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Polytechnic Institute of Coimbra (P COIMBRA 02)

Coimbra Institute of Engineering - ISEC

Civil Engineering Department

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#### ECTS CATALOGUE

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The main language of instruction at Coimbra Institute of Engineering is Portuguese. However, some courses from degree and master degree can be offered in English and/or with a tutorial support in English.

The ECTS catalogue includes subject contents in English Language. Students can choose subjects from this Catalogue to the study plan proposal (Learning Agreement) to be analyzed carefully by the Departmental Coordinators and to be adjusted, after student's arrival, if necessary.

This ECTS catalogue contains information which is valid for this academic year. ISEC reserves the right to adjust the courses offered during the academic year and is not responsible for typing errors or printing mistakes.

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Polytechnic Institute of Coimbra (P COIMBRA 02)  
Coimbra Institute of Engineering - ISEC  
Civil Engineering Department

ECTS CATALOGUE

**Master Civil Engineering**

Old Code	New Code	Title - Portuguese	Title - English	ECTS	Term
<b>1.º ano / 1<sup>st</sup> Year</b>					
667301	60013310	Matemática Aplicada à Engenharia I	Applied Engineering Mathematics I	3.5	Winter
667302	60013321	Tecnologia da Envolvente dos Edifícios	Building Envelope Technology	5	Winter
667303	60013332	Contenções Periféricas	Flexible Retaining Structures	5.5	Winter
667304	60013343	Construção Prefabricada de Aço, de Betão e de Madeira	Steel, Concrete and Wood Precast Construction	5.5	Winter
667305	60013357	Sustentabilidade e Reabilitação Urbana	Sustainability and Urban Regeneration	5	Winter
667306	60013368	Betão Estrutural	Structural Concrete	5.5	Winter
667307	60013379	Matemática Aplicada à Engenharia II	Applied Engineering Mathematics II	3.5	Spring
667308	60013385	Projeto em Espaço Urbano	Projects in Urban Spaces	5	Spring
667309	60013396	Física dos Edifícios	Building Physics	5.5	Spring
667310	60013403	Hidráulica Urbana	Urban Hydraulics	5.5	Spring
667311	60013414	Avaliação de Projetos na Construção	Constructions Projects Evaluation	5	Spring
667312	60013420	Conservação de Vias de Comunicação	Highways and Railways Maintenance	5.5	Spring
Optional*	60013442	Patologias, Inspeção e Diagnóstico	Pathologies, Inspection and Diagnosis	5	Winter
Optional*	60013431	Reabilitação e Reforço de Edifícios	Buildings Rehabilitation and Strengthening	5	Winter
Optional*	60013469	Instalações Hidráulicas em Edifícios	Hydraulic Installations in Buildings	5	Winter
Optional*	60013475	Gestão Viária Urbana	Urban Road Management	5	Winter
Optional*	60013458	Instalações de Tratamento	Treatment Installations	5	Winter
<b>2.º ano / 2<sup>nd</sup> Year</b>					
667318	61000011	Dissertação**	Dissertation**	45	Anual
	60013486	Dissertação/Projeto/Estágio**	Thesis/Professional Intership/Project**	45	Anual

\*Optional subject – May not be available

\*\*ISEC accept student for works/researches related with these subjects without ECTS attribution. At the end of the work, student will receive an evaluation report within the total of working hours. The presentation and defense will be done at home university.

**Course Unit** BUILDING ENVELOP TECHNOLOGY

**Subject type** Engineering sciences      **Research Area** Construction  
Specialty sciences

**Year** 1st      **Semester** 1st      **ECTS** 5.0

Working Hours			Unaccompanied Working Hours	
Activity Type	Working Hours Per Week	Total Hours	Activity Type	Total Hours
Theoretical Lectures			Study	60
Theoretical-Practical Lectures	3.5	49	Works / Group Works	12
Practical-Laboratory Lectures			Project	
Tutorial Orientation	0.5	7	Evaluation	4
			Additional	
<b>Total of Working Hours</b>		132		

**Lecturer**

Activity Type	Name	Qualifications	Category
Theoretical Lectures			
Theoretical-Practical Lectures	Paulo Maranhã Nunes Tiago	Specialist	Adjunct Professor
Practical-Laboratory Lectures			
Tutorial Orientation	Paulo Maranhã Nunes Tiago	Specialist	Adjunct Professor

**Responsible(s) Lecturer (s)** Paulo Maranhã Nunes Tiago

**Goals / Skills**

Acquiring knowledge and in depth understanding about technological issues of building's facades and roofs. Develop the appropriate skills in order to gather, select, and understand up-to-date technical information in the scope of the discipline contents.

**Generic skills:**

- Application of knowledge;
- Make judgments / decisions;
- Improve the communication;
- Self-learning.

**Specific skills:**

- Acquire general and specific knowledge about the different types and solutions for building's facades;
- Acquire the ability to select the adequate solutions for the various facade problems in practical situations;
- Acquire an in depth understanding of the thermo hygroscopic behaviour of facade elements and its interplay with structural elements;

Signature of Teacher:

- Hurst, M. K. - "Prestressed Concrete Design", Chapman and Hall, London, 1988.
- Leonhardt F. - "Construções de Concreto, vol 5 – Concreto Protendido", Ed. Interciência, Lda.; Rio de Janeiro, 1983.
- Nilson, A. H. - "Design of Prestressed Concrete", John Wiley & Sons, New York, 1987.
- Pompeu dos Santos, Silvino - "Ligações de Estruturas Pré-fabricadas de Betão", Laboratório Nacional de Engenharia Civil, Lisboa 1985.
- Carmo, Ricardo – Elementos de apoio às aulas – Betão Estrutural. Diapositivos apresentados nas aulas.

