UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2019/2020
MASTER'S DEGREE (MSC)	ENGINEERING AND INNOVATIVE TECHNOLOGIES FOR THE ENVIRONMENT
SUBJECT	RECLAMATION OF CONTAMINATED SITES
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50372-Ingegneria per l'ambiente e territorio
CODE	09005
SCIENTIFIC SECTOR(S)	ICAR/03
HEAD PROFESSOR(S)	DI TRAPANI DANIELE Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	9
INDIVIDUAL STUDY (Hrs)	144
COURSE ACTIVITY (Hrs)	81
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**DI TRAPANI DANIELE** Tuesday 15:00 17:00 il Dipartimento di Ingegneria, area Idraulica secondo piano, Studio Docente, Stanza n. 2035. Necessario un preventivo appuntamento via mail all'indirizzo daniele.ditrapani@unipa.it Wednesday 12:00 13:00 il Dipartimento di Ingegneria, area Idraulica secondo piano, Studio Docente, Stanza n. 2035. Necessario un preventivo appuntamento via mail all'indirizzo daniele.ditrapani@unipa.it Thursday 12:00 13:00 il Dipartimento di Ingegneria, area Idraulica secondo piano, Studio Docente, Stanza n. 2035. Necessario un preventivo appuntamento via mail all'indirizzo daniele.ditrapani@unipa.it

DOCENTE: Prof. DANIELE DI TRAPANI

PREREQUISITES	Basic knowledge of sanitary and environmental engineering, chemistry and hydraulics, allowing to understand the principles and processes analyzed in the course.
LEARNING OUTCOMES	Knowledge and understanding The student at the end of the course will acquire knowledge on criteria and methods for the assessment of contaminated soils; plans for the remediation of contaminated sites; risk analysis for the evaluation of the potential level of pollution; methods for securing and remediation of contaminated sites. Applying knowledge and understanding The student will be able to apply their knowledge on procedures and standards for interventions on contaminated sites; on interpretation of data relating to the state of quality of the contaminated soil; on methods for the preparation of a risk analysis procedure for contaminated sites; on techniques for restoring and securing of contaminated sites and their design criteria Making judgments The student will be able to assess the degree of pollution of contaminated soils; prepare the monitoring plan of contaminated sites; develop a study of risk analysis of contaminated sites; plan the restoring and securing actions of contaminated sites. Communication skills The student will acquire the ability to communicate and express issues addressed in the course, such as description of the state of pollution of a contaminated site and its environmental matrices (soil, groundwater, interstitial gas); methods of intervention for the protection of health because of the presence of the state of pollution; the choice of the best intervention strategies for the recovery or securing of the site. Learning ability The student will acquire learning skills in the field of soil and groundwater pollution. Then he can participate in second level master and advanced courses on specific environmental engineering issues, particularly with regard to pollution and remediation of contaminated soils and groundwater.
ASSESSMENT METHODS	The exam will be oral with single test. The candidate has to answer at least three questions posed orally, on the elaborate developed during practical classes and on all topics included in the program and during the course. Final assessment aims to evaluate whether the student has knowledge and understanding of the topics, has acquired jurisdiction to interpret and independent judgment of concrete cases. The pass mark will be reached when the student shows knowledge and understanding of the subjects at least in general terms, and has domain expertise in order to solve concrete cases; It will also have presentation skills and argumentative as to allow the transmission of his knowledge to the examiner. Below this threshold, the examination will be insufficient. The more, however, the examinee with its argumentative and presentation skills can interact with the examiner, and the more his knowledge and application capabilities go into detail on the subject of discipline occurs, the more theassessment is positive. The assessment is carried out of thirty. Details of the valuation methods: Excellent - 30-30 cum laude Outcome: excellent knowledge of the topics, excellent properties of language, good analytical ability, the student is able to apply knowledge to solve problems proposed Very good - 26-29 Outcome: good control of the subjects, full ownership of the language, the student is able to apply knowledge to solve problems proposed Good - 24-25 Outcome: basic knowledge of the main topics, discrete properties of language, with limited ability to independently apply the knowledge to the solution of the proposed problems Satisfactory - 21-23 Outcome: the candidate does not have full command of the main teaching subjects but it has the knowledge, satisfactory property language, poor ability to independently apply the knowledge acquired Enough - 18-20 Outcome: minimum basic understanding of the main teaching and technical language issues, very little or no ability to independently apply the knowledge acquired Insufficient Outcome: the candidate does not have an acceptable knowledge of the contents of the topics covered in the teaching.
EDUCATIONAL OBJECTIVES	Topics covered in the course are directed to provide the necessary training of students who intend to carry out their professional activities in the field of environmental engineering, with particular reference to the study of soil and groundwater pollution mechanisms and intervention tools for risk assessment of

