UNIVERSITÀ DELLA CALABRIA
DIPARTIMENTO DI **INGEGNERIA DELL'AMBIENTE**

HUMAN AND ECOLOGICAL RISK ASSESSMENT

A.A. 2021/2022

Teaching Unit	Human and Ecological Risk Assessment	
Unit Code	?	
Degree title (CdS)	ENVIRONMENTAL AND TERRITORIAL SAFETY ENGINEERING	
Degree level	Second	
Module code	?	
Scientific Disciplinary Sector (SSD)	BIO/07	
Number of ECTS credits (CFU)	6	
Teaching Unit Category (TAF)	Core Teaching Unit	
Teaching Unit Qualification	Optional	
Course year	2	
Semester	Second	
Lecturer	Nic Pacini	
Other instructors involved	none	
Module breakdown	Hours of Lectures	42
	Hours of Practicals	
	Hours of Laboratory	
	Hours of Individual study	108
Language	English	
Mandatory prerequisites	none	
Prerequisites	Basic understanding of environmental chemistry including element cycles and fundamental ecology	
Content	This module is designed to provide the student with an understanding of the theory and practice of ecological risk assessment (ERA) as a risk management tool and as a working basis for setting priorities for conservation and resource management in a broader context. It will handle the concept of uncertainty in environmental assessment and its weight in contributing to strategic choices. It will link to Human Health Risk Assessment theory and practice and it will provide an introduction to the rules of its implementation under the current regulatory framework.	
Teaching objectives	The course will provide students with fundamental concepts necessary to assess ecosystem status, address the interpretation of ecosystem functioning and the capacity to detect major changes in environmental trends. It will introduce the students to the theory and practice of Human Health Risk assessment according to the current norms and regulatory framework endorsed by Italian authorities, in such a way that they will be able to conduct independently basic assessments that will have legal value. Human and Ecological Risk Assessment protocols introduced in different countries will be contrasted and discussed to offer a critical perception of the leading theories underlining current risk management approaches. *Specific competences:* framing a risk assessment strategy able to	

	deliver on the main drivers determining ecosystem status; interpreting ecosystem degradation in terms of potential human health hazard; complying to official legal procedures regulating risk management ability to independently address and solve complex risk scenarios; ability to consult open access databases for the estimation of potential toxicity of a given substance. *Transversal competences (soft-skills)*: ability to conduct independent literature searches; consultation of highly technical normative documents; capacity to address uncertainty; independent report writing; delivering research results in public by means of a digital slide show presentation.
Programme	**I. INTRODUCTION** INTRODUCTION TO RISK ASSESSMENT • Concepts of "risk", "hazard" and definitions applied in environmental management. • Evolution of the concept of risk, from engineering to chemistry, to ecotoxicology, to the study of ecosystems. • Risk assessment as a decision-making aid: scope, limitations and role in the optimisation of resource management. • Basic theory of ecological risk assessment (ERA). Decision making trees and flow charts. **II. THE SCIENTIFIC BACKGROUND** SCIENTIFIC ISSUES AT THE FOUNDATION OF ERA • Ecotoxicology and its perspective of environmental impact; standard protocols to derive concentration levels of interest. • No Effect Level Concentrations (NOELs), Low Effect Level Concentrations (LOELs). • Several other trigger levels derived from ecotoxicological experiments. CONTAMINANT FATE IN ECOSYSTEMS • Element cycle through inorganic matrices as well as through biological components mediated by their chemical/physical properties. • Environmental fate of synthetic organic substances and of inorganic metals. TOXICITY REVEALED • Toxicokinetics & Toxicodynamics • Internal fate of dangerous contaminants • Understanding and predicting Mode of Action (MoA)

- Natural attenuation

III. THE ECOLOGICAL RISK ASSESSMETN FRAMEWORK

ERA1: PRELIMINARY PROBLEM FORMULATION

- Description of the environmental problem
- Identifying Contaminants of Probable Environmental Concern (COPECs)
- Building a conceptual site model
- Risk hypotheses

ERA2: IMPLEMENTING RISK ANALYSIS

- Probable Environmental Concentrations (PEC) and No Effect Concentration (PNEC)
- Selection of relevant screening and benchmark levels
- Quantitative analysis of exposure pathways and PEC/PNEC under different scenarios.
- Risk Screening

