Subject Guide

1. Information about the subject

SUBJECT	Experimentation in Analytical Chemistry I	**CODE**	GQUIMI01-2-002
EDUCATIONAL OFFER	Bachelor´s Degree in Chemistry	**CENTER**	Facultad de Química
TYPE	Compulsory	**N° TOTAL CREDITS**	6.0
PERIOD	Second Semester	**LANGUAGE**	Spanish

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2. Context

The course "**Experimentation in Analytical Chemistry I**" is included in the Basic Module of the report for verification of the Degree in Chemistry, in the course of Analytical Chemistry. The contents of this course are closely related to those of the subject "**Analytical Chemistry I**", to which it complements in terms of skills acquired by students. This is the first experimental course in Analytical Chemistry in the Degree in Chemistry. Therefore, it is a cornerstone for the rest of the subjects of the area with practical credits, which subsequently students will attend.Since it is preceded by the subject "**Basic Laboratory Operations and Computer Tools**" some practical skills in the laboratory have already been acquired by the students.
On the other hand, the skills acquired in handling analytical instrumentation (potentiometers, spectrophotometers, etc.) and the volumetric material used for the preparation and transfer solutions as well as the skills in the treatment of analytical results (spreadsheets) and the management of related literature justify, undoubtedly, the interest of this subject in the future professional career.
This course will be taught by professors from the Department of Physical and Analytical Chemistry (Area of Analytical Chemistry) with the distribution as indicated in the following table and is a key subject to the course "**Experimentation in Analytical Chemistry II".**

Activity	**Professors**
Seminars	**Jörg Bettmer**
Laboratory Group 1	**Noemí de los Santos Álvarez**
Laboratory Group 2	**Jörg Bettmer**

3. Requirements

As a prerequisite, the student must have passed the subjects: "**General Chemistry**" and "**Basic Laboratory Operations and Computer Tools**" in the first academic year.

4. Competencies and learning results

Specific skills

At the end of the course the student should be competent to:
1. Handle reagents, instruments and chemical devices safely. (CE-25)

2. Perform calculations and error analysis with correct use of magnitudes and units (CE-35)
3. Implement good scientific practices of measuring and experimentation. (CE-23)
4. Conduct standard laboratory analytical procedures. (CE-26)
5. Assess the risks in the use of chemicals and laboratory procedures. (CE-31)

General skills
1. Solve problems in an effective way. (CG-2)
2. Use written English correctly. (CG-8)
3. Team working. (CG-18)

Learning outcomes
1. Recognize and analyze new problems in the field of Chemistry and propose strategies for addressing them. (CG-2, GS-18, GS-35)
2. Develop and submit a written report correctly. (CG-8, GS-18, GS-35)
3. Identify and assess risks in the use of chemicals and laboratory procedures. (CG-25, CG-31)
4. Perform analytical laboratory experiments, with scientific rigour with regard to the measurement, the operative procedure and data collection (CG-23, GS-35)
5. Know and use in a safe and environmentally friendly way laboratory analytical techniques including necessary calculations and express the results properly (CG-23, GS-35)
6. Get experimental results of adequate quality (CG-24, CG-35)

In a specific way, at the end of the course, the student has to be able to:
1. Recognize the safety equipment in the lab. Identify waste generated, understanding the risks associated with them and use the resources available for their disposal.
2. Recognize and handle appropriately the materials used in laboratory experiments.
3. Perform the necessary calculations for preparing solutions using different concentration units.
4. Apply the fundamentals of gravimetric analysis to the separation and determination of chemical species.
5. Apply the fundamentals of volumetric analysis with visual and instrumental end-point detection.
6. Perform measurements required for quantitative analysis by using instrumental atomic and molecular spectroscopic techniques based on absorption and emission phenomena.
7. Perform measurements required for quantitative analysis by using electrochemical instrumental techniques at equilibrium.
8. Obtain calibration plots by different methods and justify the advantages and disadvantages of each one.
9. Express adequately the results obtained in quantitative chemical analysis, interpreting and discussing the quality of them.

5. Contents

Experiment 1 Redox titration curve: determination of iron. (6 hours)
Experiment 2 Complexometric titration: determination of Ca and Mg in domestic waters. (6 hours)
Experiment 3 Voltammetric determination of antioxidant compounds: ascorbic acid in food. (9 hours)
Experiment 4 Evaluation and analytical use of ion selective electrodes: anions determination. (9 hours)
Experiment 5 Molecular absorption spectrometry: nitrite determination. (9 hours)
Experiment 6 Resolution of mixtures by molecular absorption spectrometry. (9 hours)
Experiment 7 Molecular fluorescence spectrometry (9 hours)
Experiment 8 Atomic absorption and emission spectrometry: determination of lead and potassium (9 hours)

6. Methodology and working plan

Methodology
The students will carry out the experiments under supervision of the professors following a laboratory manual that will be available in advance.
In each experiment the following steps will be considered:
1. Personal and previous studies of the basics and the realisation of the experiments according to the lab manual.
2. Explanation by the professor and discussion with the students about operative aspects and essential or more difficult concepts.

3. Planning of the experiments to be carried out and their annotation in the booklet of the practical course.
4. Performance of the experiments and annotation of the relevant information by the student under constant supervision of the professor.
5. Elaboration and presentation of a report of each experiment on quantitative analysis which contains the obtained results and their precision.
6. Answer to the questions about the basics of the performed experiments and discussion about the quality of the presented results under direction of the professor.

Working plan

7. Evaluation of the student's learning results

- 1 st examination

Skill	Criteria	Instrument	Weight
Experimental work	1. Interest, attention and participation in the realization of the experiments. 2. Reply to the questions of the professor. 3. Accuracy and precision of the results. 4. Quality of the written reports	Assistance and participation in the problem-solving classes. Observations, professor's notes and correction of the reports	50%
Basics and calculations	Knowledge on theoretical concepts and needed calculations for obtaining and expressing analytical results	Written exam	50%

In order to pass this course it will be an inevitable requisite to obtain more than 50 % of the maximum points in each aspect.

- Extraordinary examinations

Same criteria will be applied in the case of extraordinary exams with the exception of those students that have not passed the "experimental work" skill or that wish to be examined again in this skill. Those students will have to carry out a practical exam, which will take place on the same day than the theoretical exam

8. Resources, bibliography and complementary documentation

Resources
- Analytical balances, top-loaded balances, oven, heating plate, magnetic stirrer.
- Atomic absorption and emission spectrometer.
- Fluorescence spectrometer.
- UV/Vis spectrometer.
- Potentiometer with selective working electrodes and Ag/AgCl reference electrode.
- Potentiometer with Pt working electrodes and Ag/AgCl reference electrode.
- Potentiometer with a glass electrode.
- Potentiostat with carbon paste working electrode, Ag/AgCl reference electrode and Pt counter electrode.
- Glassware and other material for volumetric analyses.
- Glassware and basic material for a laboratory of analytical chemistry.
- Solvents, reagents, and samples for analysis.

- Safety and protection systems in a laboratory of analytical chemistry.

Bibliography and complementary documentation

- Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Ed. Cengage Learning, 9th Edition, Delhi, 2014.
- Quantitative chemical analysis, D.C. Harris, Ed. W.H. Freeman, Nueva York, 1991.
- Statistics and chemometrics for analytical chemistry, J.C. Miller, J.N. Miller, Ed Prentice Hall, Harlow (UK) 2000.

The practical guides will be made available to the students in the eCampus. Any complementary documentation that is considered relevant (videos about the work in the laboratory, samples of spreadsheets, samples of reports on the results) will be also provided in the eCampus.