Other elements of study available at:

<http://www.civil.ist.utl.pt/~cristina/bape1/>  
<http://www.civil.ist.utl.pt/~cristina/bape2/>  
<http://www.qsp.pt/>

- Elementos de estudo da disciplina Estruturas de Betão I (IST) – Módulo 3 Verificação do comportamento em serviço (Estados Limites de Utilização) – Carla Marchão e Júlio Appleton
- Elementos de estudo da disciplina Estruturas de Betão II (IST) – Módulo 1 Pré-Esforço – Carla Marchão e Júlio Appleton
- Elementos de estudo da disciplina Estruturas de Betão II (IST) – Módulo 2 Lajes – Carla Marchão e Júlio Appleton
- Cálculo prático de estruturas de betão armado – aços SD

Scientific papers available at: <http://www.civil.ist.utl.pt/~cristina/GDBAPE/Artigos.htm>

- Júlio Appleton – "Eurocódigo 2 – EN1992-1-1"
- Júlio Appleton, Paulo França – "Implementação do Eurocódigo 2 – (EN1992-1) em Portugal. Comparação com o REBAP"
- Júlio Appleton, António Costa, Paulo França – "Efeitos Estruturais da Deterioração em Estruturas de Betão Armado"
- João Saraiva, Júlio Appleton – "Avaliação da Capacidade Sísmica de Edifícios de Betão Armado de Acordo com o Eurocódigo 8 – Parte 3"
- Júlio Appleton – "Construções Pré-Fabricadas em Zonas Sísmicas"
- Júlio Appleton – "Interesse e Vantagens da Aplicação de Pré-Esforço em Edifícios"
- João Almeida, Júlio Appleton, Carlos Martins – "Control of Deflections in Postensioned Slabs"
- Miguel Lourenço, João Almeida - "Campos de Tensões em Zonas de Descontinuidade"
- João Almeida, Miguel Lourenço – "Stress Field Models for Structural Concrete"

#### Evaluation Method

- A research work with presentation and discussion (5 points in the range of 0 to 20). This work can be done individually or in group (maximum of 2 students) and must be submitted with the format specified by the teacher.
- A written exam (15 points in the range of 0 to 20) to be carried out during the period of the exams.
- The student can choose not to do the research work or can do the research work and choose not to account for the final result. In these cases, the final exam will be quoted for 20 points.
- For the student who chooses to account research work for the final result, the final exam will be quoted for 15 points. In this case, the final result will be the sum of the research work result with the final exam result.
- The approval requires the achievement of at least 9.5 in the final result and the minimum of 7 points (in the range of 0 to 15) in the written exam (for the students who choose to consider the evaluation of the research work in the final result).

#### Conditions for Exam Admission

All students enrolled in the course are admitted to the exam.

#### Access Conditions and Attendance Excuse

Not applicable.

#### Conditions for Results Improvement

The improvement of the classification can only be done by exame.

Date

08-10-2018

Signature from the lecturer responsible for the course

**Program Contents**

**Course Unit** STRUCTURAL CONCRETE

**Subject type** Engineering sciences      **Research Area** Structural Mechanics  
Specialty sciences

**Year** 1º      **Semester** 1º      **ECTS** 5.5

Working Hours			Unaccompanied Working Hours	
Activity Type	Working Hours Per Week	Total Hours	Activity Type	Total Hours
Theoretical Lectures			Study	68
Theoretical-Practical Lectures	3.5	49	Works / Group Works	15
Practical-Laboratory Lectures			Project	
Tutorial Orientation	0.5	7	Evaluation	4
			Additional	
<b>Total of Working Hours</b>		143		

**Lecturer**

Activity Type	Name	Qualifications	Category
Theoretical Lectures			
Theoretical-Practical Lectures	Ricardo Nuno Francisco do Carmo	PhD	Assistant professor
Practical-Laboratory Lectures			
Tutorial Orientation	Ricardo Nuno Francisco do Carmo	PhD	Assistant professor

**Responsible(s) Lecturer (s)** Ricardo Nuno Francisco do Carmo

**Goals / Skills**

know the theory and the practice related with the design and production of reinforced concrete structures (current and complex structures)

Recognize, diagnose and prevent structural pathologies in constructions.

**Generic skills:**

- Application of knowledge;
- Make judgments / decisions;
- Improve the communication;
- Self-learning.

**Specific skills:**

- Acquire knowledge and understanding capacity in the field of reinforced concrete structures (buildings and bridges usually used in the urban space), particularly at the level of design and manufacturing;
- Review the fundamental principles about the behavior of reinforced concrete structures in order to strengthen the

Signature of Teacher:



**Access Conditions and Attendance Excuse**  
Not applicable

**Conditions for Exam Admission**  
Not applicable

**Evaluation Method**

Students will be evaluated by performing an individual final exam on the topics taught.  
The Final Exam is quoted for 20 values and the approval requires that the mark be greater than or equal to 10 values.  
It is foreseen to carry out a written or oral examination for students who request special examinations.

**Conditions for Results Improvement**  
In accordance with the general rules

**Date**

02-10-2017

**Signature from the lecturer responsible for the course**



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(Hugo Sérgio Sousa Costa)



### Program Contents

1. Construction of metallic and composite structures;
  - General concepts
  - Regulation/codes
  - Design bases: structural elements – cross section strength; compressed elements; lateral buckling of beams
  - Connections - welded, bolted, pillar-beam and pillar bases
  - Construction of metallic structures
2. Construction of precast concrete structures;
  - Concrete production and environmental management
  - Concrete: high performance; self-compacting; lightweight structural;
  - Main types of precast elements;
  - Types of connections between precast elements;
  - Structural strategies and types of connections;
  - Transport and assembly of precast elements.
3. Construction of wooden structures;
  - Wood and forest - economic and ecological aspects;
  - Products: solid wood, glued laminated timber, laminated and fiber panels - properties and strength classes
  - Durability, protection and resistance to fire;
  - Structural systems – regulation/codes and operation/behaviour, characterization and structural modeling, sizing and main constructive details;
  - Means of connection - regulation, modeling and design;
  - Prefabrication and assembly.

### Work Done

Not applicable

### Teaching Methodology

Theoretical-practical classes of exposition, discussion and problem solving. During the presentation of the subjects, the students will be asked to keep an active participation in the class. In class, students will also be encouraged to interpret technical-scientifically practical problems. The clarification of doubts in the interpretation of the subjects, in the technological discussion of the processes of execution and in the resolution of problems will be an important complement in the learning.

