

## Course file

<b>Study cycle</b>	BACHELOR IN CIVIL ENGINEERING		
<b>Course</b>	Chemistry	Mandatory	<input checked="" type="checkbox"/>
		Optional	<input type="checkbox"/>
<b>Course scientific area</b>	PHYSICS AND CHEMISTRY	Category	B

Course category: B - Basic; C - Core Engineering; E - Specialization; P - Complementary.

Year: 1st	Semester: 1st	ECTS: 5,5		Total: 149
Contact time	T:	TP: 63	PL: 4,5	S: OT:

T - Lectures; TP - Theory and practice; PL - Lab Work; S - Seminar; OT - Tutorial Guidance.

Course Director	Title	Position
Carla Maria Duarte da Silva e Costa	Doutor	Professor Coordenador

### Learning objectives (knowledge, skills and competences to be developed by students)

(max. 1000 characters)

#### Objectives:

To provide students with knowledge on materials properties and its transformation based on its internal structure. Correlate the Civil Engineer and the Chemistry areas toward the knowledge be achieving in an interdisciplinary perspective.

#### Skills:

- 1) To understand the constitution of matter;
- 2) To identify, interpret, integrate and communicate the relationship between the internal structure and the macroscopic properties of the polymeric, metallic and ceramic materials;
- 3) To understand the transformation mechanisms of materials and to propose protection methods against metals corrosion in particular within the built heritage.

### Syllabus

(max. 1000 characters)

#### 1. Constitution of matter (2 weeks)

##### 1.1 Quantum Model of the Atom

##### 1.2 Periodic Table and Periodic Variation in Physical and Chemical Properties of the Atoms

## 2. Chemical compounds: nature and properties (5 weeks)

### 2.1 Covalent bond

- Organic and inorganic polymers
- Properties of molecular compounds

### 2.2 Metallic bond

- Crystal structures of metallic compounds
- Properties of metallic compounds

### 2.3 Ionic bond

- Crystal structures of ionic compounds
- Properties of ionic compounds

## 3. Thermochemistry (2 weeks)

### 3.1 Laws of Thermodynamics

### 3.2 Thermodynamics and Chemical Equilibrium

## 4. Chemical Reactions (4 weeks)

### 4.1 Chemical Equilibrium

### 4.2 Acid- Base Equilibrium

### 4.3 Solubility Equilibrium

## 5. Electrochemistry and Corrosion (2 weeks)

### 5.1 Redox Reactions

### 5.2 Galvanic Cells

### 5.3 Corrosion and Protection Methods

### **Demonstration of the consistency between the syllabus and the course objectives**

(max. 1000 characters)

The objectives set for the Unit are consistent with the syllabus, as it can be seen through the comparative analysis of these two parameters. Oral exposition of the syllabus are illustrated with examples (as well the

laboratorial experiences performed by the students) selected in order show the relationship between the chemistry and some phenomena they will deal with in their future career as Civil Engineers.

**Teaching methodology (evaluation included)**

(max. 1000 characters)

Classes are theoretical-practical (TP) as well as laboratory sessions. In the TP classes a expository methodology is used for the presentation of the syllabus which is enlightened with the description of practical cases and with exercises resolution. A set of freeware teaching material (animations, online exercises, etc) in the scope of the syllabus - organized according with the unit plan - are made available. Students are encouraged to use the knowledge acquired through exercises resolution outside of contact hours as well as to use freeware pedagogical material.

In the lab. classes, students perform hands-on experiences in order to: (i) strengthen the knowledge acquired in the lecture classes and (ii) improve students' understanding of the scientific method namely observation, recording, critical thinking and scientific report written.

The assessment results from the average of the marks obtained in two partial tests performed along the term or the mark obtained in the exam.

**Demonstration of the consistency between teaching methodology and the course learning objectives**

(max. 3000 characters)

The teaching methodologies are consistent with the objectives of the curricular unit as the expository methodology combined with hands-on laboratory works enable a good comprehension of the chemical phenomena. The work outside of contact hours particularly using freeware teaching material intent to stretch students beyond the confines of the traditional textbook study. The hands-up laboratory sessions are considered important to facilitate conceptual understanding in engineering education.

The assessment method adopted allows to evaluate the knowledge acquire either in the theoretical-practical or in the laboratorial classes.

**Main Bibliography**

(max. 1000 characters)

Química, Kenneth Goldsby, Raymond Chang, McGraw-Hill, 11ª Ed. (2012).



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ÁREA DEPARTAMENTAL DE ENGENHARIA CIVIL

Ciência e Engenharia de Materiais de Construção, M. Clara Gonçalves e Fernanda Margarido Eds., IST Press, 1ª Ed., (2012).

The Science of Construction Materials, P. F. Hansen, O. M. Jensen, Springer (2009)

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