



POLITÉCNICA

INTERNATIONAL
CAMPUS OF
EXCELLENCE

COORDINATION PROCESS OF
LEARNING ACTIVITIES
PR/CL/001



E.T.S. de Ingenieros de
Caminos, Canales y Puertos

ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

43000610 - Ingeniería Forense

DEGREE PROGRAMME

04AN - Master Universitario En Ingeniería De Materiales

ACADEMIC YEAR & SEMESTER

2023/24 - Semester 2

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1. Description

1.1. Subject details

Name of the subject	43000610 - Ingeniería Forense
No of credits	3 ECTS
Type	Optional
Academic year of the programme	First year
Semester of tuition	Semester 2
Tuition period	February-June
Tuition languages	English
Degree programme	04AN - Master Universitario en Ingeniería de Materiales
Centre	04 - Escuela Técnica Superior De Ingenieros De Caminos, Canales Y Puertos
Academic year	2023-24

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Nuria Martin Piris (Subject coordinator)	LEM	nuria.mpiris@upm.es	Sin horario. Under students request by e-mail
Daniel Barba Cancho	LEM	daniel.barba@upm.es	Sin horario. Under students request by e-mail

Sergio Perosanz Amarillo	LEM	sergio.perosanz@upm.es	Sin horario. Under students request by e-mail
Jose Antonio Heredero Concellon	LEM	joseantonio.heredero@upm. es	Sin horario. Under students request by e-mail
Juan Manuel Antoranz Perez	LEM	juanmanuel.antoranz@upm. es	Sin horario. Under students request by e-mail
Ignacio Luque Trujillo	LEM	ignacio.luque@upm.es	Sin horario. Under students request by e-mail

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

The subject - recommended (passed), are not defined.

3.2. Other recommended learning outcomes

- Fracture mechanics
- Structural materials
- Materials properties

4. Skills and learning outcomes *

4.1. Skills to be learned

CB08 - Que los estudiantes sean capaces de integrar conocimientos y enfrentarse a la complejidad de formular juicios a partir de una información que, siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos y juicios

CE6 - Capacidad para controlar y modificar los mecanismos físicos y químicos que determinan las fases del ciclo de vida de los materiales, su durabilidad y su incidencia en el medioambiente con el fin de poder evaluar, controlar y mejorar la seguridad, durabilidad e integridad estructural de los materiales y los componentes fabricados con ellos / Ability to control and modify the physical and chemical mechanisms that determine the phases of the life cycle of materials, their durability and their impact on the environment in order to be able to evaluate, control and improve the safety, durability and structural integrity of materials and components made from them

CG1 - Uso de la lengua inglesa: Los alumnos son capaces de transmitir conocimientos y expresar ideas y argumentos de manera clara, rigurosa y convincente, tanto de forma oral como escrita, adaptándose a las características de la situación y de la audiencia / Use of the English Language: Students are able to transmit knowledge and express ideas and arguments in a clear, rigorous and convincing manner, both orally and in writing, adapting to the characteristics of the situation and the audience .

CG3 - Trabajo en equipo: Los alumnos desarrollan la capacidad para trabajar en equipo, integrarse y colaborar de forma activa en la consecución de objetivos comunes / Teamwork: Students develop the ability to work as a team, integrate and actively collaborate in achieving common goals.

CG8 - Resolución de problemas: Los estudiantes son capaces de reconocer, describir, organizar y analizar los elementos constitutivos de un problema para idear estrategias que permitan obtener, de forma razonada, una solución contrastada y acorde a ciertos criterios preestablecidos / Problem solving: Students are able to recognize, describe, organize and analyze the constitutive elements of a problem to devise strategies that allow obtaining, in a reasoned way, a contrasting solution and according to certain pre-established criteria.

CG9 - Análisis y Síntesis: Los alumnos son capaces de reconocer y describir los elementos constitutivos de una realidad, y de proceder a organizar la información significativa según criterios preestablecidos adecuados a un propósito / Analysis and Synthesis: Students are able to recognize and describe the constituent elements of a reality, and to proceed to organize significant information according to pre-established criteria suitable for a purpose.

4.2. Learning outcomes

RA43 - HC1 - Ability to communicate in technical English reports, projects, problems, methodologies, results, etc. related to research and innovation and development in materials engineering in a clear and fluid way

RA44 - Knowledge and understanding of Failure Analysis general procedures and objectives

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

The main objective is to apply the acquired skills and previous materials knowledge in researching and technological studies for the failure analysis of structures and mechanisms. Case studies will be used for this purpose.

