# COURSE DATA

## DATA SUBJECT

**Code:** 34064
**Name:** Chemical Analysis
**Cycle:** Undergraduate Studies
**ECTS Credits:** 9
**Academic year:** 2025-26

## STUDY (S)

| Degree | Center | Acad. year | Period |
|---|---|---|---|
| 1201 - Degree in Pharmacy | Facultat de Farmàcia i Ciències de L'alimentació | 2 | Annual |
| 1201 - Degree in Pharmacy | Facultat de Farmàcia i Ciències de L'alimentació | 2 | Annual |
| 1211 - Double Degree in Pharmacy and Human Nutrition and Dietetics | Facultat de Farmàcia i Ciències de L'alimentació | 2 | Annual |

## SUBJECT-MATTER

| Degree | Subject-matter | Character |
|---|---|---|
| 1201 - Degree in Pharmacy | Chemical analysis | COMPULSORY |
| 1201 - Degree in Pharmacy | Chemical analysis | COMPULSORY |
| 1211 - Double Degree in Pharmacy and Human Nutrition and Dietetics | Asignaturas obligatorias del PDG Farmacia-Nutrición Humana y Dietética | COMPULSORY |

## COORDINATION

SAN JUAN NAVARRO LORENZO

# SUMMARY

Chemical Analysis is a basic core subject of 9 ECTS credits to be taught in the second course of the Degree in Pharmacy and Double Degree in Pharmacy and Human Nutrition and Dietetics. Attending to the proficiencies that a pharmacist has to develop, chemical analysis can be considered as a needed discipline, essential for the proper development in their professional practice. This subject introduces and develops the essential knowledge needed for the identification and determination of chemical compounds in matrices of pharmaceutical interest. The program consists of 12 thematic units divided into three blocks and a thematic unit that includes a series of laboratory practices involving the application of some of the analytical methods included in the program.
In the first block general objectives and work in chemical analysis are discussed. Steps of the analytical

process are described and finally referring to statistical treatment of analytical results.
Then, work methods and applications of volumetric and gravimetric methods commonly known methods of analysis are studied.
The program ends with 6 lessons that are dedicated to the description of different instrumental methods of analysis: optical methods, electroanalytical methods and chromatographic methods.
For each basis and necessary instrumentation, way of working and usefulness for analysis of substances of interest in the pharmaceutical field it indicated.

Subject concepts will be related to those sustainable development goals that are part of the 2030 Agenda.

## PREVIOUS KNOWLEDGE

### RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

### OTHER REQUIREMENTS

In order to successfully address the subject, is essential that the student gathers a number of previous knowledge and skills:

- Nomenclature and chemical formulation.
- Adjusting of chemical reactions.
- Chemical equilibrium in solution.
- Stoichiometric calculations.
- Basic mathematical calculations (solving equations, operations with logarithms, systems of equations ...)
- Use of the scientific calculator for performing mathematical operations and least squares regression.

## COMPETENCES / LEARNING OUTCOMES

### -

Act with autonomy in learning, making informed decisions in different contexts, issuing judgements based on experimentation and analysis, and transferring knowledge to new situations.

Apply such knowledge to the professional world, contributing to the development of human rights, democratic principles, principles of equality between women and men, solidarity, environmental protection and promotion of a culture of peace with a gender pe

Collaborate effectively in work teams, assuming responsibilities and leadership roles and contributing to collective improvement and development.

Contribute to the design, development and implementation of solutions that respond to social demands, taking into account the Sustainable Development Goals as a reference.

Demonstrate critical and self-critical thinking in the field of the degree programme, considering aspects such as professional ethics, moral values and the social implications of the different activities carried out.

Design, apply and evaluate reagents, clinical analytical techniques and methods.

Develop skills to update knowledge and undertake further studies, including pharmaceutical specialisation, scientific research, technological development and teaching.

Establish the classification of the main analytical methods, understand their fundamentals and know how to select their use according to the objective of the analysis.

Gather and transmit information in English at a level of proficiency equivalent to B1 of the Council of Europe.

Identify and understand the importance of each of the stages of the analytical process.

Know and understand, within the field of the degree programme, gender inequalities in society; integrate different needs and preferences based on sex and gender into the design of solutions and problem solving.

Know how to communicate effectively, both orally and in writing, adapting to the characteristics of the situation and the audience.

Know how to interpret, evaluate and communicate relevant data in the different areas of pharmaceutical activity, using information and communication technologies.

Make an appropriate use of the working methodologies of the techniques used in the practical laboratory sessions and be able to prepare and present an analytical report.

Module: Chemistry. Identify, design, obtain, analyse and produce active ingredients, medicines and other products and materials of health interest.

Module: Chemistry. Perform hygiene and sanitary analyses, especially those related to food and the environment.

Possess and understand knowledge in the different areas of study included in pharmacist training.

Propose creative and innovative solutions to complex situations or problems within the field of knowledge, to respond to diverse professional and social needs.

Transmit ideas, analyse problems and solve them with critical spirit, acquiring teamwork skills and assuming leadership when appropriate.

Understand the importance of quality control in the analytical laboratory, as well as the statistical procedures and tools necessary to carry out this control.

