IPL
escola superior
de tecnologia e gestão
instituto politécnico
de leiria

Civil Engineering Course Plan

Scientific areas and credits that must be obtained before a degree is awarded

Scientific Area	Acronym	ECTS	
		Mandatory	Optional
Basic Sciences	CB	36	
Complementary Sciences	CC	13	
Engineering Sciences	CE	43	
Civil Engineering - Structures	EC-E	17	18
Civil Engineering - Construction	EC-C	17	18
Civil Engineering - Hydraulics and Environment	EC-HA	16	13
Civil Engineering - Planning and Transportation	EC-PT	15	18
	TOTAL	**157**	**67**

Study plan

1 year / 1 semester					
CURRICULAR UNITS	SCIENTIFIC AREA	TYPE	WORKING HOURS		CREDITS
			TOTAL	CONTACT (1)	
Mathematical Analysis	CB	semestral	162	TP:75 OT:5	6
Linear Algebra	CB	semestral	135	TP:60 OT:5	5
Physics	CB	semestral	162	T:30 TP:30 PL:15 OT:5	6
Technical Drawing	CE	semestral	135	TP:60 OT:5	5
Topography	CE	semestral	162	TP:30 PL:45 OT:6	6
English	CC	semestral	54	TP:30 OT:4	2

1 year / 2 semester					
CURRICULAR UNITS	SCIENTIFIC AREA	TYPE	WORKING HOURS		CREDITS
			TOTAL	CONTACT (1)	
Statistics	CB	semestral	81	TP:45 OT:5	3
Applied Mathematics	CB	semestral	162	TP:75 OT:5	6
Applied Statics	CB	semestral	135	T:54 PL:6 OT:5	5
Design and Computer Graphics	CE	semestral	135	TP:15 PL:45 OT:5	5
Programming	CC	semestral	162	TP:30 PL:45 OT:6	6
Engineering Geology	CC	semestral	135	T:15 TP:36 PL:9 O:T5	5

2 year / 1 semester					
CURRICULAR UNITS	SCIENTIFIC AREA	TYPE	WORKING HOURS		CREDITS
			TOTAL	CONTACT (1)	
Soil Mechanics and Foundations I	CE	semestral	162	T:30 TP:30 PL:15 OT:5	6
Strength of Materials I	CE	semestral	135	T:15 TP:42 PL:3 OT:5	5
Hydraulics	EC-HA	semestral	162	T:30 TP:39 PL:6 OT:5	6
Construction Materials	CE	semestral	135	TP:50 PL:10 OT:5	5
General Construction Processes	EC-C	semestral	108	TP:56 TC:4 OT:5	4
Urban and Regional Planning	EC-PT	semestral	108	T:15 TP:30 OT:5	4

2 year / 2 semester					
CURRICULAR UNITS	SCIENTIFIC AREA	TYPE	WORKING HOURS		CREDITS
			TOTAL	CONTACT (1)	
Soil Mechanics and Foundations II	CE	semestral	162	T:30 TP:37 PL:8 OT:5	6
Strength of Materials II	CE	semestral	135	T:15 TP:42 PL:3 OT:5	5
Hydrology and Water Resources	EC-HA	semestral	135	T:15 TP:45 OT:5	5
Theory of Structures	EC-E	semestral	135	T:15 TP:45 OT:5	5
Installations in Buildings	EC-C	semestral	108	TP:60 OT:5	4
Road Design I	EC-PT	semestral	135	T:15 TP:42 PL:3 OT:5	5

3 year / 1 semester					
CURRICULAR UNITS	SCIENTIFIC AREA	TYPE	WORKING HOURS		CREDITS
			TOTAL	CONTACT (1)	
Reinforced Concrete I	EC-E	semestral	162	T:30 TP:41 PL:4 OT:65	6
Sewage Systems	EC-HA	semestral	135	TP:60 OT:5	5
Road Design II	EC-PT	semestral	162	T:15 TP:55 PL:5 OT:5	6
Construction Planning and Safety	EC-C	semestral	162	T:15 TP:55 PL:5 OT:5	6
Innovation and Entrepreneurship	CC	semestral	54	TP:30 OT:5	2
Elective I (a)	EC-E/EC-C/EC-HA/EC-PT	semestral	135		5

3 year / 2 semester					
CURRICULAR UNITS	SCIENTIFIC AREA	TYPE	WORKING HOURS		CREDITS
			TOTAL	CONTACT (1)	
Reinforced Concrete II	EC-E	semestral	162	T:30 TP:45 OT:5	6
Buildings Physics	EC-C	semestral	81	T:30 TP:24 PL:6 OT:5	3
Civil Engineering Project	EC-E	semestral	216	PL:60 OT:15	8
Seminar	CC	semestral	81	S:30	3
Elective II (b)	EC-E/EC-C/EC-HA/EC-PT	semestral	135		5
Elective III (b)	EC-E/EC-C/EC-HA/EC-PT	semestral	135		5

Options I (a)

3 year / 1 semester					
CURRICULAR UNITS	**SCIENTIFIC AREA**	**TYPE**	**WORKING HOURS**		**CREDITS**
			TOTAL	**CONTACT (1)**	
Steel and Mixed Structures	EC-E	semestral	135	TP:60 OT:5	5
Project Management	EC-C	semestral	135	TP:60 OT:5	5
Traffic Engineering and Transportation	EC-PT	semestral	135	TP:30 PL:30 OT:5	5

Options II, III (b)

3 year / 2 semester					
CURRICULAR UNITS	**SCIENTIFIC AREA**	**TYPE**	**WORKING HOURS**		**CREDITS**
			TOTAL	**CONTACT (1)**	
Conservation and Rehabilitation of Buildings	EC-C	semestral	135	TP:50 PL:10 OT:5	5
Special Foundations and Structures	EC-E	semestral	135	TP:60 OT:5	5
Water and Wastewater Treatment	EC-H	semestral	135	TP:60 OT:5	5
Geographic Information Systems	EC-PT	semestral	135	TP:30 PL:30 OT:5	5

(1) T: Theoretical teaching; TP: Theoretical practices lectures; PL: Laboratory teaching; OT: Tutorial

Course	MATHEMATICAL ANALYSIS		
	ECTS	**Scientific area**	
1st Semester	6	Basic Sciences	CB

Hours: 80	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 162
		75				5		

LEARNING OUTCOMES	C1.Knowledge and understanding - Knowledge and understanding of mathematical concepts and their properties C2.Applying knowledge and understanding - Ability to relate concepts; Ability to interpret charts and other forms of visualization; Ability to apply mathematical concepts in modelling and solving problems related to engineering sciences. C3.Making judgments - Ability to use a critical analysis of the results obtained. C4.Communication - Ability to use correct mathematical symbolism in problem solving. C5.Learning skills - Ability to study independently
PROGRAM	1 Inverse trigonometric functions 1.1 Definition, domain, codomain and graph 2 Differential calculus in IR 2.1 Derivative of a function, differentiability and continuity 2.2 Derivations rules and Cauchy's rule 2.3 Extrema point and optimization problems 3 Primitives and integral calculus in IR 3.1 Primitives (immediate, by parts, by variable substitution, and rational fractions) 3.2 Differential equations of separable variables 3.2 Definite integral; Fundamental Theorem of integral calculus 3.3 Areas and volumes of solids of revolution 4 Real functions of several real variables 4.1 Definition, domain, contours, and graph 4.2 Limits and continuity 4.3 Partial derivatives, gradient vector, directional derivatives and chain rule 4.4 Extrema points and optimization problems 5 Double integrals 5.1 Definition, Fubini's theorem and change of order of integration 5.2 Double integrals in polar coordinates and applications
TEACHING METHODOLOGY	Contact: Theoretical practices lectures (Presentation of the concepts of mathematical analysis, examples and solving exercises and problems) Tutorial (Sessions to conduct the learning process) Autonomous: Study (Excerpts readings from recommended literature; Resolution of recommended exercises) E-learning (Learning contents in Moodle)
EVALUATION METHOD	Continuous assessment Initial assessment test knowledge T0 (20 points) 3 homeworks TPC Performance in class – D (average of questions in class) 2 tests T1 and T2 (8.5 min. / 20 points each) Final standings: CF = 0.05*T0 + 0.15*TPC+0.05*D+0.375*T1+0.375*T2 Exams Final individual examination
REFERENCES	Main:

	Anton, H., "Cálculo, um novo horizonte", Vol. I e II, Bookman, 6.ª edição, 2000. Anton, H., "Calculus, A New Horizon", Sixth Edition, Wiley, 1999. Didactic material provided by lecturers. Complementary: Larson, R., Hostetler, R., Edwards, B., "Cálculo", Vol. I e II, 8ª Edição, McGraw Hill, 2006. Stewart, J., "Cálculo", Vol. I e II, 5ª Edição, Pioneira - Thomson Learning, 2006.

Course	LINEAR ALGEBRA		
	ECTS	**Scientific area**	
1st Semester	5	Basic Sciences	CB

Hours: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 135
		60				5		

LEARNING OUTCOMES	C1. Knowledge and understanding - To know and understand the concepts of linear algebra and its properties C2. Applying knowledge and understanding - To interconnect different contents; To model problems involving linear algebra concepts; To solve abstract problems using vector space and linear transforms contents; To use Linear Algebra contents to solve engineering problems C3. Making judgments - Critical analysis of the results C4. Communication - Ability to use mathematical symbols; Ability to achieve greater accuracy and clarity of thought and language C5. Learning Skills - Self-learning ability.
PROGRAM	1. Vectors in 3-space (Dot product; Cross product; Scalar triple product; Vectors calculus) 2. Matrices and Systems of Linear Equations (Matrix notation and terminology - Simple examples of matrices; Operations on matrices; Linear independence and characteristic of a matrix - Gauss elimination; Inverse of a matrix; Matrices equations; Systems of Linear Equations) 3. Determinants. (Definition; Determinants expressions of 2x2 and 3x3 matrices; Determinant properties; Laplace's Theorem (cofactor expansion); Adjoint matrix and inverse matrix; Cramer's rule) 4. Vectors spaces (Vectors spaces; Vectors spaces properties; Subspaces; Linear combination; Linear independence; Space spanned; Basis and dimension of a subspace; Basis change; Eigenvalues and eigenvectors; Matrix diagonalization) 5. Linear Transformations (Linear transformation; Kernel, nullity, range and rank of a linear transformation; Canonical matrix transformation; Linear transformations on IR^2)
TEACHING METHODOLOGY	Contact Theoretical and practical teaching (The contents will be described, with several examples and exercises resolutions; Interaction with the students in the resolution of the exercises and answering their doubts) Tutorial orientation (Sessions of personal orientation, in order to lead the learning of the class; Answer student's doubts) Autonomous Home-study (Reading parts of the bibliography; Resolving exercises) E-learning (Searching material concerning Linear Algebra)
EVALUATION METHOD	Assessment: It is required the resolution of several exercises in lecture by the students to access the continuous assessment. Continuous Assessment (CA):2 modules with a minimum of 7.5 values:M1 (1 short written test(MT1) and 1 written test(T1)); M2 (1 short test(MT2) and 1 test(T2)). Final Classification(FC)= 0.2MT1+0.4T1+0.1MT2+0.3T2 Exams: The student can choose: 1. Perform full test; 2. Submit to an evaluation of one module, if it has minimum in the other module in the CA. FC= 0.6M1+0.4M2

REFERENCES	Main Anton, H., Rorres, C., Álgebra Linear com Aplicações, 8ed, Bookman, 2001. Anton, H., Rorres, C., Elementary Linear Algebra with Applications, 10th Edition, 2010. Complementary Anton, H., Busby, R., Contemporary Linear Algebra, John Wiley & Sons, 2003. Monteiro, A., Álgebra Linear e Geometria Analítica, McGraw-Hill, 2001. Giraldes, E., Fernandes, V. H., Santos, M. H., Álgebra Linear e Geometria Analítica, McGraw-Hill, 1994. Steinbruch, A., Winterle, P., Introdução à Álgebra Linear, McGraw-Hill, 1990.

Course	PHYSICS		
	ECTS	**Scientific area**	
1st Semester	6	Basic Sciences	CB

Hours: 80	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total work hours:** 162
	30	30	15			5		

LEARNING OUTCOMES	C1.Knowledge and understanding - knowledge in Physics (basics) and understanding the principles and laws C2.Applying knowledge and understanding - Ability to relate concepts; Ability to describe practical examples of application; Ability to solve problems involving the principles of physics; Ability to create models demonstrating the real principles; Capacity in making kits to verify physical laws C3.Making judgments - Ability to use a critical analysis of the results obtained numerically or experimentally C4.Communication - Ability to develop lab reports; Ability to represent free-body diagrams C5.Learning skills - Ability to study independently
PROGRAM	1.Static and Dynamics 1.1.Fundamental principles (Dimensional analysis; Newton's Laws; System of reference) 1.2.Forces and static equilibrium (Components; Moment; Balance; Centre of mass) 1.3.Forces and movement (Position vector; Trajectory; Linear / angular velocity; Linear/angular acceleration) 1.4.Linear momentum and collisions (Impulse; Variation and conservation of linear momentum) 1.5.Work and power (Work done by force; Power; Energy conservation) 1.6.Rotation of a rigid body (Moment and product of inertia; Angular momentum) 2.Periodic movements 2.1.Vibrations (Free; Damped; Forced) 2.2.Mechanical waves (Transverse and longitudinal waves; Pulses; Wave equation) 2.3.Interference and standing waves 3.Sound 3.1.Propagation velocity 3.2.Qualities (Intensity; Frequency) 3.3.Properties 4.Matter 4.1.Solids (Molecular structure of matter; Stresses; Elasticity, Deformation) 4.2.Fluids (Pressure; Impulse; Bernoulli's Principle)
TEACHING METHODOLOGY	Contact Theoretical teaching (Presentation of the concepts and principles of physics; Exemplification and application to real problems) Practical teaching ((Modelling and problem solving) Laboratory (Experiments; Reports; Construction of models) Tutorial (Sessions to conduct the learning process) Autonomous Study (Excerpts readings from recommended literature; Resolution of recommended exercises) E-learning (Learning contents in Moodle)
EVALUATION	Continuous Assessment

METHOD	Performance D (mean value of questions in lectures) Two written tests T1 and T2 (7.5 min / 20 val. each) 5 laboratory reports TL1-TL5 (min 7.5 / 20 val. each) Final standings: = 0.10D+0.50 (T1+T2)/2+0.4(TL1+TL2+TL3+TL4+TL5)/5 Exams Contains two parts: written (PE) and laboratory (PL) Final standings: CF=0.60*PE+0,4*PL (min: PE ≥7.5, PL ≥7.5)
REFERENCES	Main Serway A. Raymond, Princípios de Física: Vol1 Mecânica Serway A. Raymond, Princípios de Física: Vol2 Movimento Ondulatório e Termodinâmica Beer F.P. e Jonhston Jr., Mecânica Vetorial para Engenheiros, Estática, McGraw-Hill, 5ªed., 1991 Didactic material provided by lecturers Complementary Paul G. Hewitt, Física Conceitual, Bookman, 9ª ed., 2002 Alonso M. & Finn E., Física, Addison-Wesley, 1999 J. L. Meriam, L. G. Kraige, Mecânica para Engenheiros - Estática. - Rio de Janeiro : LTC Livros Técnicos e Científicos, 2009

