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|---|---|---|---|---|---|---|---|
| Course Unit | Advanced Laboratory Techniques | | | Field of study | Engineering and related technics | | |
| Bachelor in | Biology and Biotechnology | | | School | School of Agriculture | | |
| Academic Year | 2019/2020 | Year of study | 2 | Level | 1-2 | ECTS credits | 6.0 |
| Type | Semestral | Semester | 1 | Code | 9029-510-2105-00-19 | | |

| Workload (hours) | 162 | Contact hours | T | TP | PL | TC | S | E | OT | O |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 30 | - | 30 | - | - | - | 4 | - |

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tuturial; O - Other

Name(s) of lecturer(s): Luís Avelino Guimarães Dias

## Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. To interpret the results of analytical chemistry by using the statistic.
2. To understand, apply the theoretical concepts of analytical chemistry and use the quality control in analytical measurement results.
3. To know the instrumentation of various analytical methods and understand the physical principle that serves as basis for the analytical technique.
4. To understand the advantages and disadvantages of each technique and identify the qualitative and quantitative capabilities of each technique.
5. To plan, prepare laboratory experiments and apply the various methods of calibration.
6. To acquire critical analytical capability and integration of knowledge in laboratory work.

## Prerequisites

Before the course unit the learner is expected to be able to:
1. Descriptive statistics and linear regression.
2. Acid-base, precipitation, oxidation-reduction and complexation reactions.
3. Intermolecular interactions and molecules polarity.
4. Nomenclature and typical organic reactions.
5. Electricity concepts.

## Course contents

Fundamentals of instrumental analysis. Methods of spectroscopy. Electrochemical methods. Methods of separation.

## Course contents (extended version)

1. Fundamentals of instrumental analysis:
   - Characterization of the experimental error rand propagation of uncertainty.
   - Precision and Accuracy.
   - Significant figures.
   - Methods of Calibration and validation of analytical methods.
   - Quality control of analytical results.
   - Selection of analytical method and interpretation of analytical data.
2. Methods of Spectroscopy:
   - Fundamentals of spectroscopy.
   - Absorption spectroscopy: ultraviolet-visible and atomic absorption.
   - Titrations and simultaneous analysis of two or more substances.
   - Emission spectroscopy: fluorescence, phosphorescence and luminescence.
   - Instrumentation.
   - Quantitative and qualitative applications.
   - Advantages and disadvantages of each technique.
3. Electrochemical methods:
   - Fundamentals of Electrochemical.
   - Potentiometry.
   - Indicators and reference electrodes.
   - Chemical sensors and biosensors.
   - Potentiometric titrations.
   - Concepts of voltammetry and polarography.
   - Conductimetry.
   - Instrumentation
   - Quantitative and qualitative applications.
   - Advantages and disadvantages of each technique.
4. Methods of separation:
   - Fundamentals of analytical separations.
   - Gas chromatography.
   - Liquid chromatography.
   - Thin-layer chromatography.
   - Ion chromatography.
   - Cappilary electrophoresis.
   - Instrumentation.
   - Quantitative and qualitative applications.
   - Advantages and disadvantages of each technique.

## Recommended reading


1. P. Patnaik, Deans's Analytical Chemistry Handbook, McGraw-Hill, 2004
2. J. Kenkel, Analytical Chemistry for Technicians, CRC Press, 2003
3. L H J Lajunen, P Peramaki, Spectrochemical Analysis by Atomic Absorption and Emission, Royal Society of Chemistry, 2005
4. Francis Rouessac and Annick Rouessac, Chemical Analysis: Modern Instrumentation Methods and Techniques, John Wiley & Sons, 2000
5. Douglas A. Skoog and all, Analytical Chemistry: An Introduction, Harcourt Inc, 2000


## Teaching and learning methods

Lectures for the acquisition of concepts of analytical chemistry and instrumental methods of analysis. Practical/theoretical-practical lessons of: problem-solving and analytical application of theoretical concepts, practical implementation of laboratory work and developing an analytical method using a scientific article. Preparation of reports of practical work.

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## Assessment methods

1. Assessment 1 - (Regular, Student Worker) (Final, Supplementary)
   - Final Written Exam - 70% (Assessment of knowledge acquired.)
   - Laboratory Work - 30% (The practical component will be measured taking into account the evaluation of written reports.)
2. Assessment 2 - (Student Worker) (Final, Supplementary, Special)
   - Final Written Exam - 100% (Assessment of knowledge acquired.)
3. Assessment 3 - (Regular) (Special)
   - Final Written Exam - 100% (Assessment of knowledge acquired.)

## Language of instruction

Portuguese

## Electronic validation

| Luís Avelino Guimarães Dias | Miguel José Rodrigues Vilas Boas | Joaquina Teresa Gaudêncio Dias | Amilcar Manuel Lopes António |
|---|---|---|---|
| 02-12-2019 | 03-12-2019 | 03-12-2019 | 03-12-2019 |

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