

PhD in “SCIENCE AND ENGINEERING FOR THE ENVIRONMENT AND THE SUSTAINABILITY”

XXXIX cycle

TEACHING COURSES OFFERED DURING THE ACADEMIC YEAR 2023/2024

COURSE	Hours	ETCS	DESCRIPTION	FINAL EXAM	SSD	REF. PERSON
3D GEOLOGICAL AND GEOTECHNICAL MODELING OF SUBSOIL. APPLICATIONS.	16	4	The course contributes to the training of researchers and professionals interested in 2D and 3D modeling of subsoil geological data aimed at the development of a geotechnical model. Complex stratigraphic situations of a site will be highlighted to understand the influence of geological history on the mechanical response of natural materials in different fields of engineering. Specifically, skills will be provided in the design and processing of georeferenced databases to be managed in a GIS environment for the production of subsoil models aimed at the quantitative analysis of specific geotechnical problems, making reference to significant case studies.	NO	GEO/02 ICAR/07	D. Ruberti
3D IMAGE-BASED SURVEY AND REVERSE ENGINEERING	16	4	The course contributes to the Higher Education of the researcher and/or practitioner interested in mathematically mastering the potential of models from accurate 3D description of reality to design control. Methodologies and techniques for the 3D survey and 2D/3D restitution of the built environment will provide competences and skills to support further investigations and products such as the analysis of sustainable structures and functions, uses, location, design, geometric and material aspects of an artefact. At the end of the highly specialized training course, participants will be able to design and carry out a survey campaign using the Structure from Motion technique, manage the data, extract point clouds, derive orthophotos, sections and textured models to reproduce another object that has a similar or better function, or one that is more suited to the context (fitting); or an analogue that can interface with the original. The knowledge acquired will be spendable in the field of environmental, civil - construction engineering: Plant/structure optimization; Energy efficiency.	NO	ICAR/17	A. Rossi
ADVANCED METHODS FOR THE ANALYSIS OF ENVIRONMENTAL MATRICES	16	4	The purpose of the course is to provide an overview of advanced methodologies that can be used in the environmental field for the analysis of solid, gaseous or liquid matrices. During the lessons for each proposed methodology, technical information will be provided on the principles of instrumental operation or the methodological approach, details on how to sample and prepare samples of the matrices, examples of analytical results and data processing, practical examples of the use of the methodology to address specific questions in the field of environmental analysis. The following specific topics will be presented by experts: 1. Prof. Carmine Lubritto (3 hours): Isotopic analysis for environmental and archeometric applications. Fundamentals of isotope physics. Isotope fractionation. Conventional and accelerator mass spectrometry. Environmental processes and isotope marking. Methods of sample preparation and measurement processes. Applications of isotopic methodologies to environmental, archeometric processes and in the agri-food sector. 2. Prof. Giovanna Battipaglia (3 hours): Tree-ring stable isotopes analysis for environmental monitoring, from paleoclimatology to forest management and anthropogenic impacts on forest	NO	FIS/07 AGR/05 CHIM/12 CHIM/02 BIO/07 GEO/08	C. Lubritto G. Battipaglia P. Iovino S. Salvestrini S. Castaldi D. Tedesco

