

# Study Plan

School:	School of Sciences and Technology
Degree:	Bachelor
Course:	Geological Engineering (cód. 176)

### 1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
	Linear Algebra and Geometry I	Mathematics	6	Semester	156
MAT00900L					
	Mathematical Analysis I	Mathematics	6	Semester	162
MAT00905L					
	Physics 1.1	Physics	5	Semester	136
FIS00691L					
	General Chemistry	Chemistry	6	Semester	156
QUI01090L					
	General Geology	Geosciences	6	Semester	155
GEO00749L					

# 1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
	Mathematical Analysis II	Mathematics	6	Semester	162
MAT00906L					
	Introduction to Probability and Statistics	Mathematics	6	Semester	154
MAT00925L					
	Physics 1.2	Physics	5	Semester	136
FIS00692L					
	Computer Assisted Technical Drawings	Civil Engineering	3	Semester	78
ERU00469L					
	Mineralogy	Geosciences	7	Semester	175
GEO01817L					
	Introduction to Geologic Engineering	Geological Engine-	4	Semester	100
GEO01818L		ering			

### 2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
	Programming	Informatics	6	Semester	156
INF00878L					
	Surveying	Civil Engineering	4	Semester	104
ERU00482L					
	Management	Management	5	Semester	135
GES00790L					
	Petrology	Geosciences	6	Semester	160
GEO01819L					
	Structural Geology	Geosciences	6	Semester	160
GEO00748L					
Group of Free Optic	ons				

# 2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
	Hydrogeology	Geosciences	6	Semester	156
GEO00754L					



2nd Year - 4th Sen	nester				
Component code	Name	Scientific Area Field	ECTS	Duration	Hours
	Field Techniques in Geosciences	Geosciences	5	Semester	132
GEO00763L					
	Engineering Geology	Geosciences	6	Semester	159
GEO00745L					
	Hydraulics	Water Resources	5	Semester	130
ERU00568L		Engineering			
	SIG Remote Sensing	Geosciences	5	Semester	130
GEO00735L					
	Sedimentology	Geosciences	3	Semester	78
GEO00760L					

# 3rd Year - 5th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
	Mineral Resources	Geosciences	6	Semester	160
GEO00759L					
	Mineral Resources	Geosciences	7	Semester	185
GEO01820L					
	Soil Mechanics and Foundations I	Geological Engine-	6	Semester	159
GEO00518L		ering			
	Soil Mechanics and Foundations	Geological Engine-	7	Semester	180
GEO01821L		ering			
	* Rock Mechanics	Geological Engine-	7	Semester	180
GEO01822L		ering			
	* Georesources Exploitation (PE)	Geological Engine-	10	Semester	270
GEO01823L		ering			



mponent code	Name	Scientific Area F	ield EC	TS Durat	ion Ho
oup of Options	News		БСТС		
Component code	Name	Scientific Area Field	ECIS	Duration	Hours
ERU00480L	Strength of Materials I		5	Semester	130
FIS00708L	Applied Geophysics	Physics	6	Semester	156
FIS01824L	Applied Geophysics	Physics	7	Semester	185
GEO01825L	Surveys	Geological Engine- ering	4	Semester	104
GEO01826L	Surveys	Geological Engine- ering	5	Semester	135
GEO00516L	Geostatistics	Geological Engine- ering	5	Semester	130
GEO01827L	Geostatistics	Geological Engine- ering	6	Semester	150
GEO01828L	Safety Hygiene at Work	Geological Engine- ering	4	Semester	110
GEO01829L	Safety Hygiene at Work	Geological Engine- ering	5	Semester	135
QUI00574L	Quality and Use of Water	Water Resources Engineering	6	Semester	156
ERU00571L	Water Resources Monitoring	Water Resources Engineering	5	Semester	130
GEO01830L	* Industrial and Ornamental Rocks	Geological Engine- ering	6	Semester	155
GEO01832L	* Slope Stability (PE)	Geological Engine- ering	6	Semester	155
GEO01833L	* Applied Geochemistry (PE)	Geosciences	6	Semester	160
GEO01834L	* Geological Cartography	Geosciences	6	Semester	160