### Bibliography

- Construire en Béton, Kind-Barkauskas, Polónyi, Kauhse & Brandt, PPUR, Lausanne, 2006
- Multi-Storey Precast Concrete Framed Structures, Kim Elliott, Blackwell Science, Londres, 2000 Bruggeling & Huyghe,
- Prefabrication with Concrete, Balkema, Roterdão, 1991
- Construções em Madeira, P. B. Cachim, Publindústria, Porto, 2007
- Projecto de Estruturas de Madeira, J. Negrão & A. Faria, Publindústria, Porto, 2009
- Avaliação, Conservação e Reforço de Estruturas de Madeira, Verlag Dashofer, J.S. Machado, A.Dias et al., 2010
- Handbook 1 – Timber Structures, Leonardo da Vinci /TEMIS, 2008
- Construire en Bois, Herzog, Natterer, Schweitzer, Winter & Volz, PPUR, Lausanne, 2005
- Construction en Bois, Natterer, Sandoz & Rey, PPUR, Lausanne, 2004
- EN 1990 – Eurocode – Basis of structural design, CEN, 2002.
- EN 1991 – Eurocode 1 – Actions on Structures, CEN, 2002.
- EN 1995 – Eurocode 5 - Design of Timber Structures, CEN, 2008.
- EN 1993 – Eurocode 3 – Design of Steel Structures, CEN, 2005.
- EN 1992 – Eurocode 2 – Design of Concrete structures, CEN, 2005.

**Course Unit:** PRECAST CONSTRUCTION IN STEEL, CONCRETE AND WOOD

**Subject type** Engineering Sciences      **Research Area** Civil Engineering

**Year** 1      **Semester** 1      **ECTS** 5,5

Working Hours			Unaccompanied Working Hours	
Activity Type	Working Hours Per Week	Total Hours	Activity Type	Total Hours
Theoretical Lectures	-	-	Study	75
Theoretical-Practical Lectures	3,5	49	Works / Group Works	-
Practical-Laboratory Lectures	-	-	Project	-
Tutorial Orientation	0,5	7	Evaluation	6
Project	-	-	Additional	-
Seminar	0,45	6		-

**Total of Working Hours**

**Lecturer**

Activity Type	Name	Qualifications	Category
Theoretical Lectures		-	-
Theoretical-Practical Lectures	Hugo Sérgio Sousa Costa Paulo Maranhã Nunes Tiago	PhD MsC/Specialist	Assistant Professor Assistant Professor
Practical-Laboratory Lectures		-	-
Tutorial Orientation	Hugo Sérgio Sousa Costa Paulo Maranhã Nunes Tiago	PhD MsC/Specialist	Assistant Professor Assistant Professor
Project		-	-
Seminar		-	-

**Responsible(s) Lecturer (s)** Hugo Sérgio Sousa Costa

**Goals**

Execution of metallic and composite structures, execution of precast concrete structures and execution of wooden structures; main construction systems, design bases and its technological aspects.

**Skills**

1. General skills/competences:  
decision-making, technical communication and quality and safety assurance.
2. Generic competences:  
acquisition of knowledge and understanding; judgment and decision making.
3. Specific skills:  
acquire knowledge and ability to select the main structural systems, their types of joints/connections and modes of execution; competences for conducting works and inspection in construction sites.





Stability of the bottom of the excavation; Clay soils; Terzaghi hypothesis; Bjerrum and Eide method; Sand soils; Hydraulic collapse; Safety coefficients; Vertical loads stability; Global stability; Kranz method;

#### 4. Ground anchors

Generalities; Mechanical behaviour of ground anchors; Pre-tension; Main types; Design; Acceptance tests;

#### 5. Seismic behaviour of retaining structures

Introduction; Retaining structures response to ground vibration; Monobe Okabe theory; Application to frictional and cohesive soils; Analytical and graphical solutions; Culmann's methodology; Location of the seismic thrust; Evaluation of the seismic coefficients;

#### Work Done

Research and technical interpretation assignment with oral presentation.

#### Teaching Methodology

Exposition, analytical and research. Problem resolution. Oral presentation.

#### Bibliography

- Cortinas de Estacas Moldadas - Brito, J. e França, P., IST
- Earth Retention Systems Handbook - Alan Macnab, McGraw-Hill
- Earth Pressure and Earth-Retaining Structures - C.R.I. Clayton, J. Milititsky and R.I. Woods, Wiley Interscience
- Estruturas de Suporte de Terras - Matos Fernandes, M.
- Estruturas Flexíveis de Contenção Periférica - Moreira, C.
- Ground Anchors and Anchored Structures - Petros Xanthakos, John Willey & Sons, Inc.
- Paredes Moldadas - Brito, J. e França, P., IST
- Paredes Tipo Munique e Berlim - Brito, J. e França, P., IST
- Pregagens - Brito, J. e França, P., IST
- Recomendações na Área da Geotecnia - Ordem dos Engenheiros
- Tecnologia de Fundações - Coelho, Silvério, Edições E.P.G.E. Tecnologia de Fundações - Coelho, Silvério, Edições E.P.G.E.

#### Evaluation Method

- Exam at the end of the period.
  - Theoretical part: proof without consultation; maximum rating: 12 values; minimum rating: 3 values;
  - Theoretical-practical part: test with consultation of the written elements of the discipline; maximum rating: 8 values; minimum rating: 2 values.
- Interpretation and research work with oral presentation; required; maximum rating: 4 values;
- Exams marked off the usual period shall preferably be oral.
- Final grade of the course:
  - Equal to the note of the test when this is less than 10 values;
  - Equal to 9 values when the exam note is equal to or greater than 10 values but didn't hit the minimum required;
  - Equal to the sum of 80% of the exam note with the note of the work of interpretation and technique research;
  - If the grade is greater than 16 values will have to be defended in oral.
- The prior registration for exams must be performed according to the current regulations; Irregularities in the prior registration for exams can harm or condition the realization of tests and shall be recorded, so that they can be valued in the evaluation process.

#### Conditions for Exam Admission

Can access the final exam, upon registration, all students enrolled who have held and defended the research work in the current academic year or in the previous.

