calendar of activities, as well as other course-specific learning materials.

Further information regarding the course will be provided on the first day of class.

4.2. Learning tasks

The course includes 12 ECTS organized according to:

- Seminars (2 ECTS).
- Laboratory sessions (10 ECTS).

4.3. Syllabus

The course will address the following topics:

Seminars

1. Basic concepts and database in Chemistry Laboratories. Security issues. Chemical products. Safety data sheets (SDS).
2. Physicochemical methods and treatment of experimental data.
3. Basic IR and RMN spectroscopy for structural characterization of simple organic compounds.
4. Use of video tutorials for step-by-step instructions on basic instrumental techniques in organic chemistry.
5. Chemical and electroanalytical methods. Practical considerations for the laboratory sessions.

Laboratory sessions

Section 1. Experimental physicochemical techniques

- 1) Determination of thermodynamic properties (3 sessions of 3 h each).
 - Determination of the heat of combustion of a solid in a calorimetric bomb.
 - Measurement of the vapour pressure of a liquid using the isoteniscope method.
 - Determination of one equilibrium constant.
- 2) Determination of electrochemical properties (2 sessions of 2.5 h each).
 - Determination of the transport number of an ion by the movable boundary method.
 - Measurement of the electromotive force of some simple and concentration batteries.
- 3) Kinetic of chemical reaction (3 sessions of 4 h each).
 - Kinetic study of different chemical reactions in aqueous solution will be performed using spectrophotometric, polarimetric and conductimetric methods.

Section 2. Synthesis and characterization of inorganic compounds

1. Preparation of some compounds of boron from borax (1 session of 3.5 h).
2. Elements of group 15: test tube experiments (1 session of 3.5 h).
3. Production of gases. Preparation of some copper salts from copper sulphate (2 sessions of 3.5 h each).
4. Preparation of some lead salts from minium (2 sessions of 3.5 h each).
5. Production of Cl_2 . Preparation of $\text{K}[\text{ICl}_4] \cdot x\text{H}_2\text{O}$ (1 session of 3.5 h).
6. Preparation and purification of manganese(II) chloride (1 session of 3.5 h).

Section 3. Synthesis, purification and characterization of organic compounds

a) Synthesis of compounds by typical organic reactions. Isolation, purification and characterization techniques in organic synthesis (5 sessions of 4 h each).

- Synthesis of tert-butyl chloride (unimolecular nucleophilic substitution, $\text{S}_{\text{N}}1$)
- Oxidation of diphenylethanol to benzophenone by chromic acid.
- Synthesis of phenacetin (bimolecular nucleophilic substitution, $\text{S}_{\text{N}}2$)
- Elimination reactions: dehydration of alcohols (E1).
- Nitration of bromobenzene (electrophilic aromatic substitution, $\text{S}_{\text{E}}\text{Ar}$)

b) Purification techniques: column chromatography.

- Purification of the main product of a reaction mixture (1 session of 4 h).

Emphasis will be placed on the appropriate safety handling of organic compounds and proper disposal of chemical waste. In addition, students will practice database searching of the physical properties of organic compounds and basic spectroscopic analysis, using what they have learned in previous seminars.

Section 4: Chemical and electroanalytical methods

- 1) Redox, EDTA, acid-base and precipitation titrations.
 - Determination of sodium oxalate by redox titration with potassium permanganate (1 session of 4 h).
 - Determination of chloride in sparkling waters by precipitation titration (Mohr's method) (1 session of 3 h).
 - Determination of magnesium in a salt by EDTA titration (1 session of 4 h).
 - Determination of hydrogen carbonate in still water by acid-base titration: use of chemical acid-base indicators and a pH electrode to find the end point (2 sessions of 3.5 h)
- 2) Potentiometry with Ion Selective Electrodes (ISE) and Anodic Stripping Voltammetry (ASV) (2 sessions of 3.5 h each).

The study of the conditions affecting the quality of the measurements, the proper expression of the results together with their quality evaluation will be also carried out.

4.4. Course planning and calendar

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course, will be provided on the first day of class or please refer to the Facultad de Ciencias web (<https://ciencias.unizar.es/grado-en-quimica-0>).

4.5. Bibliography and recommended resources

http://biblos.unizar.es/br/br_citas.php?codigo=27210&year=2021