Study Plan

School: School of Sciences and Technology
Degree: Master
Course: Geological Engineering (cód. 123)

1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT07132M	Mathematical Analysis III	Mathematics	6	Semester	162
PAO07150M	Environmental Impact Assessment	Environment and Ecology Sciences	4	Semester	108
ERU07145M	Soil Mechanics and Foundations II	Civil Engineering	6	Semester	156
GEO07151M	Geological and Mining Exploration	Geological Engineering	6	Semester	156

Group of Options

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS07164M	Applied Geophysics	Physics	6	Semester	156
GEO07165M	Geotechnics in Communication Networks	Geological Engineering	5	Semester	130
ERU07166M	Building Materials I	Engineering	5	Semester	130
GEO07167M	Subsurface Exploration	Geological Engineering	4	Semester	104
GEO07163M	Geostatistics	Geological Engineering	5	Semester	130

Group of Free Options

1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO07155M	Thematic Mapping	Geosciences	9	Semester	234
GEO07156M	Slope Stability	Environment and Ecology Sciences Geological Engineering	5	Semester	130
GEO07157M	Quarry Technology	Geological Engineering	6	Semester	156

Group of Options

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO07162M	Clays Technology	Geological Engineering	4	Semester	104
GEO07161M	Industrial and Ornamental Rocks	Geological Engineering	5	Semester	130
GEO07159M	Applied Geochemistry	Geology	5	Semester	130
ECN08388M	Natural Resource Economics	Economy	6	Semester	156
GEO07160M	Hygienic and Security at Work	Geological Engineering	5	Semester	130

Group of Free Options

2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO07168M	Energy Resources	Geological Engineering	6	Semester	156
GEO07169M	Mining Technology	Geological Engineering	6	Semester	156

Group of Options

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO07152M	Mine Evaluation and Planning	Geological Engineering	4	Semester	104
ERU07153M	Hydrology	Engineering	6	Semester	156
GEO07154M	Environmental Rehabilitation	Environment and Ecology Sciences Geological Engineering	6	Semester	156

Group of Free Options

Mandatory alternatives

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
Dissertation					
Internship					

2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours

Mandatory alternatives

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
Dissertation					
Internship					

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Conditions for obtaining the Degree:

*** TRANSLATE ME: Para aprovação na componente curricular deste Mestrado, é necessário a aprovação (através de avaliação ou creditação), das seguintes unidades curriculares: { \ } newline

1.º Semestre { \ } newline

- 4 UC Obrigatórias num total de 22 ECTS { \ } newline

- Optativas num total de 8 ECTS, dos quais 4 ECTS podem ser em UC Optativas Livres { \ } newline

2.º Semestre { \ } newline

- 3 UC Obrigatórias num total de 20 ECTS { \ } newline

- UC Optativas num total de 10 ECTS dos quais 6 ECTS podem ser em UC Optativas Livres { \ } newline

3.º Semestre { \ } newline

- 2 UC Obrigatórias num total de 12 ECTS { \ } newline

- UC Optativas num total de 6 ECTS, dos quais 6 ECTS podem ser em UC Optativas Livres { \ } newline

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Para obtenção do grau, também é necessária a aprovação em Dissertação, Trabalho de Projecto ou Relatório de Estágio, no total de 42 ECTS, no 3.º e 4.º Semestre. ***

Program Contents

Mathematical Analysis III (MAT07132M)

