

Academic Year/course: 2021/22

25238 - Analytical technology for the detection of contaminants

Syllabus Information

Academic Year: 2021/22

Subject: 25238 - Analytical technology for the detection of contaminants

Faculty / School: 201 - Escuela Politécnica Superior

Degree: 277 - Degree in Environmental Sciences
571 - Degree in Environmental Sciences

ECTS: 6.0

Year: 3 and 4

Semester: Second Four-month period

Subject Type: Optional

Module:

1. General information

2. Learning goals

3. Assessment (1st and 2nd call)

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, laboratory sessions and tutorials.

Being a course taught on the 3th year of the Degree, it is taken for granted that the student has already received some general basic knowledge of chemical analysis. It is intended that the student retains such knowledge, expand and put them into practice. Therefore, this course is scheduled to be eminently practical.

This course is designed to be developed in 4 hours straight sessions a week. Depending on how advanced or not the matter, 2 sessions of theoretical class and then 2 sessions of laboratory practice.

On the other hand, practices or applied sessions are open and modifications can be made having regard to possible demands of students enrolled, as well as joint participation with other subjects of the same course.

This course is very practical and it is intended that students are able to apply the knowledge and skills they have acquired. Therefore, teaching is scheduled giving great importance to the practical and applied part, but from an intensification of theoretical knowledge, on which laboratory work will be developed. In order to optimize the learning process, lectures and practice sessions are interspersed, reducing the time in which students acquire the necessary knowledge or receive the corresponding instructions until applied in the laboratory.

4.2. Learning tasks

This course is organized as follows:

- **Lectures** (30 hours). 2 weekly hours. They will consist of expository sessions in the classroom whose purpose is for students to acquire theoretical knowledge about existing analytical methodologies for the determination of pollutants in the environment. Likewise, real cases will be presented that will allow the student to plan the work to be developed in the laboratory sessions.
- **Laboratory sessions** (30 hours). Theoretical knowledge acquired to apply to the analysis of real samples will be implemented. The student must follow specific protocols for the management of the different instrumental

techniques of analysis included in the course, including sampling, preparation and chemical treatment of the samples, handling equipment and collection and processing of data and interpretation of Results. To achieve the goals of the ODS, the following complementary activity is proposed: The practice script will provide an annex with a list of the most important chemical reagents to be used in the laboratory practices together with the link to download the safety data sheets of these reagents for the prevention of risks during their handling. In each of the practices, emphasis will be placed on the importance of handling each reagent correctly, its hazardousness (toxicity) to health and the environment, and therefore having basic knowledge of how to manage the waste generated in the teaching laboratory (for example: differentiating between reagents that can be poured directly down the drain from those that require collection in carafes, minimising the amount of reagents to be used).

- **Tutorials.** Sessions, student demand, to resolve any doubts both theoretical sessions and practices.

4.3. Syllabus

This course will address the following topics:

Lectures

- **Topic 1.** Bibliographic search related to analytical methods for the detection of contaminants. Legislation, scientific magazines, official methods and standardized methods.
- **Topic 2.** Planning an analysis of contaminants in environmental sample. Sample protocol. Real case studies (practical) of environmental analysis.
- **Topic 3.** Calibration Methods. External calibration. Standard addition and the use of an internal pattern. A study of the quality parameters in Chemical Analysis. Basic Chemometrics.
- **Topic 4.** Determining the metals present in environmental samples. Methods of digestion/decomposition. Atomic Emissions Spectroscopy-ICP. Emission Spectroscopy - Mass Spectroscopy. Introduction to simple solids for determining metal. Real case studies.
- **Topic 5.** Determination of organic contaminants in environmental settings.
 - 5.1- Separation methods, conventional methods of extraction and more specific methods for the analysis of organic contaminants (solid-phase extraction, solid-phase microextraction, supercritical fluid extraction). Extract cleaning methods. Practical case studies (articles of investigation).
 - 5.2- Chromatographic Analysis Techniques. Optimization of chromatographic separation. Selection of chromatographic columns. Introduction to using sample for the analysis of volatile organic compounds (techniques of the purge and trap system, technique of headspace analysis). Selective detection systems (ECD, nitrogen-phosphorous detector) and universal detection systems (UV spectrometry, mass Spectrometry, FID). Practical case studies.

