Course guide
240EM025 - 240EM025 - Structural Integrity

Last modified: 27/05/2024

Unit in charge: Barcelona East School of Engineering
Teaching unit: 702 - CEM - Department of Materials Science and Engineering.

Degree: ERASMUS MUNDUS MASTER'S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2014). (Optional subject).

Academic year: 2024 **ECTS Credits:** 4.5 **Languages:** Spanish

LECTURER

Coordinating lecturer: Llanes Pitarch, Luis Miguel

Others: Caner, Ferhun Cem
Mateo Garcia, Antonio Manuel
Llanes Pitarch, Luis Miguel

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEMCEM-07. (ENG) Dissenyar, calcular i modelar aspectes relacionats amb els materials per a components mecànics, estructures i equips
CEMCEM-08. (ENG) Avaluar el temps de vida en servei, la reutilització, la recuperació i el reciclatge de productes atenent a les característiques dels materials que el conformen

Transversal:
05 TEQ N2. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.
06 URI N2. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.

TEACHING METHODOLOGY

Subject in process of extinction. There is no teaching, the students that enroll it do so only with the right to an exam.

LEARNING OBJECTIVES OF THE SUBJECT

The objective of this course is to combine theoretical and practical knowledge of fatigue and fracture in materials, components and structures, as well as methods for evaluating structural integrity. The course pays special relevance to the analysis of cracks and notches in structural design and estimation of service life. It will provide a thorough knowledge in the field of fracture mechanics, with special relevance to its implementation to analyze the mechanical functionality of a material under different service conditions.

STUDY LOAD

Type	Hours	Percentage
Hours large group	40,5	36.00
Self study	72,0	64.00

Total learning time: 112.5 h

CONTENTS

Tema 1. Introduction

Description:
Structural integrity as a field of knowledge. Mechanical design approaches. Fundamentals of elasticity and plasticity. Elastic behavior, elastoplastic, viscoelastic and viscoplastic.

Full-or-part-time: 15h
Theory classes: 4h 30m
Practical classes: 1h 30m
Self study : 9h

Tema 2. Fundamentals of fracture

Description:
Theoretical resistance to rupture. Stress concentrators. Local stress. Fracture energy. Fracture condition. Stress-intensity factor and fracture toughness. Fracture modes. Stable fracture. Mixed-mode fracture. Plastic zone in the three fracture modes. Toughness and microstructure. Ductile-brittle transition. Decohesion and cleavage. Ductile fracture: McClintok model. Fracture in laminar composite materials.

Full-or-part-time: 30h
Theory classes: 9h
Practical classes: 3h
Self study : 18h

Tema 3. Cohesive fracture, distributed fracture and method of size effect

Description:
Hillerborg's approach. Properties of softening curve. Experimental determination of properties of cohesive cracks. Cohesive fracture compared with effective elastic fracture. Localized deformation. Basic concepts of distributed fracture. Uniaxial and triaxial distributed fracture models. Cohesive fracture compared with distributed fracture. The size effect method. Determination of fracture properties by the size effect method.

Full-or-part-time: 33h 45m
Theory classes: 9h
Practical classes: 4h 30m
Self study : 20h 15m

Tema 4. Fatigue and structural integrity

Description:
Fatigue damage: cyclic deformation, crack nucleation and crack growth. Fatigue design methods. Fatigue failure. Environmetal assisted cracking: hydrogen embrittlement, stress corrosion cracking and corrosion fatigue. Creep deformation and rupture. Creep-fatigue and creep-fatigue crack growth

Full-or-part-time: 33h 45m
Theory classes: 9h
Practical classes: 4h 30m
Self study : 20h 15m

GRADING SYSTEM

Subject in process of extinction. There is only one final test that corresponds to 100% of the final grade of the subject.

BIBLIOGRAPHY

Basic:
- Anglada, M. ; Alcalá, J. ; Llanes, L. ; Mateo, A. ; Salán, N. Fractura de materiales [on line]. Barcelona: Edicions UPC, 2002 [Consultation: 24/02/2015]. Available on: http://hdl.handle.net/2099.3/36175. ISBN 8483015927.
- Suresh, Subra. Fatigue of materials. 2nd ed. Cambridge: Cambridge University Press, 1998. ISBN 0521578477.
- Hertzberg, R.W. Deformation and fracture mechanics of engineering materials. 5th ed. New York: John Wiley & Sons, 2013. ISBN 9780470527801.
- Broek, David. Elementary engineering fracture mechanics. 4th ed. The Hague: Martinus Nijhoff, 1986. ISBN 9024725801.
- Lawn, Brian R. Fracture of brittle solids. 2nd ed. Cambridge: Cambridge University Press, 1993. ISBN 0521409721.
- Bazant, Zdenek P,; Planas, Jaime. Fracture and size effect : in concrete and other quasibrittle materials. CRC Press, 1997. ISBN 9780849382840.
- Bazant, Zdenek P. Scaling of structural strength. United Kingdom: Elsevier, 2005. ISBN 9780750668491.
- Bazant, Zdenek P.; Cedolin, Luigi. Stability of structures : elastic, inelastic, fracture and damage theories. Singapore [etc.]: World Scientific Publishing, cop. 2010. ISBN 9789814317023.

RESOURCES

Audiovisual material:
- Resource name. Resource