UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Scienze della Terra e del Mare
ACADEMIC YEAR	2018/2019
MASTER'S DEGREE (MSC)	GEOLOGICAL SCIENCES AND TECHNOLOGIES
SUBJECT	APPLIED PETROGRAPHY
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50569-Discipline mineralogiche, petrografiche e geochimiche
CODE	05671
SCIENTIFIC SECTOR(S)	GEO/09
HEAD PROFESSOR(S)	MONTANA GIUSEPPE Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	98
COURSE ACTIVITY (Hrs)	52
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**MONTANA GIUSEPPE** Monday 15:00 17:00 Studio docente in Via Archirafi 26 (piano 3)

DOCENTE: Prof. GIUSEPPE MONTANA

PREREQUISITES	Students must have good knowledge of the basic disciplines (mathematics, physics and chemistry) and some characterizing disciplines of the three-year degree course (Mineralogy, Petrography, Geology I, Geology II).
LEARNING OUTCOMES	KNOWLEDGE AND CAPACITY OF COMPREHENSION - Advanced knowledge concerning the main techniques of mineralogical and petrographic analysis applied to the compositional and structural characterization of natural and processed geomaterials (ceramics, lime-based aerial mortars, hydraulic binders, inorganic pigments, glass). Capacity of choice of the most suitable methods in specific case studies, skills in performing laboratory analysis, capacity of understanding, processing and representing the instrumental results. Basic knowledge on natural stone materials used in the Mediterranean area, in the monumental architectural and archaeological heritage, with particular reference to Sicily. To develop a suitable background of systematic knowledge and an appropriate technical-scientific language. Capacity to link the natural resources to each specific territorial context. Being able to professionally contribute to the drafting of localized plans for sustainable development. CAPACITY TO APPLY KNOWLEDGE AND UNDERSTANDING - Capacity to recognize natural and processed geomaterials in the studied contexts according to the corresponding macroscopic characteristics. To be able to collect significant samples in both rural and urban contexts and to draw up professional data sheets. To be able to propose, implement and interpret specific laboratory analyses aimed at the characterization of geomaterials. AUTHONOMY IN JUDGEMENT - Capacity to organize a collection of data on natural and processed geomaterials, both in the case of materials of ordinary quality (i.e. building stone, plaster, mortars, bricks) or in the case of particularly valuable materials (for example those used for the architectural decoration such as polished limestones, marbles, majolica tiles, stucco works). Ability to assess the relevance of the analytical mineralogical-petrographic data, chemical-physical or physicalmechanical data, also aimed to conservative interventions (substitutions, additions, consolidations). Capacity to judge the different hypothesis of methodological approach taking into account any specific problematic faced by the considered case study. COMMUNICATION SKILLS - Acquiring skills fully adequate to a second level degree in exposing the results arising from the macroscopic recognition of geomaterials and from their laboratory analysis as well as from the characterization of raw material and artificial aggregates (ceramics, bricks, mortar with aerial or hydraulic binder). Being able to qualitatively and quantitatively point out of the effects resulting from the characterization study, both in the planning phase and in the executive phase, if the considered geomaterials have been used at their natural state or even after transformation processes. LEARNING SKILLS Development of professional capabilities by consulting scientific publications of national and/or international level (in English) in the field of natural and processed geomaterials (characterization and diagnosis, recognition of degradation mechanisms, actions planning). Ability to use the acquired knowledge for following highly specialized courses, Master and/or PhD.
ASSESSMENT METHODS	Oral examination. The examination is based on a minimum of 4-5 open questions elaborated for testing the student's learning level (both qualitative and quantitative /notional). The evaluation of the examination will be based on the student's skills in expressing the topics of the followed course through an adequate technical language. The aptitude to critically examine any conceptual content through reasoning by relevant and interdisciplinary links will be appreciated. Timeliness in centering the topic and predisposition to make synthesis will be positively evaluated as well. Consequently, the minimum requirements for passing the examination are: (1) basic knowledge of the main laboratory techniques used in the field of applied petrography; (2) a proper and sufficiently detailed description of the main processes leading to the alteration/ degradation of the natural and/or processed geomaterials taken into account during the course; (3) knowledge of the procedures used for the granulometric, mineralogical and chemical analysis of incoherent rocks, sediments, soils; (4) basic knowledge of the different categories of processed and artificial aggregates studied in the course (mortars, stucco, majolica, bricks, cement aggregates). Quantity and quality of the learned notions will be positively considered in incremental way, as well as the fluency of expression, the level of technical language, the ability to reasoning linking various subjects, the synthesis skills. The maximum number of votes will be given for fulfilling in the best way all the above described conditions.
EDUCATIONAL OBJECTIVES	Acquire a critical and operative capacity within the issues of characterization and diagnosis of natural and processed geomaterials, including field surveys or surveys in urban environment, using specific mineralogical and petrographic techniques. Knowing the mechanisms that lead to the degradation of the natural and artificial building materials (i.e. stone, mortar, brick) and the most used ornamental stones in the territory. Being able to perform a particle size analysis of a geomaterial. Be able to characterize clay materials from the chemical and