			<p>growth. The lesson will also discuss the combined use of isotope fractionation, xylogenesi and crossdating, as well as methodological topics like sampling, analysis and standardization. Study cases related to forest response to disturbances will be discussed.</p> <ol style="list-style-type: none"> 3. Prof. Pasquale Iovino (3 hours): Introduction to water pollution and control. Wastewater treatment by adsorption and ion exchange. Advanced oxidation processes: Sono- and Electro-chemical treatment. Case studies on wastewater treatment with advanced electrochemical oxidation processes. 4. Prof. Salvestrini Stefano (2 hours): Advanced techniques for soil decontamination from organic compounds. Examples and theory on the use of advanced oxidation techniques to digest and degrade organic contaminants from soil matrix will be presented. 5. Prof. Simona Castaldi (2 hours): Estimate of gas exchange terrestrial and water ecosystems for biogeochemical cycling. Gas flux monitoring, principles, main techniques, techniques based on gas chromatographic analysis and other advanced analysers. 6. Prof. Tedesco Dario (3 hour) : Advanced monitoring of fluids: water and gas. The lesson will presented the most adadvanced technique to sample and monitor fluids, for the gas analysis, including water and gas compartments. Examples of the application of the specific techniques will be provided for different environments, from deep waters to geochemical degassing sampling points. 			
COMPUTATIONAL SOLID AND STRUCTURE MECHANICS: FINITE ELEMENTS AND BOUNDARY ELEMENTS	20	5	The course is aimed to give a first seminar overview on the discretization and numerical methods to formulate and solve the mathematical description of phenomena comprised into the word "structural behavior". The main perspective of the course is founded on the classical "illuministic" and "polytechnic" vision namely the rational approach to the science. In particular, the "mechanics".	NO	ICAR/08	V. Minutolo
DATA MANAGEMENT	16	4	Data are now recognized as a major organizational resource to be attained and managed like other assets such as land, labour and capital. The ability to structure, access, manage and leverage this valuable resource is becoming more and more critical to all organizations, large or small, public or private. This course is designed to present the fundamental concepts and theories in data management, in order to promote their application to research activities and professional practice. An examination of Database Management Systems, database architectures, the role of data in decisional processes and the processes that guide the data lifecycle will be a focus of the course. Due to the importance of personal data in scientific research, it is mandatory to include in the course the main concepts about personal data protection regulation. Contents: <ol style="list-style-type: none"> 1. Data Management basics: information need, sources and users, data attributes, data relationship, data life cycle. 2. The conceptual database models utilizing entity-relationship model: design of data structures that will limit redundancy and enforce data integrity. 3. The logical database model as the second step of database design: the relational data model in terms of data structure, data integrity, and data manipulation. Notes on data definition, manipulation and query languages (SQL). 4. The role of data in Decision Support Systems: multidimensional data model; operational and informational systems; Data warehousing systems and OLAP analysis; Data Mining. 5. Introduction to Big Data and large database and unstructured databases for scientific applications. 6. Data management and personal data protection regulation: ethics of privacy; basics on GDPR regulation: general principles, right of users, accountability and policies; 	NO		