#### Access Conditions and Attendance Excuse

The attendance of students in classes are recorded; It is required to be present in 75% of the laboratory classes and performing all work; Attendance is recommended and will be valued in the evaluation process.

Signature of Teacher: 

**Conditions for Results Improvement**

None.

**Date**

6.10.2018

**Signature from the lecturer responsible for the course**



Assinado por : **CARLOS MANUEL DA CRUZ  
MOREIRA**

Num. de Identificação: BI04251892

Data: 2019.04.24 12:03:01 Hora de Verão de GMT





**Program Contents**

**Course Unit** URBAN ROAD MANAGEMENT (*GESTÃO VIÁRIA URBANA*)

**Subject type** Speciality Sciences **Research Area** Civil Engineering

**Year** 2<sup>nd</sup> **Semester** 1<sup>st</sup> **ECTS** 5.0

Working Hours			Unaccompanied Working Hours	
Activity Type	Working Hours Per Week	Total Hours	Activity Type	Total Hours
Theoretical Lectures			Study	56
Theoretical-Practical Lectures	2,5	35	Works / Group Works	21
Practical-Laboratory Lectures			Project	
Tutorial Orientation	1,0	14	Evaluation	3
	0,5	7	Additional	4
<b>Total of Working Hours</b>		140		

**Lecturer**

Activity Type	Name	Qualifications	Category
Theoretical Lectures			
Theoretical-Practical Lectures	Mário Martins	PhD	Prof. Adjunto
Practical-Laboratory Lectures			
Tutorial Orientation			

**Responsible(s) Lecturer (s)** Mário Martins

**Goals / Skills**

To be able to analyze the fundamental aspects of urban road management required to overcome performance and safety related problems in urban road networks. To study the performance and geometric design of the most common at-grade road intersections in urban environment: stop controlled, roundabouts and signalized intersections. Analyze several aspects on defining a road hierarchy as well as intersections hierarchy.

**Program Contents**

Management of urban road networks:

Roles and main characteristics of urban streets in a road network management context, implementation of a road hierarchy and intersections hierarchy, applicability and influence of the spatial organization of cities, implementation problems;.

Intersections as critical points of a road network:

Unsignalized intersections: geometrical guidelines, data requirements and capacity evaluation of stop controlled junctions; Roundabouts: applicability, geometric design and capacity evaluation; Signalized isolated intersections: operational meaning of times, saturation flow rate, phase choice and conflict treatments, signal timing plan in isolated intersections, pre-timed and semi or fully actuated solutions;



**Bibliography**

- APONTAMENTOS DE INSTALAÇÕES DE TRATAMENTO. Pedro Nuno Afonso. ISEC
- WASTEWATER ENGINEERING - METCALF & EDDY, 4th ed.
- INGENIERIA AMBIENTAL – Gerard Kiely. MacGraw-Hill
- MANUAL DE DEPURACION URALITA. Aurelio Hernández Munoz, Aurelio hernández Lehmann, Pedro Galán Martínez. Editorial Paraninfo
- WASTEWATER TREATMENT PLANTS. Syed R. Qasim. Technomic Publishing

**Evaluation Method**

Exam: 100%; Number of exams: 2; Exam duration: 3h;

**Conditions for Exam Admission**

All students enrolled in the course are admitted to the exam.

**Access Conditions and Attendance Excuse**

N/A

**Conditions for Results Improvement**

The improvement of the classification can only be done by exam.

**Date**

8/10/2018

**Signature from the lecturer responsible for the course**





2. OVERVIEW OF THE DIFERENT TREATMENT METHODS
  - 2.1. Introduction
  - 2.2. Classification of the treatment processes
  - 2.3. Treatment levels
  - 2.4. Applicability of the different treatment processes
  
3. PRELIMINARY TREATMENT
  - 3.1. Introduction
  - 3.2. Screening
  - 3.3. Grit removal
  - 3.4. Fat and grease removal
  - 3.5. Flow equalization
  - 3.6. Compact systems for preliminary treatment
  
4. PRIMARY SEDIMENTATION
  - 4.1. Introduction
  - 4.2. Particle settling theory
  - 4.3. Types of clarifiers
  - 4.4. Design factors
  - 4.5. Operation, maintenance and troubleshooting
  
5. FUNDAMENTALS OF BIOLOGICAL TREATMENT
  - 5.1. Objectives of biological treatment
  - 5.2. Types of biological processes for wastewater treatment
  - 5.3. Classification of microorganisms
  - 5.4. Introduction to microbial metabolism
  - 5.5. Fundamental processes in biological treatment
    - 5.5.1. Biomass growth, substrate utilization and yield
    - 5.5.2. Biomass decay
    - 5.5.3. Hydrolysis
    - 5.5.4. Ammonification
    - 5.5.5. Phosphorus uptake and release
  - 5.6. Introduction to microbial growth kinetics
  
6. THRICKLING FILTERS
  - 6.1. Introduction
  - 6.2. Process description
  - 6.3. Physical facilities description
  - 6.4. Design of physical facilities
  - 6.5. Operation, maintenance and troubleshooting
  
7. ACTIVATED SLUDGE SYSTEMS
  - 7.1. Introduction
  - 7.2. Reactor types
  - 7.3. Process and physical facilities description
  - 7.4. Design of physical facilities
  - 7.5. Operation, maintenance and troubleshooting
  
8. SLUDGE TREATMENT
  - 8.1. Introduction
  - 8.2. Solids characteristics and quantities
  - 8.3. Thickening
  - 8.4. Stabilization
  - 8.5. Conditioning
  - 8.6. Dewatering
  
9. PROCESSES FOR BIOLOGICAL NUTRIENT REMOVAL
  - 9.1. Introduction
  - 9.2. Nitrogen removal processes
  - 9.3. Phosphorus removal processes
  - 9.4. Simultaneous phosphorus and nitrogen removal processes

**Work Done**

-

**Teaching Methododoly**

Expositive method; exercises resolution; group learning.