Course	TECHNICAL DRAWING		
	ECTS	**Scientific area**	
1st Semester	5	Engineering Sciences	CE

hours: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 135
		60				5		

LEARNING OUTCOMES	C1. Knowledge and understanding - Acquisition of a fundamental tool, of representation projects to be implemented in the engineering area. Acquisition of knowledge of legislation on the architectural design of constructions. C2. Knowledge and understanding applications - Ability to view and accurate representation in terms of forms of the material world, that reveal their spatial reconstitution. Ability to represent drawing models produced in the process of designing civil engineering projects. Ability to use the draw as a vital contribution in the creation stages of projects and its analysis. C3. Making Judgments - Ability to understand, interpret and validate de representation of forms C4. Communication - Ability to forms representation and models realization. Ability to organize and represent engineering projects. C5. Learning skills - Ability to study independently.
PROGRAM	1. INTRODUCTION.NORMALIZATION 1.1.Introduction to technical design 1.2.Normalization Scales 2. DESCRIPTIVE GEOMETRY 2.1.Geometry Introduction 2.2.Projections representation of point 2.3.Line segment 2.4.Line Plane figures 2.5.Plan Intersection (plan / plan, line / plan) 3. ORTHOGONAL PROJECTIONS 3.1.Volumes representation by their orthogonal projections 3.2.Projection representation by the European and American method 3.3.Envolving cube 4. PERSPECTIVES 4.1.Flat geometric projections types 4.2.Orthogonal axonometric projections 4.3.Orthogonal projections reading method 4.4.Free hand drawing 5. DIMENSIONING 5.1.Meaning and purpose of dimensioning 5.2.Dimension units for design construction 5.3.Dimensioning methods 6. REPRESENTATION OF BUILDINGS AND SPECIALTIES 6.1.Plans, Sections and Facades 6.2.Construction details 7. STUDY CASE PRESENTATION OF CONSTRUTIONS WITH HIGH ARCHITECTURAL QUALITY

TEACHING METHODOLOGY	Theoretical and practical teaching based on the analysis and discussion of the syllabus Application of concepts and methodologies in practical cases. Analysis of drawings of different projects of Civil Engineering and confrontation with constructed reality. Theoretical and practical teaching with application of drawing concepts and principals in practical works resolution Tutorial: personal coaching sessions in small groups to conduct the learning process and answer questions Study of the syllabus. Reading and consulting of excerpts of recommended reading. Resolution of practical work
EVALUATION METHOD	The course is theoretical and practical with a component of continuous evaluation Continuous Frequency F, obligatory (min.9.5/20val) Practical Work PW , obligatory (min.9.5/20val) Performance in class P Final Rating: FR = 0.40F + 0.50PW+ 0.10P Exams Evaluation Exam E, obligatory (min.9.5/20val) Practical Work PW, obligatory with oral defense (min.9.5/20val) Final Rating : FR = 0.55E + 0.45PW
REFERENCES	Main: A. Silva, C. Ribeiro, J. Dias, L. Sousa, Desenho Técnico Moderno, Lidel, 7ª Edição, 2004 Luís Veiga Cunha., Desenho Técnico Fundação Calouste Gulbenkian, 13ª Edição, 2004 Didactic material provided by lecturers Complementary: Guilherme Ricca, Geometria Descritiva Fundação Calouste Gulbenkian, 1992 Giesecke et al, Technical Drawing, 11th Edition, Prentice Hall, 2000 Regulamento geral das edificações urbanas (RGEU), 1951 Regulamento de Instalação e Laboração dos Estabelecimentos Industriais (RILEI), 1987

Course	TOPOGRAPHY		
	ECTS	Scientific area	
1st Semester	6	Engineering Sciences	CE

Hours: 81	T	T/P	PL	TC	S	OT	O	Total working hours: 162
		30	45			6		

LEARNING OUTCOMES	C1.Knowledge and understanding - Knowledge concerning positioning and geographical representation in the context of civil engineering; Capacity to interpret and use cartographic information; Knowledge of topographical concepts and topography skills. C2.Applying knowledge and understanding - Ability to apply knowledge in a structured way associated with basic sciences and engineering to solve real problems; ability to use topography equipment in a fieldwork context. C3.Making judgments - Capacity in using a critical thinking that allows the understanding, interpretation and evaluation of topography information. C4.Communication - Ability to work in a field context; ability to work in team. C5.Learning skills - Ability to study independently.
PROGRAM	1. Geodesy: Geoide, Natural and Geodesic Coordinates, Ellipsoids Reference, Geodesic Data, Geographic and Geodesic Coordinates, Geodesic Networks; 2. Cartography: Cartographic Projections Systems, Cartographic Azimuth Cartographic Projections; Scale Concept, Cartographic Representation of Land Surface, Aerophotogrammetry. 3. Topographic Measurements: Angles, Distances, Differences in Levels, Trigonometric and Geometric Levelling, Topographical Classic Methods; Coordinate calculation; 4. Collect and process data acquired: Working with Topographical Equipment, using GPS Receivers for Acquisition of Information. Perform a small topographic survey with classic methods and collect and process data acquired with GPS receivers. 5. Other systems to collect and process acquired data: Photogrammetry, Remote Sensing; Laser Scanning. 6. Model surface, Digital Terrain Models, Reading and interpretation of topographical maps; Visibility Maps; Slope Maps, Contours; Profiles.
TEACHING METHODOLOGY	Theoretical: Presentation of the concepts and techniques of topography Application to real problems Development of methodologies for solving exercises by autonomous mode Critical analyse of results Practical and Laboratory: Use of the acquired knowledge in the acquisition of information and the employment of topographic techniques Development practical work, integrated in a team Guidance tutorial: Personal coaching sessions to conduct the learning process and guide the work of student individual work Autonomous Reading from recommended literature Resolution of recommended exercises
EVALUATION METHOD	Continuous Assessment Two individual written exercises with a minimum score of 8.5 points (on a scale between 0 and 20) Topographic surveying work (TSW), and a final Test (T) Final grade= 0.2*(EX1+EX2)+0.4*TSW+0.4*T

	Exams Written theory and practice examination (PE)-minimum of 9.5 val Final grade= 0.4*TSW+0.6*PE
REFERENCES	Main: Fonte C., "Textos de apoio de Topografia", Departamento de Matemática, FCTUC, 2007 Gonçalves, J. A., "Topografia – Conceitos e Aplicações", Ed. Lidel, 2008. Gonçalves, L.; Samagaio, A. e Barreto Santos, M., "Caderno de Exercícios-volume I e II", Departamento de Engenharia Civil, Instituto Politécnico de Leiria, Escola Superior de Tecnologia e Gestão, 2011. Petrie, G., "Terrain modelling in surveying and civil engineering", Whittles, 1990 Shan, J., Toth, C., "Topographic laser ranging and scanning: principles and processing", CRC Press, 2009 Casaca, J.; Matos, J. e Baio, M., "Topografia Geral", Ed. Lidel, 2000. Complementary: El-Sheimy, N.; Valeo, C. e Habib A., "Digital terrain modeling: acquisition, manipulation, and applications", Artech House, 2005 Gaspar, J., "Cartas e Projecções Cartográficas", Ed. Lidel, 2008. Gaspar, J., "Dicionário de Ciências Cartográficas", Ed. Lidel, 2009.

Course	ENGLISH		
	ECTS	**Scientific area**	
2nd Semester	2	Complementary Sciences	CC

Hours: 50	**T**	**T/P**	**P/L**	**FW**	**S**	**TO**	**O**	**Total working hours:** 54
		30				4		

LEARNING OUTCOMES	C1.Knowledge and understanding – To acquire linguistic skills and knowledge in order to understand conversations and negotiations in English; C2.Applying knowledge and understanding– To understand the essential meaning of both concrete and abstract topics in texts; C3.Making judgments – To become aware of the importance and power of language in human relationships, both social and professional; C4.Communication – To acquire language skills (reading, listening, writing and speaking) to interact in formal or informal meetings and working situations in English with speakers from different social, cultural and linguistic contexts; C5.Learning skills – To improve the level of competence in English in order to prepare the students for both the present reality and the demands of the labour market, on a national as well as international level.
PROGRAM	1: English as a global language. Attitudes towards English. Expressions to convey linguistic and learning necessities. Brief notions of the characteristics that have led English to become a global language. 2: Informal Conversation: Taking part in conversations about people, places and other topics; description of personal and professional profiles; identification of cultural differences. 3: Contacts: Starting and keeping conversations about topics related to the professional context by telephone, email, letter. Describing people and exchanging information. 4: Meetings: Expressions to set up and organize meetings, make decisions, solve problems, present suggestions and lead meetings. Official register of information. Checking and clarifying facts and figures. 5: Negotiating relationships: Expression of formality and informality. Expression of likes and dislikes about travelling on business. Discussing attitudes about meetings and cultural behaviours in different countries.
TEACHING METHODOLOGY	Contact Use of oral documents in English; Use of written texts; Exercises to stimulate verbal interaction; Simulation of conversations in a socio-professional context; Production of written texts on socio-professional topics; Resolution of lexico-grammatical exercises. Autonomous Activities of consolidation of lexical and grammatical contents; E-learning by means of online material related to topics studied in class; Written and oral comprehension exercises.
EVALUATION METHOD	Continuous Assessment A writing test (including writing (PE), listening (CO) and reading skills(CE); An oral test (PO) (to assess speaking skills). Final Mark= 0.25PE + 0.25CO + 0.25CE + 0.25PO
REFERENCES	Main

	POWELL, M.(2009). In Company – Intermediate. Macmillan Publishers Ltd. Oxford.

Course	STATISTICS			
	ECTS		Scientific area	
2nd Semester	3		Basic Sciences	CB

Hours: 50	T	T/P	P/L	FW	S	TO	O	Total working hours: 81
		45				5		

LEARNING OUTCOMES	C1.Knowledge and understanding - knowledge in Statistics (basics) and understanding the principles and laws C2.Applying knowledge and understanding - Organize and summarize data. Make inferences about population parameters contained in a sample based on information. Compare data involving two random variables and study the prediction of one variable as function of the other. C3.Making judgments - Ability to make a critical analysis of a data set. C4.Communication - Ability to develop statistic reports. C5.Learning skills - Ability to study independently.
PROGRAM	1. Random variables and probability distributions: random variable concept; discrete random variables and probability distributions: binomial, negative binomial, hypergeometric and Poison distributions; continuous random variable and probability distributions: uniform, exponential, normal, chi-square and F distributions. 2. Describing and summarising data: the organization of data and descriptive statistics using the software R. 3. Statistical inference: random sampling, point estimation of parameters, statistical intervals for a single sample, tests of hypotheses for a single sample. 4. Bivariate analysis: contingent tables, chi-square tests and simple linear regression and correlation.
TEACHING METHODOLOGY	Contact Theoretical teaching (Presentation of the concepts and principles of statistics; Exemplification and application to real problems) Practical teaching (Data analysis using the software R) Tutorial (Sessions to conduct the learning process) Autonomous Study (Excerpts readings from recommended literature; Resolution of recommended exercises) E-learning (Learning contents in Moodle)
EVALUATION METHOD	Continuous assessment Four written tests T1, T2, T3 and T4 (T1 and T4: 60 min / 6 val. each; T2 and T3: 30 min / 4 val. each) Final standings: = T1+T2+T3+T4 Exams Contains two parts: P1 (chapter 1 and 2 of Syllabus) and P2 (chapter 3 and 4 of Syllabus) Final standings: 1. T1+T2+P2 or 2. P1+T3+T4 or 3. P1+P2 Remarks: Students can opt by final standing 1. only if they have T1+T2>4 and standing 2. only if they have T3+T4>4
REFERENCES	Main Murteira, B., Ribeiro, C., Silva, J. e Pimenta (2010). Introdução à Estatística, Escolar Editora.

	Montgomery, D. C. and Runger, G. C. (2011). Applied Statistics and Probability for Engineers, 5th edition, John Wiley & Sons, New York. Fox, J. (2005). The R Commander: A Basic-Statistics Graphical User Interface to R, Journal of Statistical Software, pp. 1-42 (disponível em http://www.jstatsoft.org/v14/i09/paper). Karp, N.A. (2010). R commander an Introduction, pp. 1-50 (disponível em *http://cran.r-project.org/doc/contrib/Karp-Rcommander-intro.pdf*) Complementar Pestana, D. e Velosa, S. (2010). Introdução à Probabilidade e à Estatística, 4.ª ed., Fundação Calouste Gulbenkian. Apontamentos e exercícios da UC disponibilizados no Moodle.

Course	APPLIED MATHEMATICS		
	ECTS	**Scientific area**	
2nd Semester	6	Basic Sciences	CB

hours: 80	**T**	**T/P**	**PL**	**TC**	**S**	**TG**	**O**	**Total working hours:** 162
		75		-	-	5	-	

LEARNING OUTCOMES	C1.Knowledge and understanding - Knowledge and understanding of advanced mathematical concepts and their properties C2.Application of knowledge and understanding - Capacity in relating mathematical concepts; Ability to apply mathematical concepts, to model and solve problems related to engineering and sciences; Capacity in using the worksheet C3.Making judgments - Capacity in using a critical thinking to analyse results C4.Communication - Ability to use symbolism and abstraction in mathematical problem solving; Ability to do geometric representations C5.Learning skills - Ability to study independently
PROGRAM	1.Fourier Series 1.1.Periodic functions 1.2.Fourier Series: Euler formulas, convergence, even and odd functions 2. Linear differential equations 2.1. Fundamental system of solutions 2.2. Homogeneous equations and complete 2.3. 2nd order models: free oscillations, damped and forced, linear column deflection, critical loads and modes of deformation 2.4. 4th order models: linear deflection of a beam for different boundary conditions; vibration systems 2 particles and two springs 3.Numerical methods 3.1.Euler and Runge-Kutta 3.2.Errors 3.3.Models: Movement of a pendulum and an angular deflection of a column beam 4.Partial Differential Equations 4.1.Method of separation of variables 4.2.Wave equation: vibrating string 4.3.Heat equation: propagation of heat in a slender tube 4.4.Laplace's equation: plate heat distribution at steady-state 4.5.4th ordr equations: beam in transverse vibration
TEACHING METHODOLOGY	Contact Theoretical and practical (Presentation of concepts of mathematics; Mathematical modeling of problems; Analysis, resolution and discussion of exercises) Tutorial (Sessions to conduct the learning process. Autonomous Study (Reading excerpts from the recommended literature; Resolution of recommended exercises) E-learning (Learning contents in Moodle)
EVALUATION METHOD	Continuous assessment Performance D (mean value of 6 mini-questions made in class) 2 written tests T1 and T2, (7.5 min / 20 val. each) 1 report on a spreadsheet T (min 7.5 / 20 val.) Final standings: 0.1*D+0.1*T+0.4*T1+0.4*T2

	Exams Contains two parts: written (P1) and spreadsheet (P2) Final standings: CF=0.90*P1+0.1*P2
REFERENCES	Main: Kreyszig, E., Advanced Engineering Mathematics, John Wiley & Sons, 1999 Burden, Richard L. e Faires, Douglas J., Numerical Analysis, Brooks/Cole, 7th edition, 2001 Didactic material provided by lecturers Complementary: Simmons, G., Krantz, S., Equações Diferenciais: Teoria, Técnica e prática, McGraw Hill, 2008

Course	APPLIED STATICS		
	ECTS	**Scientific area**	
2nd Semester	5	Basic Sciences	CB

