WACOMA 2ND SEMESTER TEACHING MODULES - UNIVERSITY OF CADIZ - SPAIN

Module Title GIS in aquatic pollution management	**Professor** Alfredo Fernández
Summary of Course Content The course is divided in: **Lectures:** Describe use of GIS as a practical tool for modeling marine environment along with data needed in marine environmental investigation, in order to show hydrodynamics of coastal circulation patterns in Cadiz Bay through numerical simulations. **Data analysis:** Pollution dynamics in Andalusian fishing grounds.	

Module Title Hydro-meteorological hazards and risks at coastal zones	**Professor** Óscar Ferreira
Summary of Course Content Synthesis of concepts of hazard versus risk. Concepts on mitigation, protection and adaptation. Examples for coastal areas. Characterization of hydro-meteorological coastal hazards: shoreline retreat, storm induced coastal erosion, overwash and flooding. Involved processes and their scales (time and space). Coastal hazard indicators. Cartography and representation of coastal risks, including hazard and exposure/consequence.	

Module Title Communication Science	**Professor** Sokratis Papaspyrou
Summary of Course Content Presentations and posters are some of the principle means for scientists to show their work to the scientific community, funding agencies, future employers and the general public. Although these forms of communication are an integral part of scientific work, many scientists never receive proper training. As a result, too often, unattractive and overloaded scientific presentations confuse the audience and pass-by unnoticed. The course will provide to the students some basic and advanced skills in science communication. Students will be introduced to modern theories of communication and the latest trends in design and presentations with hands-on exercises.	

Module Title Beach nourishment as a management tool	**Professor** Juan José Muñoz Pérez
Summary of Course Content Causes of erosion are presented and possible solutions are commented. Beach nourishment versus groin construction is discussed in detail. - Introduction about Shallow water characteristics (Wave climate, wave breaking, sediment transport,etc.); - Beach morphodynamics (equilibrium profile, submerged bars, sand size); - Flood level (inverted barometer effect, run up, surf beat); - Pros and cons of Beach nourishment (dredging, methodology, maintenance cost) versus Groin construction.	

Module Title	**Professor**
Bioaccumulation and bioavailability: keys for quality ecosystem	Julián Blasco Miriam Hampel

Summary of Course Content

Theoretical lectures will be given to introduce to basic and advanced concepts of bioavailability and bioaccumulation in with special emphasis on marine environments. Introduction to biomarker approaches for biomonitoring. After the theoretical lectures, the students will be asked to implement these concepts in a practical site specific environment of their choice analyzing existing contamination problems and proposing monitoring strategies for risk assessment. This work will be discussed in a workshop carried out with the students. Where they present their projects in an open session in order to assess the possibility to be developed in a real context.

Module Title	**Professor**
Microbial potential for the attenuation of contaminants in coastal ecosystems and bioremediation	Alfonso Corzo Sokratis Papaspyrou Emilio Garcia Robledo

Summary of Course Content

The course is intended to highlight the problems pollutants cause and reasons for their persistence in the environment and to demonstrate the role that microbial communities play in the clean-up of organic and inorganic compounds that are either accidentally or deliberately released into the environment. The different metabolic abilities of microbes to degrade or transform pollutants as well as the various bioremediation strategies based on the use of different groups of microorganisms will be covered. The advantages and disadvantages of using bioremediation will be made clear.

Module Title	**Professor**
Chemical and ecotoxicological guidelines for management of dredged material: regulation of disposal in open waters	Carmen Casado Martínez

Summary of Course Content

The content of this module intends to apply the methodology used for the integration of different LOEs for the evaluation and management of sediment and dredging material. It will be studied the advantages and disadvantages associated with the incorporation of sediment toxicity bioassays and new early warning measures (biomarkers) in the evaluation and management of dredging material. In the same way, the legal context of the management of dredging material in Spain and in other countries will be analyzed.

Module Title	**Professor**
Coastal & marine areas: managing complex systems	Dr. Javier García Sanabria

Summary of Course Content

1. Introduction to integrated coastal and marine management as a complex issue. Singularities of coastal and marine areas. Frameworks and methodologies (the Spyglass model, the Decalogue of management, the orders of outcomes, the public policy cycle). Key issues: policy and strategy, participation, coordination, institutions, instruments, information and communication, formation

and training, education, and resources. Exercise: Debate on Governance;
2. The international context for Marine Spatial Planning: the United Nations and the European Maritime Policy. The new Directive of Marine Spatial Planning. Cases of study from international, national, regional and local scales of management. Practical simulation exercise: planning a coastal-marine area;
3. Applying lessons learned. Group exercise: designing an integrated management initiative. Oral presentations.

