



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
MAT0900L	Linear Algebra and Geometry I	Mathematics	6	Semester	156
MAT0905L	Mathematical Analysis I	Mathematics	6	Semester	162
FIS0691L	Physics 1.1	Physics	5	Semester	136
QUI1090L	General Chemistry	Chemistry	6	Semester	156
GEO0749L	General Geology	Geosciences	6	Semester	155

1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT0906L	Mathematical Analysis II	Mathematics	6	Semester	162
MAT0925L	Introduction to Probability and Statistics	Mathematics	6	Semester	154
FIS0692L	Physics 1.2	Physics	5	Semester	136
ERU0469L	Computer Assisted Technical Drawings	Civil Engineering	3	Semester	78
GEO1817L	Mineralogy	Geosciences	7	Semester	175
GEO1818L	Introduction to Geologic Engineering	Geological Engineering	4	Semester	100

2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF0878L	Programming	Informatics	6	Semester	156
ERU0482L	Surveying	Civil Engineering	4	Semester	104
GES0790L	Management	Management	5	Semester	135
GEO1819L	Petrology	Geosciences	6	Semester	160
GEO0748L	Structural Geology	Geosciences	6	Semester	160
Group of Free Options					

2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO0754L	Hydrogeology	Geosciences	6	Semester	156
GEO0763L	Field Techniques in Geosciences	Geosciences	5	Semester	132
GEO0745L	Engineering Geology	Geosciences	6	Semester	159
ERU0568L	Hydraulics	Water Resources Engineering	5	Semester	130



2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO0735L	SIG Remote Sensing	Geosciences	5	Semester	130
GEO0760L	Sedimentology	Geosciences	3	Semester	78

3rd Year - 5th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO0759L	Mineral Resources	Geosciences	6	Semester	160
GEO1820L	Mineral Resources	Geosciences	7	Semester	185
GEO0518L	Soil Mechanics and Foundations I	Geological Engineering	6	Semester	159
GEO1821L	Soil Mechanics and Foundations	Geological Engineering	7	Semester	180

Group of Options

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
ERU0480L	Strength of Materials I	Civil Engineering	5	Semester	130
FIS0708L	Applied Geophysics	Physics	6	Semester	156
FIS1824L	Applied Geophysics	Physics	7	Semester	185
GEO1825L	Surveys	Geological Engineering	4	Semester	104
GEO1826L	Surveys	Geological Engineering	5	Semester	135
GEO0516L	Geostatistics	Geological Engineering	5	Semester	130
GEO1827L	Geostatistics	Geological Engineering	6	Semester	150
GEO1828L	Safety Hygiene at Work	Geological Engineering	4	Semester	110
GEO1829L	Safety Hygiene at Work	Geological Engineering	5	Semester	135
QUI0574L	Quality and Use of Water	Water Resources Engineering	6	Semester	156
ERU0571L	Water Resources Monitoring	Water Resources Engineering	5	Semester	130

Group of Free Options

3rd Year - 6th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO0517L	Rock Mechanics	Geological Engineering	6	Semester	161
GEO1822L	Rock Mechanics	Geological Engineering	7	Semester	180
GEO0515L	Georesources Exploitation	Geological Engineering	9	Semester	234
GEO1823L	Georesources Exploitation (PE)	Geological Engineering	10	Semester	270



3rd Year - 6th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
Group of Options					
Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO0519L	Industrial and Ornamental Rocks	Geological Engineering	5	Semester	130
GEO1830L	Industrial and Ornamental Rocks	Geological Engineering	6	Semester	155
GEO1831L	Slope Stability	Geological Engineering	5	Semester	130
GEO1832L	Slope Stability (PE)	Geological Engineering	6	Semester	155
GEO0752L	Applied Geochemistry	Geosciences	5	Semester	130
GEO1833L	Applied Geochemistry (PE)	Geosciences	6	Semester	160
GEO0738L	Geological Cartography	Geosciences	5	Semester	140
GEO1834L	Geological Cartography	Geosciences	6	Semester	160
GEO1835L	Environment Geology and Regional Planning	Geosciences	5	Semester	130
ERU0567L	Inspection of Hydraulic Works	Water Resources Engineering	4	Semester	104
Group of Free Options					

