

29742 - Advanced Industrial Materials

Syllabus Information

Academic year: 2023/24

Subject: 29742 - Advanced Industrial Materials

Faculty / School: 110 - Escuela de Ingeniería y Arquitectura

Degree: 434 - Bachelor's Degree in Mechanical Engineering

ECTS: 6.0

Year: 4

Semester: Second semester

Subject type: Optional

Module:

1. General information

The general objective of the contents of the subject is that the student knows some of the most novel materials and the traditional ones in mechanical engineering, how they are manufactured and joined with other materials, how they are protected from in-service aggressions, their properties, their applications and in-service inspection techniques.

In particular, the methodology of analysing in-service material failures and determining their root causes, and recommending solutions to those failures, will be discussed.

These approaches and objectives are aligned with some of the Sustainable Development Goals, SDGs, of the Agenda 2030 (<https://www.un.org/sustainabledevelopment/es/>) and certain specific goals, so that the acquisition of the learning results of the subject provides training and competence to the student to contribute to some extent to their achievement:

- Goal 12: Ensure Sustainable Consumption and Production Patterns.

Objective 12.5: By 2030, significantly reduce waste generation through prevention activities, reduction, recycling and reuse.

2. Learning results

1. Knows the conventional and advanced materials of application in Mechanical Engineering, their synthesis procedures and treatments, as well as their joining technologies and surface treatments and coatings.
2. Knows the processes of deterioration and damage of mechanical components in service, the appropriate design criteria and certain in-service inspection techniques, and analyses, in the case of in-service failures, the mechanism and root cause of failure systematically.
3. Chooses materials in mechanical systems taking into account their application.

3. Syllabus

- METALLIC AND NON-METALLIC MATERIALS. Ferrous alloys. Non-ferrous alloys. Special alloys: Superalloys, ODS alloys, shape memory alloys, metallic glasses, metallic foams. Non-Metallic Materials. Properties and applications.
- JOINTS: Welding. Structure of welds in ferrous and non-ferrous alloys. Weldability. Defects of the welds and their causes. Mechanical and microstructural testing of metallurgical joints. Adhesives. Mechanisms of adhesive bonding.
- SURFACE ENGINEERING. Classification. Surface treatments and advanced coatings. The laser applied to surfaces. Industrial applications.
- IN-SERVICE FAILURE ANALYSIS. Design Life. Remaining Life. In-service inspection techniques.

Methodology of damage and failure analysis in metallic materials. Case studies. Techniques and tools of the in-service failure investigation. Fractography. Technical report. The Expert in the courts of law.

4. Academic activities

The activities proposed in the continuous evaluation are:

1. Theory and problem classes.
2. Laboratory Practices: Four sessions will be held, with a group or individual report.
3. Subject work: Each group of students will do two directed works, proposed by the teachers: one of them on conventional and advanced materials, surface treatments and coatings, welding, or joining techniques, and a second one on a practical case of failure analysis. The presentation of the subject work and the subsequent discussions will be public.
4. Theoretical-practical tests of an eliminating nature: One in the middle of the semester, and one at the end of the teaching period.
5. Group work follow-up tutorials, in person or by telematic methods.

5. Assessment system

Continuous Assessment. The completion of group work and laboratory practices is mandatory.

The proposed activities are evaluated as follows:

- Laboratory practices (20% of the final grade). They must be passed independently from the theoretical activities.
- Group works (20% of the final grade).
- Theoretical-practical written tests (60% of the final grade). Of an eliminating nature before the global tests, one taken in the middle of the semester and another at the end of the semester. The minimum grades of the two written tests must be equal to or higher than 4 in order to pass the theoretical part of the subject combined with the grades of the group works.

Global Test. All students will be entitled to take a global test, with their assessments:

- Written exam on the theoretical and practical contents of the subject syllabus: 80%.
- Written examination of the conceptual and procedural contents of the practices: 20%.

In order to pass the global test, the student must obtain, in each part, a minimum of 4 out of 10, and the weighted sum of the grades must be at least 5 out of 10. In the second call, the same tests described in the first call will be carried out under the same conditions, both for students who followed the global evaluation and the continuous evaluation.