## DESCRIPTION OF CONTENTS

### 1. INTRODUCTION TO ANALYTICAL CHEMISTRY

Concept and structure. Types and levels of information. Stages of the analytical process. Classification of analytical techniques. Importance of qualitative and quantitative analysis in the pharmaceutical field.

## 2. SAMPLING, STORAGE, TRANSPORT AND PREPARATION OF MATERIALS

Importance of the processes of sampling and treatment of materials. Sampling. Sampling plan. Implementation of the sampling plan. Previous treatments of the sample. Filtration and centrifugation. Initial dissolution. Deproteinization. Extractive separation techniques. Other isolation and preconcentration techniques.

## 3. EVALUATION OF DATA, CALIBRATION AND VALIDATION OF ANALYTICAL METHODS

Errors in chemical analysis. Precision and accuracy. Rejection of discordant results. Presentation of analytical results. Concept of calibration. Linear calibration. Analytical figures of merit: sensitivity, detection and quantification limits, dynamic range. Standard addition method. Internal standard method. Concept validation. Hypothesis testing. Validation of accuracy. Validation of accuracy.

## 4. VOLUMETRIC AND GRAVIMETRIC ANALYSIS

Introduction to volumetric methods. Fundamentals of gravimetric methods. Precipitation mechanisms. Basic operations of gravimetric analysis. Calculations. Combustion analysis. Some applications of pharmaceutical interest.

## 5. ACID-BASE TITRATIONS AND BUFFER SOLUTIONS

Acid-base equilibrium. Titrating strong acids and strong bases. Titrating weak acid, weak bases and polyprotic systems. Buffer solutions: concept, limitations and utilities.

## 6. OTHER TITRATIONS. CONCEPT OF SIDE REACTION

Equilibrium of complex formation and precipitation: concepts of side reaction and conditional constant. Complexation and precipitation titrations. Equilibrium and redox titration.

## 7. ELECTROCHEMICAL ANALYSIS

Electrochemical cells. Electrode potentials. Potentiometry. Voltammetry. Instrumentation. Analytical methodology. Analytical features and performance. Some applications of pharmaceutical interest in qualitative and quantitative analysis. Electrochemical sensors.

## 8. ANALYTICAL SPECTROMETRY

Fundamentals. Instrumentation. Analytical methodology. Analytical features and performance. Some applications of pharmaceutical interest in qualitative and quantitative analysis in molecular and atomic spectrometry. Optical sensors.

## 9. INTRODUCTION TO CHROMATOGRAPHIC ANALYSIS AND COUPLED METHODS

Concept and classification of chromatographic techniques. Chromatographic modes. Main parameters in chromatography. Theory of the chromatographic separations. Coupled methods.

## 10. GAS CHROMATOGRAPHY

Fundamentals. Components in a gas chromatograph. Columns and stationary phases. Detectors. Effect of temperature. Analytical methodology. Some applications of pharmaceutical interest in qualitative and quantitative analysis. GC-MS analysis.

## 11. LIQUID CHROMATOGHRAPHY

Fundamentals. Classification. Thin Layer Chromatography. Column chromatography. Components in a liquid chromatograph. Analytical methodology. Some applications of pharmaceutical interest in qualitative and quantitative analysis. LC-MS analysis.

## 12. ELECTROPHORESIS

Fundamentals. Classification. Basic parameters. Capillary and gel electrophoresis. Methodology. Applications of pharmaceutical interest.

## 13. LABORATORY SESSIONS

SESSION 1.- Determination of total hardness of water by complexometric titration
SESSION 2.- Potentiometric determination of fluoride in toothpaste
SESSION 3.- Colorimetric determination of N-acetyl-L-cysteine with Fe (III) and 1,10-phenanthroline in pharmaceutical preparations
SESSION 4.- Determination of calcium content in tablets by atomic absorption spectrometry
SESSION 5.- Quality control of pharmaceutical preparations: determination of paracetamol, aspirin and caffeine by HPLC

## WORKLOAD

### PRESENCIAL ACTIVITIES

| Activity | Hours |
|---|---|
| Tutorials | 4,00 |
| Theory | 46,00 |
| Seminar | 15,00 |
| Laboratory | 25,00 |
| **Total hours** | **90,00** |

### NON PRESENCIAL ACTIVITIES

| Activity | Hours |
|---|---|
| Attendance at other activities | 0,00 |
| Individual or group project | 0,00 |
| Independent study and work | 0,00 |
| Preparation of lessons | 132,50 |
| Preparation for assessment activities | 0,00 |
| Resolution of case studies | 0,00 |
| **Total hours** | **132,50** |

## TEACHING METHODOLOGY

The subject is structured considering five types of activities for its development: lectures, problems seminars, laboratory sessions, tutorial sessions and workshops.

**Lectures and problems seminars.** Since the subject has a very practical nature, lectures and problem classes are alternated throughout the course, up to a total of forty hours of lectures (20 hours / semester). The time spent on theory and problems will vary depending on the needs.

**Lectures.** In the lectures, the instructor will offer an overview of the topic, emphasizing in the key concepts for understanding, and he/she will answer incidental doubts or questions.