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

2º Semestre

6 UC Obrigatórias num total de 31 ECTS

2º Ano

3º 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

5º 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

6º Semestre

2 UC Obrigatórias num total de 15 a 17 ECTS

3 UC Optativa condicionadas num total de 13 a 15 ECTS

Program Contents



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Linear Algebra and Geometry I (MAT0900L)

Systems of linear equations.

Matrices.

Determinants.

Vector spaces.

Linear applications.

Eigenvalues and eigenvectors. Jordan canonical form.

Geometry of plane and space.

Quadratic forms.

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Mathematical Analysis I (MAT0905L)

Sequences and series.

Real functions of one variable.

Differential calculus.

Sequences and series of functions.

Integral calculus and applications

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Physics 1.1 (FIS0691L)

Introduction ; Physics and measurements; Vectors

Trajectory; velocity and acceleration.

Force and mass; Newton's dynamic laws; Momentum and momentum conservation; Work; Principle of conservation of energy.

Rotation; Angular displacement, angular velocity, angular acceleration; Torque about an axis. Kinetic energy of rotation; Angular momentum; conservation of angular momentum. Gravity

Temperature and heat; thermal expansion; Heat and internal energy; State changes; The transfer of heat; The ideal gas law and kinetic theory; The first law of thermodynamics; The second law of thermodynamics.

Electromagnetic waves; properties of light; Optical images

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General Chemistry (QUI1090L)

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



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General Geology (GEO0749L)

- 1 - Introduction of the Geology. Geological Time. Geology and Society.
- 2 - Structure of the Earth. Direct and indirect methods. Physical and chemical zoning.
- 3 - Plate Tectonics and Wilson Cycle (tectonic cycle). Continental drift and seafloor spreading. Morphology and evolution of oceans and continents.
- 4 - Minerals. Major rock-forming minerals. Minerals and the rock cycle.
- 5 - Magmatic rocks. Magmas, partial melting, magma evolution. Systematic of magmatic rocks. Magmatism and plate tectonics. Volcanism.
- 6 - Sedimentary rocks. Weathering, transport, sedimentation and diagenesis. Systematic of sedimentary rocks.
- 7 - Metamorphic rocks. Types of metamorphism. Systematic of metamorphic rocks. Metamorphism and plate tectonics.
- 8 - Hydrologic Cycle. Chemical and physics weathering. River, coastal, glaciers systems and mass movements.
- 9 - Introduction to Geology of Portugal.

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Mathematical Analysis II (MAT0906L)

- Topology and Sequences in \mathbb{R}^n .
- Limits and continuity of functions in \mathbb{R}^n .
- Differential Calculus of functions in \mathbb{R}^n .
- Taylor Formula.
- Inverse function and Implicit function.
- Free extrema and Conditioned extrema.
- Line integrals.
- Multiple integrals.
- Surface integrals.

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Introduction to Probability and Statistics (MAT0925L)

1. Descriptive Statistics - Brief Review
2. Basic Probability Notions - Brief Review
3. Conditional Probability and Independence
4. Discrete and Continuous Random Variables
5. Discrete Random Vectors
6. The Most Important Families of Discrete and Continuous Probabilities Distributions
7. An Introduction to Sampling Theory
8. Statistical Inference (parametric and non-parametric)
9. Introduction to Simple Linear Regression
10. Some Non-Parametric Tests (Kolmogorov-Smirnov, Chi-Square, etc.)