Hours: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:135**
		54	6			5		

LEARNING OUTCOMES	C1. Knowledge and understanding – Knowledge of the principles and understanding of laws of static. C2. Applying knowledge and understanding - Ability to relate concepts; ability to describe practical examples of application, ability to solve problems involving the principles of statics; capacity to create real models demonstrating the principles C3. Making judgments - Ability to use a critical analysis of the results obtained numerically or experimentally C4. Communication - Ability to develop practical work; Ability to represent the free-body diagrams and diagrams of internal forces C5. Learning skills - Ability to study independently
PROGRAM	1. Review of mechanics of rigid bodies 1.1 Forces (algebra of vectors) 2. Types of structures 3. Actions 3.1 Classification 3.2 Eccentric loads and conjugates 3.3 Resultant of distributed loads 4. Connections and releases from a structure 4.1 Connections 4.1.1 Degrees of freedom 4.1.2 Classification of connections 4.1.3 Reactions that arise in each type of the connection 4.2 Releases 5. Degree of static indeterminacy of structures 6. Determination of reactions 6.1 Free body diagram 6.2 Calculation of reactions in structures without and with releases 7. Internal forces in bar structures 7.1 Beams and frames 7.1.1Forces on arbitrary and generic section 7.1.2 Diagrams of internal forces 7.1.3 Differential relations between loads and internal forces 7.1.4 Efforts in closed structures with releases 7.2 Internal forces on trusses 7.2.1 Equilibrium nodes Method 7.2.2 Section (Ritter) Method
TEACHING METHODOLOGY	Contact 1.Theoretical-practical 1.1Presentation of the concepts and principles of static 1.2Exemplification 1.3Modeling and solving problems 1.4Critical analysis of the results of the problems 2.Practical and laboratory teaching 2.1Experiments to illustrate the fundamental principles 3. Tutorial orientation 3.1Personal orientation sessions in small groups to clarify doubts

	Autonomous 1.Study 1.1Reading the recommended bibliography 1.2Resolution of exercises recommended by curriculum unit 2.E-learning 2.1Consultation of material concerning the curriculum unit
EVALUATION METHOD	Continuous assessment Two individual written examinations (PE1 e PE2) 4 practical works (TP1,TP2,TP3 e TP4) Final grade:= 0.8(0.4*PE1+0.6*PE2)+0.2(TP1+TP2+TP3+TP4)/4 Minimum grade: PE2 ≥ 8.5 Exams One individual written examination (PEx) Final grade= 0.8*PEx+0.2(TP1+TP2+TP3+TP4)/4
REFERENCES	Main: Didactic material provided by lecturers Beer, F.P. & Johnston Jr., E.R., Mecânica Vectorial para Engenheiros, Estática, McGraw Hill, 1999. Rossow, E.C., Analysis and Behavior of Structures, Prentice Hall, 1996. Sussenkind, Curso de Análise Estrutural, vol. 1 Estruturas Isostáticas, Editora Globo, 11ª edição, 1991. Complementary: Meriam, J. L. e Kraige, L. G., Mecânica - Estática, LTC Editora, 5ª edição, 2008

Course	DESIGN AND COMPUTER GRAPHICS		
	ECTS	**Scientific area**	
2nd Semester	5	Engineering Sciences	CE

Hours: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 135
		15	45			5		

LEARNING OUTCOMES	C1. Knowledge and understanding - Provide students with the necessary knowledge and fundamental methodologies in the field of computer graphics; C2. Applying knowledge and understanding - Develop the ability to independently use a 2D CAD system, develop the ability to independently use a 3D CAD system design; C3. Making judgments - Ability to analyze and understand the various drawings corresponding to the different phases of a civil engineering project; C4. Communication - Provide training that enables the use of a CAD system in the representation of all phases of design, from the perspective and interests of the Civil Engineer; C5. Learning skills - Ability to use independently a CAD system;
PROGRAM	1. Introduction to Computer Graphic Science: concepts, evolution and application domains, input / output entities 2D, 3D geometric modelling, image processing techniques; 2. Introduction to CAD: 2D drawing (2D sprites, 2D editing commands, dimensioning commands, and print functions). Definition of drawings in buildings architecture (representation of plans, elevations, sections and assembly drawings); 3. 3D modelling (sprites to 3D solid primitives, generation and manipulation of 3D models, technical exchange of files); 4. Introduction to design of structures: form of representation of the various structural elements in buildings (columns, beams, foundations and slabs); 5. Representation of some earthwork operations in Civil Engineering (digital terrain models, implementation of earthwork).
TEACHING METHODOLOGY	Classes 1. Theoretical and practical (assessment: performance in class and written tests) 1.1 Introduction to Science of Computer Graphics. 1.2 Introduction to the use of a graphics system. 2. Practical and laboratory (evaluation: performance in the classroom and 3 mandatory practical work) 2.1 Ability to modelling in 2D as a support for preparation of drawings. 2.2 Representation in 3D as a support for preparation of drawings. 3. Tutorial: personal coaching sessions in small groups to conduct the learning process and clarify any doubts. Autonomous 1. Study. 1.1 Reading excerpts of the recommended reading. 1.2 Resolution of practical work not completed in the class.
EVALUATION METHOD	Continuous Assessment Three mandatory practical works + written exam: Final Rating = A + B × 0.5 × 0.15 × 0.15 + C + D + E × 0.10 × 0.10 Where: A – Rating of the written test B – Rating of the 1st practical work C – Rating of the 2nd practical work D – Rating of the 3rd practical work

	E – Participation / attendance at the classes Final Evaluation (Normal Examination, Appeals and Special) Final Rating = A × 0.15 × 0.6 + B + C + D × 0.15 × 0.10 Note: Students who have the status student employee may as an alternative to the assessment corresponds to the participation/presence choose to take a practical exercise.
REFERENCES	Main: Azevedo, E, e Conci, A., Computação Gráfica, Elsevier, 2003; Garcia, José – "AutoCAD e AutoCAD LT 2009 – curso completo, Ed. FCA, 2008 Hugo Ferramacho, O Guia Prático do AutoCAD 2010 a 2 Dimensões, Centro Atlântico 2009; Ellen Finkelstein, AutoCAD 2011 and AutoCAD LT 2011 Bible, Wiley, 2010 Complementary: Arlindo Silva e outros, Desenho Técnico Moderno, 5ª Edição, Lidel, 2005; Veiga da Cunha, Desenho; Técnico, Fundação Calouste Gulbenkian. 1991

Course	PROGRAMMING		
	ECTS	**Scientific area**	
2nd Semester	6	Complementary Sciences	CC

Hours: 80	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 162
		30	45			5		

LEARNING OUTCOMES	C1. Knowledge and understanding - Knowledge in using in the best way a worksheet, algorithms development and program structuring using Visual Basic for Applications (VBA) and understanding the basic concepts of a computer language to solves a particular problem. C2. Applying knowledge and understanding - Ability to relate concepts; Ability to exploit the potential of a worksheet; Ability to solve real problems in a worksheet; Ability to develop an algorithm and program structuring using VBA to solve a problem; Ability to apply of learning in a new situations and context. C3. Making judgments - Ability to use a critical analysis of a problem for define an algorithm that solves it. C4. Communication - Ability to develop reports; Ability to represent data in graphical format suitable. C5. Learning skills - Ability to study independently and in keeping up to date
PROGRAM	1. Worksheet Excel (Excel 2007) 1.1. Data types 1.2. Working with Cells 1.3. Cells references 1.4. Formulas 1.5. Functions and operators 1.6 Graphics 1.7. Macros 2. Programming Excel with Visual Basic for Applications (VBA) 2.1. Algorithms 2.2. Introducing VBA 2.3. Data types 2.4. Statements (conditional statements and loops) 2.5. Procedures and functions 2.6. Objects and classes 2.7. User Forms
TEACHING METHODOLOGY	Presencial Theoretical - Practical (Presentation of the concepts and principles relating to programming ; Study of problems and issues regarding programming) Practical and laboratory (Resolution of exercises) Tutorship (Personal coaching sessions in small groups to conduct the learning process and clarify doubts). Autonomous Study (Reading of excerpts from the course recommended reading list, Resolution of exercises) E-learning (Usage of studying material made available by the teachers)
EVALUATION METHOD	Continuous Assessment The methods of assessment of knowledge and skills are: Two individual written test and six practical project. Final: average of seven best scores Exam evaluation An individual written test with a practice element performed at the computer (WT)

	Final: 100% * WT
REFERENCES	SOUSA, Maria José, Domine a 110% Excel 2007, FCA MARQUES, Paula Capela, Exercícios de Excel 2007, FCA LOUREIRO, Henrique, Excel 2007 - Macros & VBA - Curso Completo, FCA Walkenbach, J. Excel 2010 Power Programming with VBA, Bible, Wiley, 2010 Smart, M.; Learn Excel 2007 Essential skills with the smart Method, Smart Method, 2011

Course	ENGINEERING GEOLOGY		
	ECTS	**Scientific area**	
2nd Semester	5	Basic Sciences	CB

Horas de contacto: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 135
	15	36	9			5		

LEARNING OUTCOMES	C1. Knowledge and understanding - Scientific knowledge about the Earth and understanding of geological phenomena and systems C2. Applying knowledge and understanding - Ability to relate concepts; ability to apply geology knowledge to civil engineering; ability to relate the conditions and circumstances that allow the stability of future buildings; ability to identify geological materials C3. Making judgments - Ability to interpret geological maps and analyze the results obtained from laboratory tests, ability to use dictomic keys to identify minerals and rocks C4. Communication – Ability to produce geological sections and develop group work. Ability to present and defend the results orally or writing C5. Learning skills - Ability to study independently.
PROGRAM	1. Geology - objects and methods. Introduction to Engineering Geology 2. The Earth, internal geodynamics: origin, structure and constitution. Earthquakes: origin, seismic waves, earthquake scales, distribution of seismic focus, seismic risk in Portugal, effects of earthquakes on buildings. General requirements anti-seismic construction. Isostasy, continental drift and its mechanisms, plate tectonics, Earth's age and geological history. 3. Geodynamics surface processes. 4. Elements of Mineralogy and Petrology. Classification of minerals and rocks. 5. Geological maps. Geotechnical maps and geotechnical zoning maps. Reading and interpretation of topographical maps and geological maps. Execution of topography and geological profiles. 6. Principles of Rock Mechanics. 7. “In situ” prospecting. 8. Hydrogeology and water prospecting
TEACHING METHODOLOGY	T: Presentation and discussion of all matters referred to in the program contents. TP: Analysis and interpretation of geological and topographic maps at different scales. Monitoring of students in the preparation of topographic profiles and sections with identification of geological structures and the succession of geological events. PL: Macroscopic identification and observation of rocks and minerals based on physical properties. OT: Personal orientation sessions in small groups to conduct the learning process and clarify any doubts.
EVALUATION METHOD	Continuous assessment T: evaluation through individual written test, positive presence and participation in lectures TP: resolution and delivery of a set of worksheets during class PL: proof of identification of minerals and rocks Final note: 70% written test + 5% presence and performance in class + 5% worksheets + 20% test laboratory Exams: 100% Test components with theoretical and practical laboratory
REFERENCES	Didactic material provided by lecturers

	Luis I. González de Vallejo, Ingeniería Geológica, Prentice Hall- Pearson Educación, 2002 Robert B. Johnson & Jerome V. DeGraff, Principles of Engineering Geology, John Wiley & Sons,1988 David G. Price & Michael Freitas, Engineering Geology: Principles and Practice, Kindle Edition, 2007 H. Blyth & M. H. de Freitas, A Geology for Engineers, E. Arnold, 6th ed., 1974

Course	SOIL MECHANICS AND FOUNDATIONS I		
	ECTS	**Scientific Area**	
3th Semester	6	Engineering Sciences	CE

Hours: 80	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 162
	30	30	15			5		

LEARNING OUTCOMES	C1.Knowledge and understanding – Know and understand the fundamental principles of Soil Mechanics C2.Applying knowledge and understanding – Identify the characteristics of the soil foundation. Stress analysis in solid earth, water in soils and consolidation settlements C3.Making judgment – Ability to analyse the main problems that occur with the soil when used as construction material or as foundation material C4.Communication – Ability to present and defend the results found in writing appropriate C5.Learning skills – Identification and classification of soils: clay and residual soils. Perform tests for physical characterization of soils. Determination of stress state in geotechnical works. Calculation of settlements. Analysis of the characteristics of soil compaction
PROGRAM	1.A preview of soil behaviour 2.Soils identification and classification 3.Effective stress fundamental 4.Soil with water. Hydraulic rupture 4.1 One-dimensional fluid flow 4.2 Two-dimensional fluid flow 5.Consolidation: Terzaghi's Theory 6.Soil compaction
TEACHING METHODOLOGY	Contact: T teaching: theoretical concepts TP teaching: resolution of exercises and clarifying of doubts PL: conducting tests for soils classification and characterization Tutorial: personal guidance sessions to lead the learning process Autonomous Research in electronic and analogical platform, and study of bibliography in the area recommended by the course Resolution of the exercises Laboratory tests performance
EVALUATION METHOD	Continuous assessments: Individual written test, with a minimum of 8.5 values (0 to 20 values); PL: assessment by the work done in the laboratory; obligatory presence and realization, with a minimum of 9.5 values (0 to 20 values); Continuous Evaluation in TP's and PL's classes and T's classes Final Note (FN): 57.5%Freq+35%LabWork+5%Cont.Eval.TP'sPL's+2.5%Cont.Eval.T's Exams Individual written test FN: 65%Test+35%LabWork
REFERENCES	Main: Fernandes, Manuel Matos – "Mecânica dos Solos – Conceitos e Princípios Fundamentais – Volume I", FEUP edições, 2006

	IPQ: NP EN 1997-1, Eurocódigo 7: Projecto geotécnico - Parte 1: Regras gerais, 2010 Didactic material provided by lecturers. Complementary: Folque, J., “Introdução à Mecânica dos Solos”, LNEC, 1987 Terzaghi, K.; Peck, R.B., “Mecânica dos Solos na Prática da Engenharia”, Ao Livro Técnico S.A., 1962 Lambe, T.W.; Whitman, R.V., “Soil Mechanics, SI Version”, John Wiley & Sons, 1979

Course	STRENGTH OF MATERIALS I		
	ECTS	**Scientific Area**	
3th Semester	5	Engineering Sciences	CE

Hours: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 135
	15	42	3			5		

LEARNING OUTCOMES	C1. Knowledge and understanding – Ability to conduct the analysis of the stress and strain states; C2. Applying knowledge and understanding – Ability to conduct the design of members under axial loads and bending moment and to determine their deformations; C3. Making Judgments – Capacity to analyse the design options of structural members; C4. Communication – Skills necessary to present and justify the design options, by oral and written means; C5. Learning skills – Ability for autonomous to study and learning
PROGRAM	1. Fundamental basis and concepts Stress and strain. Ductile and brittle materials. Elastic and plastic deformation. Saint-Venant's Principle. Principle of superposition. Conservation of plane sections. Stress concentrations. Deformation and rigid body motion. 2. Analysis of stress and strain states Stress in an arbitrary facet. Principal stresses and principal directions. Strain in an arbitrary direction. Principal strain and principal directions. Two-dimensional analysis. Constitutive law. Isotropic, monotropic and orthotropic materials. Hooke's law. Yielding and rupture laws. 3. Axially loading members Slender members. Axial deformations. Determination of internal forces. Elasto-plastic analysis. Composite members. Effects of temperature. 4. Bending moment Circular, simple and composed bending. Plane and inclined bending. Bending of composite members. 5. Bending deformations Method of integration of the curvature equation. Moment-Area method. Theorem of virtual work.
TEACHING METHODOLOGY	The teaching methods and evaluation: 1) Contact Theoretical teaching, presenting the concepts and principles related with the strength of materials, illustrated with the resolution of small problems. Theoretical-practical teaching, with application of the concepts and principles given in theoretical lectures to practice oriented problems. Practical laboratorial, conducting laboratory experiences using didactic equipment. Tutorial, comprised by personal orientation sessions, in small groups, to conduct the learning process. 2) Autonomous Study and learning, composed by literature readings and resolution of recommended problems.
EVALUATION METHOD	Continuous Assessment Written examination (75%) and two practical works (25%). Minimum grade: 30% in the written examination. All students with the minimum attendance (75%) to lectures are dismissed to obtain the minimum grade. Exams

	Final individual examination(100%)
REFERENCES	Silva V.D., Mechanics and Strength of Materials, Springer, 2010. Beer F.P., Johnston E.R., DeWolf J.T., Mazurek D., Mechanics of Materials, 6th ed., McGraw-Hill, 2011. Timoshenko S.P., Strength of Materials, Part 1 and Part 2, 3rd ed., Krieger Pub Co, 1983. EN 1993-1-1 - Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for buildings, CEN, 2005. Sales Programme - Sections and Merchant Bars, Arcelor-Mittal, 2010. Didactic material provided by lecturers.

