

<b>Civil Engineering</b>			
<b>Year/Se mester</b>	<b>Courses</b>	<b>Hours</b>	<b>ECTS</b>
1°/1°	<p><b>MATHEMATICAL ANALYSIS I</b></p> <p>Preliminaries. Real functions of a real variable: definitions; function classes; properties. Limits and continuity: definitions; theorems. Differential calculus: definition of derivative and geometric interpretation; differentiability and continuity; derivation rules; Bolzano's, Weierstrass's, Rolle's, Lagrange's and Cauchy's theorems; Cauchy's and L'Hôpital's rules; derivative applications; increments and differentials. Integral calculus: antiderivatives; techniques of integration; definite integral; applications: areas and volumes; improper integrals.</p>	160	6,0
1°/1°	<p><b>LINEAR ALGEBRA</b></p> <p>Matrices and systems of linear equations. Vector spaces: subspaces, linear spanning; linear independence; basis and dimension; applications. Determinants and their application to the solution of linear systems and computation of the inverse of a square matrix. Analytic geometry: dot, vector and mixed product of vectors; applications; representation of straight lines and planes in the Euclidean space; application to distances. Eigenvalues and eigenvectors of square matrices: application to matrix diagonalization.</p>	133	5,0
1°/1°	<p><b>PHYSICS</b></p> <p>Material point kinematics at one and two dimension motion: position, velocity and acceleration vectors. Motions with constant velocity, constant acceleration, free-fall, and varying acceleration. Projectiles, circular motion. Material point dynamics. Force and Newton's Laws. Momentum and impulse. Conservation of momentum. Contact forces. Inertial forces. Rigid body dynamics. Work-energy theorem and kinetic energy. Law of conservation of energy. Many particles systems. Collisions.</p>	139	5,0
1°/1°	<p><b>APPLIED MECHANICS</b></p> <p>Introduction to vectorial mechanics. Applied Statics - isostatic structures: loading systems; support conditions; structural systems. Concept and properties of hinges, pistons and slides. Equilibrium of isostatic structures - support reactions, free-body diagrams and internal forces, relationship between applied load and internal forces. Plane trusses: stability and determinacy, resolution at joints, methods to calculate axial forces.</p>	134	5,0
1°/1°	<p><b>CHEMISTRY</b></p> <p>The structure of matter and the periodic table. Chemical bond. Stoichiometry and stoichiometric calculations. Solutions and concentrations. Chemical equilibrium. Solubility equilibrium. Acids and bases and ionic equilibrium. Oxidation-reduction and corrosion. Organic compounds.</p>	110	4,0
1°/1°	<p><b>BUILDING MATERIALS I</b></p> <p>Introduces students to material science and basic properties</p>	134	5,0

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	of construction materials. Processes of extraction, transformation and production, the main applications, the laboratorial procedures and the technical documents for the quality control of conventional construction materials such as natural stones, mineral binders, ceramics, glass, steel, wood, bituminous, plastics, paints and composites are studied.		
1º/2º	<b>MATHEMATICAL ANALYSIS II</b> Numerical and function series: definitions; tests for convergence; power series; Taylor and Maclaurin series; applications of power series. Real functions of several real variables: definitions; limits and continuity; partial derivatives; differentiability; increments and differentials; directional derivatives; extreme values and saddle points; optimization problems with constraints. Multiple integrals: definition and properties of double and triple integrals; geometric interpretation of double integrals; double integrals in polar coordinates ; triple integrals in cylindrical and spherical coordinates; applications of double and triple integrals.	157	6,0
1º/2º	<b>STATISTICS</b> Elements of Probabilities. Some discrete and continuous random variables and their probability distributions. Sampling distributions. Estimation of parameters (point and interval estimates). Hypothesis tests. Correlation and simple linear regression.	131	5,0
1º/2º	<b>STRENGTH OF MATERIALS I</b> Strength of materials basic concepts. Stresses and strains. Structural safety concepts. Elementary elasticity of beams and columns. Design of elements with axial load. Elasto-plastic analysis. Prestress concepts. Temperature effects. Composite sections and materials. Stability of columns. Euler critical loads. Safety provisions on compressed members.	135	5,0
1º/2º	<b>APPLIED GEOLOGY</b> Structure and composition of Earth. Internal geodynamics. Material types, scalar and directional properties and chemical unions. Crystallography and crystallochemical. Study of minerals, laboratorial identification. Study of rocks, laboratorial identification. Geologic structures. Study and geotechnical classification of rock masses. Geological maps and geological profiles. Portugal geology.	138	5,0
1º/2º	<b>CONTINUUM MECHANICS</b> Cartesians tensor concept and properties. Strain and stress analysis. Flow analysis. Constitutive laws for solid body and fluids. Conservation laws. Energy of deformation. Definition of the strength criteria applied to the most used material in Structural Engineering.	111	4,0
1º/2º	<b>BUILDING MATERIALS II</b> Aggregates; binders; mortars; concretes; steels; binder	138	5,0

