ISEL
INSTITUTO SUPERIOR DE ENGENHARIA DE LISBOA

ADEM
Área Departamental de Engenharia Mecânica

Curricular Unit Form (FUC)

Course:	**SECOND CYCLE IN MECHANICAL ENGINEERING**					
Curricular Unit (UC)	**Corrosion and Protection**			Mandatory		
				Optional	**X**	
Scientific Area:	**Mechanical Design, Manufacturing and Industrial Maintenance**					
Year: **1**	Semester: **1**	ECTS:**5**		Total Hours: **3**		
Contact Hours:	T:	TP:**45**	PL:	S:	OT:	TT:
Professor in charge		Academic Degree /Title		Position		
Maria Teresa O. Moura e Silva		**PhD**		**Adjunct Professor**		

T- Theoretical ; TP – Theory and practice ; PL – Laboratory ; S – Seminar ; OT –Tutorial ; TT – Total of contact hours

Entry into Force	Semester: **Winter**	Academic Year: **2016/2017**

Objectives of the curricular unit and competences (max. 1000 characters)

The life cycle of assets is strongly influenced by their response to the environment in which they operate. In this frame, corrosion appears as one of the main failure modes of infrastructures, and plays a key role in assessing the life cycle, safety and cost of assets and industrial equipment. Understanding the corrosive phenomenon is therefore crucial for reducing maintenance costs and increasing the life time, in particular through its control. The latter should be viewed as a dynamic process that begins at the design stage of and continues in maintenance and monitoring.
In this perspective, in this course are presented the principles of corrosion, its different forms and the main strategies used to prevent it. Corrosion monitoring techniques, particularly relevant in the control of corrosion during the equipment operation, are also introduced.

After this course students will be able to:

- Recognize the impact of corrosion in the various sectors of the economy;
- Identify and predict equipment failure by corrosion;
- Develop and implement preventive measures to provide longer life and better performance of the assets in service;
- Understand the data obtained from corrosion monitoring systems.

Syllabus (max. 1000 characters)

1. Introduction

Definition of corrosion. Social and economic impact.

2. Electrochemistry of Corrosion

Corrosion mechanism.

Thermodynamics of Corrosion

Corrosion Kinetics.

3. Forms of Corrosion

Uniform corrosion

Localized corrosion: pitting, galvanic, interstitial, selective, intergranular, corrosion under mechanical stress

Causes and remedies

4. Environmental corrosion

Atmospheric corrosion

Corrosion in waters

Corrosion in soils

5. Corrosion Prevention

Basis of corrosion protection: Materials selection and principles of design to prevent corrosion.

Protective techniques: Corrosion inhibitors, cathodic and anodic protection, organic and inorganic coatings

6. Corrosion monitoring

Methods of Inspection. Cupons exposition.

Electrochemical Methods: corrosion potential monitoring, polarization resistance, electrochemical impedance spectroscopy (EIS)

Demonstration of the syllabus coherence with curricular unit's objectives (max. 1000 characters)

As corrosion is one of the major causes for failure, the primary goal of this course is to make students aware of this phenomenon and its associated costs: according to the last estimates, the annual cost of corrosion ranges from 3% to 5% of the GNP and it is generally accepted that a considerable part of these can be reduced by adequate education and training.

In this frame, in a first chapter, the fundamentals of corrosion are presented allowing the student to understand the phenomenon, predict theoretically the possibility of corrosion occurrence and calculate the corrosion rates.

Since the types of failures by corrosion are specific of the operating conditions, in particular on the environment and on the type of mechanical stresses present, in a second chapter the different forms of corrosive attack are introduced.

The third chapter discusses the behavior of structural materials when in contact with the natural aggressive media (atmosphere, soil and water).

In the following chapters the main strategies available to combat corrosion as well as corrosion monitoring techniques are introduced, giving the necessary skills for the students to implement preventive and/or corrective measures to control corrosion, optimizing the maintenance programs.

Teaching methodologies (including evaluation) (max. 1000 characters)
Student will be introduced to each subject through presentation of each topic, followed by some practical examples to consolidate the theoretical concepts. The lectures are complemented with the resolution of exercises and analysis of case studies where students apply the knowledge acquired. Assessment: Examination (60%) and a written monography addressing relevant topics of the course (40%).

Demonstration of the teaching methodologies coherence with the curricular unit's objectives (max. 3000 characters)
In addition to lectures, where the basic concepts are transmitted through traditional teaching methods, emphasis is put in the presentation of case studies that allow students to contact with real situations that lead to equipment failure. Thus, the transmitted concepts become concrete and the examples presented will alert students to possible problems they might come across during their professional activity. Also, the students are asked to work on a monograph, with the objective of further develop some of the topics covered during the semester, being given the opportunity to the students to propose a topic that consider more framed in their interest or, if applicable, in their professional activity.

Main Bibliography (max. 1000 characters)
• D. A. Jones, Principles and Prevention of Corrosion, Prentice-Hall 2ªEd., 1996. • Pierre R. Roberge, Handbook of Corrosion Engineering, McGraw-Hill, 2000. • R. Winston Revie, Uhlig's Corrosion Handbook, John Wiley & Sons, 2000