

**Course Unit: 15711 – Instrumental Methods of Analysis I**

Year 1 Semester 2 ISCED Code: 711 ECTS: 5,0

Type of Course Unit: Compulsory Delivery Mode: Face-to-face Language of Instruction: Portuguese

COURSE COORDINATOR: Maria Teresa Borralho Marques dos Carvalhos

**HOURS OF WORK**

TOTAL HOURS	Contact Hours								Hours in autonomous work
	Theory	Theory and practice	Practical and laboratory work	Field work	Seminar	Internship	Tutorial guidance	Other	
125	30		30						65

Prerequisites (if applicable):

**LEARNING OUTCOMES (knowledge, skills and competence)**

Upon successful completion of this Unit the student should be able to:

- Identify the different types of instrumental methods of analysis, their theoretical foundations and their practical applications.
- To plan and perform an instrumental analysis in its different components: choosing the most appropriate method of analysis for the sample concerned, treatment of the sample, analysis, treatment of results and critical appraisal of the results obtained.
- To have professional capacity for the use of instrumental methods of analysis in the analysis of the different types of environmental samples (water, soil, air and tissues of living organisms).

**CONTENTS**

Programming of a Chemical Analysis: Choice of an appropriate analytical method.

Preparation of the sample for analysis (drying, calcination, digestion, acid dissolution, etc.). Analyze. Treatment of results.

Basic Concepts in Chemical Analysis: Types of errors; Accuracy, accuracy and detection limit. Standard solutions. Calibration Curves. Using the Least Squares Methods. Concentration of solutions. Dilution of solutions.

Fundamentals and applications of optical methods in environmental analytical chemistry: molecular absorption spectrophotometry; atomic absorption spectrophotometry (flame atomization and electrothermal); atomic emission spectrometry and emission flame photometry.

Fundamentals and applications of potentiometric methods: direct potentiometry with specific electrodes.

**DEMONSTRATION OF THE CONTENTS COHERENCE WITH THE COURSE UNIT'S LEARNING OUTCOMES**

The syllabus contents allow to achieve the stated learning objectives, since:

- They approach concepts related to the programming of a chemical analysis in all the steps that comprise it, from the choice of an adequate method to the treatment of data and calculation of errors associated with the analysis (accidental and systematic).
- Allow students to acquire knowledge about the different instrumental techniques of analysis associated with optical methods, what types of chemical parameters are suitable and what their potentialities in terms of sensitivity / detection limit.
- Allow students to interpret analytical data and perform their treatment in order to determine the concentration of analyte in different samples under analysis, as well as to calculate the errors associated with it in terms of precision and accuracy.

**TEACHING METHODOLOGIES**

Theoretical classes, laboratory work, reports on the results obtained in the experimental work and guided study.

## **DEMONSTRATION OF THE COHERENCE BETWEEN THE TEACHING METHODOLOGIES AND THE LEARNING OUTCOMES**

Although the learning in this unit is based on theoretical classes and classes of laboratory practices, it will be based on the last ones that the student will make contact with the reality of the application of the instrumental methods of analysis to the analytical chemistry.

The theoretical classes will be constituted by a part of expository session, which will serve to introduce the fundamental concepts of the discipline associated to the programmatic contents. These classes will be followed by laboratory classes that aim, above all, the execution of a laboratory protocol that allows the student a first contact with laboratory techniques of chemical analysis and the application of the treatment to be performed to the data obtained experimentally.

In these techniques of chemical analysis will be used some of the concepts that are part of the contents previously discussed in the theoretical-practical classes, namely: determination of nitrite content in waters for human consumption (molecular absorption spectrophotometry); determination of Cu content in contaminated soils (atomic absorption spectrophotometry); determination of Na content in waste water (emission flame photometry); determination of nitrate content in irrigation water (direct potentiometry), etc.

The objective of these laboratory classes is, fundamentally, to provide a more practical vision of the theoretical concepts, as well as to instigate to the initiative and participation of the students.

The learning acquired in these laboratory classes will be measured through the production of Reports, one for each laboratory work. This methodology allows the evaluation of the learning objectives throughout the process, requires a greater interaction between the students and the teacher, allowing a constant evaluation by the teacher of the knowledge acquired by the student, allowing him to make the necessary adjustments in the accompaniment and support to the students .

## **EVALUATION METHODS**

Reports on Laboratory Work (40% of the classification), Final Exam (60% of the classification).

## **MAIN BIBLIOGRAPHY**

- Ewing, G.W. (1985). Instrumental Methods of Chemical Analysis. 5th Edition. McGraw-Hill International Edition.
- Pecsok, R.L., Shields, L.D., Cairns, T., McWilliam, I.G. (1976). Modern Methods of Chemical Analysis. 2nd Edition. John Wiley-Gonçalves, M.L.S. (nineteen ninety). Instrumental Methods for the Analysis of Solutions - Quantitative Analysis. 2nd Edition. Calouste Gulbenkian Foundation. Lisbon.
  - Skoog, D.A. & Leary, J.J. (1992). Principles of Instrumental Analysis. 4th Edition. Saunders College Publishing.
  - Skoog, D.A., West, D.M. & Holler, F. J. (1997). Fundamentals of Analytical Chemistry. 7th Edition, Saunders College and & Sons.
  - Braun, R.D. (1987). Introduction to Instrumental Analysis. McGraw-Hill International Editions. Chemistry Series.
  - Strobel, H.A, Heineman, W.R. (1989). Chemical Instrumentation: A Systematic Approach. 3rd Edition. Wiley Interscience.
  - Welz, B., Sperling, M. (1999). Atomic Absorption Spectrometry. 3rd Edition.

Year of implementation: 2017/2018 | Date of approval by the Technical-Scientific Board: 2016-07-27