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	fabrication procedures; determination of the properties of aggregates and binders; study of the composition of mortars and concretes.		
2º/1º	<p><b>MATHEMATICAL ANALYSIS III</b></p> <p>Curved integrals: definition, computation and application of curved integrals; Green's theorem.</p> <p>Surface integrals: definition, computation and practical interpretation of surface integrals; rotational and divergence in a <math>R^3</math> vector field; Stokes theorem; Divergence theorem.</p> <p>Differential equations: definitions and terminology; initial value problem, first and higher order differential equations as mathematical models.</p> <p>Differential Equations Systems: linear operator method, fundamental solution system (<math>e^{At}</math>).</p> <p>Laplace transform: definition, existence and uniqueness, inverse transform, initial value problem.</p>	140	5,0
2º/1º	<p><b>SOIL MECHANICS I</b></p> <p>Origin and types of soil deposit. Physical and chemical properties of engineering soils. Classification and description of engineering soils. Standards for tests and interpretation methods. Soil compaction: standards; effects on soil properties; field compaction and control. Stress and deformation in soil mass: stress due to self-weight; stress due to applied loads; settlements based on elastic theory. Seepage theory and groundwater flow: flow under retaining structures and through earth dams; radial flow in confined and unconfined aquifers.</p>	145	5,0
2º/1º	<p><b>HYDRAULICS I</b></p> <p>Fluid properties; Hydrostatic; Dimensional analysis; Similarity theory; Hydrokinematics; Concepts and fundamentals principles of hydrodynamics; Global study fluid flow; Momentum equations; Head loss flow laws; Steady flow in pipe networks.</p>	129	5,0
2º/1º	<p><b>STRENGTH OF MATERIALS II</b></p> <p>Flexural and shear stresses and strains. Analysis of flexural and shear effects. Non-linear flexural analysis. Deflection of beams. Torsion. Strain energy. Lateral instability of beams.</p>	133	5,0
2º/1º	<p><b>TECHNICAL DRAWING</b></p> <p>Drawing design rules, orthogonal views (European method), rapid views (isometric, diametric and cavalier), dimensioning rules, quality of drafts, cuts and sections; drawing sheets and their graphical elements; scale and proportion, computer-aided drawing (AutoCAD, two-dimensional and three-dimensional drawing).</p>	129	5,0
2º/1º	<p><b>GENERAL CONSTRUCTION PROCESSES I</b></p> <p>Construction stages; preliminary works; site installation; excavation; planking and peripheral containment; direct and indirect foundations; common formwork; reinforced concrete structures both metallic and pre-fabricated; vertical joints; expanding joints; glass façades; urban street layout; special</p>	134	5,0

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	structures.		
2°/2°	<b>STRUCTURES I</b> General principles of static equilibrium of solids and structures. Introduction to structural theory and analysis. Virtual work theorem. Introduction to the Force Method. Energy Methods. Introduction to the Displacement Method. Cross moment-distribution Method. Introduction to the influence lines theory.	143	5,0
2°/2°	<b>SURVEYING</b> Basic concepts of surveying: planimetry and altimetry; plane-rectangular coordinates; paths; The theodolite. Distance measurement: direct and indirect measurement, trigonometric and electro-optical measurement. Fieldwork General surveying methods: triangulation and poligonation. Levelling: geometric and trigonometric methods. Surveying applications: terrain representation forms, curve marking, work setting out.	123	5,0
2°/2°	<b>SOIL MECHANICS II</b> Consolidation theory and settlement analysis: radial consolidation theory and preloading. Shear strength theory: Direct shear test and triaxial compression test: direction of failures plane and relationship between principal stress and shear strength parameters. Pore pressure parameters. Use of total stress and effective stress shear strength parameters. Lateral earth pressure. Stability of slopes. Ground investigation and methods of ground improvement. Problems. Laboratorial tests.	145	5,0
2°/2°	<b>HYDRAULICS II</b> Water hammer analysis; Open-channel flow; Pipe orifice. Elementary theory of notches and weirs; Flow measurements. Fluid machinery.	125	5,0
2°/2°	<b>GENERAL CONSTRUCTION PROCESSES II</b> Construction of masonry and concrete walls, construction of curtain-walls; traditional and non-traditional cladding of walls; thermal insulation; moisture in construction: diagnosis of situations where moisture occurs; techniques for treating humidity problems in construction; wall pathologies: fissuring; pavement cladding: classification, application forms and procedures; roof coverings: classification, composition, types and structures, building aspects and specific interventions; roof insulation: application processes and procedures. Some concepts about the regulation law of public works.	128	5,0
2°/2°	<b>CONCRETE I</b> Reinforced concrete structures behaviour and safety principles. Ultimate limit state of strength for flexion, shear and torsion. Construction provisions and reinforcement details for beams. Serviceability states and safety checks. Stress analysis and crack growing. Ultimate limit state of buckling strength for columns. Construction provisions and	146	5,0

