UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Scienze della Terra e del Mare		
ACADEMIC YEAR	2016/2017		
MASTER'S DEGREE (MSC)	ENVIRONMENTAL SCIENCES		
INTEGRATED COURSE	ENVIRONMENTAL RESTORATION		
CODE	18672		
MODULES	Yes		
NUMBER OF MODULES	2		
SCIENTIFIC SECTOR(S)	CHIM/02, ICAR/03		
HEAD PROFESSOR(S)	VIVIANI GASPARE	Professore a contratto in quiescenza	Univ. di PALERMO
OTHER PROFESSOR(S)	VIVIANI GASPARE	Professore a contratto in quiescenza	Univ. di PALERMO
	MURATORE NICOLA	Ricercatore	Univ. di PALERMO
CREDITS	9		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	1		
TERM (SEMESTER)	1° semester		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	**MURATORE NICOLA**		
	Monday 14:30 15:30 Stanza 0/A6 - Dipartimento di Fisica e Chimica - Ed. 17 - Viale delle Scienze		
	Wednesday 14:30 15:30 Stanza 0/A6 - Dipartimento di Fisica e Chimica - Ed. 17 - Viale delle Scienze		
	Friday 14:30 15:30 Stanza 0/A6 - Dipartimento di Fisica e Chimica - Ed. 17 - Viale delle Scienze		
	VIVIANI GASPARE		
	Monday 9:00 11:00 proprio studio (stanza n.2031, ed.8 2° piano) del Dipartimento di Ingegneria		
	Tuesday 9:00 11:00 proprio studio (stanza n.2031, ed.8 2° piano) del Dipartimento di Ingegneria		
	Wednesday 9:00 11:00 proprio studio (stanza n.2031, ed.8 2° piano) del Dipartimento di Ingegneria		
	Thursday 9:00 11:00 proprio studio (stanza n.2031, ed.8 2° piano) del Dipartimento di Ingegneria		
	Friday 9:00 11:00 proprio studio (stanza n.2031, ed.8 2° piano) del Dipartimento di Ingegneria		

DOCENTE: Prof. GASPARE VIVIANI

PREREQUISITES	Basic knowledge of mathematics, physics, chemistry, allowing to understand the principles and processes analyzed in the course.
LEARNING OUTCOMES	MODULO 1 Knowledge and understanding The student at the end of the course will have knowledge of the main pollution phenomena of water bodies and possible intervention techniques, the characteristics of water and wastewater, the main unit operations and processes for water and wastewater treatment, waste management cycle, air pollution, contaminated land. Applying knowledge and understanding The student will be able to interpret the data on the state of quality of water bodies, define the quality status of the receiving bodies, define the layouts of plants for water and wastewater treatment, identify appropriate technologies for waste management and contaminated sites remediation. Making judgments The student will be able to assess the quality status of water bodies, prepare monitoring plans of water and wastewater, definition of the quality status of water bodies and identify the possible restoration actions, identify the layouts of water and wastewater treatment plants, set the framework of a solid waste management system and of contaminated sites remediation. Communication skills The student will acquire ability to describe the necessary actions for water quality protection, concerning interventions for water and wastewater treatment, to discuss the steps of integrated waste cycle and to define necessary technical operations. Learning ability The student will learn ability in analysis and environmental monitoring, environmental engineering, with particular reference to control and restoration of water bodies, treatment of water, wastewater and air, waste management and contaminated sites remediation. Then he can attend second level master and advanced courses on specific issues on monitoring and environmental remediation. MODULO2 Knowledge and understanding The student at the end of the course will have knowledge of the chemical and physical phenomena related to the contamination of subsoil sites and groundwater by non-aqueous phase liquids (NAPLs) and their traditional and innovative remediation technologies. He will acquire ability to understand the scientific language of this discipline. Applying knowledge and understanding The student will be able to propose the application of remediation technologies for sites contaminated by NAPLs especially in connection with the properties of a specific contaminant. Making judgments The student will be able to independently assess the implications and potential of remediation technologies related to those proposed. Communication skills The student will acquire ability to expose, even to an audience not expert, the phenomena associated with the contamination by NAPLs and the relative remediation technologies. He will be able to highlight the impact of these technologies in the context of environmental remediation. Learning ability The student will learn ability to follow critically in-depth courses and specialized seminars in the field of innovative technologies for environmental remediation of sites contaminated by NAPLs.
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 the assessment 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.
TEACHING METHODS	The teaching will be organized by conducting lectures, exercises and organization of technical visits.

MODULE
POLLUTION PHENOMENA AND ENVIRONMENTAL RECLAMATION TECHNOLOGIES

Prof. GASPARE VIVIANI

SUGGESTED BIBLIOGRAPHY

Dispense e materiale bibliografico sono distribuiti durante il corso. Per maggiori approfondimenti, si suggerisce la consultazione dei seguenti testi:
C. Collivignarelli, G. Bertanza: “Ingegneria sanitaria-ambientale”. Ed. CittaStudi, 2012.
Metcalf & Eddy: "Ingegneria delle acque reflue: trattamento e riuso". Ed. McGraw-Hill, 2006.
G. Tchobanoglous, H. Theisen, S.A. Vigil: "Integrated solid waste management". Ed. McGraw Hill, 1993.
M. Gorla: “Siti contaminati”. Ed. Flaccovio, 2012.