Module Title Coastal Cities Planning Guidelines	**Professor** Dr. María De Andrés García Dr. Javier García Sanabria
Summary of Course Content 1. Introduction to urban coastal areas. Study of the coastal cities of the world. Relationship with coastal and marine ecosystems; 2. Integrated Coastal Zone Management initiatives in urban areas. Ecosystem services and ecosystem based management in coastal urban areas; 3. Group exercise: New initiatives for ecosystem based management in coastal urban areas.	

Module Title Coastal Flooding Hazards	**Professor** Laura del Río Rodríguez
Summary of Course Content This module focuses on the natural processes (Tsunamis, Storm surges, Tidal flooding, Flooding in estuarine environments, Coastal subsidence, etc.) that can produce flooding of coastal lowlands. The main objective is that the students understand the main characteristics of these processes, their occurrence and general dynamics, as well as some basic procedures for coastal flooding hazard assessment and risk management.	

Module Title Design and writing of research projects	**Professor** Julián Blasco Miriam Hampel
Summary of Course Content This course has as main objectives: - To learn how to design and write a international research project; - Identification of appropriate international partners and consortium building; - Elaborate a risk evaluation plan at different levels (management, experimental, etc) and to propose alternative options as contingency and mitigation plans; - To present and defend the projects at a panel composed by the students and teachers; - To evaluate a project according to EU evaluation process guidelines.	

Module Title Further Language skills	**Professor** Irene Laiz Jose Antonio López-López
Summary of Course Content	

The main subjects of this course are:
- Compilation of main keywords, including: risk, hazard, exposure, consequence, vulnerability, susceptibility, exposure, resilience, flood, erosion, bioaccumulation, biomagnification, vulnerability of natural ecosystems, integrated coastal management, climate change, sea level rise, sea water intrusion, pollutants, water resources, socio-economic indicators, stakeholder, etc.
- Examples of concepts within the right context (i.e., to distinguish between risk and hazard, or between bioaccumulation and biomagnification);
- Solution of a case study;
- Oral presentation of topics related to selected keywords using a proper scientific language in the context of the master;
- Discussion about water and coastal management topics defending a point of view.

Module Title	**Professor**
General methodology to assess quality of coastal ecosystems	Laura Martín

Summary of Course Content

The main subjects of this course are:
1. Introduction to basic techniques based on biological / ecological response measures for environmental quality assessment;
2. Introduction to basic ecotoxicological techniques under laboratory conditions: toxicity bioassays with equinoderms, bivalves and fish;
3. Techniques for environmental risk assessment calculation: Predictive no effect concentrations.

Module Title	**Professor**
Integrated management of wetlands and harbors	Dr. Javier García Onetti

Summary of Course Content

The course is divided in:
1. Introduction to port coastal areas. Importance and particularities of the maritime-port sector and relationship with the integrated and ecosystem based approach. Ecosystem services in port coastal areas. Background and new frameworks;
2. Analysis of port systems from a socio-ecological perspective. Multidimensional influence, identifying its positive and negative impacts. Delimitation and characterization of socio-ecological port systems. Real examples and exercises;
3. International initiatives for the environmental management of port systems. Group exercise: selection and analysis of port systems around the world with a socio-ecological perspective. Management considerations.

Module Title	**Professor**
Integrated tools to determine environmental quality	María Laura Martín Díaz

Summary of Course Content

The course is based on:
- Design and application of an integrated methodology for the evaluation of environmental quality.
- Interpretation and analysis of a data set that contains values related with contamination and toxicity;
- Integration of different Lines Of Evidence (LOE). Principal Component Analysis;

- Determine the pollution index of contaminated areas and environmental quality guidelines; - Propose a protocol of use of Environmental Quality guidelines for an integrated coastal area management.

Module Title Integrated water resources and natural areas management in the coastal zone	**Professor** Adolfo Chica
Summary of Course Content The course is divided in: **Lectures:** Approach to coastal and marine protected areas; Planning and management of coastal and marine protected areas; Zoning techniques for coastal and marine protected areas. **Data analysis:** Use of GIS as a practical tool to work with data needed in natural zones investigation, in order to model marine and coastal environment.	