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Physics 1.2 (FIS0692L)

- Stress and Strain; Elasticity, plasticity, fracture and rupture, Elasticity's Modulus; Strain by twist and flexion.
- Fluids; Fluid properties, Hydrostatics, Buoyancy and Archimedes' principle. Fluid motion. Equation of conservation of mass, of momentum and of energy: Flow without viscosity and non-rotational. Fluids with viscosity. Poiseuille's law. Surface tension and capillarity.
- Waves and vibrations; Propagation of mechanical waves in solid and fluid media, Wave function. Plane and spherical waves. Interference and wave superposition. Some examples.
- Electricity and Magnetism: Coulomb laws. Electric field. Electric potential. Condensers. Electric current. Forces originated by magnetic fields. Biot-Savart's Law, Gauss's Law, Ampere's Law.



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Computer Assisted Technical Drawings (ERU0469L)

1. General Aspects of Technical Drawing. Standard writing; types of lines; drawing sheets; legends; margins and frames; CAD Applications.
2. Orthogonal projections. Projections; European and American methods; projection representation in multiple views, meaning of lines; views needed and adequate, and choice of views, partial views, displaced and interrupted views; auxiliary views; CAD Applications.
3. Perspectives. Types of perspectives; isometric perspectives; CAD Applications.
4. Dimensioning and scales. General aspects of dimensioning; elements of dimensioning; inclusion of dimensions in the drawings, elements dimensioning; criteria for dimensioning; CAD Applications.
5. Cuts and sections. Introduction to 3D. Ways to cut the pieces, cuts by parallel or concurrent planes; general rules of the cuts and sections; CAD Applications.

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Mineralogy (GEO1817L)

1. Introduction: History and evolution of Mineralogy.
2. Concept of mineral: Mineral and crystal concepts. State types of matter.
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. Crystal morphology, Miller index and crystallographic form. Introduction to x-ray crystallography and crystal axes. Twinning.
4. Crystal-chemistry: Ionic radius, coordination number and polyhedron coordination. 5. Physical properties of minerals.
6. Crystal-optics: Optical properties of minerals in polarized light.
7. Systematic Mineralogy: 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.

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Introduction to Geologic Engineering (GEO1818L)

The Engineering Geology and its relationship to other branches of engineering. The Engineering Geology and the various types of Engineering Works.

The profession of Geological Engineer in three main areas: i) Geotechnics; ii) Georesources; iii) Environment.



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Programming (INF0878L)

I – THE Python LANGUAGE

- Introduction to programming
- Using the interpreter
- Variables, expression and statements
- Defining and using functions
- Control structures
- Native data structures
- Vectors e matrices
- Basic input/output concepts (I/O)
- File handling
- Using libraries
- Handling errors and exceptions
- Program development

II – BRIEF NOTIONS ON NUMERICAL METHODS

- What are numerical methods?
- Nonlinear Equations
- Matrices and Vectors
- Linear Systems
- Optimization
- Nonlinear Systems
- Fitting / adjustment

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Surveying (ERU0482L)

The main programmatic lines are:

A - Reviews (scales, angular units and it's conversions; elementary trigonometry);

B - Introduction to the concepts of geoid, ellipsoid, geographic coordinates, map projection systems, geodetic datum, geodetic network; rectangular plane coordinates (distance and direction calculations, coordinates transportation, orientation), introduction to notions of altimetry and planimetry for the interpretation and use of topographic maps, terrain cross sections and longitudinal cross sections, calculation of cut and fill volumes;

C - surveying: with optical level (geometric), with a theodolite (trigonometric) and topographic GPS (DGPS).

D - Introduction to Surveying software (Autodesk LandDesktop).

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Management (GES0790L)

- Entrepreneurship and Entrepreneur
- Management of Organizations
- Introduction to Financial Accounting
- Basic Concepts of Financial Analysis
- Introduction to Management Accounting
- Marketing
- Introduction to Financial Calculus
- Evaluation of Investment Projects
- Production and Stocks Management
- Strategic Management



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Petrology (GEO1819L)

Introduction: principles of mineralogy and stability fields of minerals; chemical, mineralogical and lithological differentiation on Earth; geodynamic environments and petrogenetic cycle of lithosphere. Igneous petrology: geodynamic setting of magmatism; classification of igneous rocks; magmatic genesis and differentiation; magmatic processes on the basis of trace element geochemistry; geochemical and geodynamic discrimination of magmatic rock associations; Metamorphic petrology: geodynamic setting of metamorphism; factors and types of metamorphism; structural and textural effects of metamorphism; protholites and metamorphic series; chemical reactions and mineralogical transformations; representative mineralogical associations; grade and facies of metamorphism; dT/dP gradients and metamorphic facies series; graphical representation of metamorphic paragenesis. Macroscopic and microscopic classification of igneous and metamorphic rocks (practice lessons).