Laboratory sessions

- **Section I.** Sampling and characterization of drinking water taken from different areas. Determining various parameters of water quality (pH, conductivity, chloride, residual chloride, hardness, nitrates, sulphates, phosphates, oxidability)
- **Section II.** Sampling and characterization of urban sewage (before and after purification). Determination of different contaminant parameters (Solids in Suspension, organic nitrogen, ammoniac, phosphates, DQO, DBO).
- **Section III.** Determination of heavy metals in solid waste (sewer sludge, industrial or agricultural waste). Study of bioavailability.
- **Section IV.** Determination of organic compounds (poly-aromatic hydrocarbons) in water and soil. Optimization of: extraction methods, Chromatographic separation (High Performance Liquid Chromatography, and Gas Chromatography), detection system for Mass Spectrometry.
- **Section V.** Selection of a method for the determination of a contaminant in an environmental sample putting in practice the different techniques of measuring, calibration method and quality control. Utilization of the Standard Material Certification.

4.4. Course planning and calendar

Further information concerning the timetable, 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 website and Moodle.

Week	1	2	3	4	5	6	7	8	9	10	11	12 (1)	13	14	15	16	17
Activity																	
Theoretical classes	2	2	2	2	2	2	2	2	2		2		2	2	2	2	

Problems																	
Laboratory classes	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Evaluation																	
Independent learning																	
Individual work	4	4	4	4	5	4	4	4	6	4	4	8	4	4	5	4	4
TOTAL	8	8	8	8	9	8	8	8	10	4	8	8	8	8	9	8	4

4.5. Bibliography and recommended resources

- BB** Análisis químico de trazas / Editoras: Carmen Cámara, Concepción Pérez-Conde . Madrid : Sintesis, 2011
- BB** Sogorb Sánchez, Miguel Angel. Técnicas analíticas de contaminantes químicos : aplicaciones toxicológicas, medioambientales y alimentarias / Miguel Ángel Sogorb Sánchez, Eugenio Vilanova Gisbert . Madrid : Díaz de Santos, 2004
- BC** Aguas / PANREAC . Barcelona [etc.] : Montplet & Esteban, 1983
- BC** Análisis químico de aguas residuales / Jesús Beltrán de Heredia Alonso ... [et al.] [Badajoz] : Universidad de Extremadura, Instituto de Ciencias de la Educación : Abecedario, 2004
- BC** Dean, John R.. Extraction methods for environmental analysis/ John R. Dean. Reprint. Chichester [etc.]: John Wiley & Sons, 1998
- BC** Dean, John R.. Methods for environmental trace analysis / John R. Dean . Chichester [etc.] : Wiley , cop. 2003
- BC** Dunnivant, Frank M.. Environmental laboratory exercises for instrumental analysis and environmental chemistry / Frank M. Dunnivant Hoboken, New Jersey : John Wiley & Sons, cop. 2004
- BC** Harris, Daniel C.. Análisis químico cuantitativo / Daniel C. Harris . 3ª ed. Barcelona [etc.] : Reverté, cop. 2007
- BC** Métodos normalizados : para el análisis de aguas potables y residuales / preparado y publicado conjuntamente por American Public Health Association, American Water Works Association, Water Pollution control Federation ; directora de edición Mary Ann H. Franson Madrid : Díaz de Santos, D.L. 1992
- BC** Métodos oficiales de análisis / [publicados por el] Ministerio de Agricultura, Pesca y Alimentación, Dirección General de Política Alimentaria . Madrid : Secretaría General Técnica, Ministerio de Agricultura, Pesca y Alimentación, 1993-1994
- BC** Reeve, Roger N.. Introduction to environmental analysis / Roger N. Reeve Chichester [etc.] : John Wiley & Sons, cop. 2002
- BC** Trace determination of pesticides and their degradation products in water / [edited by] Damià Barceló, Marie-Claire Hennion . 2nd. ed. Amsterdam [etc.] : Elsevier, 2003

The updated recommended bibliography can be consulted in: <http://psfunizar10.unizar.es/br13/egAsignaturas.php?id=10989>