COMILLAS
UNIVERSIDAD PONTIFICIA
ICAI ICADE CIHS

GUÍA DOCENTE
2018 - 2019

FICHA TÉCNICA DE LA ASIGNATURA

Datos de la asignatura	
NombreCompleto	Materiales avanzados y técnicas de unión
Código	DIM-M2S-521
Título	Máster en Ingeniería de Movilidad Seguridad/Master in Mobility and Safety Engineering
Impartido en	Máster Universitario en Ingeniería Industrial + Máster en Ingeniería para la Movilidad y Seguridad [Primer Curso] Máster en Ingeniería para la Movilidad y Seguridad/Master of Engineering in Mobility and Safety [Primer Curso]
Nivel	Master
Cuatrimestre	Semestral
Créditos	3,0
Carácter	Obligatoria
Departamento / Área	Departamento de Ingeniería Mecánica
Responsable	Dr. Juan Carlos del Real Romereo
Horario	Tuesdays 16:00 a 17:50
Horario de tutorías	Ask professor
Descriptor	Advanced materials; Composite materials; Adhesive joinig

Datos del profesorado	
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DATOS ESPECÍFICOS DE LA ASIGNATURA

Contextualización de la asignatura

Aportación al perfil profesional de la titulación

This course will be an introduction to advanced materials and joining techniques. An overview of applications and manufacturing methods of new materials will be provided while special focus will be put to polymeric matrix composites. The whole life cycle from raw material to a quality-controlled assembly will be studied, including general properties of materials, testing methods and NDT evaluation. An introduction to bioinspired materials, smart materials, functional materials will be provided. In addition this course will cover the most recent advances in welding and joining technologies.

Prerrequisitos

There are no prerequisites that formally prevent this course. However, by being immersed in a postgraduate program, it is based on concepts that have been studied before in previous courses. Students are expected to have an understanding of basic materials science and engineering, strength of materials, or an equivalent course.

Computer and Technical Requirements. Microsoft Word and Microsoft PowerPoint are useful for writing reports and presentations.

Competencias - Objetivos

Competencias

CG3. Knowledge of basic and technological subjects, which enables students to learn new methods and theories, and gives them versatility to adapt to new environments.

CG4. Ability to solve problems with initiative, decision, creativity, and critical reasoning; and to communicate and transfer knowledge, abilities and skills in the field of Engineering.

CG8. Apply the acquired knowledge to solve problems in new or unfamiliar environments within broader and multidisciplinary contexts

CG11. Acquire learning skills that will allow further study in a self-directed or autonomous manner

Resultados de Aprendizaje

Specific Competences and Learning Results

By the end of the course students should be able to:

RA1. Understand the differences between the composites and traditional materials. Know the current and emerging applications of composites in the industry.

RA2. Know the different types of matrix and its applications: polymer, metal and ceramic.

RA3. Demonstrate understanding of the different materials (fibres, resins, cores) used in composites.

RA4. Select the most appropriate manufacturing process for fabricating composite components.

RA5. Describe the non-destructive inspection (NDE) and structural health monitoring of composites.

RA6. Understand the relation between the design and manufacture of composite parts.

RA7. Know the new techniques of joining. Adhesive bonding.

BLOQUES TEMÁTICOS Y CONTENIDOS

Contenidos – Bloques Temáticos

COMPOSITE MATERIALS

1. Introduction to composite materials

Classifications, applications, terminology. Metallic, Ceramic and Polymeric Matrix Composites.

2. Materials

Characteristics of fibers and matrices. Types and properties of fibers. Types of matrix, prepegs, fillers and other additives.

3. Manufacturing processes

3.1 Basic characteristics of manufacturing processes for polymeric matrix composite

3.2 Hand lay-up, autoclave processing, compression molding, resin transfer molding (RTM), pultrusion, and filament winding.