# 3rd Year - 6th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
	Rock Mechanics	Geological Engine-	6	Semester	161
GEO00517L		ering			
	Rock Mechanics	Geological Engine-	7	Semester	180
GEO01822L		ering			
	Georesources Exploitation	Geological Engine-	9	Semester	234
GEO00515L		ering			
	Georesources Exploitation (PE)	Geological Engine-	10	Semester	270
GEO01823L		ering			
	* Mineral Resources	Geosciences	7	Semester	185
GEO01820L					
	* Soil Mechanics and Foundations	Geological Engine-	7	Semester	180
GEO01821L		ering			



rd Year - 6th Seme	ster				
Component code	Name	Scientific Area F	ield EC	CTS Dura	tion Hours
Group of Options					
Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO00519L	Industrial and Ornamental Rocks	Geological Engine- ering	5	Semester	130
GEO01830L	Industrial and Ornamental Rocks	Geological Engine- ering	6	Semester	155
GEO01831L	Slope Stability	Geological Engine- ering	5	Semester	130
GEO01832L	Slope Stability (PE)	Geological Engine- ering	6	Semester	155
GEO00752L	Applied Geochemistry	Geosciences	5	Semester	130
GEO01833L	Applied Geochemistry (PE)	Geosciences	6	Semester	160
GEO00738L	Geological Cartography	Geosciences	5	Semester	140
GEO01834L	Geological Cartography	Geosciences	6	Semester	160
GEO01835L	Environment Geology and Regional Planning	Geosciences	5	Semester	130
ERU00567L	Inspection of Hydraulic Works	Water Resources Engineering	4	Semester	104
FIS01824L	* Applied Geophysics	Physics	7	Semester	185
GEO01826L	* Surveys	Geological Engine- ering	5	Semester	135
GEO01827L	* Geostatistics	Geological Engine- ering	6	Semester	150
Group of Free Option	ons	•			·
GEO01829L	* Safety Hygiene at Work	Geological Engine- ering	5	Semester	135



# Conditions for obtaining the Degree:

\*\*\* TRANSLATE ME: Engenharia Geológica

Para obtenção do grau de licenciado em Engenharia Geológica é necessário obter aprovação a 147 a 151 ECTS em unidades de curriculares obrigatórias e 29 a 33 ECTS em unidades curriculares optativas (esta

variação depende se a UC decorre na Universidade ou numa empresa) distribuídas da seguinte forma:

- 1º Ano
- 1º Semestre:
- 5 UC Obrigatórias num total de 29 ECTS
- 2<sup>**e**</sup> Semestre
- 6 UC Obrigatórias num total de 31 ECTS

2<sup>e</sup> Ano

- 3<sup>2</sup> Semestre
- 5 UC Obrigatórias num total de 27 ECTS
- 1 UC Optativa livre num total de 3 ECTS
- 4º Semestre
- 6 UC Obrigatórias num total de 30 ECTS

3º Ano

- 5<sup>2</sup> Semestre
- 2 UC Obrigatórias num total de 12 a 14 ECTS
- 3 UC Optativa condicionadas num total de 14 a 16 ECTS
- 1 UC Optativa livre num total de 2 a 4 ECTS

6<sup>2</sup> Semestre

2 UC Obrigatórias num total de 15 a 17 ECTS 3 UC Optativa condicionadas num total de 13 a 15 ECTS \*\*\*

# **Program Contents**

# Back

# Linear Algebra and Geometry I (MAT00900L)

Systems of linear equations. Matrices. Determinants. Vector spaces. Linear applications. Eigenvalues and eigenvectors. Geometry of plane and space. Quadratic forms.

### Back

Mathematical Analysis I (MAT00905L)

Back Physics 1.1 (FIS00691L)



# General Chemistry (QUI01090L)

- 1. Constitution of matter
- 2. Periodic table
- 3. Chemical bonding
- 4. States of aggregation of matter
- 5. Solutions
- 6. Chemical thermodynamics
- 7. Chemical equilibrium
- 8. Equilibrium in heterogeneous systems
- 9. Ionic equilibria in homogeneous systems: acid-base
- 10. Electrochemistry
- 11. (Optional Chapter)
- Chemistry of life
- Chemical corrosion
- Chemical kinetics

# Back

General Geology (GEO00749L)