	mineralogical point of view. Define the characteristics of plasticity of a clayey material. Capacity of planning appropriate laboratory investigations aimed to a complete characterization of the geomaterials under study. Acquire skills in the use of the key mineralogical and petrographic analytical instruments as well as the ability of interpreting, processing and graphically represent the achieved data.
TEACHING METHODS	Frontal lessons; laboratory activities focused on the key techniques used for the diagnostic recognition and the characterization at professional level of natural and processed geomaterials.
SUGGESTED BIBLIOGRAPHY	1) Dispense fornite dal docente. 2) R. Alaimo, R. Giarrusso e G. Montana. I materiali lapidei dell'edilizia storica di Palermo. Editrice IlionBooks, 2008, Enna. 3) G. Artioli. Scientific Methods and Cultural Heritage. Oxford University Press, 2010. 4) G. Gisotti. Le cave, recupero e pianificazione ambientale. Manuale per la gestione sostenibile delle attivita' estrattive. Dario Flaccovio Editore, Palermo, 2008. 5) G. Montana (a cura di). Le "argille ceramiche" della Sicilia occidentale. Editrice IlionBooks, 2011, Enna. 6) C. Klein, A. Philipotts. Earth Materials, 2nd Edition. Cambridge University Press, 2017.

SYLLABUS

Hrs	Frontal teaching
2	The geomaterials: definitions and possible classification. Mining activities of geomaterials in Sicily and significant examples in Italy.
2	Ornamental rocks used in antiquity deriving from quarries located in the Mediterranean area.
2	The calcarenites used in the historic building practice in Sicily: mineralogical-petrographic features; chemical and physical-mechanical features.
2	The precious stones used for architectural decoration in Sicily: review of the main varieties divided by prevailing color and diagnostic criteria for their recognition in place
2	Types and mechanisms of degradation of natural stone materials in the urban environment: the composition and kinetics of formation of 'black crust' and calcium oxalate-bearing patinas; degradation due to cyclical crystallization of soluble salts.
2	Theoretical basis and procedures to be used for the analysis and characterization of natural and processed geomaterials by X-ray powder diffraction (XRPD) and optical microscopy under transmitted polarized light (PLM).
2	Theoretical basis and procedures to be used for the analysis aimed to the characterization of natural and processed geomaterials by means of X-ray fluorescence spectrometry (XRFS),
2	Theoretical basis and procedures for the analysis and the characterization of natural and processed geomaterials by means of scanning electron microscopy and chemical analysis by energy dispersive spectroscopy (SEM-EDS).
2	Theoretical basis and procedures to be used for the analysis aimed to the characterization of natural and processed geomaterials by means of IR spectroscopy (FT-IR). Porosimetric analysis of geomaterials : Mercury Intrusion Porosimeter (MIP); Helium pycnometer.
2	Theoretical basis and procedures to be used for textural analysis and testing performance of geomaterials: particle size analysis (GSD), Atterberg limits by Casagrande apparatus, linear shrinkage (after drying and firing).
4	Pottery and bricks in the Sicilian historic tradition: mineralogical-petrographic characterization of the Sicilian clays; chemical and technological characterization of the Sicilian clays (plasticity, linear shrinkage and color for drying and firing).
4	Petrography applied to the study of archaeological ceramics: case studies from Sicily and western Mediterranean.
4	Mineralogical, petrographic and chemical analysis of historic mortars, plasters and stucco. Provenance determination of raw materials (binder and sand aggregate) and determination of the degradation mechanisms.
4	Natural hydraulic lime (NHL) and cements: generality about the production processes. Classifications and normatives (general overview). Methods for the characterization by mineralogical-petrographic analysis.
4	Interpretation of the data deriving from the analysis aimed at the diagnosis of the degradation of natural and artificial geomaterials. Criteria for setting up a technical-scientific report.

Hrs	Workshops
2	Methods and procedures for the preparation of samples to be analyzed by XRPD for the characterization and/ or the diagnosis of degradation mechanisms.
2	Methods and procedures for the preparation of samples to be analyzed by SEM-EDS e FT-IR for the characterization and/or the diagnosis of degradation mechanisms.
2	Methods and procedures for the preparation of samples to be analyzed by XRFS for the characterization and/ or the diagnosis of degradation mechanisms.
3	Observation of thin sections of ceramic materials, aerial lime-based mortars and hydraulic lime-base mortars by the polarizing microscope.
3	Guided surveys in the center of Palermo. On site recognition of geomaterial of various nature and of the respective degradation products. Selection and sampling criteria.