

30801 - Basics of analytical chemistry

Syllabus Information

Academic Year: 2019/20

Subject: 30801 - Basics of analytical chemistry

Faculty / School: 105 - Facultad de Veterinaria

Degree: 568 - Degree in Food Science and Technology

ECTS: 6.0

Year: 1

Semester: First semester

Subject Type: Basic Education

Module: ---

1.General information

1.1.Aims of the course

1.2.Context and importance of this course in the degree

1.3.Recommendations to take this course

2.Learning goals

2.1.Competences

2.2.Learning goals

2.3.Importance of learning goals

3.Assessment (1st and 2nd call)

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

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as lectures, practice sessions and autonomous work and study.

40 hours of lectures in the classroom plus 20 hours of practical classes in the chemical lab and in the computer room, in addition to all the work that the student needs to carry out to follow the course and complete all the tasks.

All the material needed to follow the sessions will be available in the Moodle 2.0 platform, and the student is expected to review it in detail before every class. The goal of the sessions is to expose only the most relevant and/or more complicated aspects. It is the responsibility of the student, who can otherwise ask the lecturer any questions during the tutorial activities, to read and understand the most descriptive aspects of the program. At least 25% of the duration of the lectures will be allocated to the application of the concepts exposed to problem solving and case studies. Discussion of the most important concepts with the students will be promoted.

Practice sessions will be held in sessions of 4 hours. Each group is expected to complete one practice session every week. Students should read in advance the material available in Moodle for every practice session in order to be able to follow every procedure and find the required information, when applicable, with the help of the lecturer, so that they can answer the questions that will be raised during the discussion prior to the beginning of the lab work, and even introduce the practice to other peers. After every practice session, students will present a written report. After finishing the practice sessions, in the last session, students will discuss for 4 hours with the lecturer about the results obtained, the calculations and the possibility of using other methods available in the literature.

4.2.Learning tasks

This course includes the following learning tasks:

Section I: Fundamentals of Analytical Chemistry (3.6 ECTS)

- **Lectures** (25 hours). It includes at least 6 hours devoted to problem-solving focused on the calculation of analytical results and on basic significance tests.
- **Practice sessions** (12 hours). Design to stress the different steps of the analytical procedure and their influence on the results, the selection of the right analytical method, calibration and the evaluation of the quality of the analytical results.
- **Autonomous work and study** (10 hours). Detailed as follows:
 - 8 hours devoted to following the activities of the course ?Information management in CTA?, available in Moodle and prepared by personnel from the Library, and to answer the questionnaires, which will be also available in Moodle, upon completion of a relevant theoretical item.
 - 2 hours of individual work searching for analytical information in databases.

Section II: Analytical techniques. Classic vs. Instrumental analysis (2.4 ECTS)

- **Lectures** (15 hours). Sessions last one hour, including at least 5 hours devoted to problem-solving.
- **Practice sessions** (8 hours). Focused on the comparison between classical and instrumental techniques and their impact on the analytical procedure.
- **Autonomous work and study** (7 hours) detailed as follows:
 - 3 hours of individual work, devoted to answer the questionnaires, which will be available in Moodle, upon completion of a relevant theoretical item.
 - 4 hours of work consisting in meeting with the lecturer and discussing with him about the practical classes, the calculations carried out, the answers provided to the reports, and about alternatives methods found in the bibliography. This activity will be carried out in the same groups organized for the practice sessions.

4.3.Syllabus

This course will address the following topics:

Section I: Fundamentals of Analytical Chemistry

- **Topic 1.** Introduction to Analytical Chemistry. Purpose of Analytical Chemistry. The analytical signal. Examples of analytical signals. Classifications. Searching for scientific information.
- **Topic 2.** Treatment of the analytical signal. Obtaining quantitative results. Standards in Analytical Chemistry. Error and imprecision of the measurements. Statistical treatment of quantitative results. Accuracy of the determinations. Treatment of qualitative signals.
- **Topic 3.** The analytical process. Difficulties in obtaining the analytical signal. Amount of analyte required to generate the analytical signal. Interferences affecting the analytical signal. Development of the analytical process. General characteristics of the analytical process.
- **Topic 4.** The analytical problem. Purpose of the analytical process. Analytical properties. Bibliography in Analytical Chemistry. Quality of the analytical results.
- **Topic 5.** Evaluation of analytical results. Introduction. Evaluation and reduction of the uncertainty of the results. Evaluation and reduction of the bias. Finding the causes of bias and uncertainty. The sampling problem.

Section II: Analytical techniques. Classic vs. Instrumental analysis.

- **Topic 6.** Gravimetric analysis. Introduction. Integrity of precipitation. Physical characteristics of the precipitate. Purity of the precipitate. Analytical properties of gravimetry. Gravimetric applications.
- **Topic 7.** Volumetric Analysis. General concepts. Requirements of a volumetric reaction. Primary standards. Influence of pH on titrations. Indicators of the endpoint. Working technique. Precision in volumetry. Causes of error in volumetric analysis.
- **Topic 8.** Applications of volumetry. Acid-base titrations. Titrations based on complex formation. Titrations based on redox reactions. Titrations based on precipitation reactions. Indirect titrations. Analytical properties of volumetry.
- **Topic 9.** Introduction to instrumental analysis techniques. General concepts. Optical analysis techniques: fundamentals, applications and analytical properties. Electroanalytical techniques: fundamentals, applications and analytical properties. Other techniques.

4.4.Course planning and calendar

| Activity | Classroom | Factor | Personal study | Total |
|-------------------|-----------|--------|----------------|-------|
| Lectures | 40 | 1,50 | 60 | 100 |
| Practice sessions | 20 | 0,5 | 10 | 30 |

| | | | | |
|----------------------------------|-----------|--|-----------|------------|
| Moodle and supervised activities | | | 17 | 17 |
| Exams | | | 3 | 3 |
| Total | 60 | | 90 | 150 |

Week 1 to 3: No activities are programmed. Instead, more lecturers are devoted to the subject 'Química General', so that students learn all the basic chemical concepts necessary to study Analytical Chemistry.

Weeks 4 to 13: 4 lecturers of 1 hour per week. In addition, on weeks number 5, 6, 9, 11 and 14, Moodle activities and questionnaires will be carried out.

Practice sessions will begin on week number 7 and will be held in the afternoon, according to the following distribution:

- Week 7: Basic concepts for calculation of results upon completion of an analytical procedure. Calibration. 4 h.
- Week 8: Working in an analytical lab. Titration. 4h.
- Week 9: Steps on an analytical procedure. Titration II. 4h.
- Week 10: Comparison between two different strategies to detect the end point of a titration. 4 h.
- Week 11: Sample and analyte preparation. UV-vis Molecular absorption. 4h.
- Weeks 14 and 15: Discussion focused on the results obtained and the reports presented. 4 h.

Further information concerning the timetable (<http://veterinaria.unizar.es/horarios1cta>), 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 Faculty of Sciences website and Moodle (<http://moodle.unizar.es/>).

4.5. Bibliography and recommended resources

All the class presentations, problems to solve, procedures for practical classes, as well as some examples of basic calculations, questions that students must be resolved over the course, and forums to raise further questions are available at <https://moodle2.unizar.es/add/>, within the corresponding site of 'Fundamentos de Química Analítica'. Registered students can access this site using their NIA and password.