**Program Contents**

**Course Unit** TREATMENT INSTALLATIONS

**Subject type** Wastewater Treatment      **Research Area** Wastewater Treatment

**Year** 2º      **Semester** 1º      **ECTS** 5

Working Hours			Unaccompanied Working Hours	
Activity Type	Working Hours Per Week	Total Hours	Activity Type	Total Hours
Theoretical Lectures			Study	21
Theoretical-Practical Lectures	3.0	42	Works / Group Works	17
Practical-Laboratory Lectures			Project	
Tutorial Orientation	0.5	7	Evaluation	4
			Additional	
<b>Total of Working Hours</b>		130		

**Lecturer**

Activity Type	Name	Qualifications	Category
Theoretical Lectures			
Theoretical-Practical Lectures	Pedro Nuno Castelo Madeira Afonso	Doutoramento	Prof. Adjunto
Practical-Laboratory Lectures			
Tutorial Orientation	Pedro Nuno Castelo Madeira Afonso	Doutoramento	Prof. Adjunto

**Responsible(s) Lecturer (s)** Pedro Nuno Castelo Madeira Afonso

**Goals / Skills**

On successful completion of this module, students will have:

- The ability to do a preliminary design of the most widely used wastewater treatment unit operations and how to organize these into a functioning treatment system;
- Developed the basic skills for the operation of municipal wastewater treatment plants.

On successful completion of this module, students will have developed a range of generic skills spanning: wastewater treatment plant operation and design; communication skills required for multi-disciplinary civil and environmental engineering objectives.

**Program Contents**

1. 1. Wastewater characteristics
  - 1.1. Quality of wastewater
  - 1.2. Wastewater flow
  - 1.3. Unit waste loadings and population equivalents
  - 1.4. Calculation of mass loadings
  - 1.5. Selection of design flowrates and mass loadings
  - 1.6. Regulations for effluent discharge in Portugal

**Bibliography**

- "Inspeções e Ensaios na Reabilitação de Edifícios", Vitor Coias e Silva
- "Reabilitação Estrutural de Edifícios Antigos", Vitor Coias, GECORPA
- "Inspeção e Diagnóstico Estrutural de Construções Históricas. Algumas contribuições da FEUP, A intervenção no património. Práticas de Conservação e Reabilitação", FEUP, 2 a 4 de Outubro, Porto, 2002.
- "Vida Útil das Construções e Sua Previsão", Brito, J. Mestrado em Construção, IST, Lisboa, 2004.
- "Non-destructive testing for plant life assessment" International Atomic Energy Agency, IAEA, Industrial Applications and Chemistry Section, IAEA-TCS-26, 2005 ISSN 10 18-551
- "Monitorização Automática de Estruturas de Betão com Processamento de Imagem e Análise Multi-Espectral de Imagem", Valença, J. Tese de Doutoramento, FCTUC, Coimbra, 2012.
- "Aplicações de Fotogrametria na Engenharia de Estruturas", Valença, J. Tese de Mestrado, FCTUC, Coimbra, 2006.
- "Guia Prático para Conservação de Imóveis", Vitor Cóias e Silva, Dom Quixote

**Access Conditions and Attendance Excuse**

Students with regular enrollment and enrollment who have the minimum attendance (1/3) to classes will be admitted to the exam.

**Conditions for Exam Admission**

Not applicable

**Evaluation Method**

- Assessment: a Final Exam (FE) is evaluated for 20 values quotation, which consists of theoretical questions and theoretical-practical questions;
- The approval requires that the note of the FE is greater than or equal to 10 values;
- The practical work (PW) is an oral and individual presentation and is worth 20 values, of which 5 are reserved for the PW carried out during the semester;
- The final grade will be  $FG = 0,5 (FE + PW)$ ;

It is foreseen to carry out a written or oral examination for students who request special examinations.

**Conditions for Results Improvement**

In accordance with the general rules

**Date****Signature from the lecturer responsible for the course****15-10-2018**

(António José Pedroso de Moura Correia)



**Program Contents**

1. Fundamental concepts.
  - 1.1 Introduction;
  - 1.2 Useful life of buildings;
  - 1.3 Structural and non-structural pathology;
  - 1.4 Sustainable construction;
  - 1.5 General principles of inspection and diagnosis.
  
2. Evaluation of concrete constructions.
  - 2.1 Pathology of concrete;
  - 2.2. Anomalies in concrete structures;
  - 2.3 Methods of evaluation and monitoring;
  - 2.4 Non-Destructive Testing (NDT);
  - 2.5 In situ and laboratory tests;
  - 2.6 Concrete heritage.
  
3. Evaluation of wooden constructions.
  - 3.1 Pathology of wood;
  - 3.2 Anomalies in wood structures;
  - 3.3 Methods of evaluation and monitoring;
  - 3.4 Non-Destructive Testing;
  - 3.5 In situ testing and laboratory tests;
  - 3.6 Wood heritage.
  
4. Evaluation of masonry constructions.
  - 4.1 Masonry pathology;
  - 4.2 Anomalies in masonry structures;
  - 4.3 Methods of evaluation and monitoring;
  - 4.4 Non-Destructive Testing;
  - 4.5 In situ and laboratory tests;
  - 4.6 Masonry heritage.
  
5. Evaluation of constructions in metallic structure
  - 5.1 Pathologies of metallic structures
  - 5.2 Anomalies in metal structures
  - 5.3. Methods of evaluation and monitoring
  - 5.4 Non-Destructive Testing (NDT)
  - 5.5 In situ testing and laboratory tests
  
6. Inspection analysis and diagnosis.
  
7. Elaboration of technical reports.

**Work Done**

Not applicable

**Teaching Methododoly**

Theoretical-practical classes of exposition and discussion.

During the presentation of the subjects, the students will be asked to keep an active participation in the class. In class, students will also be encouraged to interpret technical-scientific problems and diagnosis situations. The clarification of doubts in the interpretation of the subjects, in the technological discussion of the processes of inspection and in the diagnosis will be an important complement in the learning.

