

Curricular Unit Form (FUC)

Course:	FIRST CYCLE IN MECHANICAL ENGINEERING					
Curricular Unit (UC)	Applied Chemistry				Mandatory	X
					Optional	
Scientific Area:	Mechanical Design, Manufacturing and Industrial Maintenance					
Year: 1º	Semester: 2º	ECTS: 4,0		Total Hours: 3,0		
Contact Hours:	T: 45,0	TP:	PL:	S:	OT:	TT:
Professor in charge		Academic Degree /Title		Position		
Maria Teresa Moura e Silva		Doutora		Professora Adjunta		

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

Entry into Force	Semester: Winter	Academic Year: 2010/2011
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Objectives of the curricular unit and competences (max. 1000 characters)

- To introduce the corrosion phenomena and the associated costs: according to the last estimates, the annual cost of corrosion ranges from 3% to 5% of the GNP and it can be significantly reduced by educational training.
 - To present the principles of corrosion, its different forms and the ways to prevent it
 - To introduce the fundamental concepts on lubricants (mineral oils, synthetic oils and greases), their properties and composition.
- With this course, it is intended that the students acquire the necessary skills to recognize failures associate with to corrosion degradation and to prescribe measures to avoid them, increasing the life cycle of equipment. Also, it is expected that the students get to know the basic information on various lubricants and their specific properties.

Syllabus (max. 1000 characters)

1. CORROSION AND PROTECTION OF METALS

- 1.1. Introduction:** Definition of corrosion. Causes and effects; Social impact; Economics of Corrosion.
- 1.2. Corrosion Theory:** Basics of Electrochemistry: Spontaneity of Electrochemical Reactions - Free Energy; Electrochemical and Galvanic series; The Nernst Equation; Corrosion Mechanisms
- 1.3. Passivity of Metals**
- 1.4. E-pH (Pourbaix) Diagrams**
- 1.5. Kinetics of Corrosion:** Corrosion current and open circuit potential; Evans Diagram; Corrosion Rate Expressions; Faraday's Law; Mixed-potential Theory
- 1.6. Corrosion Cells;** Galvanic Cell; Concentration Cell; Differential-Aeration Cell.
- 1.7. Forms of corrosion:** Uniform Attack; Galvanic, Pitting, Crevice and Intergranular Corrosion; Selective Leaching; Stress Corrosion Cracking; Corrosion-Related Damage by H₂, Corrosion Erosion.
- 1.8. Corrosion Prevention:** Cathodic and Anodic protection; Organic and Inorganic Coatings; Corrosion inhibitors

2. LUBRICANTS

2.1. Introduction: Types of lubricants; Objectives of lubrication.

2.2. Mineral Oils: Refining principles and operations; Chemical and Physical Properties; Additives; Oil Analysis; Viscosity classifications.

2.3. Synthetic Oils

2.4. Greases

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

Chapter 1 of the course syllabus deals with the fundamental aspects of corrosion science needed for achieving the skills described in two first curricular unit objectives. In Chapter 2 the basic concepts of lubricants are given which allows the accomplishment of the last objective.

Teaching methodologies (including evaluation) (max. 1000 characters)

Lectures are complemented with quizzes to illustrate the application of theoretical concepts.

Continuous assessment: Two partial tests (for approval, the student must have minimum score of 8 in each test and a weighted average minimum of 10).

Summative assessment: a final examination in accordance with procedures performed in ISEL

Demonstration of the teaching methodologies coherence with the curricular unit's objectives
(max. 3000 characters)

The various theoretical concepts are presented in the schedule lectures, enabling the students to understand the underlying phenomena of the different the topics covered in this course. This theoretical part is complemented with a practical component in which students solve exercises that will allow them to consolidate the theoretical concepts. When appropriate, cases studies are presented, in which the students must identify the type of corrosion responsible for structure failure.

Main Bibliography (max. 1000 characters)

T. Moura e Silva, Química Aplicada (Apontamentos)

CORROSION

- D. A. Jones, Principles and Prevention of Corrosion, Prentice-Hall 2ªEd., 1996
- V. Gentil, Corrosão, LTC Editora 3ªEd., 1996
- Pierre R. Roberge, Handbook of Corrosion Engineering, McGraw-Hill, 2000
- R. Winston Revie, Uhlig's Corrosion Handbook, John Wiley & Sons, 2000

LUBRICANTS

- J. George Wills, Lubrication Fundamentals, Marcel Dekker Inc., 1980
- T. Many e W. Drechal, Lubricants and Lubrication, Wiley-VCH, 2001
- Robertson, Lubrication in Practice, Faulkner e S.B. Menkes Eds, 1984