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, archaeometric 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	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

			management and anthropogenic impacts on forest growth. The lesson will also discuss the combined use of isotope fractionation, xylogenesis and crossdating, as well as methodological topics like sampling, analysis and standardization. Study cases related to forest response to disturbances will be discussed. 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 chormatographic analysis and other advanced analysers. 6. Prof. Tedesco Dario (3 hour) : Advanced monitoring of fluids: water and gas. The lesson will presented the most adavanced 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	The course aims to provide the basics for the analysis and management of Stochastic data using statistical, probabilistic and machine learning. Models and examples are given to demonstrate applications of the topics. Discrete event simulation is taught via lectures and computer workshops. The purpose of this course is to introduce stochastic modeling methods and data analytics tools for analysis, design, and decision support for engineering applications. Specifically, some methods will be showed, using MATLAB and/or Phyton software, related to the following topics: statistical analysis, outliers, principal component analysis, autocorrelation analysis, stationarity, identification methods (AR, ARMA, etc.), elements of predictive approaches, machine learning techniques, etc.	NO	ICAR/02	A. Di Nardo
DESIGNING CLIMATE ADAPTATION SOLUTIONS AND STRATEGIES ALONG THE COASTLINES AND AT TRANSITIONAL WATER BOUNDARIES	24	6	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.The course promotes a strategic (long-term viewing), integrated and adaptive approach to coastal zone planning and management. Best practices and alternative worldwide solutions (in the short term) against climate change will be also included. Theoretical lessons will be accompanied by numerical exercises (which include the use of spread sheets/macro programming languages and specialist software), laboratory activities and visits to significant facilities.	NO	ICAR/02	P. Contestabile
ENGLISH FOR ACADEMIC PURPOSES HONING COMMUNICATION	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	YES	L-LIN/12	G. Nuzzo

SKILLS FOR STEM SPECIALISTS			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.			
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 thermo-baric 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. Overviews will be also provided about the risks associated with fluid-related activities in reservoir exploitation, including induced seismicity and its monitoring.	NO	GEO/08	R. Moretti
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 "monitor and model" approach (i.e., temporal dynamic probability). An overview of how hydrologic systems are affected by both long- and short-term meteorological forcing, and how process-based modeling informed by field monitoring can help to identify the major hydrological controls of catchment and hillslope response to precipitation will be given, and the case of a real catchmentwill be presented, where intense field monitoring activities have been carried out and mathematical models with different degrees of complexity have been developed to assess landslide and debris flow hazard. Finally, the students will be guided to develop a	NO	ICAR/02	R. Greco

Course			Summary / Aims			
			practical exercise on hydrologic hazard mapping.			
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
MONITORING SYSTEMS FOR LANDSLIDE DISASTER PREVENTION	24	6	The course is aimed at providing the skills necessary to identify landslide-prone urbanized areas and to select the most effective monitoring systems for reducing landslide risk. The basic knowledge of stability analysis of both natural and made-man slopes, as well as identifying predisposing and triggering factors that contribute to slope movement will be given, first. Then, conventional and innovative devices and techniques for monitoring landslides and structures interacting with them will be explored, highlighting their respective advantages and limitations. Finally, through hands-on laboratory activities and visits to fully instrumented monitoring sites, students will develop critical abilities in selecting and setting up the most appropriate monitoring systems for various landslide scenarios.	NO	ICAR/07	E. Damiano
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. F. 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	YES	ICAR/13	A. Capece

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Dipartimento di Ingegneria

			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.			
PILE FOUNDATIONS UNDER MECHANICAL AND THERMAL LOADS: ANALYSIS AND INNOVATIVE DESIGN	12	3	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.	NO	ICAR/07	C. Iodice
RESEARCH AND INNOVATION THROUGH NATIONAL AND INTERNATIONAL STANDARD REFERENCES	24	6	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.	NO	ICAR/13	E. Laudante
SOIL MICROBIAL COMMUNITY DIVERSITY BY MOLECULAR TECHNIQUES	16	4	The course focuses on the application of denaturing gradient gel electrophoresis (DGGE) to study soil microbial diversity and its role in soil health evaluation. DGGE is a widely used molecular technique for microbial community analyses that allows a valuable characterization of community diversity as well as changes in community structures due to several stress/disturbance factors, such as pollution, fire, land use change and climate change. The course will introduce and describe the soil DNA extraction procedures of the soil microbial community, the main PCR protocols required to amplify target genes of specific functional groups (e.g. nitrifies, denitrifies and methanogens), the electrophoresis separation by denaturing gradient, and finally processing and interpretation of the obtained genetic fingerprint.	NO	BIO/07	R. Marzaioli
STATISTICS FOR THE ENVIRONMENT	24	6	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.	NO	BIO/03	S. Strumia