### Back Mathematical Analysis II (MAT00906L)

### Back

# Introduction to Probability and Statistics (MAT00925L)

Descriptive StatisticsBasic Probability NotionsConditional probabilities and independence Random Variables and VectorsMore important Discrete and Continuous distributionsStatistical Inference (parametric and non parametric)Linear Regression Analysis

# Back

Physics 1.2 (FIS00692L)

# Back

Computer Assisted Technical Drawings (ERU00469L)



# Mineralogy (GEO01817L)

1. Introduction: History and evolution of Mineralogy. $\{ \}$  newline

2. Concept of mineral: Mineral and crystal concepts. State types of matter.{\}newline

3. Elementary crystallography: 2-D Symmetry, 2-D plane lattices and plane groups. 3-D Symmetry, crystallographic systems, Bravais lattice and 3-D point groups. Introduction to 3-D space groups. Crystal morphology, Miller index and crystallographic form. Introduction to x-ray crystallography and crystal axes. Twinning.

4. Crystal-chemistry: lonic radius, coordination number and polyhedron coordination. {\}newline

5. Physical properties of minerals: Color, luster, streak, habit, hardness, cleavage, fracture and magnetism. {\}newline

6. Crystal-optics: Optical properties of minerals in polarized light. Opaque, isotropic, uniaxial and biaxial anisotropic minerals. $\{\}$  newline

7. Systematic Mineralogy: Introduction to mineral systematic. Notions of class, family, group, specie and mineral series.

8. Non silicates systematic: Native elements, halides, sulfates, carbonates, phosphates, sulfides, oxides and hydroxides.

9.Silicates systematic: Nesosilicates, sorosilicates, cyclosilicates, single chain inosilicates, double chain inosilicates, phyllosilicates and tectosilicates.

### Back

### Introduction to Geologic Engineering (GEO01818L)

### Back

# Programming (INF00878L)

- Introduction to programming: algorithms, variables, data types, arithmetic operators, logical values and operators, relational operators.

- Control structures: selection, repetition, decision making.
- Data structures: lists, tuples, dictionaries, sets.
- Working with text: string manipulation, text parsing.
- Functions and modularity.
- Using and creating modules.
- Methods (and classes).
- Looping structures.
- Working with files (I/O).
- Plots.
- Scientific computing libraries.

Note: The order may vary.

### Back

Surveying (ERU00482L)

### Back

Management (GES00790L)

# Back

Petrology (GEO01819L)



Back Structural Geology (GEO00748L)

Back Hydrogeology (GEO00754L)

Back Field Techniques in Geosciences (GEO00763L)

Back Engineering Geology (GEO00745L)

Back Hydraulics (ERU00568L)

Back SIG Remote Sensing (GEO00735L)

Back Sedimentology (GEO00760L)

Back Mineral Resources (GEO00759L)

Back Mineral Resources (GEO01820L)

Back Soil Mechanics and Foundations I (GEO00518L)



# Soil Mechanics and Foundations (GEO01821L)

Theoretical component: Definition, purpose and scope of Soil Mechanics. Basic properties of soils. Definition of soil and soil mass. Relations of mass and volume between the soil phases. Identification of soils. Soil classification for engineering purposes. Residual soils. State of stress in soil masses. Principle of effective stress. Percolation. Permeability. Flow in porous media. Instability of hydraulic origin. Capillarity Compressibility and consolidation of clay layers. Stress-strain relationships in confined soils. Secondary consolidation. Acceleration of the consolidation. Compaction of soils. Compaction equipment. Control of compaction. Shear strength of soils. Stress-strain behavior of soils. Failure criteria. Experimental determination of the shear strength parameters of soils. Site Improvement for engineering purposes. Shallow foundations. Practical component Physical, compaction, compressibility, and shear strength soil laboratory testing. Study visit to a Engineering Work.