**Course Unit:** PATHOLOGY, INSPECTION AND DIAGNOSIS

**Subject type** Engineering Sciences      **Research Area** Civil Engineering

**Year** 2      **Semester** 1      **ECTS** 5

Working Hours			Unaccompanied Working Hours	
Activity Type	Working Hours Per Week	Total Hours	Activity Type	Total Hours
Theoretical Lectures	-	-	Study	40
Theoretical-Practical Lectures	3,0	42	Works / Group Works	35
Practical-Laboratory Lectures	-	-	Project	-
Tutorial Orientation	0,5	7	Evaluation	3
Project	-	-	Additional	-
Seminar	-	3		-
<b>Total of Working Hours</b>		130		

**Lecturer**

Activity Type	Name	Qualifications	Category
Theoretical Lectures		-	-
Theoretical-Practical Lectures	António José Pedroso Moura Correia	PhD	Adjunct Professor
Practical-Laboratory Lectures	-	-	-
Tutorial Orientation	António José Pedroso Moura Correia	PhD	Adjunct Professor
Project	-	-	-
Seminar	Invited speaker	-	-

**Responsible(s) Lecturer (s)** António José Pedroso de Moura Correia

**Goals**

Provide students with experience in analysing the state of conservation of buildings, in particular knowledge related to pathology, inspection and diagnosis. At the end of the course students should: identify existing anomalies, their causes and form of manifestation; know the techniques of inspection, namely the fields of application, limitations and their advantages and disadvantages; and carry out a diagnosis of the state of conservation of current buildings.

**Skills**

- General skills:**  
 decision-making, technical communication and quality and safety assurance.
- Generic competences:**  
 application of knowledge and understanding; realization of judgment and decision making; Communication; self-learning.
- Specific skills:**  
 knowledge and comprehension capacity in the field of structural and non-structural pathology, in terms of detection, identification and characterization; building inspection skills; realization of the diagnosis of the state of conservation of constructions and elaboration of technical reports.

- 8. FIRE FIGHT AND EMERGENCY FACILITIES
- 9. SANITARY EQUIPMENT
- 10 LOCAL WATEWATER TREATMENT SYSTEMS

**Work Done**

practical work involving the design and dimensioning of a hot water network with a return circuit

**Teaching Methododoly**

Expositive method; exercises resolution; group learning; discussion (exchange of ideas).

**Bibliography**

- Creder, Hélio "Instalações Hidráulicas e Sanitárias", Livros Técnicos e Científicos Editora, 5ª.edição
- Grundfos Portugal. "Manual de Engenharia Sistemas de Pressurização".
- Hall, F. "Manual de Redes de Águas e Esgotos – Instalação e Conservação", Edições CETOP, 3ª. edição
- Macintyre, Archibald "Manual de Instalações Hidráulicas e Sanitárias" Editora Guanabara
- Macintyre, Archibald Joseph. "Bombas e instalações de bombeamento", Rio de Janeiro, 1987.
- Pedroso, Victor "Manual dos Sistemas Prediais de Distribuição e Drenagem de Águas", Laboratório Nacional de Engenharia Civil
- Pedroso, Victor. "Sistemas de Combate a Incêndio em Edifícios", Laboratório Nacional de Engenharia Civil, 2010
- Paixão, Mário "Águas e Esgotos em Urbanizações e Instalações Prediais" Edições Orion

**Evaluation Method**

Students have to make a practical work involving the design and dimensioning of a hot water network with a return circuit. A final exam (EF) is performed, which consists of a theoretical part (7 points) and a practical part (13 points); The approval requires the mark EF to be greater than or equal to 10 points;

The practical work (TP) is worth a total of 3 points; The final mark will be  $NF = 0.85EF + TP$ .

**Conditions for Exam Admission**

All students enrolled in the course are admitted to the exam.

**Access Conditions and Attendance Excuse**

N/A

**Conditions for Results Improvement**

The improvement of the classification can only be done by exame.

Date

8/10/2018

Signature from the lecturer responsible for the course



## Program Contents

**Course Unit** HYDRAULIC INSTALLATIONS IN BUILDINGS

**Subject type** Hydraulics **Research Area** Hydraulic installations

**Year** 2º **Semester** 1º **ECTS** 5

Working Hours			Unaccompanied Working Hours	
Activity Type	Working Hours Per Week	Total Hours	Activity Type	Total Hours
Theoretical Lectures			Study	40
Theoretical-Practical Lectures	3.0	42	Works / Group Works	37
Practical-Laboratory Lectures			Project	
Tutorial Orientation	0.5	7	Evaluation	4
			Additional	
<b>Total of Working Hours</b>		130		

### Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures			
Theoretical-Practical Lectures	António Moura Correia Pedro Madeira Afonso	PhD PhD	Prof. Adjunto Prof. Coordenador
Practical-Laboratory Lectures			
Tutorial Orientation	António Moura Correia Pedro Madeira Afonso	PhD PhD	Prof. Adjunto Prof. Coordenador

**Responsible(s) Lecturer (s)** Pedro Madeira Afonso

### Goals / Skills

The course contents cover the various components of the plumbing in buildings with the following objectives: 1) characterize the structure and operation of each facility; 2) set standards for its design; 3) define best building practices; 4) develop best exploration practices.

On successful completion of this module, students will have acquired knowledge about the constitution, the design, sizing, implementation, operation and rehabilitation of water distribution and domestic wastewater and rainwater drainage, in ordinary and special buildings, including complementary facilities.

