

Course Unit	Advanced Analytical Techniques	Field of study	Engineering and Similar Techniques
Master in	Food Quality and Safety	School	School of Agriculture
Academic Year	2022/2023	Year of study	1
Type	Semestral	Semester	2
Level	2-1	ECTS credits	6.0
Code	6369-508-1105-00-22		
Workload (hours)	162	Contact hours	T 30 TP - PL 30 TC - S - E - OT 4 O -

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

Name(s) of lecturer(s) Clementina Maria Moreira dos Santos, 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 recognize the sampling and treatment of the sample as a fundamental step in the analysis.
2. To organize and carry out sampling procedures.
3. To use different treatments of sample and realize the goal of each analytical application.
4. To know the instrumentation and learn how to interpret the information obtained from various analytical methods.
5. To understand the advantages and disadvantages of each technique.
6. To identify the qualitative and quantitative capabilities of each technique.
7. 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. General knowledge of inorganic and organic chemistry.
2. General knowledge of analytical chemistry.
3. Fundamentals knowledge of instrumental methods of analysis.

#### Course contents

Sampling and processing of samples for analysis. Infrared spectroscopy. Mass spectrometry. Nuclear magnetic resonance. Sensors and food analysis. Simple and multivariate models of calibration.

#### Course contents (extended version)

1. Sampling and sample processing for analysis:
  - Solubilization, digestion, extraction, pre-concentration and interfering compounds.
2. Physical characterization and rheological properties of food: texture and viscosity.
3. Infrared spectroscopy applications in food analysis (NIR and MIR):
  - Infrared absorption and vibrational interactions;
  - Characteristic bands of functional groups and interpretation of spectra;
  - Techniques for analyzing samples and quantitative applications (NIR and MIR).
  - Application of multivariate models of prediction.
4. Mass spectrometry:
  - Introduction of the sample, sample ionization techniques, ion analyzers and detectors;
  - mass spectrometers coupling for gas and liquid chromatography and qualitative applications.
  - Qualitative and quantitative applications.
5. Nuclear magnetic resonance:
  - Magnetic field interaction and nuclear spin;
  - Analytical principles, relaxation processes, chemical deviation and interference;
  - Heteronuclear and homonuclear coupling, structural information from spectra and applications.
6. Sensors and food analysis:
  - Chemical sensors and biosensors;
  - Electronic Tongue;
  - Application of multivariate models of prediction.
7. Simple and multivariate models of calibration.
  - Analytical methods validation.
  - Models validations and predictive performance evaluation.

#### Recommended reading

1. D. P. Pavia, G. M. Lampman, G. S. Kriz, J. R. Vyvyan, Introduction to Spectroscopy, Brooks/Cole, Cengage Learning, 2009
2. D. A. Burns and E. W. Ciurczak (ed.), Handbook of near-Infrared Analysis, CRC Press; Taylor&Francis Group, 2008
3. B. Mistry, Handbook of Spectroscopic Data: Chemistry - UV, IR, PMR, CNMR and Mass Spectroscopy, Oxford Book Company, 2009
4. U. Holzgrabe, I. Wawer, B. Diehl, B Diehl, NMR Spectroscopy in Drug Development and Analysis, Wiley-VCH, 1999
5. P. Traldi, F. Mango, I. Lavagnini, Quantitative Applications of Mass Spectrometry, John Wiley & Sons, Ltd, 2006

#### Teaching and learning methods

Lectures for the acquisition of concepts of 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.

#### Assessment methods

- Assessment 1 - (Regular, Student Worker) (Final, Supplementary, Special)
- Final Written Exam - 100% (Assessment of knowledge acquired.)

#### Language of instruction

1. Portuguese
2. English

## Electronic validation

Clementina Maria Moreira dos Santos, Luís Avelino Guimarães Dias	Maria da Conceição Constantino Fernandes	Maria Letícia Miranda Fernandes Estevinho	Maria Sameiro Ferreira Patrício
19-12-2022	19-12-2022	11-01-2023	11-01-2023