



Study Plan

School: School of Sciences and Technology

Degree: Master

Course: Geological Engineering (cód. 654)

1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT12516M	Mathematical Analysis III	Mathematics	6	Semester	156
GEO07151M	Geological and Mining Exploration	Geological Engineering	6	Semester	156
ERU07145M	Soil Mechanics and Foundations II	Civil Engineering	6	Semester	156
GEO07168M	Energy Resources	Geological Engineering	6	Semester	156

Options

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO12519M	Geotechnics in Communication Networks	Geological Engineering	6	Semester	156
GEO12520M	Applied Geostatistics	Geological Engineering	6	Semester	156
FIS07164M	Applied Geophysics	Physics	6	Semester	156

1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO07155M	Thematic Mapping	Geosciences	9	Semester	234
GEO12517M	Slope Stability	Environment and Ecology Sciences Geological Engineering	6	Semester	156
GEO07157M	Quarry Technology	Geological Engineering	6	Semester	156
GEO12518M	Seminar in Geological Engineering	Geological Engineering	3	Semester	78

Options

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
ECN07158M	Natural Resource Economics	Economy	6	Semester	156
GEO10093M	Applied Geochemistry	Geosciences	6	Semester	156
ERU12521M	Building Materials	Civil Engineering	6	Semester	156

2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO07169M	Mining Technology	Geological Engineering	6	Semester	156



2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO07154M	Environmental Rehabilitation	Environment and Ecology Sciences Geological Engineering	6	Semester	156
Options					
Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO12522M	Petrogenetic Processes	Geosciences	6	Semester	156
GEO12523M	Prospecting and abstraction of groundwater	Geosciences	6	Semester	156
GEO12524M	Geotechnical works	Geological Engineering	6	Semester	156
Dissertation					
Report					
Project Work					

2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
Dissertation					
Report					
Project Work					

Conditions for obtaining the Degree:

*** TRANSLATE ME: Para aprovação na componente curricular é necessário a aprovação (através de avaliação ou creditação) das seguintes unidades curriculares:

1º Ano{\}newline

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1º Semestre:

4 UC obrigatórias num total de 24 Ects

1UC optativa num total de 6 Ects{\}newline

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2º Semestre:

4 UC obrigatórias num total de 24 Ects

1UC optativa num total de 6 Ects

2º Ano{\}newline

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3º Semestre:

4 UC obrigatórias num total de 12 Ects

1UC optativa num total de 6 Ects

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Para a obtenção do grau é necessária a aprovação na Dissertação ou Estágio ou Trabalho de Projecto, no 4º semestre com o total de 42 ECTS ***

Program Contents



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Mathematical Analysis III (MAT12516M)

Elements of Differential Geometry in \mathbb{R}^3 : Contours. Parameterization by arc length. Curvature and torsion. Frenet-Serret formulas. Tangent plane and normal line to a surface. Orientability.

Introduction to Complex Analysis: Complex functions and analytic functions. Cauchy-Riemann equations. Laplace equation. Harmonic functions. Geometry of analytic functions. Complex integration. Fundamental Theorem of Calculus. Cauchy's theorem and its evolution. Cauchy integral formula.

Ordinary Differential Equations: Exact equations and integrating factors. Equations of 1st order. 2nd order linear equations.

Systems of ordinary Dif. Eq.: Linear systems and with constant coefficients. Stability of solutions.

Fourier series. Periodic functions. Trigonometric series. Euler formulas for Fourier coefficients.

Convergence and the sum of the Fourier series. Functions with a generic period $2L$. Expansion in series of sines and cosines. Periodic extensions. Complex Fourier series. Fourier integrals.

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Geological and Mining Exploration (GEO07151M)

- Objectives and scope of the prospection: Concepts of resources and reserves, general notes of mineral economy and mining legislation.

- Phases and planning of a survey project: Strategic exploration, tactical exploration and mineral deposit evaluation.

- Remote analysis: Remote detection and multispectral images analysis. Acquisition and image processing with drone.

- Geological prospection: Mineralometric studies. Thematic cartography. Guide levels and geological models. Survey trenches.

- Geophysical prospection: Geophysical methods and their applications. Meaning of geophysical data.

- Geochemical prospection: Objective and planning of a geochemical survey. Concepts of geochemical mobility and dispersion. Background and anomalies.

- Computer graphics: Analysis, data interpretation and construction of 3D geological models.

- Drilling and evaluation: Drilling analysis and log construction. Calculation of contents and volumes.

- Case studies of exploration/exploitation in Portugal.

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Soil Mechanics and Foundations II (ERU07145M)

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Energy Resources (GEO07168M)

(Energy resources and society.