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Structural Geology (GEO0748L)

Theoretical:

1. Basic concepts of structural geology;
2. Dynamic analysis;
3. Kinematic analysis;
4. Mechanical behavior of rocks,
5. Descriptive Analysis and Classification: faults, folds, shear zones, joints and diaclases;
6. Relationship between Structural Geology and tectonics.

Theoretical and Practical:

1. Using geometric and statistical stereographic projection in structural geology,
2. Structural interpretation of geological maps, including the identification, description and interpretation of structures at various scales, as well as understanding the processes that originate them.

Fieldwork: Study visits for consolidation of knowledge. Annually two days of field work are planned in places where the conditions of the various geological structures allow excellent observation and interpretation.



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Hydrogeology (GEO0754L)

Theoric classes:

Hydrogeology: concepts. Distribution of water resources on the Globe.

Hydrological cycle and water balance.

Aquifer types.

Types of porosity.

Storage coefficient (S).

Physical proprieties of the fluids. Basic equations of hydrodynamics.

Circulation in porous media.

Type of groundwater uses and contamination.

Oscillations of the piezometric groundwater levels.

Hydraulics of groundwater impounding.

Type of wells and flux generated.

Hydraulics of complete wells.

Flow tests.

Hydrogeology of Portugal.

Practical classes:

Granulometric analysis. Calculation of the Uniformity Coefficient (U). Calculation of the permeability based on the Hazen formulae. Horizontal and vertical permeability.

Geologic and hydrogeologic profile based on drilling reports.

Graphics flow/drawdown, specific flow/drawdown. Graphics time/flow and time/drawdown. Distinction between phreatic and confined aquifers.

Flow tests.

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Field Techniques in Geosciences (GEO0763L)

Use the compass in geology: Reference to magnetic declination and its determination to 1:25,000 scale topographic maps; Orientation 1:25,000 scale topographic map using the compass; Determination of azimuths and location in the field by the method of inverse azimuths; Determination of the attitude of a plan; Determination of the attitude of a line.

Rocks and Minerals: Identification and characterization of minerals, sedimentary rocks, igneous and metamorphic rocks by gross examination.

Execution of geological profiles of the scale of the outcrop.

Execution of synthetic stratigraphic columns prepared in accordance with observations made on the scale of the outcrop.

Drafting of schematic plans interpretation the observations made at the outcrop scale.

Using GPS to support field work, regarding the geographical location marking points on the GPS and in topographic maps.



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Engineering Geology (GEO0745L)

Theoretical component

Definition of Engineering Geology. Origin and development of engineering geology. Relations between the Engineering Geology and the other disciplines of Geotechnics.

Preliminary studies. Concept and methodology

Site engineering classification. Geological classification. Classification for engineering purposes: Soils; Rocks and rock masses.

Discontinuities. Definition and properties. Methods for the study of discontinuities

Subsurface exploration. Methods of subsurface exploration

Sampling. Methods of sampling. Undisturbed samples. Disturbed samples

Geophysical exploration. Electrical methods: Earth resistivity method. Seismic methods: refraction, reflection and direct.