			GDPR rules on personal data in the scientific research.			
DESIGNING CLIMATE ADAPTATION SOLUTIONS AND STRATEGIES ALONG THE COASTLINES AND AT TRANSITIONAL WATER BOUNDARIES	12	3	Climate change is expected to severely impact coastal areas due to sea level rise and changes in the frequency and magnitude of severe storms and related storm-surges. This can cause an increase in flood risk, coastal erosion and loss of low-lying systems (e.g. deltas, coastal lagoons and barrier islands) due to permanent inundation. Sea level rise can also induce or increase saltwater intrusion in freshwater systems, further endangering coastal ecosystems. Moreover, the expected rise in seawater temperatures will contribute to restructuring marine ecosystems with implications for ocean circulation, biogeochemical cycling and fishery yields. Biological systems will be affected by ocean acidification, too.	NO	ICAR/02	P. Contestabile
ENGLISH FOR ACADEMIC PURPOSES HONING COMMUNICATION SKILLS FOR STEM SPECIALISTS	60	15	Objective 1: Enhancing written communication skills with a focus on the accomplishment of specific tasks at an acceptable level (comprehensible at least for an international audience) in terms of form and content Objective 2: Developing oral communicative competence in terms of appropriacy in ordinary daily campus exchanges but the focus will be on comprehensibility in public speaking.	YES		
ENVIRONMENTAL ASSESSMENT AND PERMITS	16	4	Provide indications for the definition of the correct authorization procedures in the environmental field. Transfer the knowledge of tools, methodologies and procedures for the presentation and evaluation of authorization requests by defining the necessary procedures and specialist studies. Analysis of the environmental compatibility of works and production activities.	NO	ING-IND/25; ICAR 03	A. Panico
FUNDAMENTALS OF ACOUSTICAL OCEANOGRAPHY	16	4	Objectives: To provide students with fundamental knowledge on acoustical oceanography, including a) physics of underwater sound and sound propagation, b) physical oceanography, c) solution of the sonar equation to inform underwater sound propagation models, d) design of acoustic monitoring experiments and methods.	NO	FIS/07 GEO/12	J.F. Borsani
FUNDAMENTALS OF WIND ENGINEERING	16	4	Objective of the course is to provide Ph.D. students with basic knowledge of the subjects underlying Wind Engineering applications, e.g. wind actions and effects on civil structures, wind energy, pollutant dispersion in the atmosphere, fire propagation. The topics dealt with in the course are transversal, therefore of potential interest for scholars in Civil, Environmental and Energy Engineering. The course covers selected topics on the atmospheric circulation and on meteorology, on the fluid dynamics of the Atmospheric Boundary Layer, on mean and extreme wind climate analysis, on bluff body aerodynamics; basic concepts about random processes and random vibrations are also given.	NO	ICAR/09	F. Ricciardelli
GEOCHEMICAL TECHNIQUES FOR THE EXPLORATION AND EXPLOITATION OF GEOTHERMAL ENERGY AND CRITICAL MINERALS	16	4	As a local, scalable, most stable and reliable source of renewable energy, geothermal is becoming pivotal for energy systems, providing power, heat and thermal storage. At the same time, geothermal systems open new routes to valorize critical minerals of strategic value, lithium particularly: these can be in fact produced from naturally occurring geothermal fluids with a net zero carbon footprint, the geothermal power being the renewable power source for their recovery or even production at different commercial and industrial-grades. Among EU countries, Italy shows a large extractive potential from fluids of both geothermal and mineral interest. To pursue joint geothermal-mineral strategies, we must: 1) identify and promptly characterize the useful and profitable sites: geochemical techniques allow proving the potential of hidden (or blind) geothermal reservoirs, which do not show appreciable signs of their presence at surface. 2) define methods for metal/mineral removal and recovery from dep fluids when at surface and on the other side favor their transport to surface. Geochemical techniques provide indicators about the thermobaric conditions of the reservoirs, their chemical characterization and, most importantly, allow defining their potential and tracking their evolution via the study of water-gas-rock interaction based on reaction path modelling.	NO	GEO/08	R. Moretti

			Overviews will be also provided about the risks associated with fluid-related activities in reservoir exploitation, including induced seismicity and its monitoring.			
HYDROLOGICAL HAZARDS AND EARLY WARNING SYSTEMS	16	4	The course aims at framing the problems of assessing the geo-hydrological hazard and geo-hydrological risk with an approach based not only on cartographic and historical information (susceptibility estimation, i.e. static probability), but through the development of mathematical models (i.e., temporal dynamic probability).	NO	ICAR/02	R. Greco
ISOTOPE PHYSICS AND METHODOLOGIES	12	3	Summary: During the course the most important issues regarding the isotope sciences will be covered. In details, among the others, the most important issues such as i) a general overview of the isotope nomenclature for both stable and radioactive nuclides; ii) the most important isotope fractionation mechanisms; iii) the approaches and methodologies utilized to address research issues will be covered with a special emphasis onto Mass Spectrometry and data reduction/analysis. AIMS: Provide a general basis for the production and interpretation of isotope data in the applied sciences framework.	NO	FIS/07	C. Lubritto
LIFE CYCLE ASSESSMENT FOR GOODS AND SERVICES	16	4	The aim of the course is to provide an essential but comprehensive introduction to the metrics of environmental performance of a production process for a good or service. The focus will be mainly on the approach of Life Cycle Thinking and the tools of Life Cycle Assessment (of environmental, economic and social aspects) and Material and Substance Flow Analyses.	NO	ING-IND/25	F. Ardolino
LIFE CYCLE ASSESSMENT IN AEC SECTOR: ENVIRONMENTAL ASSESSMENT OF BUILDINGS AND BUILDING COMPONENTS	12	3	Provide the necessary tools to understand the role of LCA in the construction sector and the benefits derived from its application. Offer the basics for conducting an LCA study applied to the construction sector (regulations, databases, and inventory analysis).	NO	ICAR/10	L. Mollo R. Agliata
MARINE RENEWABLE ENERGY	24	6	The course aims at providing a guide into the field of ocean energy utilization. The idea for the course has been shaped by the development, research, and teaching that we have carried out at the Wave Energy Research Group at University of Campania over the past decades. It is our belief and experience that it would be useful in order to enhance the understanding of the sector for a wide variety of potential students. The course will introduce and describe the processes that characterize the oceanic environment, as wind, tide, wave and currents, their loads and interaction with the structures, the assessment of the marine renewable energy (currents and waves) and basics on the device's typologies. Principles of energy conversion from the sea: Wind, Waves, Tidal Range (tidal rise and fall), Tidal Currents, Ocean Currents, derived from wind-driven and thermohaline ocean circulation, Ocean Thermal Energy Conversion (OTEC), Salinity Gradients (osmotic power), Wave Energy conversion (WEC) typologies; Sea Current turbines.	NO	ICAR/02	D. Vicinanza
OPTIMIZATION METHODS FOR THE MANAGEMENT OF WATER RESOURCES	16	4	The course aims at providing the students with notions relating to management and operational issues, with the related economic aspects, as part of the optimal management of water resources facing them with modern optimization techniques.	NO	ICAR/02	G. Santonastaso
PATENT AS AN INVENTIVE RESEARCH ACTIVITY	24	6	The course focuses on patenting principles, practices and strategies in the processes of intellectual property management and enhancement and technology transfer at national and international level. The lessons aim to promote the exploitation of research results through the protection of Intellectual Property (IP), providing tools and methods on procedural forms and steps to structure patent applications. Specifically, they will concern the principles of IP protection, patent submission and evaluation procedures, information on how to retrieve data on existing patents (anteriority search) and the necessary bibliographical tools.	YES	ICAR/13	A. Capece