Energy resources and economy.

Coal: Genesis, typologies and exploitation.

Hydrocarbons (oil and gas): Genesis, migration and accumulation.

Unconventional hydrocarbons.

Methane hydrates.

Nuclear resources: Genesis and exploitation.

Geothermal resources: Genesis and exploitation.

The future of energy.



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Geotechnics in Communication Networks (GEO12519M)

Introduction: Framework of the role of Geotechnics in Transport Infrastructures, namely, in the different phases of the life cycle of this type of undertaking, from design, construction and operation.

Geology and Geotechnics in Transport Infrastructures: Tasks and objectives of geological and geotechnical study, in the various phases of construction projects (Feasibility study of the project; Preliminary study; Preliminary design; Final design) and in conservation projects; Geotechnical aspects related to the construction of Transport Infrastructures; Geotechnical follow-up and quality control of works in the construction phase and collaboration in the interpretation of the results of the observation of the geotechnical behaviour of the project in the operation phase.

Introduction to the role of contract specifications, as regulatory documents, both for the preparation of the design and for the construction of the undertaking, for the guarantee and control of the quality of the works.

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Applied Geostatistics (GEO12520M)

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.

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Applied Geophysics (FIS07164M)

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.

VI - Electromagnetic methods - Ground penetrating radar.



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Thematic Mapping (GEO07155M)

Introduction: Cartography as science applied to geosciences.

Structural Mapping: Identifying, mapping and characterizing large-scale geological structures. Structural contours maps and 3D dimensional models of structures. Mapping using GPS and GIS integrated systems;

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Mapping of mineral resources: Fundamentals of mineral cartography; large-scale mining maps and metallogenic provinces maps; mineral occurrences maps; Classification of occurrences and their representation in a mining district; Small-scale mapping; Detailed mineral mapping; Mineral occurrences mapping; mining cartography; infrastructure maps; mining works surveys (trenches, galleries);

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Geotechnical Mapping: General Concepts. The Geotechnical Mapping in Urban and Regional Planning. Typology of geotechnical maps and Geotechnical Units. Remote Sensing, field survey and use of GIS applied to Geotechnical Mapping. Geotechnical Units and Zoning Maps. Classification of terrains.

Application examples: Natural Resources; Suitability for Construction; Hazards; Environmental Protection; Exploitation of Construction Materials; Regional and Urban Planning.

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Slope Stability (GEO12517M)

Geotechnical Engineering:

Introduction: Fundamentals about the methodology of study and data processing concerning to slope stability problems; Methods of analysis on stability of slopes.

Selection of the stabilization design on soil slopes and rock slopes.

Stabilization of soil slopes: Modification of slope geometry; Drainage and surface protection; Mass reinforcement.

Stabilization of rock slopes: Fragmentation and removal of blocks; Slope geometry modification; Mass reinforcement; Measures to reduce the risk of rockfall.

Instrumentation and monitoring of slopes: Parameters to be measured; Type of instrumentation.

Soil Bioengineering:

Introduction to Soil Bioengineering.

Construction methods; Preparatory work: Sowings; Plantations; Techniques with herbaceous.

Techniques with woody plants; Techniques with vegetal associations; Combined methods of construction; Maintenance work.

Constructive design.

Shipyards management.

Maintenance.



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Quarry Technology (GEO07157M)

Theoretical

- I - Legal framework of the national mining sector.
- II - Economic background of the natural stone sector.
- III - Development stages of a dimension stone quarry.
- IV - Cycle characterization quarry works in extractive units carbonated ornamental stone, slates, granite and similar rocks.
- V – Open pit aggregate exploitation. Technical parameters for design of a mining unit.
- VI - Cycle quarry works characterization in extractives units for the production of aggregates.
- VII - Introduction for executing a quarry plan. Mining plan, PARP and Health and Safety Plan.

Practice

- Exercises about management, planning and various technical aspects.
- Technical visits to extractive units producing dimension stone and aggregates production.
- Internship in quarry (where available).
- MaxamPor training (15 hours) on industrial explosives and practice in quarry.

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Seminar in Geological Engineering (GEO12518M)

- 1. Formal standards of research.
- 2. Theory of scientific production. Determination of the scientific domain. The importance of interdisciplinarity.
- 3. Stages of research: office data collection, field studies (surface exploration, subsurface exploration, "in situ" testing), laboratory testing, processing of data obtained, discussion and interpretation of results, conclusions and future perspectives.
- 4. Methods. The comparison of the sources. Summary, citation and reference. The determination of the problem and research hypotheses. The preparation and presentation of the thesis.
- 5. International standards for the preparation of articles and papers in engineering.
- 6. The phases of the project. Feasibility study, preliminary project, final project, construction, post project monitoring of a geotechnical work (observation and monitoring).
- 7. Thesis Justification.
- 8. Writing and presentation of a work plan.