### Program Contents

1. INTRODUCTION
2. NORMS AND REGULATIONS
3. HOT AND COLD WATER DISTRIBUTION
4. HOT WATER PRODUCTION AND RETURN CIRCUITS
5. WASTEWATER DRAINAGE
6. RAINWATER DRAINAGE
7. WATER AND WASTEWATER PUMPING STATIONS

Signature of Teacher:



Curso de Especialização sobre Revestimentos de Paredes, 5ª Ed., LNEC, Lisboa, 2004  
RSA - Regulamento de Segurança e Acções para Estruturas de Edifícios e Pontes, Dec.-Lei nº 235/83 de 31 de Maio, INCM, Lisboa, 1983  
NP EN 1991-1-4:2010 - Eurocódigo 1: Acções em estruturas - Parte 1-4: Acções gerais, Acções do vento, IPQ, Caparica, 2010  
NP EN 1991-1-5:2009 - Eurocódigo 1: Acções em estruturas - Parte 1-5: Acções gerais, Acções térmicas, IPQ, Caparica, 2009  
NP EN 1993-1-1:2010 - Eurocódigo 3: Projecto de estruturas de aço - Parte 1-1: Regras gerais e regras para edifícios, IPQ, Caparica, 2010  
NP EN 1993-1-8:2010 - Eurocódigo 3: Projecto de estruturas de aço - Parte 1-8: Projecto de ligações, IPQ, Caparica, 2010  
NP EN 1996-1-1:2008 - Eurocódigo 6: Projecto de estruturas de alvenaria - Parte 1-1: Regras gerais para alvenaria armada e não armada, IPQ, Caparica, 2008  
NP EN 1998-1:2010 - Eurocódigo 8: Projecto de estruturas para resistência aos sismos - Parte 1: Regras gerais, acções sísmicas e regras para edifícios, IPQ, Caparica, 2010  
CEN/TS 1992-4-1:2009, Design of Fastenings for Use in Concrete - Part 4-1: General, CEN/TC 250, 2009  
CEN/TS 1992-4-3:2009, Design of fastenings for use in concrete - Part 4-3: Anchor channels, CEN/TC 250, 2009  
CEN/TS 1992-4-4:2009, Design of Fastenings for Use in Concrete - Part 4-4: Post-installed fasteners - mechanical systems, CEN/TC 250, 2009  
CEN/TS 1992-4-5:2009, Design of Fastenings for Use in Concrete - Part 4-5: Post-installed fasteners - chemical systems, CEN/TC 250, 2009  
Documento Básico SE-F – Seguridad estructural: Fábrica, Suplemento del BOE núm. 74, Madrid, 2006  
Especificação E 464 - 2007 – Betões – metodologia prescritiva para uma vida útil de projecto de 50 e 100 anos face às condições ambientais, LNEC, Lisboa, 2007  
Especificação E 465 - 2007 – Betões – metodologia para estimar as propriedades de desempenho do betão (...) sob as exposições ambientais XC e XS, LNEC, Lisboa, 2007.

#### Evaluation Method

Final exam: Individual written examination about any topics lectured during course period and with practical questions. Approval requires achievement of a 9.5/20.0 mark, at least, with minimum of 50% in practical questions part. Marks higher than 16/20 must be orally defended. During examination students will be allowed to use texts or abridged form of texts from the pertinent standards, without any commentaries, graphics or table design aids and a written set of self collected adequate formulae.

#### Conditions for Exam Admission

All students enrolled in the course having attended at least 30% of theoretical-practical lectures will be admitted to examination.

#### Access Conditions and Attendance Excuse

Not applicable.

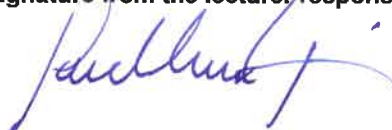
#### Conditions for Results Improvement

Accordingly to official regulation.

Date

9-10-2018

Signature from the lecturer responsible for the course





### Teaching Methododoly

Expositive method; exercises resolution; discussion (exchange of ideas); case study presentations; tutorial orientation.

### Bibliography

Written materials for the support of practical-theoretical lessons available in Moodle platform.

