

Master 2
Chemical and Microbiological Characterization for Environmental Issues

Semester 1 (Autumn) (30 ECTS out of the 40 proposed)

Topic	Course Title	Course Description	ECTS
Advanced analytical chemistry	Advanced separation techniques	Knowledge of today's separation methods, from sample preparation to analysis of separated compounds, their use in the fields of research, industry and environmental risk management in a regulatory context (environment and living)	2
	Advanced spectrometric techniques-Coupling	Applied atomic spectrometric techniques (AAS, AFS ICPAES, ICPMS) including sample introduction approaches (nebulization, laser ablation, GC), oriented toward practical applications. Couplings between liquid chromatography and spectrometric detectors such as ICP-MS or AFS for the speciation analysis of different trace elements (e.g. As, Se, Cr, Sb, Hg). Examples of application for chemical species determination in environmental samples (water, sediment/soil), biological tissues and industrial samples are also presented.	2
	Electrochemical sensors	Recent developments in the field of analytical electrochemistry and sensor design, microsensors (theory of mass transport) Reminders of basic notions of analytical electrochemistry (if necessary); Main methods of electroanalysis; Microsensors, electrochemical sensors: Principle, design and role in the miniaturization of the analyzes (microfluidic, lab-on-chip and μ TAS). Applications to Biological Target Analyzes and Cell Scale Measurements; Electrochemical sensors / microsensors: Applications to pollutants detection in the environment and on-site analyzes.	2
	Biological macromolecules characterization	Introduction into proteomics and the related modern analytical methods (including proteomic mass spectrometry) for proteome analysis of biological organisms.	2
	Organic contaminants analysis	Overview of the analytical techniques applied to trace organic contaminants analysis in environmental and / or food matrices, with a focus on families of current toxic contaminants. (sample preparation and separation methods, analysis of trace compounds especially mass spectrometry methods, regulatory aspects related to validation of quantitative methods of multi-residue analysis)	2

Microbiology and molecular biology for Environmental applications	Microbial biotransformations and environmental applications: project	Knowledge on the environmental applications of microbial metabolisms, selected examples on the application of the metabolic capacities of microorganisms as an environmental tool, a tool for bio-depollution and / or bioremediation	4
	Microbial biotransformations and environmental applications : conferences	Presentation of some selected examples on biodegradation and biotransformation of organic and metallic compounds, and applications of metabolic capacities of microorganisms as environmental tool, tool for bio-depollution and / or bioremediation	2
	Molecular biology, Technological applications	Knowledge of recent molecular tools and their applications Design and implementation of a laboratory project Acquire autonomy in setting up experimental protocols in molecular biology	6

Statistical tools , chemometrics and quality	Analytical methods performances evaluation	Tools to ensure the reliability of a physical-chemical measurement method. Characterization and validation of a physical-chemical measurement method: Concepts of statistical control in a laboratory - Standardized definitions - Evaluation of the characteristics of a method and / or a measuring device	2
	Quality Assurance for Analysis	Implementation of quality in chemical or biological analyses laboratories : Metrology : definition, organization General principles of quality assurance for analysis Laboratory validation of analytical techniques (quality Control samples, Reference materials and standards...) External validation: control charts, proficiency testing Accreditation	2
	Statistical tools project	Advanced statistical tools used in biology Multiple regression, Generalized linear model selection Multivariate analysis (PCA, AFC, ACoP, Hierarchical classification) Multivariate regressions (PerMANOVA, CCA, RDA) Introduction to the analysis of microbial biodiversity	4

Trace elements in the environment	Trace elements biogeochemical cycles	Know and understand the cycle of elements in the environment (water, soil, air / natural or anthropized environments): sources, transport, accumulation, transfer to the living, and physicochemical and microbiological mechanisms involved in their reactivity and physical-chemical distribution.	2
	Speciation concepts and analysis	Knowledge of the various concepts related to the term "speciation" and the main methods for determining the physical-chemical distribution of elements in a given medium. Control of the parameters related to analysis of trace elements through knowledge of the speciation and fractionation strategies and analysis techniques	2

Research tools and applications	Scientific papers and documentation critical evaluation	Reading, summary and commentary of several types of scientific and technical documents: publication, report, standard and instructions for use in order to be able to critically read a scientific document, summarize it or make a guide, comment and make a synthetic oral presentation	2
	Environmental Project	An environmental subject is proposed to a group of students who are in charge to prepare a report including technico-economic approaches. The projects are carried out in partnership with APESA or local authorities or with professionals with special needs in line with the training theme.	2

Language	French as a Foreign language		2
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Semester 2 (Spring) (30 ECTS)		
Internship	Academic or industrial research project	30