Course	HYDRAULICS		
	ECTS	**Scientific area**	
3th Semester	6	Civil Engineering - Hydraulics and Environment	EC-HA

Hours 80	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 162
	30	39	6			5		

LEARNING OUTCOMES	C1.Knowledge and understanding – Know and understand the principles and laws of hydraulics and fluid mechanics or concepts, principles and fundamental theories that convey the reality of the various types of flow. C2.Appling knowledge and understanding – Ability to relate concepts. Ability to identify practical examples of application. C3.Making judgments – Ability to solve problems involving principles of hydraulics and fluid mechanics. Ability to analyse experimental results. C4.Communication – Ability to prepare reports. C5.Learning Skills – Ability to study independently
PROGRAM	1. Fluid properties. 2. Hydrostatic and fluid dynamics 2.1. Impulse and hydrostatic pressure. 2.2. Flow and average velocity. Continuity equation. 2.3. Theorems of Bernoulli and Euler. 2.4. Power and hydraulic load. Pumps and turbines. 3. Resistance laws for uniform flow. 3.1. Laminar and turbulent flows. 3.2. Empirical laws for the turbulent regime. 4. Fluid flows under pressure pipes and open channel flow. 4.1. Types of flows. 4.2. Head losses. 4.3. Pipe design. 4.4. Influence of pipe design. 4.5. Bernoulli's theorem and open channel flow. 4.6. Permanent flow gradually and rapidly varied. 5. Flow through the orifices and discharger weirs. 6. Hydraulic pumps 6.1. Pump installation conditions. 6.2. Study of the operation from the characteristic curves. 6.3. Suction head pump.
TEACHING METHODOLOGY	Presential 1. Theoretical lectures 1.1 Presentation of concepts and principles of hydraulics and fluid mechanics. 1.2 Exemplification and application to real problems. 2. Theoretical and practical lectures 2.1 Exercises. 2.2 Monitoring students in solving exercises. 3. Practical and laboratorial lectures 3.1 Laboratorial works. Data analysis and reports execution. 4. Tutorial lectures: Personal guidance sessions in small groups to conduct the learning process and doubts clarification. Autonomous 1. Study

	1.1 Reading excerpts from recommended reading 1.2 Resolution of the recommended exercises 2. Data analysis and reports execution.
EVALUATION METHOD	Evaluation 1. Continuous evaluation 1.1 Written test (70%) 1.2 Exercise classes (15%) 1.3 Laboratory work (15%) 2. Exams: Written test (100%)
REFERENCES	Main: Didactic material provided by lecturers. Quintela, A. C. “Hidráulica”. Editor: Fundação Calouste Gulbenkian, 1998. Çengel e Cimbala, "Mecânica dos Fluidos – Fundamentos e Aplicações", McGraw Hill, 2007 Complementary: Manzanares, A. A. “Hidráulica Geral: Volume II”. Editora: AEIST, 1980. Chow, V. T. “Open Channel Hydraulics”. Editora: McGraw-Hill, 1959. Munson, B.R.; Young, D.F.; Okiishi, T. H. “Fundamentals of Fluid Mechanics”. Editora: Wiley, 2006. Franzini, J.B.;Finnemore, E.J. “Fluid Mechanics”. Editora: McGraw-Hill, 1997. White, F. M. “Fluid Mechanics”. Editora: McGraw-Hill, 1994

Course	CONSTRUCTION MATERIALS		
Frame	**ECTS**	**Scientific area**	
3th Semester	5	Engineering Sciences	CE

Hours: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 135
		50	10			5		

LEARNING OUTCOMES	C1. Knowledge and understanding - Knowledge and understanding of the processes of manufacture, processing, constitution, properties and applications of construction materials; Knowledge of the main existing commercial building materials and their characteristics; Knowledge and understanding of the main existing techniques for evaluation and testing of construction materials. C2. Applying knowledge and understanding - Ability to indicate the types, characteristics and preparation of materials to be applied in construction work. C3. Making judgments - Ability to justify the choice of building materials; Ability to evaluate the performance of building materials. C4. Communication - Ability to transmit information and ideas about the application of building materials; Ability to communicate problems and solutions on the performance of building materials. C5. Learning Skills - Ability to study independently.
PROGRAM	1. Introduction to the course and the science of the materials 2. Rocks 3. Binders 4. Mortars 5. Concrete 6. Timbers 7. Metallic materials 8. Ceramic materials 9. Glasses 10. Polymers
TEACHING METHODOLOGY	1. Theoretical and practical education 1.1 Analysis and discussion of the program contents; 1.2 Exercises. 2. Practical and laboratory 2.1 Carry out testing in the laboratory for the testing of construction materials. 3. Tutorial education 3.1 Personal guidance sessions in small groups or in the classroom, to lead the learning process, including guiding the individual work of the student and answer questions. Autonomous: Reading the recommended bibliography; Resolution of recommended exercises; Development of a practical work.
EVALUATION METHOD	Continuous Assessment: Two short written test (SWT) (2 x 10%) Individual written test (IWT) (72.5%) Practical work (PW) (7.5%) Final mark: 0.725*IWT1+0.2*SWT+0.075*PW Exams: Individual written exam (100%).

REFERENCES	Didactic material provided by the lecturers. Ministério da Indústria e Energia. Direcção-Geral de Geologia e Minas, Catálogo de rochas ornamentais portuguesas, Lisboa, 1992, 061-01-08 – 19457 COUTINHO, A. Sousa, Fabrico e propriedades do betão. Vol. I e II, LNEC, Lisboa, 1988. NP EN 206-1 Betão – Especificação, desempenho, produção e conformidade, 2007 Associação Portuguesa da Indústria de Cerâmica, Manual de aplicação de revestimentos cerâmicos, Coimbra, 2003, 062-01-17 – 20758 SAINT-GOBAIN GLASS, Manual do Vidro, 2000 NP 4305:1995, Madeira serrada de pinheiro bravo para estruturas. Classificação visual. ESGALHADO, Helena; ROCHA, Adélia Materiais plásticos para a construção civil. Características e tipos de aplicação, LNEC, Lisboa, 2002. William D. Callister, Jr., Materials science and engineering, Third edition, New York : John Wiley & Sons, Inc., 1994, Smith, R. C.; Andres, C. K. Materials of construction, New York, McGraw-Hill, 1989

Course	GENERAL CONSTRUCTION PROCESSES		
	ECTS	**Scientific area**	
3th Semester	4	Civil Engineering - Construction	EC-C

Hours: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 108
		56		4		5		

LEARNING OUTCOMES	C1. Knowledge and understanding - Knowledge and understanding of the taught concepts C2. Applying knowledge and understanding - Ability to relate concepts; ability to describe and resolve practical examples of application; ability to solve problems involving the principles taught or national legislation C3. Making judgments - Ability to use a critical analysis of the proposed constructive solutions C4. Communication - Ability to propose solutions C5. Learning skills - Ability to study autonomously
PROGRAM	1. General Movement of soil 1.1. Earthmoving equipment 1.2. Methods of Peripheral Containment 1.3. Jet Grouting 1.4. Anchorages, Nailing and Projected concrete 2. Superficial Foundations 2.1. Functional requirements 2.2. Execution process 2.3. LNEC E217-1968 Specification 3. Deep Foundations 3.1. Piles and Micropiles 4. Concrete structures 4.1. Structural solutions 4.2. Formwork and exposed concrete 5. Masonry walls 5.1.Technical implementing 5.2. Fissuration of walls 6. Drainages and waterproofing 6.1. Manifestations of moisture and solutions 6.2. Drainage of the exterior wall 7. Coverings 7.1. Wall, roof and floor coverings
TEACHING METHODOLOGY	Presential Theoretical and practical teaching (Presentation of fundamental concepts and principles, Exemplification and practical application problems, Critical analysis of the results) Work-field teaching (Observation of generic construction process examples (eg: study trip)) Guidance tutorial (Personal coaching sessions) Autonomously Study (Reading the recommended bibliography for the course, Resolution of exercises) E-Learning (Interaction with learning contents of the UC)
EVALUATION METHOD	Continuous assessment 2 short tests: ST1 and ST2 + 1 Written Test (WT) not covering the program of the

	short tests Final Classification: FC= 10%(ST1+ST2)+80%WT ≥ 9.5 val. For student workers and students who are not registered for the 1st time: Final Test (FT) covering all the program FC=100%FT ≥ 9.5 val. Exams FC=100%FT ≥ 9.5 val. Only students with minimum 75% attendance and who underwent continuous assessment: FC=10%(ST1+ST2)+80%FT ≥ 9.5 val.
REFERENCES	Main: COUTINHO, A. Sousa «Fabrico e propriedades do betão. Vol. II - Fabrico», LNEC, Lisboa, 1988. I.N.C.M.“Regulamento de Estruturas de Betão Armado e Pré-esforçado”, D.L. 349-c/83 de 30 Julho. NP EN 206 (2007) Betão-Comportamento, produção, colocação e critérios de conformidade, Instituto Português da Qualidade, Lisboa LNEC, “Curso de especialização sobre revestimentos de paredes”, Lisboa, 1990. HENRIQUES, Fernando «Humidade em paredes», LNEC, Lisboa, 1994 *C*oelho, Silvério “Tecnologia de Fundações”, Edições EPGE, 1996 NP ENV 13670-1 (2007) Execução de Estruturas em Betão. Parte 1 - regras gerais, Instituto Português da Qualidade, Lisboa Didactic material provided by lecturers. Complementary: R. Barry, “The construction of buildings: foundations and oversite concrete-walls-floors-roofs”, Blackwell Science, 1999. R. Barry, “The construction of buildings: windows-doors-stairs-fires, stoves and chimneys-internal finishes and external rendering”, Blackwell Science, 1999

Course	URBAN AND REGIONAL PLANNING		
	ECTS	**Scientific area**	
3th Semester	4	Civil Engineering - Planning and Transportation	EC-PT

Hours: 50	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 108
	15	30				5		

LEARNING OUTCOMES	C1 Knowledge and understanding - Understanding of the fundamental theoretical concepts, techniques and models for demographic analysis, urban, socio-economic and accessibility; C2 Applying knowledge and understanding - Relationship of concepts and techniques through an applied study (eg. analysis of territorial management tools, technical standards of accessibility and urban design, including the use of geographic information systems); C3 Formulating judgments - Ability to analyze and understand situations where the fundamental concepts and techniques of planning may be used; C4 Communication skills - Development of communication skills and teamwork, through the work presentation, including contacts with key actors/agents of urban planning level (eg. Leiria City Council); C5 Learning Skills - Ability to use independently the techniques and concepts learned
PROGRAM	I - Fundamental Concepts 1 A Planning System 2 Land Management Instruments 3 Characterization of Reality 3.1 Models 3.2 Indicators 4 Geographic Information Systems II - Specific Techniques 1 Demographic Analysis 1.1Description of the Population 1.2. Demographic Projection 2. Urban Analysis 2.1. Planning of Equipment 2.2. Technical Standards of Accessibility and Urban Design 2.3. The Provision of Collective Urban Equipment 2.4. Transport System 2.5. Transportation Systems Modeling
TEACHING METHODOLOGY	Presence Theoretical: concepts and techniques in regional and urban planning, examples of applications Theoretical and practical: exercises and practical work where students apply the concepts acquired in lectures Tutorial: specific orientation sessions to conduct the learning process and answer questions. Autonomous Study: reading of recommended bibliography, problems solving with the application of specific techniques Introduction to the geographic information systems for the analysis of a given problem using ArcMap software
EVALUATION METHOD	Continuous Assessment Written examination (75%) and two practical works (25%). Minimum grade: 30% in the written examination. All students with the minimum attendance (75%) to

	lectures are dismissed to obtain the minimum grade. Exams Final individual examination (100%)
REFERENCES	Silva V.D., Mechanics and Strength of Materials, Springer, 2010. Beer F.P., Johnston E.R., DeWolf J.T., Mazurek D., Mechanics of Materials, 6th ed., McGraw-Hill, 2011. Timoshenko S.P., Strength of Materials, Part 1 and Part 2, 3rd ed., Krieger Pub Co, 1983. EN 1993-1-1 - Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for buildings, CEN, 2005. Sales Programme - Sections and Merchant Bars, Arcelor-Mittal, 2010. Didactic material provided by lecturers

Course	SOIL MECHANICS AND FOUNDATIONS II		
	ECTS	Scientific area	
4th Semester	6	Engineering Sciences	CE

Hours: 80	T	T/P	PL	TC	S	OT	O	Total working hours: 162
	30	37	8			5		

LEARNING OUTCOMES	C1.Knowledge and understanding – Know and understand the fundamental principles of geotechnical characterization. Main theories of lateral earth pressure. Load capacity theories C2.Applying knowledge and understanding – Determination of the soils mechanical characteristics. Calculation of lateral earth pressure and design of cantilever retaining walls. Evaluation of the resistant capacity of the soil. Knowledge of the main tests for the soils mechanical characterization C3.Making judgment – Ability to use a critical analysis of the results obtained experimentally or by numerical method C4.Communication – Ability to present and defend the results found in writing appropriate C5.Learning skills – Know estimate the bearing capacity of retaining structures and/or foundations conditioned by the behavior and resistance of soils. Perform laboratory tests for the soils mechanical characterization
PROGRAM	1.Shear strength of soils 2.Lateral earth pressure 3.Design according to EN 1997-1 (Eurocode 7): partial safety factors 4.Design of cantilever retaining walls and cantilever sheet-pile walls according to the traditional methodology 5.Slope and landfills stability 6.Shallow foundations. Bearing capacity 7.Isolate deep foundations subjected to vertical actions 8.Geotechnical prospecting: in-situ testing and sampling
TEACHING METHODOLOGY	Contact: T teaching: theoretical concepts TP teaching: resolution of exercises and clarifying of doubts PL: realization of a work to characterize the shear strength and tension-deformation relations of soils Tutorial: personal guidance sessions to lead the learning process Autonomous Research in electronic and analogical platform, and study of bibliography in the area recommended by the course Resolution of the exercises Perform laboratory tests
EVALUATION METHOD	Continuous Assessment: Assessment by 2 individual written tests (IT1 and IT2), with a min. of 8.5 values (0 to 20 values); PL: assessment by the laboratory work; obligatory presence and realization, with a min. of 9.5 values (0 to 20 values); Continuous Evaluation in TP's and PL's classes and T's classes Final Note (FN): 40%IT1+40%IT2+12.5%LabWork+5%Cont.Eval.TP'sPL's+2.5%Cont.Eval.T's Exams Individual written test FN: 87.5%Test+12.5%LabWork
REFERENCES	Main: Fernandes, Manuel Matos – "Mecânica dos Solos – Conceitos e Princípios

