ISEL
ADEM
Área Departamental de Engenharia Mecânica

Curricular Unit Form (FUC)

Course:	**FIRST CYCLE IN MECHANICAL ENGINEERING**					
Curricular Unit (UC)	**Materials**			Mandatory	**X**	
				Optional		
Scientific Area:	**Mechanical Design, Manufacturing and Industrial Maintenance**					
Year: **1**	Semester: **1**	ECTS:**6,0**		Total Hours: **4,5**		
Contact Hours:	T: **22,5**	TP:**22,5**	PL: **22,5**	S:	OT:	TT:**67.5**
Professor in charge		Academic Degree /Title		Position		
Armando António Soares Inverno		**PhD**		**Assistant 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: **2020/21**

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

- Enable students to learn skills and basic knowledge on materials engineering, including the relationship between structure, processing, properties and performance of the main materials used in Engineering (metals, ceramics, polymers, composites and nanomaterials).
- Demonstrate to students the importance of materials and their properties in order to know how to suit their intended use.
- Provide students access to mechanical testing of materials, including the relationship between mechanical performance and structure dependent on their thermal history.

Syllabus (max. 1000 characters)

THEORETICAL
Introduction to Materials Science and Engineering
Crystalline Solid Structures
Defects in Crystalline Solids
Diffusion in Solids
Phase Diagrams
Mechanical Properties of Materials
Metallic Materials
Polymeric Materials
Ceramic and Glass Materials
Composite Materials
Nanomaterials

LABORATORY PRACTICAL
Uniaxial Tensile Test, Bending, Hardness (Brinell, Vickers, Rockwell) and Charpy.

Demonstration of the syllabus coherence with curricular unit's objectives (max. 1000 characters)
The proposed contents follow the best practices used to provide students basic knowledge on materials science and engineering, which are essential for proper materials selection for mechanical engineering applications, taking into account the service conditions and the desired performance in each application. The basic concepts of structure, defects, solid state diffusion and phase transformations allow the correlation between the materials behaviour and their properties, namely mechanical and thermal properties. Although the focus is on metals and their alloys, reference is made to new materials used in engineering, namely composites and nanomaterials.

Teaching methodologies (including evaluation) (max. 1000 characters)
This Curricular Unit consists of a theoretical and theoretical/practical component (3 hours per week) and a laboratory practical component (1,5 hours per week). Theoretical topics are complemented with case studies /exercises, to consolidate the basic knowledge necessary for the appropriate selection of materials for Engineering. **Students' evaluation:** **Theoretical** 2 written tests. If mark obtained is less than 8 points or if the final average is less than 9,5 points, the student must take a written examination. Approval on requires a minimum score of 9,5 or higher. In case grade is higher than 16, the student must take an oral examination. **Working group** Work on a topic for research/development on relevant themes regarding the application of materials in mechanical engineering. The submission and discussion of the working group is considered pedagogically fundamental. The minimum final grade for approval is 9,5 points. **Practical Component** Carrying out 4 laboratory material tests and 2 written tests. If in case the mark obtained is less than 8 points or if the final average mark is less than 9,5 points, the student must take global test. For grades higher than 16 points the student must take an oral examination. **Final Grade** **Final Grade (FG)=0.6*FG Theoretical+0.2*FG Workgroup+0.2*FG Lab. Practical**

Demonstration of the teaching methodologies coherence with the curricular unit's objectives (max. 3000 characters)
The contents are organized in an integrated way, aiming to allow students to acquire basic concepts about science and materials engineering which they can apply to concrete cases related to mechanical engineering. Both theoretical and theoretical-practical approaches will be employed so that students can understand the relationship between the structure, processing, properties and

performance of the main materials used in Engineering. In the laboratory practice component, four mechanical properties characterization tests will be undertaken and the experimental results shall be analysed and reported. The research/development working group component on relevant topics regarding the application of materials in mechanical engineering aims at to value teamwork and demonstrate the importance of synthesizing information on a given theme and present it succinctly and clearly.

Bibliography (max. 1000 caracteres)

Main

- **W.D. Callister Jr., D.G. Rethwisch**, Materials Science and Engineering, An Introduction, 2010, 8th Edition, John Wiley & Sons Inc.
- **W. F. Smith**, Princípios da Ciência e Engenharia dos Materiais, 1998, McGraw-Hill.
- **M.A. Meyers, K.K. Chawla**, Mechanical Behavior of Materials, 2009, 2nd Edition, 2009, Cambridge University Press.
- **J.M.G. Cowie, V. Arrighi**, Polymers: Chemistry and Physics of Modern Materials, 3rd Edition, 2007, CRC Press.
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- **A. Kelly, K.M. Knowles**, Crystallography and Crystal Defects, 2nd Edition, 2012, Wiley
- D**. A. Porter, K. E. Easterling, M.Y.A. Sherif**, Phase Transformations in Metals and Alloys, 3rd Edition, 2009, CRC Press