Application of geophysical methods in geotechnical exploration

In situ testing. Introduction. Strength tests. Permeability tests. Deformability tests

Practical component

Laboratory classification testing on soils

Swelling test

Permeability test

Study visit to a Engineering Work

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Hydraulics (ERU0568L)

1. Fluids physical properties;

2. Hydrostatics: Hydrostatic pressure; Pressure measurement; Manometers; hydrostatic impulsion.

3. Hydrocinematics: Types of flow; Continuity equation; Applications.

4. Hydrodynamics: Bernoulli Theorem, application to real fluids; Hydraulic power; Euler Th.

5. Head Losses in uniform flow.

6. Pressurized flows; Calculation of installations and pipe trajectory.

7. Pumps.

8. Free surface flow: Types of flow; Application of the Bernoulli Th. to open channels flow.

9. Flow through holes and weirs.

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SIG Remote Sensing (GEO0735L)

- GIS and the sciences.

- Graphical representations; Projection Systems; Georeferencing; Scanning information.

- Computer georeferenced data.

- Aerial and satellite photography, principles of acquisition and treatment of images.

- Ortorectified and stereoscopic images.

- Symbols and Labels in GIS

- Creation of Layouts:

- Digitizing of points and lines.

- Creating and editing symbols

- Georeferencing:

- Creating layouts

- Use of images from Google Earth for the recognition of human, geographic and geological structures.

- Use of Landsat 7 images for terrain characterization. The algorithms for NDVI, clays and iron oxides.

- Small GIS project.



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Sedimentology (GEO0760L)

Lecture:

Sedimentology framed in Geology, Mining, Engineering Geology and Environmental Sciences. Genesis of sedimentary rocks. Systematic of sedimentary rocks. Methods applied to the study of Sedimentary Rocks. Fluid flow. Transport and deposition (Reynolds and Froude numbers). Sedimentary structures (primary and secondary). Depositional environments: Continental (fluvial; desert; alluvial; lacustrine); Transitional (estuarine; deltaic; littoral) and Marine (Siliciclastic and Carbonate Shelf)

Lab Assignments:

Laboratory Techniques

Sedimentary textures. Petrographic analysis.

Classification of the Sedimentary according to compositional and textural analysis.

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Mineral Resources (GEO0759L)

Introduction to the study of mineral resources: position, geological context and usefulness

Global economy and the geological resources:

The geology of mineral resources in the wider context of earth sciences;

Mineral prospecting and mineral resources:

Geophysical prospecting methods

Geochemical prospecting methods

geochemical anomalies

Energy resources: importance; types; production; consumption

Metallic Mineral Deposits:

Study methods for metallic mineral deposits - fluid inclusions and stable isotopes;

Ortomagmáticos deposits;

Deposits associated with intermediate rocks;

Deposits associated with acid rock (skarns; deposits in shafts)

Deposits associated with sedimentary processes and vulcanossedimentares

Deposits associated with metamorphic processes.

Portuguese examples

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Mineral Resources (GEO1820L)

Introduction to the study of mineral resources: position, geological context and usefulness

Global economy and the geological resources:

The geology of mineral resources in the wider context of earth sciences;

Mineral prospecting and mineral resources:

Geophysical prospecting methods

Geochemical prospecting methods

geochemical anomalies

Energy resources: importance; types; production; consumption

Metallic Mineral Deposits:

Study methods for metallic mineral deposits - fluid inclusions and stable isotopes;

Ortomagmáticos deposits;

Deposits associated with intermediate rocks;

Deposits associated with acid rock (skarns; deposits in shafts)

Deposits associated with sedimentary processes and vulcanossedimentares

Deposits associated with metamorphic processes.

Portuguese examples



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Soil Mechanics and Foundations I (GEO0518L)

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.

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Soil Mechanics and Foundations (GEO1821L)

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.



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Strength of Materials I (ERU0480L)

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.

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Applied Geophysics (FIS0708L)

I – Introduction

II – Electrical methods

III – Gravimetric methods

IV- Seismic methods

V – Well logging



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Applied Geophysics (FIS1824L)

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.