ERA3: RISK CHARACTERISATION

- Quantitative risk assessment on the basis of the relevant extant species
- Evaluation of uncertainties, errors, checks of the internal coherence
- Weight of evidence
- Evaluating the potential value of further investigation: tier 2 and tier 3

ERA4: ECOLOGICAL RISK ASSESSMENT PROTOCOLS

- Evolution of risk theory and practice under the U.S. EPA
- Population-level ERA
- The European ERA framework
- The Dutch School and the basis for the TRIAD approach
- The proposed Italian ERA framework

IV. HUMAN RISK ASSESSMENT AND THE REGULATORY FRAMEWORK

HUMAN HEALTH RISK ASSESSMENT

- Humans as the sole “endpoint”.
- Evaluation of environmental data for the selection of optimised trigger levels.
- Handling of uncertainty and its weight in quantifying acceptable risk levels.
- Step-wise procedures for the calculation of HHRA.
- Relationship between Human and Ecological Risk

	Assessment. HHRA UNDER THE ITALIAN REGULATORY FRAMEWORK • Specific provisions set by Law 152/2006 and regulatory decrees • Implementation case studies: contaminated soils, polluted continental and coastal waters, air pollution THE BACKGROUND ISSUE • Role of natural concentration levels and definition of background • Background assessment protocols and case studies • Statistical strategies and practical solutions: the Added Risk Approach SELECTED CASE STUDIES • Dioxins in Campania • Further case studies **V. ERA UNDER BROADER PERSPECTIVE** LIMITS TO RISK ANALYSIS AND ALTERNATIVES • Limits and merits of the ERA approach • The Precautionary Principle • Alternatives Assessment EXTENDED ENVIRONMENTAL RISK and ECOSYSTEM HEALTH • Expanding risk assessment beyond chemical impact • Expanding risk assessment from single-chemical toxicity to encompass impacts due to multiple stressors, analysing their cumulative effects • Expanding the scale of risk assessment to reach river basin dimension and to the consideration of global environmental risk
Delivery Mode	Frontal teaching
Teaching Methods	Frontal teaching assisted by slide shows; recordings will be made available for later viewing
Methods and Criteria of Learning Assessment	*Student performance assessment methods:* The final examination will comprise: a brief technical report on a subject agreed with the lecturer beforehand to be prepared at home and to be handed in during the oral examination and an oral examination with questions about the theory learned during the course. The oral examination will have a duration of 30 minutes (20-60 minutes) In case of a distant examination to be conducted online, the report will have to be sent by e-mail one day in advance.

	Student performance assessment criteria: 1. Quality in drafting a formally correct brief technical report, and 2. Demonstrated understanding of the course material, ability in a clear and concise oral exposition, critical evaluation of the scientific literature *Criteria used in the students' performance assessment:* The final grade will be assigned on a scale 0-30, as a result of both parts of the exam (written and oral). The two portions of the exam have equal weight on the final grade.
Textbooks and recommended reading	1. Ecological Risk Assessment 2nd Edition. by Glenn W. Suter II (2007) 2. Guidance for Human Health Risk Assessment by the European Chemicals Agency (2013) 3. Additional reference material available through the University Library facilities
Peer review	Prof. Salvatore Straface; Prof. Alessio Siciliano
Teaching timetable	http://diam.unical.it
Examination calendar	http://diam.unical.it
Examinatory commission	Prof. Salvatore Straface; Prof. Alessio Siciliano

*** Teaching organization**

ESTIMATED STUDENT WORKLOAD				
	Lectures [hours]	Praticals [hours]	Laboratory [hours]	Individual study [hours]
I. INTRODUCTION TO RISK ASSESSMENT *Definitions and fundamental concepts of risk and hazard*	6			12
II. THE SCIENTIFIC BACKGROUND *Environmental fate of contaminants and Toxicology*	12			24
III. THE ECOLOGICAL RISK ASSESSMENT FRAMEWORK *The key steps in the U.S. EPA original framework*	12			24
IV. HUMAN RISK ASSESSMENT AND THE REGULATORY FRAMEWORK *HHRA as a derivation of ERA, application of regulations*	12			24
V. ERA UNDER BROADER PERSPECTIVE *Ecosystem health, Alternatives Assessment and recent derivations*	6			12
Hours dedicated to soft skills				3
Reports/other homeworks				9
Additional hours dedicated to final exam preparation				
TOTAL	**42**			**108**
OVERALL NUMBER OF HOURS	✓ **150**			