<p>PILE FOUNDATIONS UNDER MECHANICAL AND THERMAL LOADS: ANALYSIS AND INNOVATIVE DESIGN</p>	<p>12</p>	<p>3</p>	<p>Piles are deep foundations having the role of transferring the loads from the structure to the deep, and thereby stronger, soil layers. If they are equipped with closed loop pipes attached to the steel rebars, in which a heat carrier fluid is circulated thanks to a heat pump, piles also gain the role of heat exchangers with the soil allowing the heating and cooling of buildings in a sustainable manner by exploiting the renewable geothermal energy. In this framework, the course is intended to cover the main features concerning the behaviour of pile foundations under different loading conditions, including temperature variations. The starting point will be the performance of the single pile which is analysed in terms of load-displacement response due to mechanical as well as to thermal loads via analytical and numerically-based approaches. Design issues are then discussed for pile groups subjected to generalised loading conditions.</p>	<p>NO</p>	<p>ICAR/07</p>	<p>C. Iodice</p>
<p>RESEARCH AND INNOVATION THROUGH NATIONAL AND INTERNATIONAL STANDARD REFERENCES</p>	<p>24</p>	<p>6</p>	<p>The course will focus on the analysis and study of standard references as "tools" for innovation and support to research activities, starting from the categorisation of the standards issued by the different national, European and international standardization organisations. The main standard references related to environmental management and protection systems will be analysed. The main requirements useful for obtaining certifications of products and processes in compliance with EU safety, health and environmental protection requirements will also be introduced. Examples of standards in different areas of research with particular reference to production processes aimed at ensuring the safety and well-being of user-operators in industrial settings will also be given. The PhD students will be involved in research activities with respect to the specific objectives of the PhD course through practical exercises aimed at the framework of the standard references applicable to the different subject areas through the use of the main UNI, CEN and ISO platforms.</p>	<p>NO</p>	<p>ICAR/13</p>	<p>E. Laudante</p>
<p>STATISTICS FOR THE ENVIRONMENT</p>	<p>24</p>	<p>6</p>	<p>The goal is to provide basic knowledge of descriptive and inferential statistics, data analysis and data mining. The program intends to describe the most appropriate methodologies to acquire critical capacity towards each instrument in terms of advantages and limitations. An essential role will be played by the introduction to the concepts of descriptive statistics, such as measures of central tendency, variability, dependence, probability and statistical inference.</p>	<p>NO</p>	<p>BIO/03</p>	<p>S. Strumia</p>