	anthropogenic pollution of industrial and civil origin and the definition of measures to securing and / or remediation of the site.
TEACHING METHODS	The teaching will be organized by conducting lectures, exercises for the preparation of a project, in groups, and consequent revision of the topics, seminars and technical visits.
SUGGESTED BIBLIOGRAPHY	Dispense e materiale bibliografico sono distribuiti durante il corso. Per maggiori approfondimenti, si suggerisce la consultazione dei seguenti testi: L. Bonomo (edr.): “Bonifica di siti contaminati”. Ed. McGraw-Hill, Milano, 2005. A. Di Molfetta, R. Sethi: “Ingegneria degli acquiferi”. Springer Italia ed., Milano, 2012. M. Gorla: “Siti contaminati”. Ed. Flaccovio, Palermo, 2012. J. Kuo: “Practical design calculations for groundwater and soil remediation”. Lewis pub., N.Y., 1999. M. Mendola, L. Morra: "Bonifica dei siti inquinati". Ed. DEI, Roma, 2010.

SYLLABUS

Hrs	Frontal teaching
5	Definition of polluted site. Characteristics of soils and pollutants. Hydrostatic and hydrodynamic of saturated and unsaturated soils. Diffusion of pollutants in the soil. Phenomena of soil pollution. Monitoring of contaminated sites: direct and indirect analysis.
3	Main reference laws : D.L. 471/99; D.lgs. 36/2003; D.lgs. 152/2006; related standards.
3	Intervention plans: characterization plan, preliminary and final design; conceptual site model. Types of intervention: emergency security measures, remediation and environmental restoration, remediation with security measures, permanent security.
5	Risk analysis: definitions, models; health and environmental risk analysis. Use of software for risk analysis of a contaminated site: RBCA, RISK-NET
3	Interventions for the rehabilitation of contaminated sites. Remediation and securing: overview, classification, selection criteria. In situ and ex situ, on site and off site treatments.
20	Biological treatments: bioventing, biosparging, bioflushing, composting (biopile, windrows), landfarming, bioreactors, phytoremediation, permeable reactive barriers, monitored natural attenuation. Physical and chemical-physical treatment: soil washing, soil vapor extraction, air sparging, multi-phase extraction, chemical oxidation, solidification / stabilization, soil flushing, recovery of free product. Heat treatments: thermal desorption, incineration.
10	Techniques of securing: hydraulic barriers, pump and treat, encapsulation techniques (vertical and horizontal barriers, capping). Geosynthetic: types, selection and use.criteria
2	Technical and economic comparisons on the applicability of remediation and securing techniques.
2	Contaminated sediments in marine-coastal areas: regulatory aspects, aspects related to sampling and handling, intervention techniques for recovery / disposal
2	Landfills remediation: encapsulation and aeration; landfill mining. technical and procedural aspects of the project and operational and aftercare management. The restoring plans.
2	Remediation of asbestos: characteristics of materials and waste containing asbestos. Reclamation techniques. Laws.

Hrs	Practice
24	Redaction of a risk analysis procedure for a case of contaminated site. Preliminary design of some remediation and securing intervention for contaminated sites: bioventing, PRB, pump & treat, etc.