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Applied Geochemistry (GEO10093M)

- 1. Geochemistry as a geoscience to the study of interaction of geospheres.
- 2. Chemical equilibrium, Ions 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 stones 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.



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Building Materials (ERU12521M)

Aggregates.

Cement.

Lime.

Concrete.

Ceramics.

Natural stones.

Ferrous and nonferrous materials.

Plastics.

Timber.

Bitumen materials.

Paints

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Mining Technology (GEO07169M)

Theoretical

1 - Introduction

1.1 - General information

1.2 - Valuing phases of a mineral deposit

2 – Mining works cycle

2.1 - Introduction

2.2- Drilling

2.3 – Charging and Blasting

2.4 - Ventilation

2.5 - Scaling

2.6- Supported methods

2.7- Loading and transport

2.8- Water management and sediment control system

2.9- Electricity supply and compressed air system

3 – Underground mining methods: 1-Open stopes; 2- Timbered stopes; 3- Filled stopes; 4- Shrinkage stopes; 5- Caving methods;

6- Combined methods

4 - Safety and Health in the mining industry. Accidents prevention and control.

5 - Environmental risks from the mining industry

6 - Introduction to mineral processing

Practice

I - Mineral reserve calculation methods

II – Blasting project in galleries and tunnels

III – Pumping calculation

IV - Calculation of loading and transport cycles

V - Technical visits in principals underground portuguese mines. Internship if applicable.



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Environmental Rehabilitation (GEO07154M)

Introduction to the concepts of environmental rehabilitation and ecological restoration. The objectives, criteria, benchmarks of recovery.

Impacts due to mining, quarries and gravel pits. Correction of impacts related to noise and vibration.

Management of toxic and radioactive waste. Treatment of degraded areas.

Correction of impacts on water systems. Surface Water. Rehabilitation of Aquifers.

Contamination of soils, sediments and water by heavy metals from mines. Decontamination of land.

Tailings dams.

Correction of impacts on air quality, soil, landscape and ecological systems.

Introduction to Environmental Geotechnics. Sustainable development.

Correction of impacts in Linear Works (road and rail).

Characterization and classification of waste management and waste disposal.

Management and recovery of waste in geotechnical works. Legislative framework for the recovery of waste.

Environmental recovery methods for coastal and estuarine areas.

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Petrogenetic Processes (GEO12522M)

1. Igneous processes associated with the genesis and evolution of oceanic crust

1.1 - Magmatism in divergent boundaries

1.2 - Magmatism in convergent boundaries

1.3 - Intraplate magmatism.

2. metamorphic processes associated with the evolution of oceanic crust

2.1 - Hydrothermal vents

2.2 - Oceanic metamorphism

2.3 - Dynamic metamorphism

3. Igneous processes associated with the genesis and evolution of continental crust

3.1 - Anorogenic magmatism

3.2 - Orogenic magmatism

4. Metamorphic processes associated with the evolution of continental crust

4.1 - Low-grade metamorphic belts

4.2 - High grade metamorphic belts

4.3 - Paired metamorphic belts

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Prospecting and abstraction of groundwater (GEO12523M)

Geophysical methods for prospecting and exploration of groundwater: Geoelectrics, VLF, Seismic, Gravity, Magnetic, Georadar.

Hydrogeology of Portugal. Use of different methods of prospecting according to the different types of aquifer.

Execution of wells. Methodology and appropriateness of the methodologies to real conditions of terrain and geology.

Flow tests and its importance for defining the hydraulic characteristics of aquifers and the establishment of exploitation rates.

Protection of groundwater and wells against pollution.

Type of wells and flow generated in them.



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Geotechnical works (GEO12524M)

Introduction. Definition of the concept of geotechnical work. Methodologies of the geotechnical design. Eurocode 7. Introduction to Eurocode 8 (aspects related to the geotechnical design under seismic conditions).

Types of geotechnical works:

1. Foundations of buildings and other structures;
2. Retaining walls. Earth pressures. Gravity walls;
3. Hydraulic works (dams, dykes, other river works, etc.);
4. Transport infrastructures (highways, railways, airports, airfields, canals, etc.);
5. Introduction to Embankment works. Landfill Slopes. Compaction;
6. Underground works (tunnels and cavities);
7. Maritime works (harbours, oil rigs, coastal protection structures, etc.);
8. Geomaterials. Its use in building construction. New application perspectives. Site improvement;
9. Introduction to geosynthetics: classification, functions and applications;
10. Study cases. Special geotechnical works.