ISEL
INSTITUTO SUPERIOR DE ENGENHARIA DE LISBOA

ISEL ADEM
Área Departamental de Engenharia Mecânica

Sheet course ()

Course	MSc IN MECHANICAL ENGINEERING		
Unit	WELDING AND JOINING PROCESSES	Mandatory	☒
		Optional	☐
Unit scientific area	Manufacturing and Mechanical Design	Category	C

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

Year: 1st	Semester: 1st		ECTS: 6,5			
Contact time	Total: 67,5	T:	TP: 67,5	PL:	S:	OT:

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

Unit Director	Title	Position
Ivan Garcia Galvão	Ph.D.	Assistant Professor

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

(max. 1000 characters)

The main objective of the curricular unit is to understand the joining processes of metallic and non-metallic materials used in mechanical engineering. The deepening of the concepts transmitted in undergraduate course are released and also the new joining techniques in the field of new materials, including composite materials.

It is particularly relevant the metallurgical aspects associated with welding of metal components, which are also key objectives of the UC.

It is intended that students acquire skills in the context of advanced studies involving the processes and technologies of metallic and non-metallic materials. Students gain also skills in technical assessment of damages and quality control of mechanical components joints.

Syllabus

(max. 1000 characters)

1 – Welding.Electric arc welding; resistance welding, Design and calculation. Codes and standards.

2-Screwed Connections: Functions of the screw components; manufacturing. Standard table dimensions; nomenclature; resistance classes.

3-Motion transmission screws: mechanical link; tightening and loosening torque; reversibility, irreversibility;

yield.

4 - Preloading screwed connections: Preloading requested and preloading recommended; constant stiffness link. Combined safety. Screw safety; Screw strength. Fatigue of screwed connections.

5-Riveted Connections. Failure modes; fracture and bending; cutting and tear the sheath; Shear loads: curly brackets, pins.

6-Pin bolts and brakes: Typology and its application. Processes of choice.

7-Welded Connections: Design of welded connections in bending and twisting; typical problems.

8 Joining processes of non-metallic materials. Plastics, ceramics, composite materials. Adhesive bonding. Fracture. Welding of thermoplastics. Drilling of composites.

Demonstration of consistency of the syllabus with the objectives of the course

(max. 1000 characters)

Provide a comprehensive knowledge, of the most important aspects, of the welding of metallic materials, electric arc welding; resistance welding, Design and calculation. Codes and standards.

Provide a comprehensive knowledge, of the most important aspects, of the screwed connections, namely preloading screwed connections. As important aspects where it is intended that the students acquire skills are the screw safety, screw strength and fatigue of screwed connections.

Joining processes of non-metallic materials, plastics, ceramics, composite materials, adhesive bonding, welding of thermoplastics and drilling of composites are important aspects to learn.

The student should be aware of the need to deepening of the concepts transmitted in undergraduate course.

Know, understand and produce the technical information necessary for technicians to drilling composite components and structures of composite materials in the different application areas.

Teaching methodology (evaluation included)

(max. 1000 characters)

The student is progressively introduced to the subjects, either through the exposition of the related topics and in its illustration carrying out “by hand” the inherent models development and implementation. The exposure of the matter is made using the theoretical lessons and theoretical practice. Each student develops a Project that consists of a thorough search libraries online knowledge, B-on, about a topic chosen by the student or indicated by the teacher. The aim is to deepen the research techniques and refinement of the

search information.

The evaluation of knowledge will be implemented by individual Project (20%), in the module related with the non-metallic materials, and a final examination (80%). The completion of the Project is mandatory and its presentation to an audience of students is the key component of its assessment. The work will be an interim presentation and his final presentation (10 minutes) will be made until the end of school semester that concerns

Demonstration of consistency of teaching methods with the learning objectives of the course

(max. 3000 characters)

The fundamental concepts of the syllabus are introduced in class, giving emphasis to industrial examples, in the case of manufacturing processes and design with composite materials.

Predicting the mechanical behavior of the laminate or component, through calculus based on the most relevant failure criteria provides, to the future engineer, means to be able to integrate a design team and project in the field of composite materials.

The sequence of program content leads students to understand the various methods of manufacturing, drilling and calculation of composite components.

The theoretical calculation of damage of laminated composites is supported by programs of symbolic computation and finite elements, which allow the calculation automation and ease in understanding the various phenomena. Through graphics and 3D models containing these latter stresses and strains arising in the form of color fringes, the student can visualize the result from a given set of loads which were applied to drilling composites.

Are shown videos and computational animations that enable better understanding of the essential aspects of the study.

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 damage responsible for structure failure.

Main Bibliography

(max. 1000 characters)

Shigley´s, Mechanical Engineering Design, R. G. Budynas e J. K. Nisbett, VIII Edition, McGraw-Hill

AWS – Welding Handbook Vol 1 7ª edição

ASM – Metals Handbook Welding and Brazing

Edições Técnicas ISQ - Processos de soldadura

Edições Técnicas ISQ – Ensaios mecânicos

Edições Técnicas ISQ – Soldabilidade

ASME IX e EUROCODE 3

Composites Manufacturing, Materials, Product and Process Engineering, S. K. Mazumbar, CRC Press