1. Elements of Differential Geometry in R 3 {\}newline
1.1. General information on the space R ⁿ {\}newline
1.2. Contours and parameterized curves {\}newline
1.3. Length of arc. Parameterization by arc length {\}newline
1.4. Curvature and torsion. Frenet-Serret formulas {\}newline
1.5. Surfaces. {\}newline
1.6. Tangent plane and normal line to a surface. Orientability. {\}newline
{\}newline
{\}newline
2. Introduction to Complex Analysis {\}newline
2.1. General. {\}newline
2.2. Complex functions and analytic functions. {\}newline
2.3. Cauchy-Riemann equations. {\}newline
2.4. Laplace equation. Harmonic functions. {\}newline
2.5. Geometry of analytic functions. Conformal transformation. {\}newline
2.6. Elementary complex functions. {\}newline
(I) Exponential function {\}newline
(Ii) trigonometric and hyperbolic functions{\}newline
(Iii) logarithm function {\}newline
(Iv) Generalized complex powers functions{\}newline
2.7. Complex integration {\}newline
(I) Path Integral {\}newline
(Ii) Elementary properties {\}newline
2.8. Fundamental Theorem of Calculus. {\}newline
2.9. Cauchy's theorem and its evolution. {\}newline
2.10. Cauchy integral formula and applications. {\}newline
{\}newline
{\}newline
3. Ordinary Differential Equations {\}newline
3.1. Definitions and generalities. {\}newline
3.2. Exact equations and integrating factors. {\}newline
3.3. Basic equations of 1st order {\}newline
(I) equation with separable variables {\}newline
(Ii) homogeneous equation {\}newline
(Iii) homographic Equation   (Iv) linear equation of 1st order {\}newline
(V) Bernoulli Equation {\}newline
(Vi) Ricati Equation   3.4. Linear equations of 2nd order {\}newline
(I) reduction of order. {\}newline
(Ii) Particular solution of the nonhomogeneous equation {\}newline
(Iii) homogeneous equation with constant coefficients {\}newline
{\}newline
4. Systems of ordinary differential equations {\}newline
4.1. Introduction and notations {\}newline
4.2. Linear systems {\}newline
4.3. Systems with constant coefficients {\}newline
4.4. Stability of solutions {\}newline
4.5. Planar autonomous systems {\}newline
{\}newline
{\}newline
5. Fourier series {\}newline
5.1. Periodic functions. {\}newline
5.2. Trigonometric series. {\}newline
5.3. Euler formulas for Fourier coefficients. {\}newline
5.4. Convergence and the sum of the Fourier series. {\}newline
5.5. Functions with a generic period 2L {\}newline
5.6. Expansion in series of sines and cosines {\}newline
5.7. Periodic extensions {\}newline
5.8. Complex Fourier series. {\}newline
5.9. Fourier integrals. {\}newline

Environmental Impact Assessment (PAO07150M)

Soil Mechanics and Foundations II (ERU07145M)

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.

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.

Geotechnics in Communication Networks (GEO07165M)

Building Materials I (ERU07166M)

Subsurface Exploration (GEO07167M)

Geostatistics (GEO07163M)

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;
{\\}newline
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);
{\\}newline
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.

Slope Stability (GEO07156M)

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.

Clays Technology (GEO07162M)

Industrial and Ornamental Rocks (GEO07161M)

Applied Geochemistry (GEO07159M)

Natural Resource Economics (ECN08388M)
1. Economic Exploitation of Natural Resources
2. Management of Renewable Natural Resources
3. Economic Management of Fisheries
4. Economic Management of Forests
5. Economic Management of Water Resources
6. Economic Management of Exaustible Resources
7. Economics and Environment

Hygienic and Security at Work (GEO07160M)
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.

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.

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.

Mine Evaluation and Planning (GEO07152M)
Introduction to mine industry, exploitation and processing methods.
Inventorying and evaluation of geological resources, products and markets.
Sustainable exploitation planning, management and valuation of geological resources.
Marketing.
Geological and mining data collection, processing and analysis procedures.
Representativity and integration of information.
Preparing technical reports.
Case studies.

Hydrology (ERU07153M)
1 - The water cycle;
2 - The Watershed: characterization;
3 - Precipitation: depth and intensity, precipitation measures, statistical analysis of precipitations
time series, short term rainfall;
4 - Evaporation and Evapotranspiration: measures and estimation;
5 - Infiltration: quantification;
6 - Surface Runoff: Measures, evaluation, hydrograph study, hydrograph decomposition;
7 - Hydrologic Balance: sequential;
8 - Floods: estimation methods of the peak runoff and estimation methods of the flood hydrograph;
Discharge for the dimension oh hydraulics works; Evaluation of superficial water resources.

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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.