**Problems seminars.** They have the aim of applying the knowledge acquired the lectures by solving questions and problems. The instructor will resolve for the whole class some selected problems; the students will work other new examples in small groups. Additional problems will be proposed to the students, to be resolved individually and they will be discussed with the instructor along individual evaluation meetings.

**Tutorial sessions.** Students will assist in small groups, participating in 4 sessions along the course. In them, the teacher will give to the student advices on all the elements of the learning process, in terms of global strategies and specific issues. Also, students will present the results they have obtained on the additional problems and the questions set by the teacher, and will discuss them on the blackboard.

**Laboratory sessions.** Prior to attending the lab, the student must have studied the script of each practice, review all the theoretical concepts involved, answer a series of previous questions, and prepare a flow diagram of the work to do. In the lab, the teacher will emphasize the most important points on the current session and will supervise the experiments. Once completed the experimental work, the student will perform the relevant calculations and will process statistically the gathered data, using spreadsheets and software available in the lab PCs. During the last laboratory session, the students will be evaluated by an exam on some issues discussed during the practical sessions. Finally, the student will prepare a detailed report showing the analytical results in all experiments performed.

**Workshops.** Throughout the course there will be workshops on various aspects of depth on the subject. At least one workshop will be devoted to working on sustainable development goals, by comparing different extraction techniques. The teacher will provide the necessary materials and propose a series of activities to promote learning.

## EVALUATION

The assessment of student learning will take into account all aspects outlined in the methodology section of this guide and be conducted in a continuous manner by the teacher. For this, the course is divided into three sections: theory, practice and other activities.

The rating of block theory constitutes 65% of the final grade. This section describes the knowledge acquired will be evaluated by performing two written exams throughout the course, the first at the end of the first quarter and the second will coincide with the first call. The tests will consist of two parts: (i) conceptual issues, which may also include topics to be developed for demonstrating the ability of synthesis and exposure, and (ii) problems that allow the student to demonstrate the degree of assimilation of fundamental concepts. The minimum offset between the two parts of the tests will be 4.

The minimum offset between the two partial exams note will be 4. The minimum mark to be obtained in theory block to average with the other activities of the subject is 4.5.

Those students who do not pass the minimum grade average in theory but have received a higher rating to 5 in either of the two parties (first or second semester) will be able to keep that note for the second call the academic year in force, but it will not be maintained for subsequent courses.

To evaluate laboratory practice, students will have to deliver memory and analytical report with the results obtained in all the practices. In addition, during the final practice session, an examination on issues discussed during the performance thereof will be made. The practice report 20% of the practice note, 30% consideration of issues and 50% the results obtained (depending on the precision and accuracy thereof) will be assessed. This rating will involve 20% of the final grade. The minimum mark that must be obtained in the laboratory practices to be able to make the average with the other activities of the subject is 4.5. In the case of not passing the subject, if the mark obtained in this block is equal or higher than 5.0, it can be maintained over the next two academic years. These practices are of mandatory attendance, and therefore non-recoverable, according to what is established in article 6.5 of the UV Assessment and Qualification Regulations for Bachelor's and Master's degrees. In case, for justified reasons, it is not possible to attend any of these activities, you will have to communicate with sufficient advance notice. In this way, the person in charge of the subject will be able to assign the student a session in another group.

15% of the overall grade for the course will come from activities in any of the sections of the learning process. These activities are non-recoverable. Aspects to be taken into account: active participation in tutorials and seminars, preparation and presentation of the proposed activities; class attendance, reasoned and clear participation in the discussions raised; progress in the proper use of chemical language; raising doubts; critical thinking and ability to collaborate with the rest of the group. In the case of not passing the subject, the mark obtained in this block will NOT be maintained for subsequent courses. The student may request in writing to be only evaluated with the exam.

FIRST CALL

The final course grade is calculated from the marks of theory, practices and activities by the following expression

**FINAL rating = THEORY x 0.65 + LABORATORY x 0.20 + CONTINUOUS ASSESSMENT x 0.15**

This expression only applies in the case of having obtained a minimum score of 4.5 points out of 10 on each of the parties. In order to pass the subject, it is necessary to obtain a final grade of 5 points out of 10.

Evidence of copying or plagiarism in any of the assessable tasks will result in failure to pass the subject and in appropriate disciplinary action being taken. Please note that, in accordance with article 13. d) of the Statute of the University Student (RD 1791/2010, of 30 December), it is the duty of students to refrain from using or participating in dishonest means in assessment tests, assignments or university official documents.

In the event of fraudulent practices, the **Action Protocol for fraudulent practices at the University of Valencia** will be applied (ACGUV 123/2020): https://www.uv.es/sgeneral/Protocols/C83sp.pdf

SECOND CALL

In the second call, the rating is obtained by applying the same criteria as in the first call. The students who in the first call fail the theory exam or the laboratory practice block will have to take an exam of the part or parts they failed.

Those students who do not show the theory exam (June and July) but who have participated and have noted in some / s of educational activities (partial review, seminars practices, tutorials) were qualified as *Not presented* in the first call Thriller course as in the second.

## REFERENCES


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