#### Bibliography :

- Construire des Façades, T. Herzog, R. Kripper & W. Lang, PPUR, Lausanne, 2007  
 Modern Construction Facades, Andrew Watts, Springer, Viena, 2005  
 Envoltantes (II) – Cerramientos Pesados: aplacados y paneles, Tectónica 2, ATC Ediciones, Madrid, 1995  
 Wall Technology, Vol. A: Performance Requirements, CIRIA Special Publication 87, Londres, 1992  
 Wall Technology, Vol. B: Loadbearing Small Units, CIRIA SP 87, Londres, 1992  
 Wall Technology, Vol. C: Small Units on Framed Buildings, CIRIA SP 87, Londres, 1992  
 Wall Technology, Vol. D: Large Lightweight Units on Framed Buildings, CIRIA SP 87, Londres, 1992  
 Wall Technology, Vol. E: Large Heavy Units on Framed Buildings and In-situ Concrete, CIRIA SP 87, Londres, 1992  
 Wall Technology, Vol. F: Glazing, Curtain Walls and Overcladding, CIRIA SP 87, Londres, 1992  
 Masonry Wall Construction, A. W. Hendry & F. M. Khalaf, Spon Press, Londres, 2001  
 Paredes de Alvenaria, Situação Actual e Novas Tecnologias, Paulo B. Lourenço & Hipólito de Sousa, Eds., Fund. Cupertino de Miranda, Porto, 2002  
 Paredes Exteriores de Edifícios em Pano Simples, Sérgio Alves & Hipólito de Sousa, Lidel, Lisboa, 2003  
 Paredes de Alvenaria – Inovação e Possibilidades Actuais, P. B. Lourenço, E. Coelho, G. Vasconcelos & C. P. Santos, Eds., LNEC, Lisboa, 2007  
 Manual de Alvenaria de Tijolo, 2ª Ed., A. Baio Dias, Ed., Centro Tecnológico da Cerâmica e do Vidro, Coimbra, 2009  
 Avaliação da vulnerabilidade e reforço de edifícios existentes de betão armado não dimensionados ao sismo, Humberto Varum, Mestrado em Reabilitação do Espaço Construído, FCTUC, 2006  
 Sismos e Edifícios, Mário Lopes, Coord., Orion, Amadora, 2008  
 Ouvrages en Maçonnerie de Petits Éléments – Pairs et Murs, DTU 20.1, CSTB, Paris, 1995  
 Fachadas de Ladrillo Cara Vista, Concha del Rio, Geohidrol, Madrid, 2010  
 Fachada Ventilada, Vicente Sarrablo, Caleidoscópio, Casal de Cambra, 2008  
 Architectural Precast Concrete, 2nd Ed., Precast/Prestressed Concrete Institute, Chicago, 1989  
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 GRC Technical Data, Cem-Fil International, Merseyside, England  
 A Recommended Practice: Design, Manufacture and Installation of GRC, National Precast Concrete Association Australia, 2nd Ed., 2006  
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 Building Movements and Joints, Portland Cement Association, Skokie, 1982  
 Les Joints et leur Géométrie, Jean Lugez, Cahiers du CSTB, Cahier 2840, Paris, 1995  
 Anchorage in Concrete Construction, Rolf Elgehausen, Rainer Mallée & John F. Silva, Ernst & Sohn, Berlin, 2006  
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 Componentes de Edifícios – Selecção de Caixilharia e seu Dimensionamento Mecânico, João Carlos Viegas, Informação Técnica Edifícios – ITE 51, 5ª Ed., LNEC, Lisboa, 2010  
 Revêtements muraux attachés en pierre mince – Travaux de bâtiment, DTU 55.2, CSTB, Paris, 2007  
 Revestimentos em Pedra Natural com Fixação Mecânica, Rui de Sousa Camposinhos, Edições Sílabo, Lisboa, 2009  
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 Over-cladding of Existing Buildings using Light Steel, SCI Pub. P247, The Steel Construction Institute, Ascot, 1998  
 Introduction to Structural Aluminium Design, Ulrich Müller, Whittles Publishing, Dunbeath, 2011  
 Alucobond, 3A Composites GmbH, Singen, 2014 ([www.3acompositesgmbh.de](http://www.3acompositesgmbh.de))  
 CE 117, Construção de Edifícios I, LNEC, Lisboa, 1970  
 CPP 510, Paredes de Edifícios, 7ª Ed., LNEC, Lisboa, 2008  
 Condicionamentos Climáticos da Envolvente dos Edifícios de Habitação, Ruy J. Gomes, Memória 181, LNEC, Lisboa, 1962  
 Insulating Materials – Principles, Materials and Applications, M. Pfundstein, R. Gellert, M. H. Spitzner & A. Rudolph, Detail-Birkhäuser, Basileia, 2008  
 Caracterização Térmica de Paredes de Alvenaria, Carlos A. Pina dos Santos & José A. Vasconcelos de Paiva, Informação Técnica Edifícios – ITE 12, 9ª Ed., LNEC, Lisboa, 2009  
 Coeficientes de Transmissão Térmica de Elementos da Envolvente dos Edifícios, Carlos A. Pina dos Santos & Luís Matias, Informação Técnica Edifícios – ITE 50, 15ª Ed., LNEC, Lisboa, 2009  
 Térmica de Edifícios, A. Moret Rodrigues, A. Canha da Piedade, A. Marta Braga, Orion, Amadora, 2009  
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 Cubiertas y Tejados – Manual Práctico, J. López Castellanos, Progensa, Sevilha, 1996  
 NTE – Cubiertas: diseño, cálculo, construcción, valoración, control, mantenimiento, Ministerio de Fomento, Centro de Publicaciones, Madrid, 2000  
 Gros Œuvre en Maçonnerie des Toitures Destinées à Recevoir un Revêtement d'Étanchéité, DTU 20.12, CSTB, Paris, 1993  
 Over-roofing of Existing Buildings using Light Steel, SCI Pub. P246, The Steel Construction Institute, Ascot, 1998





## Program Contents

1. The building envelope.
  - 1.1. A brief historical perspective.
  - 1.2. Envelope's performance requirements.
    - 1.2.1. Thermal behaviour.
      - 1.2.1.1. Mackey & Wright method.
    - 1.2.2. The action of rain and wind.
      - 1.2.2.1. Driving rain.
  2. Exterior walls of buildings.
    - 2.1. Continuous systems.
      - 2.1.1. Stone masonry walls.
      - 2.1.2. Brick masonry and concrete block masonry walls.
      - 2.1.3. Walls with structural function.
      - 2.1.4. Walls without structural function.
      - 2.1.5. Cavity walls.
      - 2.1.6. Thermo-hygrometric displacements.
    - 2.1.5. Differential structure-wall behaviour.
    - 2.2. Discontinuous systems.
      - 2.2.1. Historical evolution.
      - 2.2.2. Technological evolution.
      - 2.2.3. Main principal types of discontinuous systems.
        - 2.2.3.1. Facing stone outer leaf systems.
        - 2.2.3.2. Facing tiles outer leaf systems.
        - 2.2.3.3. Facing wood outer leaf systems.
        - 2.2.3.4. Facing metal sheet outer leaf systems.
        - 2.2.3.5. Facing architectural concrete outer leaf systems.
        - 2.2.3.6. Facing architectural glassfibre reinforced concrete (GRC) outer leaf systems.
  3. Structural joints in buildings.
    - 3.1. Main types of joints.
    - 3.2. Strategies for building block division by structural joints.
    - 3.3. Code's approaches and design guidance.
    - 3.4. Joints between facade elements.
      - 3.4.1. The closed type joints.
      - 3.4.2. The open type joints.
  4. A Precast concrete facade panels
    - 4.1. Main types of panels
    - 4.2. Modulation. Joints. Clearances.
    - 4.3. Precast concrete panels.
    - 4.4. Precast Glassfibre reinforced concrete (GRC) panels.
      - 4.4.1. The sandwich type panel.
      - 4.4.2. The ribbed type panel.
      - 4.4.3. The stud-frame type panel.
    - 4.5. Basic notions about precast panels design.
    - 4.6. Ventilated wall systems.
    - 4.7. Supporting and fixing precast facade elements in building structure.
      - 4.7.1. Metal anchor design.
      - 4.7.2. Support devices design.
        - 4.7.2.1. Reinforced concrete corbel design.
        - 4.7.2.2. Steel corbel design.
        - 4.7.2.3. Steel fixing rails design.
  5. Thermal insulation.
    - 5.1. Main insulating materials.
      - 5.1.2. Characteristics.
      - 5.1.3. Applications.
  6. Natural stone panel facing
    - 6.1. Design of support and fixing elements.
  7. Building roofs.
    - 7.1. Main types of roof systems.
    - 7.2. Flat roofs.
      - 7.2.1. Traditional roofs.
      - 7.2.2. Inverted roofs.
    - 7.3. Roof constructive issues.

## Work Done

Design of various fixing devices and support solutions for facade panels.