#### Back

Rock Mechanics (GEO01822L)

Back Georesources Exploitation (PE) (GEO01823L)



# Strength of Materials I (ERU00480L)

Basic concepts Brittle and ductile material; Stress and strain; Energy of strain; Toughness and resilience; Fatigue; Principle of Saint-Venant; Principle of superposition; Safety; Rods. Normal force Stress and strain under normal force; Statically determinate structures under normal forces; Statically indeterminate structures under normal forces; Plastic strained systems. Bending Pure bending; Eccentric tension-compression; Transverse bending; Elastoplastic bending. Shearing force Shearing stress on longitudinal sections; Shearing stress at cross sections; State of stress. Torsion Torsion of a rod of circular cross section; Torsion of a thin-walled closed rod; Rectangular cross section; Thin-walled open section rod. Elastic curve displacements in bending Mohr theorems. Stability of elastic systems compressed by central forces Euler critical load; Effect of end conditions on the critical load; Critical stress and slenderness ratio.

#### Back

Applied Geophysics (FIS00708L)



# Applied Geophysics (FIS01824L)

I - Introduction - Forward and inverse problems in Geophysics. Physical properties. The signal in A. G.

II - Electrical methods - Electrical properties of rocks. Archie's Law. Concept of geoelectrical section. Wenner, Schlumberger, and dipole-dipole configurations. Electrical resistivity profiles and electrical soundings and their interpretation.

III - Gravimetric methods - Universal attraction. Geological and non-geological causes of gravity acceleration changes. Gravity meters. Gravity maps and profiles and their interpretation. Gravity

response of some simple shapes.

IV - Seismic methods - Elements of Elasticity theory. Elastic constants and their physical meaning. Waves, wave reflection and wave refraction; Snell's Law. P and S waves. Reflection and refraction methods. Seismometers and geophones. Seismic refraction method; time-distance graphs and their interpretation.

V - Well logging - Electrical logs and nuclear logs.

Back Surveys (GEO01825L)

Back Surveys (GEO01826L)

# Back

Geostatistics (GEO00516L)

### Back

# Geostatistics (GEO01827L)

Introduction to different types of Geosciences data and to its collection and preparation. Introduction

to Geostatistics. R language as a tool for application in Geostatistics. Exploratory data analysis. Spatial data prediction. Theory of regionalized variables. Analysis of the spatial data structure: experimental variogram and modeling of the variogram. Geostatistical estimation or prediction: kriging. Basics of multivariate data analysis. Main types of kriging: general characterization and exercises in R. Geostatistical Simulation: general characterization and exercises in R.

### Back

# Safety Hygiene at Work (GEO01828L)

- 1 Works accidents legislation.
- 2 Risk analysis
- 3 Administrative and organizational aspects related to health and safety.
- 4 Security at work Technical Audits at safety
- 5 Industrial Health
- 5.1 Chemical Hazards (solids, liquids, gaseous and vapors)
- 5.2- Physical risks (noise, thermal / ventilation, vibrations)
- 6 Ventilation
- 7 Industrial Safety
- 7.1- Electrical hazards
- 7.2- Fire
- 7.3 Ergonomy / loads and handling.



# Safety Hygiene at Work (GEO01829L)

- 1 Works accidents legislation.
- 2 Risk analysis
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- 5 Industrial Health
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- 6 Ventilation
- 7 Industrial Safety
- 7.1- Electrical hazards
- 7.2- Fire
- 7.3 Ergonomy / loads and handling.

# $\mathsf{Back}$

# Quality and Use of Water (QUI00574L)

Structure of water molecule.

Some properties of liquid water. Solute-solvent interaction. Hydration.

Kinetic behaviour of some compounds in the water. The gases dissolved in water. Oxygen. Factors responsible for variation of the oxygen in the water.

The metal ions in water. Precipitation, dissolution and complexation.

Water quality.

Sources of water contamination. Agricultural sources, domestic and industrial.

Treatment of water to produce water for public supply.

Quality indicators.

Wastewater treatment.

Water quality modelling.

# Back

# Water Resources Monitoring (ERU00571L)

1 - Objectives and methods of monitoring;

2 - Fields of water resources monitoring (water as a natural resource; quality, physics, chemistry, and ecological water concepts; water quality classifications; utilization and consumption; integrated water resources management);

3 - Measurements and observations (parameters and fundamental quantities to measure; supporting structures to measurements; systems and equipment for data acquisition; registration systems and equipment; systems and equipment of communications and data transmission);

4 - Water resources monitoring methods (data collection and storage; treatment of data and information; setting up of information);

5 - Water resource monitoring networks (basic networks; complementary or specific networks; SNIRH.).