	Fundamentais – Volume II", FEUP edições, 2006 IPQ: NP EN 1997-1, Eurocódigo 7: Projecto geotécnico - Parte 1: Regras gerais, 2010 CEN: EN 1997-2, Eurocode 7: Geotechnical Design - Part 2: Ground investigation and testing, 2005 Especificação E 217-1968, "Fundações Directas Correntes", LNECDidactic material provided by the lecturers Complementary: Terzaghi, K.; Peck, R.B., "Mecânica dos Solos na Prática da Engenharia", Ao Livro Técnico S.A., 1962 Lambe, T.W.; Whitman, R.V., "Soil Mechanics, SI Version", John Wiley & Sons, 1979

Course	STRENGTH OF MATERIALS II		
	ECTS	**Scientific area**	
4th Semester	5	Engineering Sciences	CE

Hours: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 135
	15	42	3			5		

LEARNING OUTCOMES	C1. Knowledge and understanding – Ability to conduct the analysis of the stress and strain states; C2. Applying knowledge and understanding – Ability to conduct the design of members under shear forces, torsion and buckling by compression and to determine their deformations; C3. Making Judgments – Capacity to analyse the design options of structural members; C4. Communication – Capacity to present and justify the design options, by oral and written means; C5. Learning skills – Ability for autonomous to study and learning.
PROGRAM	1. Shear force Longitudinal shear force. Shear stresses due to shear forces. Rectangular cross-sections. Symmetrical cross-sections. Open thin-walled cross-sections. Closed thin-walled cross-sections. Shear center. Composite members. Deformations due to shear forces. 2. Torsion Circular cross-sections. Closed thin-walled cross-sections. Open thin-walled cross-sections. Rectangular cross-sections. Optimal shape of cross-sections under torsion. 3. Elasto-plastic analysis Elastic moment. Plastic moment. Shape factor. Plastic hinge. Static method. Kinematic method. Equation of two moments. Equation of three moments. Elasto-plastic analysis of beams and frames under bending. 4. Stability Critical load. Post-critical behaviour. Effect of imperfections. Euler's theory. Instability under pure compression and composed bending
TEACHING METHODOLOGY	Contact Theoretical teaching, presenting the concepts and principles related with the strength of materials, illustrated with the resolution of small problems. Theoretical-practical teaching, with application of the concepts and principles given in theoretical lectures to practice oriented problems. Practical laboratorial, conducting laboratory experiences using didactic equipment. Tutorial, comprised by personal orientation sessions, in small groups, to conduct the learning process. Autonomous Study and learning, composed by literature readings and resolution of recommended problems.
EVALUATION METHOD	Assessment: Two written tests during the semester (50% + 50%). A final examination (100%) at the end of the semester. Minimum grade: 30% in the theoretical and practical part of the written tests. All students with the minimum attendance (75%) to lectures are dismissed to obtain the minimum grade.
REFERENCES	Silva V.D., Mechanics and Strength of Materials, Springer, 2010. Beer F.P., Johnston E.R., DeWolf J.T., Mazurek D., Mechanics of Materials, 6th ed.,

	McGraw-Hill, 2011. Timoshenko S.P., Strength of Materials, Part 1 and Part 2, 3rd ed., Krieger Pub Co, 1983. EN 1993-1-1 - Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for buildings, CEN, 2005. Sales Programme - Sections and Merchant Bars, Arcelor-Mittal, 2010. Didactic material provided by lecturers.

Course	HYDROLOGY AND WATER RESOURCES		
	ECTS	**Scientific area**	
4th Semester	5	Civil Engineering - Hydraulics and Environment	EC-HA

Hours: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 135
	15	45				5		

LEARNING OUTCOMES	C1. Knowledge and understanding – Knowledge about the availability of water resources and hydrological cycle; Understand the implications of the issue in social and professional; Provide students with elements that allow the determination of flow for the design of hydraulic works, through the knowledge of flow processes and measuring hydrological variables. C2. Applying knowledge and understanding – Ability to determine the peak flow and areas of flooding; Skills for design of drainage systems for rainwater C3. Making judgment – Identification of areas of flood risk; Competence to perform the quality control of materials of the infrastructures C4. Communication – Capacity to prepare reports and projects of the rainwater drainage C5. Learning Skills – Apply the knowledge and interpretation of the legislation
PROGRAM	1. Water resources and water cycle 1.1. Quantity, availability and regularity 1.2. Components of water cycle 2. Watersheds 2.1. Characteristics of the watersheds and drainage system 2.2. Geology and soils 3. Precipitation 3.1. Measurement of precipitation 3.2. Classification of rainfall 3.3. Statistical analysis of precipitation series 4. Interception, evaporation and evapotranspiration 5. Groundwater flow 5.1. Productivity of the aquifers 5.2. Darcy's law 6. Surface runoff 6.1. Measurement of surface runoff 6.2. Components of surface runoff 6.3. Study of flood (peak flood and hydrograph) 7. Rainwater drainage 7.1. Legislation 7.2. Design of rainwater drainage 7.3. Functional aspects and constructive
TEACHING METHODOLOGY	Presential Theoretical lessons: Review and discussion of program Theoretical-practical lessons: Solving exercises Tutorial lessons: Personal guidance sessions Autonomous Reading the bibliography recommended Solving the exercises recommended
EVALUATION METHOD	Evaluation Continuous evaluation (written test + project+performance): approval ≥ 9.5/20 Written exam (50%)

	Individual performance (5%) Project: Design of rainwater drainage (45%) Exams (written test + project): approval ≥ 9.5/20 Written exam (75%) Project: Design of rainwater drainage (25%)
REFERENCES	Main: Didactic material provided by the lecturers. Hipólito, J. R.; Vaz, A. C. "Hidrologia a recursos hídricos". Editor: Instituto Superior Técnico, 2011. Lencastre, A., Franco F. M. "Lições de hidrologia". Editor: Universidade Nova de Lisboa, 2006. Decreto Regulamentar nº 23/95, de 23 de Agosto de 1995, Regulamento Geral dos Sistemas Públicos e Prediais de Distribuição de Água e de Drenagem de Águas Residuais. Complementary: Chow, V. T.; Maidment, D. R.; Mays, L. W. "Applied Hydrology". Editor: Mcgraw-Hill, 1988. DGRN "Manual de Saneamento Básico". Editora: Direção Geral dos Recursos Naturais, 1991. Singh, V. P. "Elementary Hydrology". Editor: Prentice Hall, 1992

Course	THEORY OF STUCUTURES		
	ECTS	**Scientific area**	
4th Semester	5	Civil Engineering - Structures	EC-E

Hours: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 135
	15	45				5		

LEARNING OUTCOMES	C1. Knowledge and understanding - Knowledge of basic methods of linear elastic analysis of statically indeterminate structures. Knowledge of the influence lines. Knowledge to model actions of different nature and perform combinations of actions. C2. Applying knowledge and understanding - Ability to apply the knowledge and understanding in a manner that indicates a professional approach, within the field of structural analysis. C3. Making Judgments - Ability to solve problems within field of structural analysis, justifying the recommended solutions, the methods used and judgments issued. Ability to use a critical analysis of the results obtained. C4. Communication - Communicate about their understanding, skills and activities, with peers, supervisors and clients. C5. Learning skills - Learning skills to undertake further studies with some autonomy
PROGRAM	CAP I – Introduction to Theory of Structures Fundamental concepts. CAP II - Force Method Statically indeterminate structures. Presentation and systematization of the method. Analysis of structures for different types of loads (vectorial loads, temperature changes, differential settlement of the foundation, fabrication errors) CAP III - Displacement Method Kinematic Indeterminacy. Presentation and systematization of the method. Analysis of structures for different types of loads (vectorial loads, temperature changes, differential settlement of the foundation, fabrication errors). CAP IV - Influence Lines for beams Definitions Direct Method. Indirect Method. CAP V - Actions and actions combination Limit state design. Classification of actions. Dead loads, live loads, snow and temperature changes. Combination of actions.
TEACHING METHODOLOGY	Contact Theoretical lessons are used to present the concepts and basis of Theory of Structures. Some problems are solved in these lessons. Theoretical-practical lessons are used to present the theoretical basis of some methods of structural analysis. Then, the lecturer exemplifies the resolution of some problems to apply the learned concepts. The Tutorial study involves personal orientation sessions, in small groups, to lead the learning process, namely to guide the student work and to elucidate the doubts. Autonomous Study and learning, composed by literature readings and resolution of

	recommended problems.
EVALUATION METHOD	Assessment Continuous assessment - made by short written exams. Final grade= 0.10 MT1 + 0.10 MT2 + 0.40 FREQ1 + 0.40 FREQ2 ≥ 9.5 Exams Final assessment includes a written examination involving all the contents given in the theoretical and practical lessons.
REFERENCES	Main: Ghali & Neville, Structural Analysis, Chapman and Hall, London, 1978 West H.H., Fundamentals of structural Analysis, Wiley, 1993 Sussekind J. C., Curso de Análise Estrutural, Edições Globo P.A., Brasil, 1980 Pereira E., Linhas de Influência, IST 1994 Didactic material provided by lecturers. NP EN 1990 - Bases para o Projeto de Estruturas NP EN 1991 – Ações em Estruturas: Parte 1-1 Ações gerais, Parte 1-3 Ações da neve, Parte 1-5 Ações térmicas. Complementary: William M., Matrix Structural Analysis, 2nd edition John Wiley & Sons, IncHsiehY.Y., Elementary Theory of Structures, 3th edition, Prentice Hall, 1988 Kassimali, A. - Structural Analysis, 4th Edition, Cengage Learning, 2011 Kassimali, A. - Matrix Analysis of Structures, 2nd Edition, Cengage Learning, 2011

Course	INSTALATIONS IN BUILDINGS		
	ECTS	**Scientific area**	
4th Semester	4	Civil Engineering - Construction	EC-C

Hours: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 108
		60				5		

LEARNING OUTCOMES	C1. Knowledge and understanding - Knowledge and understanding of specific legislation; Knowledge and understanding of technical requirements and regulations on building systems; Knowledge and understanding of calculation methods, of theorems and basic concepts. C2. Applying knowledge and understanding - Ability to do projects of instalations in buildings; Ability to organize and structure the calculations. C3. Making judgments - Ability to take decisions; Development of a critical spirit that allows understanding and interpreting the building installation project. C4. Communication - Ability to present the written and design parts and to make oral presentation (discussion between project teams) of building installations projects. C5. Learning Skills - Ability to study independently.
PROGRAM	1.Building installations for water supply: supply systems, reservoirs, water consumptions, Conception, materials and equipment, pipe sizing, pumping facilities and pressure boosters, hot water systems, Reception 2.Building installations for fire fighting with water: Legislation, supply sources, water consumption, pipe sizing, pumping facilities and pressure boosters, devices, reception 3.Building drainage of domestic wastewater, rainwater and underground water: drainage systems, discharge flow rates, Conception, pipes, fittings and sanitary equipment, pipe sizing, additional facilities, private treatment systems, reception 4.Building installations for gas supply: materials and equipment, storage and gas transportation, distribution networks, Conception of gas installations
TEACHING METHODOLOGY	Contact: Theoretical and practical education: Analysis and discussion of the program contents; Resolution of exercises. Tutorial education: Personal guidance sessions in small groups or in the classroom, to lead the learning process, including guiding the practical work and to clarify doubts. Autonomously: Reading the recommended bibliography of the course; Resolution of exercises; Elaboration of a practical work.
EVALUATION METHOD	Continuous assessment: 2 written evaluations (65%) - minimum of 8 values each (0 to 20 values). Practical work with oral discussion required (35%) – reduced by 5% for each day of delay. Exams Practical work with oral discussion required (35%). Written evaluation (65%) – minimum of 8 values (0 to 20 values).
REFERENCES	Pedroso, Vitor M. R. «Manual dos sistemas prediais de distribuição e drenagem de águas», LNEC, Lisboa, 2000. 434 p. Regulamento Geral dos Sistemas Públicos e Prediais de Distribuição de Água e de Drenagem de Águas Residuais, Decreto Regulamentar 23/95 de 23 de Agosto,

	Diário da República nº 194, Série I – Parte B, de 23/08/1995, p. 5284-5319. Rectificação do "Regulamento Geral dos Sistemas Públicos e Prediais de Distribuição e de Drenagem de Águas Residuais", Declaração de Rectificação 153/95, Diário da República nº 277, Série I - Parte B, de 30/11/1995 –Suplemento Guimarães, João. Instalações de Redes de Gás - Livro Técnico para Profissionais da Construção, Verlag Dashöfer. EN 806-4:2010 Specifications for installations inside buildings conveying water for human consumption. EN 12056-1:2000 Gravity drainage systems inside buildings. Didactic material provided by lecturers.

Course	ROAD DESIGN I		
	ECTS	**Scientific area**	
4th semester	5	Civil Engineering - Planning and Transportation	EC-PT

Hours: 65	**L**	**E**	**PL**	**TC**	**S**	**T**	**O**	**Total working hours:** 135
	15	42	3			5		

LEARNING OUTCOMES	C1. Knowledge and understanding – Knowledge regarding the issues arising from the design of Roads. Concepts relating to road traffic and its forecasting and level of service of a road; C2. Applying knowledge and understanding – Understanding, interpretation and ability to design geometric component projects of road transport routes. Ability to define the dimensions and main features of a road such as the size and composition of the cross section; C3. Making Judgments – Understanding and ability to integrate all major constraints inherent to road design; C4. Communication – Ability to produce reports; capacity to represent a road; C5. Learning skills – Ability to study independently
PROGRAM	1.General overview of a road project 2.Road design basic knowledge. Design phases and their logical sequence. 3.Analysis and prediction of road traffic. Road levels of service. 4.Road design restrictions: geometric constraints, geological, geotechnical, hydrological, topographical, environmental, economic and territorial planning 5.Layout in plan. Straight alignments, curved and circular transition curves 6.Layout in profile. Grades and vertical curves
TEACHING METHODOLOGY	Presence: Theoretical Presentation of concepts, calculation and design methods Exemplification and application to real problems Theoretical and practical Modeling and solving problems inspired by real cases Review of results Practical and laboratory Trials with laboratory equipment related to some aspects covered in UC Tutorial Personal coaching sessions in small groups to conduct the learning process and answer questions Autonomous: Selected readings from the recommended literature Exercises solving Interaction and material search from the Internet
EVALUATION METHOD	Continuous Assessment Class performance10%,two practical work assignments with oral presentation and defence 40%, 50% written exam. Exams Two practical work assignments with oral presentation and defence 40%, 60% written exam.
REFERENCES	Main: Branco, E. F. Picado-Santos, L.; Vias de Comunicação: Vol. I; Faculdade de Ciências e Tecnologia da Universidade de Coimbra, 2006

	Comissão de Coordenação e Desenvolvimento Regional do Norte (CCRDN); Manual de Planeamento das Acessibilidades e da Gestão Viária, CCRDN, 2010 Junta Autónoma de Estradas (JAE), Norma de Intersecções, JAE P5/90 Divisão de Estudos e Projetos, Lisboa-Portugal, 1990 JAE; Norma de traçado JAE P3/94; Divisão de Estudos e Projetos, Lisboa-Portugal, 1994 Laboratório Nacional de Engenharia Civil (LNEC); Vocabulário de Estradas e Aeródromos, 4ª Edição, Especificação E1-1962, LNEC, 1962 Complementary: American Association of State Highway and Transportation Officials (AASHTO); A Policy on Geometric Design of Highways and Streets, 4ed, AASHTO, Washington, D.C. 2001 McShane, William R.; Roess, Roger P.; Traffic Engineering, Prentice Hall Polytechnic Series in Traffic Engineering, 1990

Course	REINFORCED CONCRETE I		
	ECTS	**Scientific area**	
5th Semester	6	Civil Engineering - Structures	EC-E

