UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Scienze della Terra e del Mare		
ACADEMIC YEAR	2018/2019		
MASTER'S DEGREE (MSC)	GEOLOGICAL SCIENCES AND TECHNOLOGIES		
INTEGRATED COURSE	TECHNICAL GEOLOGY AND GEOTECHNICS - INTEGRATED COURSE		
CODE	18134		
MODULES	Yes		
NUMBER OF MODULES	2		
SCIENTIFIC SECTOR(S)	GEO/05, ICAR/07		
HEAD PROFESSOR(S)	CAPPADONIA CHIARA	Professore Associato	Univ. di PALERMO
OTHER PROFESSOR(S)	CAFISO FABIO CAPPADONIA CHIARA	Professore a contratto Professore Associato	Univ. di PALERMO Univ. di PALERMO
CREDITS	9		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	1		
TERM (SEMESTER)	1° semester		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	**CAPPADONIA CHIARA** Wednesday 15:00 17:00		

DOCENTE: Prof.ssa CHIARA CAPPADONIA

PREREQUISITES	The candidate must have knowledge of mathematics and physics, developed in the three-year degree, as well as general skills relating to geology and geomorphology which are also studied in detail in the undergraduate cycle.
LEARNING OUTCOMES	TECHINCAL GEOLOGY Knowledge of actual laws in the main fields of work for Geologist (environment, georesources, groundwater, soil conservation, civil protection); technical geology and geothecnics; types of geological investigations; the importance of geology in an engineering context; geological modeling to evaluate and mitigate hazard and risk in geology. Knowledge of the main software to support the geological analyses. GEOTECHNICS Knowledge and understanding Acquisition of knowledge and methodology for: the study of soil mechanical properties in relation to the specific problems of design and realization of civil engineering works; the geo-structural and mechanical characterization of jointed rock masses aimed at the assessment of the stability analysis and mapping of areas subjected to rock falling risk in relation to the study of the probabilistic trajectories; the choice of foundation, based on the geological and geotechnical soil model on which it will have to be realized; the geological and geotechnical approach needed to tunnel design. Knowledge applying and understanding Being able to: define the geological and geotechnical soil model to support the design of civil engineering works; identify possible failure mechanisms in the rock mass in relation to dip and dip direction of discontinuities and to shear strength of the rock along joints; Making judgments Being able to evaluate: the geological and geotechnical problems connected with the design and construction of a work of engineering; the hazard of a rock mass, the vulnerability of buildings placed under a rock face and the degree of risk for the same buildings. Interpersonal skills The student will be able to: competently interact with other partners in an interdisciplinary team, identifying the technical problems of specific skills, so as to contribute to the choice of appropriate solutions; exhibit and illustrate problems of soil and rock mechanics even to partners without specific skills. Learning ability The student will be able to synthesize into a single cognitive framework: the individual information obtained through studies, geological investigations and laboratory tests in order to reconstruct a geological and geotechnical model to be based on the design choices of the various engineering works; the geo-structural and mechanical characterization of a rock mass with the theoretical analysis of stability, in order to define a geo-mechanical rock model.
ASSESSMENT METHODS	The assessment will be based on a oral exam which will be evaluated in thirtieth. Students will be asked to response to three queries regarding the contents of the two modules. Exercise solving will be also proposed. The evaluation is expressed in thirtieths and takes into account: acquisition of disciplinary contents (for 35%), analytical and critical capacity (for 35%), exhibition capacity and technical language (for 30%).
TEACHING METHODS	TECHINCAL GEOLOGY Lectures (2 ECTS) and practical laboratory activities (1 ECTS). Depending on the financial resources available to the Department, the practical activities will be carried out on the field. GEOTECHNICS The teaching will consist of lectures, related to the development of the discipline's theoretical concepts and laboratory, where the equipment and some tests carried out will be explained. If it is possible relating to available funds of course of study, the geo-structural relief of a rock mass will be performed “in-situ”.

MODULE
GEOTECHNICS

Prof. FABIO CAFISO

SUGGESTED BIBLIOGRAPHY

- Hoek E., Bray (1977) - Rock Slope Engineering.
- Bruno G. (2012) - Caratterizzazione geomeccanica per la progettazione ingegneristica
- Pietro Lunardi(2010) – Progetto e costruzione di gallerie
- Viggiani C. (1999) – Fondazioni

Durante il corso il docente fornira' agli studenti materiale didattico in formato PDF.

AMBIT	21015-Attività formative affini o integrative
INDIVIDUAL STUDY (Hrs)	94
COURSE ACTIVITY (Hrs)	56

EDUCATIONAL OBJECTIVES OF THE MODULE

The first part of the course provides the principles of soil mechanics under full saturation, highlighting the interaction between the mineral and the pore phase present in the soil and the distribution of strain between them, according to the effective stress principle of Terzaghi, whether the load is only geostatic, that in the presence of one-dimensional or two-dimensional steady fluid flow induced by external loads or changes in the configuration of the sites. The problems related to deformability and soil rupture are then addressed, highlighting the parameters of the soil involved and laboratory tests aimed at determining them experimentally.
In the second part of the course the substantial differences between soil and rock mechanics will be addressed, developing in detail the geotechnical aspects related to fissured rock masses, with particular reference to: characteristics of the surfaces of discontinuities; “in-situ” geological data collection; statistical processing methodologies of “in-situ” measured data; graphical presentation of geological data. After, the mechanical properties of the fissured rock will be studied, with particular reference to shear resistance along the joints, highlighting the major failure criteria. Then, we will study the stability problems in jointed rock masses, using the "hard-discontinuous" model, to recognize failure mechanisms. We will proceed with the statistical study of the trajectories of blocks falling from rock masses and with the mapping of areas subjected to rock falling risk; at last, we will develop the risk mitigation works, that are divided into the three types: "active", "passive" and “mixed”.
The last part of the course is dedicated to: the study of foundations of engineering structures, depending on the geological and geotechnical soil model, distinguishing between “shallow foundations” and “deep foundations” (pile foundations and caisson foundations); the definition of the geological and geotechnical soil model, that has a great influence on the execution tunnel methods.

