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**COURSE: Engineering Geology and Hydrogeology**

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**ACADEMIC YEAR: 2019-2020**

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**TYPE OF EDUCATIONAL ACTIVITY: Characterizing**

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**TEACHER: Salvatore Grimaldi**

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phone: 0971/20215045

mobile (optional): **329/3606187**

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Language: **Italian**

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ECTS: **12** (lessons e  
tutorials/practice)n. of hours: **112**( 64 lessons  
e 48 tutorials/practice)Campus: **Potenza**  
Dept./School: **Dipartimento di  
Scienze**  
Program: **Geological Sciences  
(L34)**Semester: I-II (Annual)  
**I Semestre - II  
Semestre:**  
From 01 oct. 2019  
to 20 june 2020;

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**EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES**

- *the course aims at proving of the tools (base knowledge) to the acquisition the parameters and knowledge needed for quantitative analysis of the main processes occurring between the geological media and human activity: landslides, aquifers and groundwater, rocks and rock masses, etc..; This knowledge comes from a learning of the subsoil and the character recognition, the parameters and physical-mechanical properties of soil, rocks and water that make it up. The main objective of the course is to provide students with the foundation to face the study and assessment of the geological, geomechanical and hydrogeological system and the stresses that the territory undergoes before, during and after natural events or human actions that involve it.*
- *The main knowledge provided will be:*
- *basic elements of soil mechanics (geotechnical);*
- *basic elements of rock mechanics;*
- *knowledge regarding the water filtration processes in soils and rocks;*
- *key features of slope stability (landslides and other unstable);*
- *fundamentals of general hydrogeology;*
- *basic elements for geological and applied studies in the Great Works (Dams, Tunnels, Roads and Railways).*
- *The main skills will be:*
- *to analyze the territory in key geological;*
- *to identify questions and the physical and mechanical properties of soils and rocks that compose the means geological;*
- *to use known methods and instruments, also independently starting with a good basic knowledge;*
- *evaluate the methods, tools and the most appropriate applications to apply to the real case in the professional.*

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**PRE-REQUIREMENTS**

You must have acquired basic knowledge of:

Geology - Geomorphology

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**SYLLABUS**

Introduction to the Course **(Part I) - Soil Mechanics** (base knowledge): Soils Description - Soils consistency - Atterberg limits - Geotechnical classification of soils (plasticity chart, USCS - Unified Soil Classification System) - Flow net, filtration and permeability (Darcy's law). Terzaghi's principle (effective principal stress). Consolidation (soils). Shear resistance and shear strength. **(8 hours of lesson, 4 hours of exercises)**

**Rock Mechanics** (base knowledge): Rocks, soils and rock mass. Physical and mechanical properties of the rocks and rock mass. Principles of rock mechanics and rock masses. Laboratory tests. Joint and discontinuities. Rock masses. Description, parameters and detection of rock masses; major classifications of rock masses (Rock quality designation - RQD - geomechanics classification: RMR - Rock Mass Rating system and GSI - Geological Strength Index). **(8 hours of lesson, 4 hours of exercises)**

**(Part II) In situ geognostic investigations:** drilling and geophysical exploration. **(6 hours of lesson)**

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**Soil and rock improvement methods** (base knowledge): Injection and grouting - jet grouting - soil densification (compaction) - forced consolidation and drainage methods - Heating and freezing soils - Rock and ground anchors, nails and bolts - electrosmosis consolidation. **(6 hours of lesson)**

**Landslides types and other mass movements:** recognition, identification, movement and causes. Surface observation and geologic mapping - morphological and geotechnical parameters (basics) - Methods of location slip surface - Field investigation and monitoring - slope stability analysis (basics) - Slope stabilization methods: interventions and mitigation. Subsidence - Liquefaction - Sinkholes. **(12 hours of lesson, 4 hours of exercises)**

**Hydrogeology** (base knowledge): hydrogeologic cycle - water type in the ground (soil moisture/vadose water, retention and capillary waters, field capacity, ecc) - groundwater flow - aquifer types (unconsolidated, fractured and karst) - catchment and hydrogeological basins. Groundwater budget and hydrogeologic equation - Darcy's law and experiments (relative permeability, applicability) - Properties and parameters of aquifers (porosity, specific yield, hydraulic conductivity, transmissivity)- Aquifers characteristics - Coastal aquifers - groundwater flows to well/aquifer test - Borehole permeability tests (slug-test, Lefranc. Lugeon) - Potentiometric surface maps (dataset, methods and interpretation) - Springs: measuring of discharge - hydrograph analysis (recession curve)- evaluation or geologic reserve and resources (dynamic and regulated) - Spring catchment and capture groundwater. **(14 hours of lesson, 8 hours of exercises)**

**(III Parte)**

**Engineering-geology Model** (base knowledge) - **Foundations** (base knowledge) - **Applied Geology to large Engineering Projects:** General knowledge of issues of applied geology on the dams, tunnels, roads and railways and support works. **(10 hours of lesson, 4 hours of exercises)**

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**TEACHING METHODS**

The course includes:

theoretical lessons (64 hours); classroom tutorials (24 hours); technical visits and field trips (3 days, 24 hours).

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**EVALUATION METHODS**

*The exam consists of:*

- *intermediate verifications;*
- *final written examination;*
- *oral examination and discussion of the written.*

*The written exam, held in a different day, will also be valid for the next session.*

*The student passes the exam if achieves an overall average mark of not less than 18/30, with no less 17/30 in the written test.*

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**TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL**

**Reference Textbooks:**

- L.I.Gonzales De Vallejo.(2006) - Geoingegneria. Pearson Editrice, Italia.
- Papini, Scesi & Gattinori. Geologia Applicata- Il Rilevamento Geologico-Tecnico. Vol 1. Casa Editrice Ambrosiana.
- Papini, Scesi & Gattinori. Geologia Applicata- Applicazione Ai Progetti D'ingegneria Civile. Vol 2. Casa Editrice Ambrosiana.
- Slides Lessons (Pdf).

**Text to deepen/ Detailed Text**

- Lancellotta R. (1991) - "Geotecnica" Ed. Zanichelli;
  - Lambe T.W. & Whitman R.V. (1997) – "Meccanica Dei Terreni", Flaccovio Ed., Palermo, Pp. 595 (In Italiano Trad. Prof. C. Valore).
  - Evert Hoek (2007) - "Practical Rock Engineering" - Course Notes By (Testo Digitale) -
  - P. Celico (1986, 1988) - "Prospezioni Idrogeologiche I-Ii". Liguori Ed.
  - M. Civita (2005) - "Idrogeologia Applicata E Ambientale" - Cea (Mi)
  - C.W.Fetter (1994) - "Applied Hydrogeology", Prentice-Hall.
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**INTERACTION WITH STUDENTS**

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At the first lesson, after describing the main objectives, program and methods of verification, the teacher makes available educational material.

Office hours: Monday from 10.00 am to 1.00 pm.

Available in week for talks, agreement through e.mail or telephone, consistent with institutional commitments.

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EXAMINATION SESSIONS (FORECAST)<sup>1</sup>

**Thursday 27.06.19 – Thursday 25.07.19 – Thursday 19.09.19 – Wednesday 23.10.19 – Wednesday 27.11.19 – Thursday 19.12.19 – Wednesday 29.01.20 – Wednesday 26.02.20 – Wednesday 25.03.20 – Wednesday 29.04.20 – Wednesday 27.05.20.**

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SEMINARS BY EXTERNAL EXPERTS    YES     NO

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FURTHER INFORMATION

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<sup>1</sup>Subject to possible changes: check the web site of the Teacher or the Department/School for updates.