Hours:	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 162
	30	41	4			6		

LEARNING OUTCOMES	C1. Knowledge and understanding – To know the properties of materials and understand their influence on the behavior of reinforced concrete elements subjected to standalone or combined stresses of axial forces, bending, shear and torsion; C2. Applying knowledge and understanding - To integrate and apply knowledge acquired in other courses such as Statics, Strength of Materials I and II and Theory of Structures for the analysis and design of reinforced concrete elements (beams and columns) according to the proposed EU standards; C3. Making judgments – Select the right design options and adopt the most appropriate particular rules in the design of reinforced concrete elements (beams and columns); C4. Communication – Present and justify the design options and the particular rules adopted, both orally and in writing (including the use of drawings); C5. Learning skills – Ability to study, research solutions and do autonomous learning.
PROGRAM	1. Materials properties: concrete and reinforcing steel. 1.1 Concrete 1.2 Reinforcing steel 2. Ultimate Limit States 2.1. Bending without axial force 2.2. Shear 2.3. Torsion 3. Serviceability Limit States. 3.1. Crack control. 3.2. Deflection control 4. Analysis of second order effects with axial load. 4.1 Simplified criteria for second order effects. Slenderness 4.2 Methods of analysis: Method based on nominal curvature 4.3 Biaxial bending 4.4 Particular rules and detailing
TEACHING METHODOLOGY	Contact Theoretical–presentation of the concepts and basis of reinforced concrete structures with emphasis to the behaviour of beams and columns Practical–exemplification and application of the concepts with exercises targeted for the design of reinforced concrete elements according to safety criteria in the proposed EU standards Laboratorial–laboratory testing and observation of structural elements behaviour under real conditions Guidance tutorial–personal coaching or small groups sessions to conduct the learning process Autonomous Study–Excerpts readings from recommended literature and resolution of proposed exercises
EVALUATION METHOD	Continuous assessment written teorical test (T) 4 val (mín 1.5 v); 1 pratical test (beams 10 v–mín 5.5 v); 2 practical test (columns 6 v–mín 2.5 v)

	Final standings: P1+P2+T Exams Written test - theoretical (4 p, min. score 1.5 p); practical component (16 p, one part of 11 p for beams–min. score 5.5 p, and another part of 5 p for columns–min. score 2.5 p)
REFERENCES	Main: NP EN 206-1:2000/A2:2005: Betão – Parte 1: Especificação, desempenho, produção e conformidade, IPQ NP EN 1990: 2009: Eurocódigo 0 – Bases para o cálculo de estruturas, IPQ NP EN 1991:2010: Eurocódigo 1: Ações em estruturas, IPQ NP EN 1992:2010: Eurocódigo 2: Projeto de estruturas de betão, IPQ NP EN 1998:2010: Eurocódigo 8: Projeto de estruturas para resistência aos sismos, IPQ Barros, H., Figueiras, J., Tabelas e Ábacos de dimensionamento de secções de betão armado solicitadas à flexão e a esforços axiais segundo o Eurocódigo 2, FEUP, 2010 Montoya, P. J, et al. Hormigón Armado (vol.1). Editorial Gustavo Gili, SA, Barcelona, 14ª Edição, 2000 Complementary. Leonhardt, F. Mönning, E. – Construções de Concreto, Volume 2 e Volume 3, 1ª edição, Editora Interciência, 1979

Course	SEWAGE SYSTEMS		
	ECTS	**Scientific area**	
5th Semester	5	Civil Engineering - Hydraulics and Environment	EC-HA

Hours: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 135
		60				5		

LEARNING OUTCOMES	C1. Knowledge and understanding – Knowledge in the field of infrastructure water supply and sewerage, in order to develop its projects; Knowing the different materials used in infrastructure for water supply and sewerage and their properties C2. Applying knowledge and understanding – Application of knowledge to specify construction materials in infrastructure; Skills to develop projects for water supply and sewerage C3. Making judgments – Competence to perform the quality control of materials of the infrastructures C4. Communication – Capacity to elaborate projects for water supply and sewerage C5. Learning Skills – Apply the knowledge and interpretation of the legislation
PROGRAM	I. WATER SYSTEMS 1. Legislation. 2. Water supply sources, transport and reservoirs. 3. Calculation of reservoirs capacity. 4. Design of water supply networks. 5. Materials used in water supply networks. 6. Functional aspects and constructive. II. SEWERAGE 1. Legislation. 2. Classification of sewerage systems. 3. Design of sewerage systems. 4. Materials used in sewerage systems. 5. Functional aspects and constructive.
TEACHING METHODOLOGY	Presential Theoretical-practical lectures: Review and discussion of program. Solving exercises. Tutorial lectures: Personal guidance sessions. Autonomous Reading the bibliography recommended Solving the exercises recommended
EVALUATION METHOD	Continuous evaluation (written test + 2 projects): approval ≥ 9.5/20 Written test (50%) Individual performance (5%) 2 Projects: - Design of water supply network (35%) - Design of sewerage system (10%) Exams (written test + 2 projects): approval ≥ 9.5/20 Written test (70%) 2 Projects: - Design of water supply network (20%) - Design of sewerage system (10%)
REFERENCES	Main: Didactic material provided by lecturers.

	Decreto Regulamentar nº 23/95, de 23 de Agosto de 1995, Regulamento Geral dos Sistemas Públicos e Prediais de Distribuição de Água e de Drenagem de Águas Residuais. Sá Marques A.; Sousa S. "Hidráulica Urbana: Sistemas de Abastecimento de Água e de Drenagem de Águas Residuais". Editora: Imprensa da Universidade de Coimbra, 2008. Complementary: DGRN "Manual de Saneamento Básico". Editora: Direção Geral dos Recursos Naturais, 1991. Mays, L. W. "Water Distribution Systems Handbook". Editora: McGraw-Hill Companies, Inc, 2000. Pereira, J. A. R.; Silva, J. M. "Rede Colectora de Esgoto Sanitário: projeto, construção e operação". Editora: José Almir Rodrigues Pereira, 2010. Trifunovic, N. "Introduction to Urban Water Distribution". Editora: Taylor & Francis Group, 2007.

Course	ROAD DESIGN II		
	ECTS	**Scientific area**	
5th semester	6	Civil Engineering - Planning and Transportation	EC-PT

Hours: 80	**L**	**E**	**PL**	**TC**	**S**	**T**	**O**	**Total working hours:** 162
	15	55	5			5		

LEARNING OUTCOMES	C1. Knowledge and understanding – Knowledge needed to design and monitor earthworks construction; knowledge regarding paving materials and their characteristics; knowledge related to road drainage systems, understanding the environmental implications due to the construction, operation and maintenance of a road infrastructure; Understanding the use of ancillary works on road infrastructures; C2. Applying knowledge and understanding - Understanding, interpretation and ability to design earthworks and road pavements; understanding, interpretation and ability to design road drainage systems; C3. Making judgments - Understand and be able to integrate all the main aspects related to the construction and operation of a road infrastructure; C4. Communication – Ability to produce reports; C5. Learning skills – Ability to study independently
PROGRAM	1.Review of geotechnical concepts 2.Road Construction earthworks 3.Road Pavements 4.Road Drainage 5.Environmental Impact of Road Infrastructures 6.Ancillary works
TEACHING METHODOLOGY	Presence Theoretical Presentation of concepts, calculation and design methods Exemplification and application to real problems Theoretical and practical Modelling and solving problems inspired by real cases Review of results Practical and laboratory Trials with laboratory equipment related to some aspects covered in UC Tutorial Personal coaching sessions in small groups to conduct the learning process and answer questions Autonomous Selected readings from the recommended literature Exercises solving Interaction and material search from the Internet
EVALUATION METHOD	Continuous Assessment Class performance10%, two practical work assignments with oral presentation and defence 40%, 50% written exam. Exams Two practical work assignments with oral presentation and defence 40%, 60% written exam.
REFERENCES	Main: Branco, E. F. Picado-Santos, L.; Vias de Comunicação: Vol. II; Faculdade de

	Ciências e Tecnologia da Universidade de Coimbra, 2006 Branco, E. F. Picado-Santos, L.; Pavimentos Rodoviários 4ª reimpressão; Almedina, 2011 Junta Autónoma de Estradas (JAE), Norma de Pavimentação, Divisão de Estudos e Projetos, Lisboa-Portugal, 1995 Asphalt Institute, - Asphalt Pavement Thickness Design, Lexington, Kentucky USA, 1990. Complementary: Washington State Departement of Transportation (WSDOT), Pavement Guide, WSDOT, 1999. Kendrick, P., Copson, M. Beresford S., McCormick, P. Roadwork: Theory and Practice, Fifth Edition, Butterworth-Heinemann, 2004

Course	CONSTRUTION PLANNING AND SAFETY		
	ECTS	**Scientific area**	
5th Semester	6	Civil Engineering - Construction	EC-C

Hours: 80	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 162
	15	55	5			5		

LEARNING OUTCOMES	C1. Knowledge and understanding – understanding of basic principles of building construction. C2. Applying knowledge and understanding – the ability to relate concepts, ability to identify practical examples of application, ability to solve problems. C3. Making judgments – ability to use a critical analysis of the results obtained numerically. C4. Communication – ability to produce reports and budgets. C5. Learning skills – ability to study independently.
PROGRAM	1. Measurement projects 2. Budgeting 3. Introduction to Programming 4. Legislation on public works 5. Organization of building site 6. Safety and health in construction
TEACHING METHODOLOGY	Contact: Theoretical teaching Presentation of the concepts and principles of construction and legislation Exemplification and application to real problems Practical teaching Troubleshooting Critical analysis of the results of problems Guidance tutorial: personal coaching sessions or small groups to conduct the learning process Autonomous: Study Reading of excerpts from the course recommended reading Resolution of the exercises recommended by the course E-learning: Interaction with learning contents of the Internet
EVALUATION METHOD	Continuous assessment: 3 mini-test T1, T2 e T3 in theoretical classes (mín 1,5/20 val cada) 1 test T4 (mín 3.5/20 val) 1 pratical work TP (mín 5,0/20 val) Final classification: CF = 0.15 (T1 + T2 + T3)/3 + 0.35 T4 + 0.50 TP Final assessment: 1 test T (mín. 5.0/20 val.) 1 pratical work TP (mín 5.0/20 val.) Final classification: CF = 0.50 T+ 0,50 TP
REFERENCES	Main: Fonseca, M. S. 2001, Regras de medição na Construção. LNEC Fichas de Rendimentos (Ed. LNEC) Estudo da Implantação e Organização de Estaleiros – Tradução 459 (Ed. LNEC)

	Rendimentos de Mão-de-Obra na Construção de Edifícios (J. Paz Branco) Didactic material provided by lecturers. Complementary: Miguel, Alberto Sérgio - Manual de Higiene e Segurança - Porto Editora Cabral, Fernando A. e Roxo, Manuel M. - Segurança e Saúde no Trabalho - Legislação Anotada – Almedin Frank Harris, Ronald McCaffer, Francis Edum-Fotwe - Modern Construction Management, Blackwell, 2006

Course	INNOVATION AND ENTREPRENEURSHIP		
	ECTS	Scientific area	
5th semester	2	Complementary Sciences	CC

hours: 34	T	T/P	PL	TC	S	OT	O	Total working hours: 54
		30				5		

LEARNING OUTCOMES	C1.Knowledge and understanding – Knowledge in Entrepreneurship of the basic concepts of entrepreneurship and understanding how to start and manage its own company; Recognize the different parts of a business plan; explain the different components of a entrepreneurial project. C2.Applying knowledge and understanding - Ability to relate concepts; Ability to develop an write a business plan; Ability use the instruments to perform internal and external analyses of the new venture. C3.Making judgments - Ability to evaluate practical examples/cases of entrepreneurship; Ability to critically analyze a business plan. C4.Communication - Ability to understand internal and external analyses of the new venture; Ability to write and present an entrepreneurial idea and a business plan; Ability to develop communication skills in small groups. C5.Learning skills - Ability to study independently; Ability to develop and write a business plan.
PROGRAM	1.Introduction to Entrepreneurship 2.The entrepreneur 3.Opportunities and Ideas 4.New venture marketing 5.The environment and the industry (concepts of business strategy) 6.Building and managing a team 7.The legal aspects of a new venture 8.Financing the new venture 9.Economical and financial aspects of the new venture 10.The investment plan 11.The business plan
TEACHING METHODOLOGY	Contact Theoretical and Practical teaching (presentation of concepts of entrepreneurship; Examples and cases of real and simulated situations) Tutorial (office hours to accompany the learning process and the writing of a business plan) Autonomous Independent study (Readings of the recommended bibliography) Writing of a business plan in small groups (identify the opportunity, perform analyses, organization and structure of report)
EVALUATION METHOD	Continuous assessment One written test T1 (min 7.5 / 20 val.) One in class presentation of the business idea T2 (min 7.5 / 20 val.) One written business plan T3 (min 7.5 / 20 val.) Final standings: = 0.60T1 + 0.05T2 + 0.35T3 Exams One final written exam (100%) or written exam (60%) + written business plan (40%)
REFERENCES	Main: Ferreira, M., Santos, J. & Serra, F. (2010) Ser Empreendedor: Pensar, Criar e Moldar

	a Nova Empresa. (2ª ed) Lisboa: Edições Silabo. (Edição original 2008). Didactic material provided by lecturers. Complementary: Barringer, B. & Ireland, D.(2006) Entrepreneurship. Pearson Prentice-Hall. Hisrich, R. & Peters, M. (2007). Entrepreneurship. (5th ed) McGraw-Hill Irwin. Christiansen, J. (2000). Competitive Innovation Management. New York: St. Martin's Press. Sahlman, A. (1997). How to write a great business plan. Harvard Business Review, July-August, 98-108. Gumpert, D. & McNeill, J. (1996). How much money does your new venture need? Harvard Business Review, 64(3), 122. Five Myths about Entrepreneurs: Understanding how businesses start and grow, National Commission on Entrepreneurship, 2001

Course	BUILDINGS PHYSICS		
	ECTS	**Scientific area**	
6th Semester	3	Civil Engineering - Structures	EC-E

Hours 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 81
	30	24	6			5		

LEARNING OUTCOMES	C1. Knowledge and understanding - Knowledge and understanding of the taught concepts C2. Applying knowledge and understanding - Ability to relate concepts; ability to describe practical examples of application; ability to solve problems involving the principles taught, national legislation and standards C3. Making judgments - Ability to use a critical analysis of the results C4. Communication - Ability to propose solutions C5. Learning skills - Ability to study autonomously
PROGRAM	1. Human and functional requirements of buildings 1.1. Human and functional requirements 1.2. Portuguese Regulation 2. Hydrothermal of buildings 2.1. Basic notions of heat transfer, thermal comfort and energy efficiency 2.2. Portuguese Regulation 2.3. Passive systems 2.4. Moisture and natural ventilation in buildings 3. Acoustic of buildings 3.1. Concepts of acoustic 3.2. Portuguese Regulation 4. Fire safety of buildings 4.1. General Concepts 4.2. Portuguese Regulation
TEACHING METHODOLOGY	Presential: Theoretical teaching (Presentation of fundamental concepts and principles, Exemplification and practical application problems) Theoretical and practical teaching (Resolution of exercises, Critical analysis of the results) Practical and laboratory teaching (Experiments based on available equipment) Guidance tutorial (Personal coaching sessions) Autonomously: Study (Reading the recommended bibliography for the course, Resolution of exercises) E-Learning (Interaction with learning contents of the UC)
EVALUATION METHOD	Continuous assessment 2 tests (80%) with minimum of 8 val. each + 4 Practical tests (20%) Exams Written evaluation (100%)
REFERENCES	Main: REGEU, “Regulamento Geral das Edificações Urbanas”; RCCTE, “Regulamento das Características de Comportamento Térmico dos Edifícios”, DL 80/2006 de 4 de Abril; RJSCIE, “Regime jurídico de segurança contra incêndio em edifícios”, DL 220/2008 de 12 de Novembro; RTSCIE, “Regulamento Técnico de Segurança contra Incêndio em Edifícios”,

	Portaria n.º 1532/2008, 29 de Dezembro; RGR, “Regulamento Geral do Ruído”, DL 9/2007 de 17 de Janeiro; RRAE, “Regulamento dos Requisitos Acústicos dos Edifícios”, DL 96/2008 de 9 de Junho; Didactic material provided by lecturers. Complementary: ITE 50; Santos, Carlos A., Matias, Luís; “Coeficientes de transmissão térmica de elementos da envolvente dos edifícios”; LNEC; ICT Informação Técnica; Lisboa; 2009. EPBD 2010/31/EU. “Directive of the European Parliament and of the council of 19 May 2010 on the Energy Performance of Buildings”.