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	reinforcement details for columns and walls.		
3º/1º	<b>STRUCTURES II</b> Fundamentals of structural idealization and conception criteria. Structural safety and design. Effects of vertical loads on structures. Effects of horizontal loads on structures: bracing systems, wind design, earthquake design. Structural computational analysis and design. Introduction to the finite element method.	135	5,0
3º/1º	<b>APPLIED HYDRAULICS I</b> Population and its evolution; flow computation; collection of subsoil and surface water; water supply; reservoirs; water pipe network; rainwater and domestic waste water drainage systems; structural dimensioning and drain implantation. Introduction to household water and domestic wastewater treatment systems.	135	5,0
3º/1º	<b>FOUNDATIONS</b> Formulation of global and partial safety criteria. Shallow foundations: types, load capacity, settlement analysis and estimation of coefficient of safety. Retaining walls: types of walls and stability check. Excavation by planking. Deep foundations: types, construction processes and compression dimensioning: group functioning.	125	5,0
3º/1º	<b>CONCRETE II</b> Reinforced concrete slabs: design and details. Surface and deep reinforced concrete foundations: design and details. Serviceability and ultimate limit states of design: generalization of the concepts applied to the reinforced and prestressed concrete structures. Design and detail of prestressed concrete structures.	146	5,0
3º/1º	<b>MANAGEMENT AND SECURITY</b> <b>Abstract:</b> Provides knowledge in the construction management and safety construction domains with special emphasis to the procedures and rules of measurement during design and execution, principles and applications of the Critical Path Method (CPM) and Project Evaluation and Review Techniques (PERT), definition and allocation of materials, equipment, and manpower resources, cost planning and control, review cost methods. Legal issues and procedures that provide the construction works development in safety conditions are also studied.	141	5,0
3º/1º	<b>BUILDING DESIGN AND DETAILING</b> Different phases of a project and their presentation rules. Graphic design of buildings (plans, elevations and sections), surveying techniques, rules for the representation of amendments, types of buildings. The Portuguese building code and anti-fire regulations for buildings. Detail drawing of: foundations, walls, floors, roof coverings, fireplaces, expansion joints, spans, escalators, false ceiling, entresols, glass façades, etc.	128	5,0

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3°/2°	<p><b>APPLIED HYDRAULICS II</b> Distribution systems classification. Water distribution building systems. Hot water production and distribution systems. Sewerage and pluvial drainage building systems. The hydrologic cycle; Hydrological basin; Rainfall; Surface interception and uptake; Evaporation and total loss; Infiltration; Surface runoff; Rainfall- runoff models. Erosion and sedimentation.</p>	105	4,0
3°/2°	<p><b>BUILDINGS PHYSICS</b> Functional requirements of construction. Thermics: general concepts and application of the Building Energy Regulation. Natural ventilation of buildings. Natural ventilation and comfort. Grounds for natural ventilation. Recommendations and devices for natural ventilation. Acoustics: general concepts and application of the Noise Regulation Law and the Noise Pollution Regulation Law. Thermal and acoustic behaviour of buildings and characterization of the corresponding constructive solutions. Fire protection: general concepts and application of the Fire Protection Regulation.</p>	131	5,0
3°/2°	<p><b>HIGHWAY AND TRAFFIC ENGINEERING</b> An overview of road design. Traffic systems. Horizontal projection and longitudinal profile. Consistency between layout (horizontal projection) and profile. Transverse profile. Traffic geotechnic. Earthworks. Paving. Draining.</p>	131	5,0
3°/2°	<p><b>STEEL AND MIXED STEEL-CONCRETE CONSTRUCTIONS</b> Mechanical properties of the steel. Structural behaviour of steel structures. Plasticity and stability phenomena. How the building structural systems work. Application of Eurocode 3 specifications in the steel structures design. Concept and examples of mixed steel-concrete structures according with Eurocode 4.</p>	116	4,0
3°/2°	<p><b>URBAN AND REGIONAL PLANNING</b> The basic principles for planning: concepts, main goals, identification of land-related problems and issues in a variety of environments: urban, suburban, rural, regional and resources lands. Strategies and policies in Urban Planning – The major elements of the "planning process" related to their legal and formal background with outcome in a physical document, a plan with maps and policies to be implemented, usually by a municipal planning department. Urban design: an approach to a methodological and critical analysis through a morphological study of urban components.</p>	131	5,0
3°/2°	<p><b>PROJECT</b> Written and drawn elements of a project; analysis and consistency between the various project components, including architectural aspects, stability, water system, waste water system, electrical and telephone installations; dimensioning in execution plans; preparation of contract</p>	196	7,0

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	specifications documents; execution of safety plans; work planning: mapping, labour, material and equipment diagrams using Project software. Checking the structural safety of a building by means of specialized analysis methods. Design, pre-dimensioning, structural modelling, stress analysis and dimensioning of a building. Supporting documents and drawings of a stability project.		