Grado en Ingeniería de Materiales

Department (School) / Departamento (Escuela)
Departamento de Ciencia de Materiales (ETSI Caminos Canales y Puertos)

Asignatura / Subject
Mechanical Behaviour of Materials IV (Fracture Mechanics)

ECTS	Type	Curso / Semestre	Idioma	Sylabus code	Subject Code
6	Compulsory	3 / 6	EN	04MI	45000125

Lecturers (Name)	Contact email	Office hours (Tutorials)
Jose Miguel Atienza	josemiguel.atienza@upm.es	Upon request (via e-mail)
Rafael Sancho	rafael.sancho@upm.es	Upon request (via e-mail)
Mihaela Iordachescu	mihaela.iordachescu@upm.es	Upon request (via e-mail)

El profesor que aparece en primer lugar es el coordinador de la asignatura

Evaluation criteria

Continuous assessment
Passmark: 50/100 points
Continuous assessment consists in four partial exams and lecture exercises.
- Partial exams: maximum 20 points each (total of 80 points for the four of them). At least, students need to obtain 28 points in order to pass continuous assessment.
- Lecture exercises: total of 20 points.
- Transversal activity: taking part and attending to transversal activity makes feasible getting some extra-points.

The final mark takes into account partial exams, lecture exercises and transversal activity and it is calculated using the formula: (Points_exams+Points_exercises+Points_trans.activity).

Ordinary Exam (June)
Passmark: 50/100 points.
For those students who were not evaluated through continuous assessment. The exam covers the whole subject.

Extraordinary Exam (July)
Passmark: 50/100 points.
For those students who did not pass the continuous assessment or the ordinary exam.

Justification and Objectives

As an introductory course, the programme is focused on the essential concepts and analytical methods of fracture mechanics, providing a practical understanding of fatigue and fracture calculations. Related subjects such as damage tolerance analysis, reliability, and risked-based inspection will also be discussed. You will learn:

- The underlying assumptions and limitations of fracture mechanics
- Material selection for fatigue and fracture resistance
- How to perform simple to moderately complex fracture mechanics calculations
- Codified procedures for flaw evaluation and failure analysis.

It is essential for the following objectives of the Degree:
Obj 1. Learning and understanding the scientific foundations of materials and the relationship between structure, properties, processing and applications.
Obj 3. Learning the mechanical, electronic, chemical and biological behaviour of materials and its application to the design, calculation and modelling of the elements, components and equipment.
Obj 5. Developing capacities to innovate, design and produce new materials and to synthetize, through alternative procedures, conventional materials to improve competitiveness or to solve social and environmental problems.
Obj 6. Promote the interest for scientific research.

Prerequisites
Mechanics of Materials II.

Previous knowledge of the student
Mathematical, Physical and Mechanical foundations of Materials Science. Mechanics of materials I, II, III.

Generic competencies
CG1: English communication skills CG2: Team work capabilities CG3: Spoken and written communication CG4: Usage of CIT CG11: Responsibility and professional ethics

Specific competencies
CE2: Modelling the materials behaviour; CE5: Capacity of autonomous learning

Bibliography
FRACTURE MECHANICS. FUNDAMENTALS AND APPLICATIONS (Anderson), CRC Press, Boca Raton (Florida), 1995 THE PRACTICAL USE OF FRACTURE MECHANICS (Broek), Kluwer Academic Publisher, Dordrecht (Holanda), 1989 ADVANCED FRACTURE MECHANICS (Kanninen y Popelar), Oxford University Press, Nueva York (USA), 1985 MECANICA DE LA FRACTURA (Manuel Elices). Publicaciones de la Escuela de Ingenieros de Caminos (6a Edición) CLASS PRESENTATIONS (uploaded to Moodle platform)

Subject contents and time distribution

The course contents are shown in the following table. LM: Lesson at room, RP: Problems Resolution, TI: Individual Work, EV: Exams.

Item	Contents	Code
	Introduction	LM, TI
	P1. LEFM. Global approach to fracture: The energy criterion	**EV**
1.1	History of fracture mechanics. Global approach: Example. G & R	LM, TI
1.2	Computation of the energy release rate (G)	LM, RP, TI
1.3	Measurement of the crack resistance (R)	LM, RP, TI
1.4	Fracture of thin sheets.	LM, RP, TI
	P2. LEFM. Local approach to fracture: The stress intensity criterion	**EV**
2.1	Local approach: Introduction to K and Kc	LM, RP, TI
2.2	Computation of the stress intensity factor (K)	LM, RP, TI
2.3	Fracture toughness (Kc). Measurements of Kc	LM, RP, TI
	P3. Crack growth with time: Fatigue and Stress Corrosion	**EV**
3.1	Introduction to fatigue. Crack propagation. Paris' law	LM, RP, TI
3.2	Constant and variable amplitude loading. Loading spectra	LM, RP, TI
3.3	Stress life approach and strain life approach	LM, RP, TI
3.4	Stress corrosion and corrosion-fatigue crack growth	LM, RP, TI
	P4. Elastoplastic fracture mechanics. Failure Analysis	**EV**
4.1	Crack-tip plasticity. Plastic zone correction of LEFM	LM, RP, TI
4.2	The fracture diagram method	LM, RP, TI
4.3	Failure analysis. Fractography. Examples and exercises	LM, RP, TI
4.4	Criteria based on the J-Integral	LM, RP, TI