Course	REINFORCED CONCRETE II		
	ECTS	**Scientific area**	
6th Semester	6	Civil Engineering - Structures	EC-E

Hours: 80	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 162
	30	45				5		

LEARNING OUTCOMES	C1.Knowledge and understanding–To know the properties of materials and understand their influence on the behavior of reinforced concrete elements subjected to standalone or combined stresses of axial forces, bending, shear and torsion C2.Applying knowledge and understanding - To integrate and apply knowledge acquired in other courses such as Statics, Strength of Materials I and II, Theory of Structures and Reinforced Concrete I for the analysis and design of reinforced concrete elements (slabs, walls, foundations and D regions) according to the proposed EU standards C3.Making judgments–Select the right design options and adopt the most appropriate particular rules in the design of reinforced concrete elements (slabs, walls, foundations and D regions) C4.Communication–Present and justify the design options and the particular rules adopted, both orally and in writing (including the use of drawings) C5.Learning skills–Ability to study research solutions and do autonomous learning
PROGRAM	1. Design of concrete slabs 1.1 Type of slabs. General rules of design. Initial design phase. 1.2 Design Philosophies. Methods of analysis: elastic and plastic methods 1.3 Solid slabs, ribbed slabs and flat slabs 1.4 Detailing of slabs and practical 2. Design with strut and tie models 2.1 Discontinuity Regions 2.2 Design Models: struts, tie and nodes 2.3 Cantilever and deep beams 3. Spread Foundations and Retaining walls 3.1 Type of foundations: shallow foundations, single footing, strip footing and combined footings 3.2 Ultimate limit state design and serviceability limit design 3.3 Structural design of spread foundations and retaining walls 3.4 Particular rules and detailing
TEACHING METHODOLOGY	Contact Theoretical–presentation of the concepts and basis of reinforced concrete structures with emphasis to the behaviour of slabs, walls, foundations and D regions Practical–exemplification and application of the concepts exposed in lectures with exercises targeted for the design of reinforced concrete elements (slabs, walls, foundations and D regions) according to safety criteria in the proposed EU standards Guidance tutorial–personal coaching or small groups sessions to conduct the learning process Autonomous Study – Excerpts readings from recommended literature and resolution of proposed exercises
EVALUATION METHOD	Continuous assessment Written test-theoretical component (TC) 3 points (min. score 1 point); practical

	component (PC) 16 points (11 points for slabs – min. score 6 points, and 5 points for foundations and strut and ties models – min. score 2.5 points); Performance (D) Final standings: 0.15*TC + 0.80*PC + 0.05*D Exams Final standings: 0.15*TC + 0.85*PC
REFERENCES	Main: NP EN 206-1:2000/A2:2005: Betão – Parte 1: Especificação, desempenho, produção e conformidade, IPQ NP EN 1990: 2009: Eurocódigo 0 – Bases para o cálculo de estruturas, IPQ NP EN 1991:2010: Eurocódigo 1: Ações em estruturas, IPQ NP EN 1992:2010: Eurocódigo 2: Projeto de estruturas de betão, IPQ NP EN 1998:2010: Eurocódigo 8: Projeto de estruturas para resistência aos sismos, IPQ Barros, H., Figueiras, J., Tabelas e Ábacos de dimensionamento de secções de betão armado solicitadas à flexão e a esforços axiais segundo o Eurocódigo 2, FEUP, 2010 Montoya, P. J, et al. Hormigón Armado (vol.1). Editorial Gustavo Gili, SA, Barcelona, 14ª Edição, 2000 Complementary: Leonhardt, F. Mönning, E. – Construções de Concreto, Volume 2 e Volume 3, 1ª edição, Editora Interciência, 1979

Course	CIVIL ENGINEERING PROJECT		
	ECTS	**Scientific area**	
6th Semester	8	Civil Engineering - Structures	EC-E

Hours: 75	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 216
			60			15		

LEARNING OUTCOMES	C1.Knowledge and understanding – Know and understand the fundamental principles of structural design of reinforced concrete structures C2.Applying knowledge and understanding – Design and structural modeling. Quantification of static and dynamic actions. Design limit states of linear and plans members C3.Judgment making – Capacity to use a critical thinking when analyzing the results obtained by analytical and numerical methods C4.Communication – Ability to present and defend the structural solutions found. Ability to develop a concept design report C5.Learning skills – Ability to research what the best structural solution for each case and proceed with the design of reinforced concrete structures
PROGRAM	1.Structural design of buildings: basic criteria for the distribution of mass and inertia; modelling for the structural calculation; approaches used in modelling. 2.Preliminary design of structural members: criteria commonly used in the preliminary design; estimation of static actions applies. 3.Description and quantification of the different actions presents in a structure: permanent actions; variables actions: overloads; combination of actions. 4.Evaluation of seismic actions 5.Evaluation of the wind action 6.Interpretation of test results: introduction of the actions presents in the design model; output and analysis of the results. 7.Checking the safety of structural elements: ultimate limit states; service limit states. 8.Organization of the design process
TEACHING METHODOLOGY	Classroom Practical and laboratory teaching: integration and application of knowledge in a real situation; laboratory tests Tutorial: personal guidance sessions to lead the learning process and to clarify doubts Autonomous Research in electronic and analogical platform, and study of bibliography in the area recommended by the course Resolution of some examples Laboratory tests performance
EVALUATION METHOD	Assessment by individual written test (PEI) Group project (Proj): structural design Oral evaluation (Oral): oral presentation and oral defence of the project Individual continuous evaluation (Cont. Eval.) Continuous evaluation: Final grade: 50%Proj+25%PEI+12,5%Oral+12,5%Cont.Eval. Exame Final grade: 40%Proj+40%PEI+10%Oral+10%Cont.Eval.
REFERENCES	Main:

	Regulamento de Estruturas de Betão Armado e Pré-Esforçado (REBAP) – INCM Regulamento de Segurança e Acções em Estruturas de Edifícios e Pontes (RSA) – INCM IPQ: Eurocódigos 0, 1, 2, 7 e 8, 2010 CEN: EN 1997-2, Eurocode 7: Geotechnical Design - Part 2: Ground investigation and testing, 2005 Didactic material provided by lecturers. Complementary: NP ENV 206-93 - Betão - Comportamento, Produção, Colocação em Obra e Critérios de Conformidade, IPQ Reis, António; Camotim, Dinar, “Estabilidade Estrutural”, McGraw-Hill, 2000 Farinha, J. S. Brazão; Reis, A. Correia; “Tabelas Técnicas”, 2010

Course	SEMINAR		
	ECTS	**Scientific area**	
6th Semester	3	Complementary Sciences	CC

Hours: 30	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 81
					30			

LEARNING OUTCOMES	C1.Knowledge and understanding – Expand and strengthen knowledge on various civil engineering areas, through either the participation in seminars to which reputed persons from academia/industry are invited or the research investigation on scientific literature C2.Applying and understanding – Interpret and value scientific literature, integrate knowledge, correlating different scientific concepts through analysis and synthesis; Stimulate creativity, intellectual curiosity, openness to innovation and experimentation C3. Critical thinking – Creating greater awareness on recycling and other sustainability issues; ability to apply critical thinking to sustainable issues C4.Communication skills - Develop oral and writing skills; to clear state results, analyzing and discussion them; Write a scientific paper C5.Learning skills – Undertake a research investigation in any topic of current interest; Competently undertake autonomous work; develop teamwork
PROGRAM	1. Fundamentals of Scientific Research Seminar titles 2. Information systems and urban planning 3. Innovation and intellectual property 4. Environmental responsibility, social governance and business ethics 5 Eurocodes for fire-structural safety of buildings 6 Energy efficiency in buildings 7 Earth construction 8 Earthquake analysis of reinforced concrete structures 9 Sustainable Construction 10 Advanced 3D modelling techniques and simulation for construction 11 Information technology systems as a support to plan urban environments 12 Novel composite materials and its application in construction 13 Recycling and reuse of materials to reduce overall construction waste. 14 Post-tensioning systems and methodologies applied to civil engineering 15 Biomimetics in engineering 16 Building information Models are the future of construction management
TEACHING METHODOLOGY	Face to face theoretical/Practical learning Personal guidance sessions in small groups to conduct the learning process, to clarify issues and develop scientific and research skills towards the elaboration of a scientific paper Seminars Presentations on civil engineering issues are carried out by invited reputed persons from academia and industry Tutorial: Personal guided sessions Self-study Autonomous work Reading of bibliography Critical analysis and synthesis of several scientific

	Application of acquired skills to elaborate a scientific paper Methods to assess knowledge and skills
EVALUATION METHOD	Continuous assessment Classification: F = (0.3*P+0.5*T+ 0.15*ADT+ 0.05 S) P – Poster on 10 of the seminars presented T – scientific paper ADT – presenting and defending the scientific work S –Seminar participation Exams Classification: F = (0.7*T+ 0,3*ADT) T – Research work ADT – presenting and defending the scientific work
REFERENCES	Main: Didactic material provided by lecturers. Complementary: Alexander, D., and Tomalty. (2002). Smart Growth and Sustainable Development: Challenges, solutions and policy directions. Local Environment, 7(4), 397-409. Alwaer, H. and Clements-Croome, D.J. (2010) Key performance indicators (KPIs) and priority setting in using the multi-attribute approach for assessing sustainable intelligent buildings, Building and Environment, 45(4), 799-807. Baker, N. and Steemers, K. (2000) Energy and environment, E & FN Spon, London, UK. Bentley, I; Alcock, A; Murrain, P; McGlynn, S; Smith, G (1996) Responsive Environments, Butterworth-Heinemann, London, UK. Bryman, A. (2008). Social Research Methods. 3rd ed. Oxford University Press, New York, USA. CABE. (2002). The Value of Good Design: How buildings and spaces create economic and social value. Commission for Architecture and the Built Environment, London, UK.

Course	STEEL AND MIXED STRUCTURES (Elective)		
	ECTS	**Scientific area**	
5th Semester	5	Civil Engineering - Structures	EC-E

Hours: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 135
		60				5		

LEARNING OUTCOMES	C1.Knowledge and understanding -Knowledge of the mechanical properties of the steel, the structural steel behaviour and how structural steel systems work. Use the Eurocode 3 specifications for the design of steel structure. C2.Applying knowledge and understanding - Ability to apply the knowledge and understanding in a manner that indicates a professional approach, within the field of steel structures design. Ability to use computer tools to solve problems. C3.Judgment making - Ability to solve problems within field of Steel Structures design, justifying the recommended solutions, the used methods and issued judgments. Ability to use a critical analysis of the results obtained numerically or experimentally. C4.Communication - Communicate about their understanding, skills and activities, with peers, supervisors and clients. C5.Learning skills - Learning skills to undertake further studies with some autonomy.
PROGRAM	1. Basic design principles. Materials. 2. Limit states theory. Ultimate and service limit state. 3. Local buckling. 4. Sections classes. 5. Steel column, beams and frames. 6. Steel connections. 7. Mixed steel-concrete slabs.
TEACHING METHODOLOGY	Contact Theoretical-practical teaching - the lessons are used to present the theoretical basis of Steel and Mixed Structures design and to learn the program contents. Then, the resolution of some problems is exemplified to apply the learned concepts. At the end of the class, the lecturer will propose other problems that the student should solve at home. Tutorial - The study involves personal orientation sessions in small groups, inside and outside of the classroom, to lead the learning process, namely to guide the individual student works and to elucidate the doubts. Autonomous Study and learning, composed by literature readings and resolution of recommended problems.
EVALUATION METHOD	Assessment The continuously/final assessment on this course unit includes a written examination 60%), involving all the contents given in lessons, and the assessment of design work (40%).
REFERENCES	NP EN 1990- Bases para o Projeto de Estruturas NP EN 1991– Ações em Estruturas: Parte 1-1 Ações gerais, Parte 1-3 Ações da neve, Parte 1-5 Ações térmicas. NP EN 1993: Design on Steel Structures, Part 1-1: General rules and rules for buildings, Part 1-8: Design of joints, NP EN 1994: Design of Composite Steel and Concrete Structures, Part 1-1: General rules and rules for buildings,

	Simões, R. Manual de Dimensionamento de Estruturas Metálicas. Eurocódigo 3: Projecto de Estruturas Metálicas, Parte 1-1: Regras gerais e regras para edifícios, Cmm Press (www.cmm.pt), 2005. Silva, L. S. e Gervásio, H., Manual de Dimensionamento de Estruturas Metálicas. Métodos Avançados. Eurocódigo 3: Projecto de Estruturas Metálicas, Parte 1-1: Regras gerais e regras para edifícios, Parte 1-5: Estruturas Constituídas por Placas, Cmm Press (www.cmm.pt), 2007. Didactic material provided by lecturers.