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Surveys (GEO1825L)

1 - Introduction

2 - Drilling planning

3 - Drilling with trade

4 - Percussion drilling

5 - Drilling geometry

6 - Rotation drilling with probe recovery

7 - Samplers

8 - Casing

9 - Underwater drilling

10 - Rotary drilling

11 - Oil drilling

12 - Drilling muds

13 - Roto-percussion drilling

14 - Mine drilling

15 - Geotechnical recognition using drilling

16 - Drilling for water abstraction

17 - Filters

18 - Equipment manufacturers



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Surveys (GEO1826L)

- 1 - Introduction
- 2 - Drilling planning
- 3 - Drilling with trade
- 4 - Percussion drilling
- 5 - Drilling geometry
- 6 - Rotation drilling with probe recovery
- 7 - Samplers
- 8 - Casing
- 9 - Underwater drilling
- 10 - Rotary drilling
- 11 - Oil drilling
- 12 - Drilling muds
- 13 - Roto-percussion drilling
- 14 - Mine drilling
- 15 - Geotechnical recognition using drilling
- 16 - Drilling for water abstraction
- 17 - Filters
- 18 - Equipment manufacturers

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Geostatistics (GEO0516L)

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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Geostatistics (GEO1827L)

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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Safety Hygiene at Work (GEO1828L)

- 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.



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Safety Hygiene at Work (GEO1829L)

- 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.

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Quality and Use of Water (QUI0574L)

- 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.

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Water Resources Monitoring (ERU0571L)

- 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.).



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Rock Mechanics (GEO0517L)

Theoretical component:

Definition, purpose and scope of Rock Mechanics. Weak rocks and weak rock masses.

Description, classification and zonation of rock masses. Overall geomechanical evaluation of the rock mass.

Deformability of rocks and rock masses. Main types of behaviour of rocks. Factors affecting the behaviour of rocks. Creep.

Rheology of rocks. Rheological models. Anisotropy. Characterization of the deformability of rocks and rock masses.

Strength of rocks and rock masses. Failure criteria. Shear strength of discontinuities. Characterization of the strength of rocks and rock masses.

In situ stresses in rock masses. The natural in situ stress states in rock masses. Methods for the determination of the in situ stress state.

Practical component

Laboratory testing:

i) physical tests;

ii) mechanical tests;

iii) index tests.

In-situ testing:

(i) deformability tests (LFJ, BHD);

ii) methods for in situ stress determination (SFJ, STT)

Study visit to the Laboratory of Rock Mechanics at LNEC.

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Rock Mechanics (GEO1822L)

Theoretical component:

Definition, purpose and scope of Rock Mechanics. Weak rocks and weak rock masses.

Description, classification and zonation of rock masses. Overall geomechanical evaluation of the rock mass.

Deformability of rocks and rock masses. Main types of behaviour of rocks. Factors affecting the behaviour of rocks. Creep.

Rheology of rocks. Rheological models. Anisotropy. Characterization of the deformability of rocks and rock masses.

Strength of rocks and rock masses. Failure criteria. Shear strength of discontinuities. Characterization of the strength of rocks and rock masses.

In situ stresses in rock masses. The natural in situ stress states in rock masses. Methods for the determination of the in situ stress state.

Practical component

Laboratory testing; i) physical tests; ii) mechanical tests; iii) index tests. In-situ testing: deformability tests (LFJ, BHD); ii)

methods for in situ stress determination (SFJ, STT)

Study visit to the Laboratory of Rock Mechanics at LNEC.



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Georesources Exploitation (GEO0515L)

Rocks and Industrial Minerals

- 1 - Quarries exploitation (types of mining and conditionings);
- 2 - Quarries Exploitation Methods of Dimension Stones;
- 3 - Aggregates exploitation methodologies and gravel quarries;
- 4 - Underground Exploitation.

Water

- 1 - Methods and projects of groundwater wells;
 - 2 - Type of wells;
 - 3 - Drilling methods;
 - 4 - Application to the different types of aquifers;
 - 5 - Well dimension's;
 - 6 - Definition of drilling diameters and well casing diameters;
 - 7 - Dimension of screens and sand package;
 - 8 - Construction of wells;
 - 9 - Flow tests;
 - 10 - Definition of abstraction volumes;
 - 11 - Definition of protection areas.
- Technical visits to extractive units with a report by visit.