3.3 Automated composites manufacturing

3.4 Overview of ceramic and metallic matrix composites manufacturing method

4. Manufacturing parts and assemblies

4.1 Physical and chemical joint

5. Non destructive testing of composites

5.1 Introduction to NDT of compsite materials

5.2 Ultrasonics inspection. Phased array

5.3 Thermography

5.4 Fiber Bragg gratings

JOINING METHODS

6. Mechanical joining.

6.1 Self-piercing riveting. High-speed bolt joining. Clinching.

7. Adhesive bonding

7.1 Introduction. Adhesive families

7.2 Surface treatments

7.3 Applications.

ADVANCED MATERIALS

8. Advanced materials

8.1 Smart Materials

8.2 Functional materials

8.3 Bioinspired materials.

METODOLOGÍA DOCENTE

Aspectos metodológicos generales de la asignatura

The best way to achieve a fundamental understanding of the basics of advanced materials, manufacturing processes and applications is a practical approach to this concepts. Both classroom sessions and independent study are developed to imply the students within the learning activities. The contents are developed to keep the student attention and following the competencies acquisition by the students.

Metodología Presencial: Actividades

Lectures and problem-solving sessions (22 hours)

The lecturer will introduce the fundamental concepts of each chapter, along with some practical recommendations, and will go through worked examples to support the explanation. Active participation will be encouraged by raising open questions to foster discussion and by proposing short application exercises to be solved in class either on paper or using a software package.

Lab sessions (8 hours)

Under the instructor's supervision, students, divided in small groups, will apply the concepts and techniques covered in the lectures to real problems and will become familiar with the most widespread software tools and libraries.

Metodología No presencial: Actividades

Personal study of the course material and resolution of the proposed exercises (30 hours)

Lab results analysis and report writing (10 hours).

EVALUACIÓN Y CRITERIOS DE CALIFICACIÓN

Calificaciones

A new project could have to be developed and handed in. In addition, all students will take a final exam. The resulting grade will be computed as follows:

- Final exam: 70%
- Lab: 15%
- Final project: 15%

As in the regular assessment period, in order to pass the course, the mark of the final exam must be greater or equal to 4 out of 10 points and the mark of the final project must be at least 5 out of 10 points. Otherwise, the final grade will be the lower of the two marks.

In-class activities Competences

Theory will account for 60%, of which:

- Mid-term: 20%
- Final exam: 40%

Lab will account for the remaining 40%, of which:

- Lab practices: 20%
- Final project: 20%

In order to pass the course, the mark of the final exam must be greater or equal to 4 out of 10 points and the mark of the final project must be at least 5 out of 10 points. Otherwise, the final grade will be the lower of the two marks.

Course rules

Class attendance is mandatory according to Article 93 of the General Regulations (Reglamento General) of Comillas Pontifical University and Article 6 of the Academic Rules (Normas Academicas) of the ICAI School of Engineering. Not complying with this requirement may have the following consequences:

- Students who fail to attend more than 15% of the lectures may be denied the right to take the final exam during the regular assessment period.
- Regarding laboratory, absence to more than 15% of the sessions can result in losing the right to take the final exam of the regular assessment period and the retake. Missed sessions must be made up for credit.

Students who commit an irregularity in any graded activity will receive a mark of zero in the activity and disciplinary procedure will follow (cf. Article 168 of the General Regulations (Reglamento General) of Comillas Pontifical University).

BIBLIOGRAFÍA Y RECURSOS

Bibliografía Básica

- Notes prepared by the lecturer (available in Moodle).

Bibliografía Complementaria

- *Composite Materials. Science and Engineering*. K. Chawla. Springer
- *Composites Manufacturing. Materials, Product and Process Engineering*. S.K. Mazumdar. CRC Press
- Fiber-Reinforced Composites: Materials, Manufacturing, and Design, P. K. Mallick, 2nd edition, New York: Marcel Dekker, Inc. (1993).
- Introduction to Composite Materials Design, 2nd ed., Ever J. Barbero, CRC Press, 2011
- Advanced Welding Processes. J. Norrish. Woodhead Publishing Limited (2006)
- Handbook of Adhesion Technology. L. F. M. da Silva, A. Öchsner, R.D. Adams, Springer Science & Business (2011)