Course	PROJECT MANAGEMENT (Elective)		
	ECTS	**Scientific area**	
5th Semester	5	Civil Engineering - Construction	EC-C

Hours: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 135
		60				5		

LEARNING OUTCOMES	C1- Knowledge and understanding - Knowledge of principles and methods of financial evaluation and multi-criteria evaluation, and understanding its application to the infrastructure engineering projects C2- Applying knowledge and understanding - Ability to plan, organize, coordinate and control all aspects of a project using an information system C3- Judgment making - Ability to make critical review of the problems of evaluation and decision C4- Communication - Capacity of draw, in a formal chart way, the wide financial flows of the project, and the internal structure of construction companies based on the value of annual sales turnover C5- Learning skills - Ability to study and research independently
PROGRAM	1. Principles of management and project evaluation 1.1-Concept design and its management 1.2-Participating entities 1.3-The Project Manager role 1.4-The feasibility analysis phase 2. Financial evaluation and methods of financial evaluation 2.1-Capitalization and Discount. 2.2-Formal projects financial evaluation methods 3. Multi-criteria evaluation 3.1- Definitions and general concepts. The multi-attribute methods 4- Construction company organization 5- Principles of information technologies applied to project management. A Project Simulation in Computer. Case Studies fully developed by students: 5.1-Study and cost analysis 5.2-Strategies for develop the final price 5.3-Planning-time, financial and resources 5.4-Implementation and control 5.5-Logistics
TEACHING METHODOLOGY	Contact Theoretical. Presentation of concepts and principles of management and project evaluation of large infrastructure engineering and the remaining theoretical content Exemplification and application to case studies of large project Theoretical and practical Modelling and solving practical cases Critical analysis of the results of practical cases A Project Simulation in Computer: Case Studies fully developed by students during the semester Tutorial Personal guidance sessions or in small groups, to drive the learning process and clarify any doubts Autonomous Study

	Reading excerpts from recommended reading Resolution of the exercises recommended E-Learning Interaction with learning contents of the Internet
EVALUATION METHOD	Continuous assessment Final grade=10 % Participation in class + 50% T. Frequency + 40% Practical Work Exams Final grade= 60% Exam (min: 9,5/20)+ 40% Practical Work
REFERENCES	Main: Coutinho Rodrigues, João - Gestão de Empreendimentos - A Componente de Gestão da Engenharia, ed. Ediliber, Coimbra, 2003. Bandeira, Filipe - Organização de empresas de construção civil, DEC-ESTG--IPL, Leiria, 2005. Curso sobre Medições na Construção, LNEC Informação sobre Custos, LNEC (Biblioteca) Manual Pyramid (fornecido com o programa). Didactic material provided by lecturers. Complementary: Project Management Institute – A guide to the Project Management Body of Knowledge, PMI, 1996. Roy, B. – Méthodologie Multicritére d´Aide à la Decision, Economics, Paris,1985 Reis, A. Correia – Organização e gestão de obras, Edições Técnicas E.T.L., Ldª, Lisboa, 2006 Bandeira, Filipe - Organização de empresas de construção civil, DEC-ESTG--IPL, Leiria, 2005. Curso sobre Medições na Construção, LNEC Informação sobre Custos, LNEC (Biblioteca) Manual Pyramid (fornecido com o programa). Software: PYRAMID®

Course	GEOGRAPHIC INFORMATION SYSTEMS (Elective)		
	ECTS	**Scientific area**	
6th Semestre	5	Civil Engineering - Planning and Transportation	EC-PT

Hours: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total work hours:** 135
		30	30			5		

LEARNING OUTCOMES	C1. Knowledge and understanding - knowledge about data bases models, basic concepts of data structures of vector and raster models, spatial analysis using vector and raster data sources. C2. Applying knowledge and understanding – Students should be able to relate concepts, to select structure and match geographical datasets from different sources deemed adequate for the solution of the case-studies related with Civil Engineering. C3. Making judgments - ability to interpret and make a critical analysis and evaluation of the data quality and adequacy of cartographic information. C4. Communication – ability to develop lab reports, develop skills such as team working C5. Learning skills - it is intended that students develop skills that enable them to develop and implement GIS applications related with Civil Engineering
PROGRAM	1.Cartographic Information, Coordinates, Georeferencing Systems. 2.Geographic Data quality. 3.Relational Database Structure. 4.Data models for geographic information: vector data model, raster data model. 5.Spatial analysis using vector data sources. Data structures for vector data storage. Geoprocessing operators. Proximity operators. Buffers. 6.Spatial analysis using raster data sources. Data structures for raster data storage Map algebra. Local, focal, block, zonal and global functions. 7.Relief Modeling: Spatial interpolation, IDW methods Slope, aspect and curvatures. Viewshed analysis. 8.Hydrologic Modeling: Surface analysis,watershed . 9.Development of GIS applications in the scope of Civil Engineering.
TEACHING METHODOLOGY	Contact Theoretical and Practical teaching are used to present the concepts and basis data models for geographic information and spatial analysis methods; Modelling and solving concrete problems related with Civil Engineering spatial analysis using vector and raster data sources. Laboratory lessons are used to perform experimental work using geographic information systems software. Tutorial: Sessions to conduct the learning process)
EVALUATION METHOD	Continuous assessment written test (T) – 8.5 min val./ 20 val. Exercises (EX) and practical work (P) – min 8.5 val. / 20 val. Final standings =0.2*EX+0.4*P+0.4*T Exams written test (T) and pratical work (P) – min 9.5 val. / 20 val. each. Final standings =0.4*P+0.6*T
REFERENCES	Main: Didactic material provided by lecturers.

	João Luís de Matos − Fundamentos de Informação Geográfica. Ed. Lidel, 2001 P.A. Longley, M.F.Goodchild, D.J.Maguire, D.W.Rhind, Geographic Information Systems and Science, 2nd Edition, Wiley, 2005 Complementary: ESRI, GIS for Building and Managing Infrastructure, Esri Press, 2010 Ana Azevedo l – Bases de Dados com Microsoft Access XP, CentroAtlântico.pt, 2002. José Luís Pereira − Tecnologia de Bases de Dados. Ed. FCA 3ª Edição, 1999

Course	CONSERVATION AND REHABILITATION OF BUILDINGS (Elective)		
	ECTS	**Scientific area**	
6th Semester	5	Civil Engineering - Construction	CE-C

Hours: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 135
		50	10			5		

LEARNING OUTCOMES	C1. Knowledge and understanding – of concepts and basis to understand the intervention principles in existing constructions, promoting their conservation and rehabilitation; C2. Applying knowledge and understanding – to identify anomalies in the construction, to select and use non-destructive tests on site to assess the condition of existing constructions and to define all tasks related with the conservation, repair, rehabilitation and strengthening of constructions made of concrete, steel, timber and masonry; C3. Making judgment – about the intervention options on the construction; C4. Communication – to present and justify the intervention options on the construction; C5. Learning skills – ability for autonomous to study and learning.
PROGRAM	1. Fundamental concepts Introduction. Conservation, repair, rehabilitation and strengthening. Sustainable construction. Intervention principles. 2. Inspection and monitoring of construction Survey and inspection techniques. Equipment, records and inspection reports. Monitoring techniques and equipment. 3. Symptoms, causes and deterioration mechanisms Errors, omissions and deficiencies in design, construction and maintenance. Climatic, environmental, mechanical and biological actions. 4. Concrete structures Symptoms, causes and deterioration mechanisms. Laboratorial and in-situ testing. Repair and strengthening techniques. 5. Steel and mixed constructions Symptoms, causes and deterioration mechanisms. Laboratorial and in-situ testing. Repair and strengthening techniques. 6. Timber and masonry constructions Symptoms, causes and deterioration mechanisms. Laboratorial and in-situ testing. Repair and strengthening techniques. 7. Case studies
TEACHING METHODOLOGY	Presential Theoretical-practical: teaching, presenting the concepts and principles related with conservation and rehabilitation of buildings, illustrated with case studies and the resolution of practical problems. Practical laboratorial, conducting laboratory experiences using non-destructive tests. Tutorial, comprised by personal orientation sessions, in small groups, to conduct the learning process. Autonomous Study and learning, composed by literature readings and resolution of recommended problems
EVALUATION METHOD	Continuous assessment Written examination (13 Val.) and a practical work (7 Val.) that could be a

	monograph or a laboratorial project. Exams written exam (20 val.)
REFERENCES	Cóias V., Inspecções e Ensaios na Reabilitação de Edifícios, IST Press, 2006. Appleton J., Faria A., Reabilitação de Edifícios Antigos, Edições Orion, 2003. Helene P., Pereira F., Manual de rehabilitación de estructuras de hormigón, CYTED, 2003. Bungey J.H., Millard S.G., Testing of concrete in structures, 3rd ed., Chapman & Hall, 1996. Malhotra V.M., Carino N.J., Handbook on nondestructive testing of concrete, 2nd ed., CRC Press, 2004. Broto C., Enciclopedia Broto de patologías de la construcción, Links Internacional, 2005. Didactic material provided by lecturers.

Course	SPECIAL STRUCTURES AND FOUNDATIONS (Elective)		
	ECTS	**Scientifc area**	
6th Semester	5	Civil Engineering - Structures	EC-E

Hours: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 135
		60				5		

LEARNING OUTCOMES	C1. Knowledge and understanding - Knowledge of the principles of structural safety and structural dynamics, and understanding the use of precast construction and the design of structures, reservoirs and special foundations. C2. Applying knowledge and understanding - Ability to model and solve structures, reservoirs, and special foundations. C3. Judgment making - Ability to make critical review of the numerical, dimensional, and regulatory results. C4. Communication - Ability to produce and present solutions in a numerical, geometric and graphically way. C5. Learning skills - Ability to study and research independently and collect geotechnical, and seismic data of the site.
PROGRAM	1. Introduction to structural safety 1.1. The probabilistic concept 1.2. The Limits States method 2. Dynamics analysis of structure 2.1. Single and Multiple degrees of freedom systems 2.2. The modal superposition method 3. Reservoirs and silos. Structural analysis 3.1. Structural and functional requirements 3.2. Elastic Analysis and design of walls and bottom slab 4. Precast concrete structures 4.1. Industrial plants with precast elements 4.2. Design a composite beam 5. Shallow foundations 5.1. Design. Design approach 6. Flexible foundations 6.1. Design according to the Winkler model.
TEACHING METHODOLOGY	Theoretical Presentation of concepts and principles of design and structural safety and other theoretical concepts Exemplification of real cases and resolution of practical exercises Theoretical and practical Modeling and solving problems Review of practical exercises Realization of a compulsory practical work related to the verification of safety and design a structure that cover all syllabus taught at the course Tutorial

	Personal guidance sessions, or in small groups, to drive the learning process and clarify any doubts Autonomous Study Reading excerpts recommend by the course Resolution of the exercises recommended by the course E-learning Interaction with learning contents of the Internet
EVALUATION METHOD	Continuous assessment Written test (T)+ Performance (D)+ Practical Work (P) Final standings: 40%PW+10%D+50%T. Exams Contains two parts: written exam (E) and Practical Work (PW) Final standings: 40%PW+60%E
REFERENCES	Main: NP EN 1990: Bases para o projeto de estruturas NP EN 1991-1-1: Ações em estruturas - Parte 1.1: Ações gerais, Pesos volúmicos, pesos próprios, sobrecargas em edifícios NP EN 1992-1-1: Projeto de estruturas em betão - Parte 1-1: Regras gerais e regras para edifícios EN 1992-3: Design of concrete structures - Part 3: Liquid retaining and containment structures NP EN 1997-1:Projeto geotécnico – Parte 1 : Regras gerais NP EN 1998-1 e NP EN 1998-5 : Projeto de estruturas para resistência aos sismos – Parte 1 e 5 Pedro A. M. Mendes, Reservatórios em Betão Armado – Análise Estrutural e Dimensionamento, IST, 2000 Jaime Santos, Estacas sob ações verticais. Importância do controlo de qualidade, IST, 2008 Nuno Guerra, Estruturas de contenção, IST, 2004 Pedro Melo, Melhoramento de Terrenos, IST, 2000 Didactic material provided by lecturers. Complementary: Bowles, J. E, “Foundations Analysis and Design, McGraw Hill International Editions, 5th Edition, 1996

Course	TRAFFIC ENGINEERING AND TRANSPORTATION (Elective)		
	ECTS	**Scientific area**	
5th Semestre	5	Civil Engineering - Planning and Transportation	EC-PT

Hours: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 135
		30	30			5		

LEARNING OUTCOMES	C1. Knowledge and understanding – Knowledge concerning the interpretation and design of the components of an urban transport network, understanding and establishment of road network according to principles of hierarchical organization; knowledge needed to design intersections; knowledge necessary to design traffic calming devices; knowledge on infrastructure adapted to environmentally sustainable modes of transport; Knowledge of public transport and public parking; C2. Applying knowledge and understanding - Understanding, interpretation and ability to design the items listed in C1. C3. Making Judgments – Understand and be able to integrate all the constraints inherent in a major urban road network; C4. Communication – Ability to produce reports; C5. Learning skills – Ability to study independently.
PROGRAM	1. Basic principles of planning and management of transport systems 2. Road hierarchy, organizational and functional principals 3. Road intersections (priority junctions, roundabouts and traffic light controled) 4. Scope and design of traffic calming measures 5. Design and integration of environmentally sustainable modes (walking and cycling networks) 6. Public Transport, strategies and solutions 7. Parking management, strategies, location and design
TEACHING METHODOLOGY	Presence Theoretical Presentation of concepts, calculation and design methods Exemplification and application to real problems Theoretical and practical Modelling and solving problems inspired by real cases Review of results Practical Resolution of practical exercises Tutorial Personal coaching sessions in small groups to conduct the learning process and answer questions Autonomous Selected readings from the recommended literature Exercises solving Interaction and material search from the Internet
REFERENCES	Main: Comissão de Coordenação e Desenvolvimento Regional do Norte (CCRDN); Manual de Planeamento das Acessibilidades e da Gestão Viária, CCRDN, 2010 Ewing, R. e S. J. Brown, U.S. Traffic Calming Manual. American Planning Association. Washington, DC., 2010 Junta Autónoma de Estradas (JAE), Norma de Intersecções, JAE P5/90 Divisão de

	Estudos e Projetos, Lisboa-Portugal, 1990 McShane, William R. e Roess, Roger P., Traffic Engineering, Prentice Hall Polytechnic Series in Traffic Engineering., 1990 Complementary: AustRoads, Guide to Traffic Engineering Practice; Sydney Australia, 1993 Ewing, R. H. Traffic Calming: State of the Practice. Institute of Transportation Engineers. Washington, DC., 1999

Course	WATER AND WASTE WATER TREATMENT (Elective)		
	ECTS	**Scientific area**	
5th Semestre	5	Civil Engineering - Hydraulics and Environment	EC-HA

Hours: 65	**T**	**T/P**	**PL**	**TC**	**S**	**OT**	**O**	**Total working hours:** 135
		60				5		

LEARNING OUTCOMES	C1.Knowledge and understanding - Basic knowledge consolidation on water quality; Quantitative and qualitative knowledge on hydrologic pollutants characterization; Knowledge of the main water/wastewater treatment technology. C2.Applying knowledge and understanding – Ability to decide on different water and wastewater treatment solutions that satisfy water quality for different uses or discharge restrictions; Ability to design treatment units; Ability to use bibliographic sources within the area of expertise (books, articles, law) C3.Making judgments – Develop critical analysis of the numerical results obtained in problem solving. C4.Communication – Ability to work in groups. C5.Learning skills – Ability to study autonomously
PROGRAM	1. Water and wastewater characteristics. 2. Screening: bars 3. Screening and microscreenings 4. Flotation 5. Coarse solids size reduction 6. Equalization 7. Coagulation and flocculation 8. Sedimentation 9. Filtration 10. Disinfection 11. Wastewaters biological treatment 11.1. Activated–sludge process 11.2 Trickling filters 11.3 Lagoons 12. Treatment and disposal of sludge
TEACHING METHODOLOGY	Presential Theoretical-practical lectures (presentation of the contents of the UC; practical application examples; solving exercises and discussion, individually and/or in small groups). Tutorial lectures (guidance of the study and clarification of doubts). Extra-lectures schedule (study visit at S. Romão water treatment plant; study visit at Olhalvas wastewater treatment plant) Autonomous Study (Study based on recommended bibliography; Search and consult complementary bibliography; solving exercises).
EVALUATION METHOD	Continuous evaluation 3 mini-tests: MT1, MT2 and MT3 1 individual written test: F (mín. 8.0/20 val.) Final score: CF= 0.30[(MT1+MT2+MT3)/3]+0.7F Exams 1 individual written test: E (mín. 9.5/20 val.)

	Final score: CF=E
REFERENCES	Main: Tchobanoglous G., Burton, F., e Stensel, H. D. (2003). Metcalf&Eddy, Wastewater Engineering – Treatment and Reuse. Editor: McGraw Hill. Davis, M. (2010). Water and Wastewater Engineering – Design, Principles and Practice. Editor: McGraw Hill, New York. Decreto Regulamentar 23/95 de 23 de agosto, Regulamento Geral dos Sistemas Públicos e Prediais de Distribuição de Água e de Drenagem de Águas Residuais. Decreto-Lei nº 236/98 de 1 de agosto, Normas, critérios e objectivos de qualidade com a finalidade de proteger o meio aquático e melhorar a qualidade das águas em função dos seus principais usos. Decreto-Lei nº 152/97 de 19 de junho, Recolha, tratamento e descarga de águas residuais urbanas no meio aquático. Didactic material provided by lecturers. Complementary: Wiesmann, U. et al. (2007). Fundamentals of Biological Wastewater Treatment. Editor: Wiley. Gray, N. F. (2005). Water Technology. Editor: Elsevier.