AMBIT	50572-Discipline giuridiche, economiche e valutative
INDIVIDUAL STUDY (Hrs)	102
COURSE ACTIVITY (Hrs)	48

EDUCATIONAL OBJECTIVES OF THE MODULE

The course deals with the study of mechanisms of receiving natural bodies pollution and intervention actions, ensuring environmental protection. Topics covered in the course are directed to complete the preparation of the students who intend to carry out their professional activities in the fields of monitoring and environmental remediation. The course provides lectures and exercises, the latter dedicated mainly to quantitative assessment of analysis and environmental monitoring and possible remediation.

SYLLABUS

Hrs	Frontal teaching
2	Introduction to the course. Main physical, chemical and microbiological characteristics of water and wastewater. Background of supply systems, water transport and distribution, wastewater collection and transport systems.
5	Pollution of the receiving bodies - Characteristics of receiving bodies with reference of pollution phenomena: rivers, lakes, groundwater, sea, soil. Discharges into the sea with marine outfalls. Eutrophication of lakes: basic, trophic status indicators, forecasting methods of the trophic state, rehabilitation techniques. Self-purification of rivers.
5	Water supply - Standards of water depending on uses. Layout of water treatment plants for surface water. Coagulation, flocculation, sedimentation. Filtration. Disinfection. Sludge treatment. Laws.
5	Wastewater – Definitions. Sampling. Layout of wastewater treatment plants. Screens. Grit removal. Oil removal. Clarification. Biological treatments: activated sludge, biological ponds. trickling filters. RBC. Sludge treatment: thickening, aerobic and anaerobic digestion, biogas production and recovery, sludge drying. Final disposal and reuse of sludge. Wastewater reuse. Laws.
5	Management of waste - Classification of solid waste. Composition, sampling and analysis. Production of MSW. Collection. Transport. Recycling. Transfer stations. Landfill disposal. Heat treatments. Recycling plants. Production of compost and secondary solid fuel (SSF). Laws.
5	Contaminated sites - Definitions. Criteria of soil quality. Characterization of contaminated sites. conceptual models. risk analysis. Interventions for the reclamation and the securing of land and ground water. The remediation of landfills. The asbestos removal. Laws.
5	Air pollution - Classification of pollutants and their effects on health and the environment. Climatology. Atmospheric dispersion models. Technical for emission control: removal of particulate and gaseous pollutants. Laws

Hrs	Practice
16	Assessment of the state of pollution of a water body. Analysis of layouts of water and wastewater treatment plants. Setting up a waste management system in urban areas. Characterization and risk analysis of a contaminated site. Evaluation of air emissions of pollutants from point sources.

MODULE
CHEMICAL-PHYSICAL TRAITS OF ENVIRONMENTAL RECLAMATION

Prof. NICOLA MURATORE

SUGGESTED BIBLIOGRAPHY

Dispense preparate dal docente; Principles of Colloid and Surface Chemistry, P. C. Hiemenz, Marcel Dekker, 1978; Surfactants and Interfacial Phenomena, M. J. Rosen Ed., Wiley-Interscience, 1978; D. Myers, Surfaces, Interfaces and Colloids (Wiley-VCH,1999).

AMBIT	21017-Attività formative affini o integrative
INDIVIDUAL STUDY (Hrs)	51
COURSE ACTIVITY (Hrs)	24

EDUCATIONAL OBJECTIVES OF THE MODULE

The course aims to provide tools and concepts for the understanding of the interfacial and bulk phenomena related to environmental remediation of contaminated soil sites from non-aqueous phase liquids (NAPLs). Therefore, the main issues of interest related to such contamination and the related traditional and innovative remediation techniques are treated.

SYLLABUS

Hrs	Frontal teaching
2	Objectives of the course and its subdivision. Introduction to the physico-chemical problems related to the recovery of soil and subsoil waters contaminated by non-aqueous phase liquids (NAPLs).
5	Surfaces and interphases. Surface tension of liquids: thermodynamic definition. La Place equation. Capillarity phenomena. Methods for experimental determination of the surface tension. Adhesion and cohesion. Wetting. Spreading coefficient. Contact angle. Young equation.
5	Dynamic and kinematic viscosity. Newtonian and non-Newtonian behavior. Flow of fluid in the capillaries. Poiselle equation. Methods for experimental determination of the viscosity. Viscoelasticity. Elastic and viscous modulus..
4	Dynamics of a fluid in a porous medium: Darcy's law. Darcyan and seepage velocity. Hydraulic conductivity and intrinsic permeability.
3	Adsorption phenomena at the solid/liquid interphase. Adsorption isotherms. Langmuir and BET isotherms. Conventional and macromolecular surfactants: physico-chemical properties.
3	Critical micelle concentration. Micellization. Solubilization of non-polar additives in micellar solutions. Emulsions and Microemulsions. Remediations technologies in situ flushing with surfactant solutions (SEAR).
2	Removal mechanisms. Solubilization and mobilization. Critical success factors of flushing technologies. SEAR applicability.