

Academic Year/course: 2022/23

29915 - Experimentation in Chemistry

Syllabus Information

Academic Year: 2022/23

Subject: 29915 - Experimentation in Chemistry

Faculty / School: 110 - Escuela de Ingeniería y Arquitectura

Degree: 435 - Bachelor's Degree in Chemical Engineering

ECTS: 6.0

Year: 2

Semester: Second semester

Subject Type: Compulsory

Module:

1. General information

1.1. Aims of the course

The subject and its expected results respond the following approaches and goals:

The course completes the student training in chemistry since, the theoretical/practical knowledge acquired in the courses Chemistry I, II and III adds the knowledge and skills of the chemical laboratory in all its facets.

Expected goals for the student.

1. To know and to acquire the necessary skills in handling instruments and chemical reagents both as regards the principal basic operations of a chemistry lab as some of the experimental methods used specifically in Analytical Chemistry, Physical Chemistry, Inorganic Chemistry and Organic Chemistry.

2. To reach a better understanding of the theoretical and practical knowledge in the areas of Analytical Chemistry, Physical Chemistry, Inorganic Chemistry and Organic Chemistry previously acquired, through its application to laboratory processes which to show them some of the relevant practical applications of this knowledge.

3. To be able to perform the interpretation and / or appropriate mathematical treatment of results and present them in a clear and orderly manner.

These approaches and objectives are aligned with some of the Sustainable Development Goals, SDGs, of the 2030 Agenda (<https://www.un.org/sustainabledevelopment/en/>) and certain specific goals, in such a way that the acquisition of the Learning outcomes of the subject provide training and competence to the student to contribute to a certain extent to their achievement:

Goal 9: Industry, Innovation and infrastructure

Target 9.5 Increase scientific research and improve the technological capacity of the industrial sectors of all countries, particularly developing countries, inter alia, by promoting innovation and increasing considerably, by 2030, the number of people working in research and development per million inhabitants and the expenses of the public and private sectors in research and development

1.2. Context and importance of this course in the degree

This course is scheduled in the spring season corresponding to second year (sophomore) of chemical engineering map degree. At this time, they have already taken the subjects of Chemistry I, II (Analytical Chemistry and Physical Chemistry) y III (Inorganic and Organic Chemistry), and therefore, he/she knows the basic principles of chemistry, laws governing reactions and has a general knowledge of the behavior of the elements and their main compounds. Moreover, it's necessary to consider that the Experimental Chemistry must provide the concepts that will be needed to carry out successfully courses in later years. Both, mandatory subjects such as Materials Engineering, Environmental Engineering, Industrial Chemistry, Separation Operations, Reactor Design and Experimental Chemical Engineering (I and II) as well as those included in the elective modules.

1.3. Recommendations to take this course

Highly recommended to have studied the subjects Chemistry I (29904), II (29909) and III (29914).

2. Learning goals

2.1. Competences

To pass this course, students will be more competent to...

- Generic skills

? C04 To solve problems and make decisions with initiative, creativity and critical thinking.

? C11 To learn continuously and develop independent learning strategies.

- Specific skills

? C30 To calculate the physico-chemical parameters of systems and chemical reactions with special emphasis on the chemical equilibrium in solution and its application to the analysis.

? C31 To develop chemical processes according to the characteristics of the elements and to the organic and inorganic compounds.

2.2. Learning goals

For passing this subject, students should demonstrate the following results...

To apply properly to the theoretical / practical concepts in the development of chemical analysis and chemical processes in the laboratory.

To use a rigorous language in chemistry field.

To present and interpret correctly data and results.

2.3. Importance of learning goals

The knowledge of experimental techniques and its theoretical basis in the different fields of Chemistry (Analytical Chemistry, Physical Chemistry, Inorganic Chemistry and Organic Chemistry) will provide students the ability to discriminate the techniques and chemical methods most suitable to be used in the design and control of facilities and processes, both in their future studies as his/her career as a chemical engineer.

The correct interpretation and processing of data and experimental results, as well as its clear and orderly presentation, are essential to establish habits of rigor in these tasks that are not unique in chemistry lab. Specifically in the field of chemistry will enable students to make correct reports if they are requested for that, as well as evaluate the correctness of those will receive.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

Students must be demonstrating that it has achieved the intended learning outcomes through the following evaluation activities:

This subject is considered an exception to the continuous assessment system in accordance with Article 9. Item 4, of UZ evaluation rules. This system allows students to get the 100% of the grade in the first call. This first call exclude overall assessment test. Thus, attendance at laboratory sessions scheduled during the academic year will be mandatory.

The evaluation will be conducted separately for the four areas involved in the subject (Analytical Chemistry, Physical Chemistry, Inorganic Chemistry and Organic Chemistry).