SYLLABUS

Hrs	Frontal teaching
6	Principles of soil mechanics under full saturation, highlighting the interaction between the mineral and pore phase present in the soil; phase relationships; particle size characteristics Atterberg limits; soil classification; the distribution of strain between mineral and pore phase according to the effective stress principle of Terzaghi; stresses within a soil mass, whether the load is only geostatic, that in the presence of applied loads; principal stresses and Mohr circle; permeability and Darcy’s low; one-dimensional or two-dimensional steady fluid flow.
6	Consolidation Theory; drained and undrained stress-strain behavior; initial, consolidation and final settlement; average consolidation ratio; oedometer method to settlement evaluation; undrained and drained shear strength in peak and ultimate condition.
6	Laboratory tests – equipment, procedure and data processing: index properties, particle size characteristics, Atterberg limits; permeability tests; oedometer test; direct shear test; consolidated drained triaxial test, unconsolidated undrained triaxial test; consolidated undrained triassial test with measurement of pore pressure.
3	Geotechnical aspects related to jointed rock masses, with particular reference to: characteristics of the surfaces of discontinuities; “in-situ” geological data collection; statistical processing methodologies of “in-situ” measured data; graphical presentation of geological data.
5	Mechanical properties of the fissured rock mass: compression, traction and shear resistance along the joints. Laboratory equipment. Mohr-Coulomb, Patton, Jagger Barton, Ladanyi and Archambault, Hoek failure criteria. Geomechanical classifications. Study of the stability problems of jointed rock masses, using the "hard-discontinuous" model to recognize failure mechanisms: sliding (plane failure and wedge failure), toppling, falling. Numerical stability analysis. The risk mitigation works, divided into the three types: "passive", "active" and “mixed”. High energy absorbing rock fall barriers: crush tests, M.E.L . (Maximum Energy Level) and S.E.L. (Service Energy Level). Rock fall embankments. Rock fall shelters. Rock slope stabilization system: steel nets and cables; rock anchors.
6	Study of foundations of engineering structures, depending on the geological and geotechnical soil model, distinguishing between “shallow foundations” and “deep foundations” (pile foundations and caisson foundations). Surface and deep galleries. Geological and geotechnical soil model. Methodologies of excavation and supporting: traditional and mechanized type. NATM approach; ADECO-RS system approach.

Hrs	Workshops

24	Laboratory features to soil and rock mass characterization. Statistical study of the trajectories of blocks falling from rock masses: empirical methods (reach angle and shadow angle); two-dimensional and three-dimensional "lumped mass" criteria. Statistical analysis of the results obtained, assessment of the vulnerability of urban areas and mapping of areas at risk of falling rock blocks. Choice of foundations in relation to the geological and geotechnical soil model. Geological and geotechnical investigations necessary to tunnel and choice of excavation type (mechanized or traditional).

MODULE
TECHNICAL GEOLOGY

Prof.ssa CHIARA CAPPADONIA

SUGGESTED BIBLIOGRAPHY

•DISPENSE DEL DOCENTE.
•L. Scesi, M. Papini, P. Gattinoni, L. Longoni GEOLOGIA TECNICA - Idrogeologia applicata - Dinamica dei versanti - Strade, opere in sotterraneo, dighe Casa Editrice Ambrosiana
•F. Cestari –INDAGINI GEOGNOSTICHE IN SITO. Ed. Dario Flaccovio
A. Lagonegro e C. Romano - GEOLOGO: MANUALE PER LA PROFESSIONE– Ed. DEI
Murachelli A. e Riboni V. – Ed. Dario Flaccovio RISCHIO IDRAULICO E DIFESA DEL TERRITORIO

AMBIT	21015-Attività formative affini o integrative
INDIVIDUAL STUDY (Hrs)	47
COURSE ACTIVITY (Hrs)	28

EDUCATIONAL OBJECTIVES OF THE MODULE

The course aims to equip students to with skills to operate as applied geoscience professionals and more generally to: Develop the intellectual and practical skills of the student in the collection, analysis, interpretation and understanding of geological data and information with specific reference to geotechnical and engineering design aspects of the applied geoscience environment. Design and implement a ground investigation strategy. Carry out basic geotechnical design to the relevant Italian and international standards. Prepare technical reports and give technical presentations; Utilize appropriate engineering geological mapping techniques to display field data effectively and appropriately. Analyse, critically evaluate and interpret the results from in site and laboratory test procedures.

SYLLABUS

Hrs	Frontal teaching
1	Introduction: the Geologist, professional activity and responsibilities.
2	Laws and rules for geologists in Italy.
5	Hydrogeological risk, geology and urban planning, seismic zonation for building areas, Civil Protection: the role of the Geologist.
2	Vulnerability of aquifers and S.U.W. landfill. Water and Waste laws problems, role of an engineering geologist, and fields involved
2	Terrain classification, standards and guidelines
4	Ground investigations techniques mechanical and geophysical survey. Planning and evaluation of costs

Hrs	Workshops
8	Geotechnical laboratory instruments, mechanical drilling description, analysis and lecture of PAI maps, exercise on design and cost evaluation of ground investigation plan.
4	Main software to support the geological investigations