5.2. Syllabus

1. Presentation. Forensic engineering. Introduction to failure analysis
2. Incidents and accidents. General Procedure for Failure Analysis
3. Stages of a failure analysis. Final Reports
4. Failure modes in metallic materials. Fractography
5. Overload failures
6. Creep failures
7. Embrittlement failures (hydrogen embrittlement, metal embrittlement)
8. Fatigue failures
9. Corrosion failures

10. Wear failures
11. Failure of welded structures
12. Residual stresses analysis
13. Failure modes in composites
14. Laboratory session 1 (macrofractography)
15. Laboratory session 2 (microfractography)

6. Schedule

6.1. Subject schedule*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1	Lesson 1 Duration: 02:00 Lecture			
2	Lesson 2 Duration: 02:00 Lecture			
3	Lesson 3 Duration: 02:00 Lecture			
4	Lesson 4 Duration: 02:00 Lecture			
5	Lesson 5 Duration: 02:00 Lecture			
6	Lessons 6 & 7 Duration: 02:00 Lecture			
7	Lesson 8 Duration: 02:00 Lecture			
8				
9	Lesson 9 Duration: 02:00 Lecture			
10	Lesson 10 Duration: 02:00 Lecture			
11	Lessons 11 Duration: 02:00 Lecture			
12	Lesson 12 Duration: 02:00 Lecture			
13	Lesson 13 Duration: 02:00 Lecture	Lessons 14 & 15 Duration: 02:30 Laboratory assignments		Group Presentation Group presentation Continuous assessment Presential Duration: 01:00
14				Written exam Written test Continuous assessment Presential Duration: 01:30

15				
16				
17				Final Global Exam Written test Final examination Presential Duration: 01:30 Individual Presentation Individual presentation Final examination Not Presential Duration: 01:00

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

* The schedule is based on an a priori planning of the subject; it might be modified during the academic year, especially considering the COVID19 evolution.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
13	Group Presentation	Group presentation	Face-to-face	01:00	60%	5 / 10	CG1 CG3 CG8 CG9 CB08 CE6
14	Written exam	Written test	Face-to-face	01:30	40%	5 / 10	CG1 CG8 CG9 CB08 CE6

7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Final Global Exam	Written test	Face-to-face	01:30	40%	5 / 10	CG1 CG8 CG9 CB08 CE6
17	Individual Presentation	Individual presentation	No Presential	01:00	60%	5 / 10	CG8 CG9 CG1 CG3 CB08 CE6

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Final Global Exam	Written test	Face-to-face	01:30	40%	5 / 10	CG1 CG8 CG9 CB08 CE6
Individual Presentation	Individual presentation	Face-to-face	01:00	60%	5 / 10	CG1 CG3 CG8 CG9 CB08 CE6

7.2. Assessment criteria

a) CONTINUOUS EVALUATION.

To be evaluated through the Continuous Evaluation method, attendance at a number higher than 80% of the classes is required, including attendance at the practical class(es).

Final grade = PE1 (60%) + PE2 (40%)

PE1: presentation and public defense of a work carried out on a published in-service failure case study, of structures or mechanisms, in the presence of the professor who imparts the subject on the corresponding day, in a maximum time of 30 minutes per group, and response to a series of questions considered by the professor for approximately 10 minutes. All the students must attend to the other students presentations, so being a non-recoverable activity. It will be a necessary condition before starting the presentation the paper delivery of the content to be exhibited, for

its evaluation, and it will obligatorily include the data on names and surnames of the speakers and complete bibliographic reference (including the URL of the website) of the original work on which the exposition is based.

The work will deal clearly and explicitly with a real in-service case study of a failure in a structure or mechanism, produced by the assigned failure mechanism, and the exposition should be based on the systematic for in-service failure analysis explained on the second class. For this reason, it is recommended to search and choose a published work that explicitly presents all (or at least the most important) points of the systematic for in-service

failure analysis.

Among the most important criteria for evaluation are the technical quality of the work done, the exposure adjusted to the systematic for in-service failure analysis, and the ability to synthesize information.

The work will be done in groups (preferentially, pairs, but will depend on the number of students enrolled); in case of being uneven the total number of students enrolled, one of the groups could be formed by a single student. The groups must be formed voluntarily, or they will be assigned by the professor. Also, the presentation will be held at similar times between the speakers.

The real case studies will be freely chosen by the groups, although they should be adjusted in terms of the suitability of the contents in relation to the subject, and will be evaluated according to the indicated criteria. In view of this, it is recommended to consult the bibliography available in the resources of the UPM library, such as technical articles of electronic journals. Through INGENIO, you can access technical articles such as "Case studies in engineering failure analysis" and "Engineering failure analysis", among many others. It is also advisable to consult reports of case studies published in open access on the internet.

PE2: written exam covering the theoretical and practical contents of the subject.

b) FINAL EXAM

Ordinary exam. PE2

Extraordinary exam. PE2

In both cases, the class and Lab attendance and the group presentation are a non-recoverable activities, that the student must have completed at the scheduled date with the other students.

The students that do not pass the PE1 by continuous evaluation, must present a new individual work for the ordinary/extraordinary exam

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Moodle	Web resource	Presentations
Fallos en servicio de los materiales metálicos. J.M. Pintado. INTA	Bibliography	
Understanding how components fail. D.J. Wulpi. ASM International	Bibliography	
ASM Handbook Vol. 11, Failure Analysis and Prevention	Bibliography	
ASM Handbook Vol. 12, Fractography	Bibliography	
ASM Handbook Vol. 19, Fatigue and Fracture	Bibliography	

9. Other information

9.1. Other information about the subject

The subject is related to SDG7 and SDG9.

TRIBUNAL:

President: Nuria Martín Piris

Vocal: Daniel Barba Cancho

Secretary: Juan Manuel Antoranz Pérez

Substitute: José Antonio Heredero Concellón