The numerical rating to the subject will be the result of apply the average value to the numerical rating obtained in each of the areas (Analytical Chemistry, Physical Chemistry, Inorganic Chemistry and Organic Chemistry), provided the following condition is satisfied: having overcome (note equal or higher than 5.0) in, at least, two areas, and to have compensable rating (4.0 or higher) in a maximum of two areas. To pass the course, the average value should be equal or greater to 5.0.

In all cases, tracing of each laboratory sessions will be performed with the goal of assessing the session preparation, the lab session development, and the presentation and interpretation of results of the results obtained in the laboratory practices

At the end of practical sessions of each knowledge area, each area might take a written examination about subject taught. The obligatoriness (or not) of carry out this exam will be communicated to students in the first session lab.

In case of conducting the examination, the note will be calculated using the following formula:

$$\text{Note} = (0.3 \times \text{Note exam}) + (0.7 \times \text{Note lab})$$

A minimum grade of 3.0 is required on the exam to apply the formula. If the note is not reached, the student will be considered suspended in the part corresponding to that area.

In the second call a theoretical and practical exam will be conducted.

For those students who are presented to other calls different to the first, the EINA will schedule, in the exam period established to such effect, a global exam. This global test will account for 100% of the student's grade and will have a theoretical and practical character.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

Students' practical work at the chemical laboratory. Previously of the lab's session, students will know the practice's topic and the procedure described in the practices' manual must be read and understood. Besides, they must be completed preliminary questions, if it's required.

Practices' manuals will be available at the Moodle course of the subject, prior to the date of the practical sessions. Students will work both, individually or teams, with support and supervision from the teacher when necessary.

4.2. Learning tasks

Chemistry laboratory classes: each chemical area will teach 5 sessions of 3 hours maximum time. It would be possible to organize a previous session, classroom or laboratory depending on chemical areas, with the objective of developing a brief description of working in a chemical laboratory.

Moodle 2.0 Course.

Academic support and supervision.

Possibility of receiving a Course on Information Management for freshman students (organized and conducted by the Hypatia library).

4.3. Syllabus

The course will address the following topics:

Analytical Chemistry area: 5 sessions, selected by teachers, including the following

- Practice 1. Introduction to the analytical laboratory. Laboratory material, identification and handling. Preparation of solutions. (max. 3 h)
- Practice 2. Analytical determinations based on acid-base equilibria. (max. 3 h)
- Practice 3. Analytical determinations based on complexation equilibria. (max. 3 h)
- Practice 4. Analytical determinations based on the use of classical gravimetry. (max. 3 h)
- Practice 5. Analytical determinations based on redox equilibria. (max. 3h)
- Practice 6. Analytical determinations based on the use of instrumental techniques of analysis (optical). (max. 3 h)
- Practice 7. Analytical determinations based on the use of instrumental techniques of analysis (electrical). (max. 3 h)

Physical Chemistry area:

- Practice 1: Conductimetric titrations
- Practice 2: Corrosion
- Practice 3: Vapour-liquid equilibrium of a pure substance
- Practice 4: Liquid-liquid equilibrium of a binary system
- Practice 5: Phase equilibrium of a ternary liquid system
- Practice 6: Determination of the surface tension of several liquids by the ring method

By reasons of the length of the practices, the practices 4 and 6 will be carried out in the same session

Inorganic Chemistry area: 5 sessions, selected by teachers, including the following

- Practice 1: Preparation of lead compounds using Pb_3O_4 as starting material.
- Practice 2: Halogens: Synthesis of Br_2 and I_2 . Study of their oxidizing power.
- Practice 3: Preparation of ferrosilicon.
- Practice 4: Production of CO_2 . Preparation of NaHCO_3 and Na_2CO_3 via the Solvay process.
- Practice 5: Preparation of the cis and trans isomers of the coordination complex, bisglycinatocopper(II)- H_2O .
- Practice 6: Preparation of a silver mirror.
- Practice 7: Preparation of silica gel.
- Practice 8: Preparation of copper salts.

Organic Chemistry area: 5 sessions, four of the following practices (selected by teachers) will be carried out

- Practice 1: Separation of organic compounds. Acid-base reactions.
- Practice 2: $\text{S}_{\text{N}}1$ versus $\text{S}_{\text{N}}2$ reactions.
- Practice 3: Esterification reactions.
- Practice 4: Organic reduction reactions.
- Practice 5: Synthesis of organic colourants.

4.4. Course planning and calendar

The practice sessions are held in the laboratory according to the schedule established by the EINA and will be published

prior to the start date of the course (schedules available on the EINA website).

Each professor will inform about his tutoring hours.

Study time, time of student work off the lab, and evaluation time: 22.5 hours for each involved chemical area.

Practical sessions will be planned depending on the enrolled student's number and will be announced in good time.

Final planning of several activities to develop in this course will be established once the University of Zaragoza and EINA will approve the academic calendar and will be available on the website of the EINA.

4.5. Bibliography and recommended resources

<http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=29915>