Module Title Quarrying and mining activities impacts on water quality	**Professor** José Miguel Nieto Liñán M Dolores Basallote Sánchez
Summary of Course Content This module describes the case of river basin management in catchment areas with sulphide or coal mining. The module deals with water characterization, assessment and remediation of freshwater bodies affected by Acid Mine Drainage.	

Module Title Remote Sensing (part I): management applications	**Professor** Jesús Gómez-Enri
Summary of Course Content Understanding the basis of Remote Sensing applied to Earth Observation with theory and computer workshops: - Introduction; - Electromagnetic Radiation; - Useful concepts in Remote Sensing; - Ocean Remote Sensing techniques; - Applications.	

Module Title Remote Sensing (part II): algal blooms	**Professor** Jesús Gómez-Enri
Summary of Course Content Understanding the basis of Remote Sensing applied to Earth Observation with theory and computer workshops: - Introduction; - Ocean Colour; - Sensors; - Ocean Colour Remote Sensing Techniques; - Applications.	

Module Title Salt marshes for flood risk management strategies	**Professor** Gloria Peralta
Summary of Course Content The course is articulated in: • Ecosystem services of vegetated coastal habitats; • Coastal protection services of salt marshes; • The FAST project and the MI-SAFE package; • Study cases: using the MI-SAFE viewer to evaluate potential role of salt marshes on coastal protection.	

Module Title Scientific databases: organization and management	**Professor** Gloria Peralta
Summary of Course Content The main topics of this module are: • Open source database structure; • Types of variables and use of categorical ones for processing information; • Spreadsheet tools for basic database processing; • Study cases: working with scientific data.	

Module Title Scientific paper writing	**Professor** M Laura Martín Díaz Alfredo Izquierdo
Summary of Course Content The content of this module addresses the acquirement of the knowledge related to scientific paper writing: 1. Search for scientific abstracts, scientific publications, etc: Databases; 2. Writing scientific articles and reviews; 3. Preparation of master thesis; 4. Authors' guide and presentation of an article for evaluation and publication; 5. Types of journals and impact indexes.	

Module Title Integrative assessment of sediment quality	**Professor** Sokratis Papaspyrou Ignacio Moreno Garrido
Summary of Course Content The objective of this course is to provide students the essential knowledge background to understand the necessity of a multidisciplinary approach to sediment ecotoxicology and the tools to perform and analyse different toxicity tests in this ecological compartment. - Introduction: Rationale of sediment integrative toxicity assessment; - Sampling strategies and sample conservation and treatment;	

- Chemical characterization of sediments;
- Benthic organisms and standard sediment bioassay species;
- Bioavailability, bioaccumulation and biomagnifications;
- Identifying ecological stress: in vitro vs. in situ bioassays; classical approaches and new insights;
- Practical design of an avoidance tool to measure toxicity using aquatic invertebrates (rotifers, artemia or both).

Module Title	**Professor**
Sensitive tools for the assessment of environmental and human risk	María Laura Martín Díaz

Summary of Course Content

The content of this module addresses the acquirement of the knowledge related to biomonitoring environmentally polluted areas using biomarkers of exposure, effect and susceptibility, in order to be included as early warning tools in environmental/human risk assessment. Together with this main aim, the use of different biomonitoring species will be analysed as sentinel species in laboratory and field ecotoxicological studies.

Module Title	**Professor**
Tools for hazard assessment of chemical and complex environmental media	Julián Blasco Pablo A. Lara Martín

Summary of Course Content

This course has as main subjects:
- Introduction to contamination in aquatic settings;
- Organic legacy and emerging contaminants;
- Metal and metalloids legacy substances;
- Metal and metal oxide nanoparticles;
- Environmentally relevant physicochemical properties of contaminants;
- Environmental processes involved in the partitioning and degradation of chemicals;
- Equilibrium Criterion (EQC) models.

Module Title	**Professor**
Weight of Evidence Assessment of Chemical Contamination in Aquatic Environments	Roberta Guerra

Summary of Course Content

Weight of Evidence refers to integration of data generated from multidisciplinary environmental studies involving multiple, independent Line of Evidence, which typically comprise both chemical and biological measurements. It is a determination related to possible ecological impacts based on multiple Line of Evidence. Weight of Evidence assessments provide three types of information: 1) relative certainty of adverse environmental effects due to stressors; 2) possible causation; 3) key uncertainties that, if resolved, will improve management decision-making.