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Georesources Exploitation (PE) (GEO1823L)

Rocks and Industrial Minerals

- 1 - Quarries exploitation (types of mining and conditionings);
- 2 - Quarries Exploitation Methods of Dimension Stones;
- 3 - Aggregates exploitation methodologies and gravel quarries;
- 4 - Underground Exploitation.

Water

- 1 - Methods and projects of groundwater wells;
- 2 - Type of wells;
- 3 - Drilling methods;
- 4 - Application to the different types of aquifers;
- 5 - Well dimension's;
- 6 - Definition of drilling diameters and well casing diameters;
- 7 - Dimension of screens and sand package;
- 8 - Construction of wells;
- 9 - Flow tests;
- 10 - Definition of abstraction volumes;
- 11 - Definition of protection areas. -Technical visits to extractive units with a report by visit.



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Industrial and Ornamental Rocks (GEO0519L)

Theoretical

- 1 - Introduction - National and global framework of ornamental stones, aggregates and ores; varieties, trade and industry. Definitions, occurrences and applications. Dimension Stones
- 2 - Transformation of marble, limestone, granite and schist as ornamental rocks (processes and equipment): Aggregates and Ores
- 3 - Characterization of concentration (ponderal yield, recovery, degree of release and content of concentrate).
- 4 - Production of aggregates and ores (processes and equipment).

Practice

- 1 - Design of ornamental stones transformation plants
- 2 - Design of crushing lines.
- 3 - Aggregates characterization tests (European Standard):
- 4 - Technical visits to ornamental stones factories, crushing lines and ores concentration units.

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Industrial and Ornamental Rocks (GEO1830L)

Theoretical

- 1 - Introduction - National and global framework of ornamental stones, aggregates and ores; varieties, trade and industry. Definitions, occurrences and applications. Dimension Stones
- 2 - Transformation of marble, limestone, granite and schist as ornamental rocks (processes and equipment): Aggregates and Ores
- 3 - Characterization of concentration (ponderal yield, recovery, degree of release and content of concentrate).
- 4 - Production of aggregates and ores (processes and equipment).

Practice

- 1 - Design of ornamental stones transformation plants
- 2 - Design of crushing lines.
- 3 - Aggregates characterization tests (European Standard):
- 4 - Technical visits to ornamental stones factories, crushing lines and ores concentration units.

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Slope Stability (GEO1831L)

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.



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Slope Stability (PE) (GEO1832L)

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.

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Applied Geochemistry (GEO0752L)

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 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.

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Applied Geochemistry (PE) (GEO1833L)

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 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.



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Geological Cartography (GEO0738L)

- 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 o

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Geological Cartography (GEO1834L)

- 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.

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Environment Geology and Regional Planning (GEO1835L)

- 1 - Geologic hazards and land-use planning
- 2 - Geologic risks and water resources
 - a) Floods
 - b) Groundwater contamination
 - c) Aquifer remediation and protection
 - d) Seawater intrusion
 - e) Subsidence
- 3 - Sismicity
- 4 - Coastal hazards and coastal erosion
- 5 - Soils and erosion
- 6 - CO₂ storage and climate change



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Inspection of Hydraulic Works (ERU0567L)

- 1) Projects and works. Contest, award, contract, consignment contracts. Organization and installation of the yard. Shipyard equipment execution of the work, billing, payment, receipt and settlement
- 2) cost optimization models
- 3) Safety and Health in the Construction Industry
- 4) Quality in construction
- 5) Dams - General aspects; types and choice of solutions; hydrology notions applied to dams; organ safety and exploitation
- 6) regulations on dams and waterworks
- 7) Incidents, accidents and breaks in dams
- 8) Safety check - structural safety; hydraulic and operational safety; environmental security
- 9) routine visual inspections
- 10) Legal obligations of the developer
- 11) Emergency and risk management.