# Back

# Industrial and Ornamental Rocks (GEO01830L)



#### $\mathsf{Back}$

# Slope Stability (PE) (GEO01832L)

Introduction: Types of slopes; Causes of slope instability; Influence of geological characteristics of the terrains in the stability of slopes.

Classification of mass movements: Types of mass movements; Classification of the mass movements according to the rate of movement; Consequences of mass movements.

Methodology of study and data processing: Geotechnical site characterization; Shear strength; Geotechnical exploration; Installation of instruments for geotechnical monitoring of the slope; Processing and presentation of data.

Slope stability analysis: Deterministic methods (limit equilibrium analyses at the circular failures in soil slopes and also at planar, wedge and toppling failures in rock slopes; for the more complex cases stress-strain analyses can be performed); Probabilistic methods; Choice of method of analysis; Specialized software for slope stability analysis.

Fundamentals of slope stabilization and instrumentation.

Study visit to a engineering work.

### Back

### Applied Geochemistry (PE) (GEO01833L)

1. Geochemistry as a geoscience to the study of interaction of geospheres.

- 2. Chemical equilibrium, lons in solution and ionic mobility.
- 3. Oxide-reduction process: sedimentation and pH and Eh, Interpretation of Eh-pH diagrams, , the oxidation of the sulphites.
- 4. Geochemistry of weathering.

4.a. Weathering of the stone monuments: The main stomes of Portuguese monuments, Main pathologies: characterization and diagnosis, examples.

5. Sorption and ionic exchange on the surface of minerals.

- 6. New Minerals: Precipitation-dissolution and stability, Retention of pollutant metals, Examples in wastes and landfills.
- 7. Hydro-geochemistry and transport of pollutants.

8. Potentially toxic metal geochemistry: Origins of metals (anthropogenic and natural), Mobility of metals in natural environments,

Examples of "natural" pollution, the example of the mines and abandoned wastes.

9. Correction strategies.

### Back

### Geological Cartography (GEO01834L)

A. Introduction: Concepts and objectives. Main areas of importance and application of geological mapping. Relationship with other geosciences.

B. Elements for the preparation of geological maps: legends, supplementary schemes and geological sections, symbols and abbreviations.

Methodologies for the geological mapping - planning and project planning, data collection and interpretation, preparation of sheets for fieldwork and maps in the office.

C. Mapping geological units and structures: individualization of structures. Geological mapping of sedimentary, igneous and metamorphic rocks.

D. Introduction to GIS in Geological Cartography.

E. Reference and applications for geological mapping of professional interest.

F. Practice: Lessons integrated office and field; Study of aerial photographs, treatment and representation of obtained data, preparation of graphs, drawings, sketches and final report. Field work classes consist of one day trips, to carry out geological maps in scale 1: 10 000.

#### Back Rock Mechanics (GEO00517L)



Back Georesources Exploitation (GEO00515L)

Back Industrial and Ornamental Rocks (GEO00519L)

# Back

Slope Stability (GEO01831L)

# Back

# Applied Geochemistry (GEO00752L)

1. Geochemistry as a geoscience to the study of interaction of geospheres.

2. Chemical equilibrium, lons in solution and ionic mobility.

3. Oxide-reduction process: sedimentation and pH and Eh, Interpretation of Eh-pH diagrams, , the

oxidation of the sulphites.

4. Geochemistry of weathering.

4.a. Weathering of the stone monuments: The main stomes of Portuguese monuments, Main pathologies: characterization and diagnosis, examples.

5. Sorption and ionic exchange on the surface of minerals.

6. New Minerals: Precipitation-dissolution and stability, Retention of pollutant metals, Examples in wastes and landfills.

7. Hydro-geochemistry and transport of pollutants.

8. Potentially toxic metal geochemistry: Origins of metals (anthropogenic and natural), Mobility of metals in natural environments,

Examples of "natural" pollution, the example of the mines and abandoned wastes.

9. Correction strategies.

# Back

Geological Cartography (GEO00738L)

Back Environment Geology and Regional Planning (GEO01835L)

### Back

Inspection of Hydraulic Works (ERU00567L)