340202 - FIPI-L7P02 - Reliability and Integrity of Industrial Products

Coordinating unit: 340 - EPSEVG - Vilanova i la Geltrú School of Engineering
Teaching unit: 702 - CMEM - Department of Materials Science and Metallurgy
Academic year: 2019
Degree: BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
ECTS credits: 6
Teaching languages: Catalan, Spanish, English

Degree competences to which the subject contributes

Specific:
1. CE25. Knowledge and ability to apply material engineering.

Transversal:
2. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
3. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
4. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.

Teaching methodology

Attending sessions of exposition of contents.
- Attending sessions of practical work (resolution of exercises).
- Attending sessions of practical work in working groups (practices of laboratory).

The professor will introduce the theoretic bases of the matter of the manufacturing processes in the sessions of exposition of contents.
The professor will guide the student in the understanding of the theoretic concepts in the sessions of resolution of exercises, likewise, the oral communication by means of the presentation will be worked up and resolution in public of the proposed problems.
The ability of work in team will develop in the sessions of laboratory.

In the out-class activities the professor supervises the student's work by means of the analysis of his evolution through the evaluation activity and the guided activities.

Learning objectives of the subject

1. Applying design criteria in order to ensure the mechanical reliability of products and systems.
2. Identifying the possible causes of failures of a component, in terms of the in service environment.
3. Offering solutions to avoid the failure of components.
4. Analyzing and applying the methodology of application of nondestructive testing

<table>
<thead>
<tr>
<th>Study load</th>
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<tbody>
<tr>
<td><strong>Total learning time</strong>: 150h</td>
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<tr>
<td>Hours large group:</td>
<td>45h</td>
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<tr>
<td>Hours medium group:</td>
<td>0h</td>
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<tr>
<td>Hours small group:</td>
<td>15h</td>
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<tr>
<td>Guided activities:</td>
<td>0h</td>
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<tr>
<td>Self study:</td>
<td>90h</td>
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</table>
### 1. Nondestructive testing and quality management

**Degree competences to which the content contributes:**

**Description:**
- (ENG) 1.1 Nondestructive Testing: Applicability
- (ENG) 1.2 Reliability
- (ENG) 1.3 Qualification and Certification

### 2. Penetrant testing

**Degree competences to which the content contributes:**

**Description:**
- (ENG) 2.1 Penetrant Testing: Theory and principles
- (ENG) 2.2 Penetrant procedures
- (ENG) 2.3 Techniques and variables
- (ENG) 2.4 Advantages and limitations

### 3. Magnetic particles testing

**Degree competences to which the content contributes:**

**Description:**
- (ENG) 3.1 Magnetic particle testing: Theory and principles
- (ENG) 3.2 Equipment and techniques
- (ENG) 3.3 Variables
- (ENG) 3.4 Advantages and limitations

### 4. Ultrasonic testing

**Degree competences to which the content contributes:**

**Description:**
- (ENG) 4.1 Theory and principles: sound waves
- (ENG) 4.2 Ultrasonic Wave Propagation: Transmission and damping
- (ENG) 4.3 Equipment and techniques
- (ENG) 4.4 Variables
- (ENG) 4.5 Advantages and limitations

### 5. Eddy currents testing

**Degree competences to which the content contributes:**

**Description:**
- (ENG) 5.1 Eddy currents testing: Theory and principles (electromagnetic induction)
- (ENG) 5.2 Impedance of samples
- (ENG) 5.3 Metallurgical variables
- (ENG) 5.4 Inspection techniques
- (ENG) 5.5 Advantages and limitations

### 6. Radiographic Testing

**Degree competences to which the content contributes:**
<table>
<thead>
<tr>
<th><strong>Description:</strong></th>
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<tbody>
<tr>
<td>(ENG) 6.1 Electromagnetic spectrum. 6.2 Sources of emissions. 6.3 Damping of radiations. 6.4 Radiographic equipment and procedures. 6.5 Radiographic evaluation. 6.6 Biological Effects: safety considerations and health hazard</td>
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<thead>
<tr>
<th><strong>(ENG) 7. Other Nondestructive testing techniques</strong></th>
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<td><strong>Degree competences to which the content contributes:</strong></td>
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<tr>
<td><strong>Description:</strong></td>
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<tr>
<td>(ENG) 7.1 Thermal infrared testing. 7.2 Holography. 7.3 Barkhausen effect</td>
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<tr>
<th><strong>(ENG) 8. Mechanical failures</strong></th>
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<td><strong>Degree competences to which the content contributes:</strong></td>
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<tr>
<td><strong>Description:</strong></td>
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<tr>
<td>(ENG) 8.1 Mechanical Failures: prevention and/or analysis?. 8.2 Failure modes: ductile fracture and brittle fracture</td>
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<tr>
<th><strong>(ENG) 9. Fracture mechanics</strong></th>
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<tr>
<td><strong>Description:</strong></td>
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<tr>
<td>(ENG) 9.1 Fracture mechanics: Fracture toughness 9.2 Metallurgical variables</td>
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<th><strong>(ENG) 10. Fatigue</strong></th>
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<td><strong>Description:</strong></td>
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<tr>
<td>(ENG) 11.1 Fatigue design: cyclic loadings. 11.2 Crack initiation and growth 11.3 Total-life approaches and damage-tolerant approaches.</td>
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<th><strong>(ENG) 11. Design for high temperature</strong></th>
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<td><strong>Degree competences to which the content contributes:</strong></td>
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<tr>
<td><strong>Description:</strong></td>
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<tr>
<td>(ENG) 10.1 Creep: Alloys for high temperatures. 10.2 Thermal shock.</td>
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Qualification system

The evaluation of the course will become according to the following indicators:

T, Theory: average mid-term exam 1 and mid-term exam 2.

P, Interventions in the classroom, in the case study. It is mandatory to evaluate, at least, 75% of the presentations.

L, Practices of laboratory: Weighted average of the different programmed practices.

Final grade = 0.55T + 0.20P + 0.25L

The laboratory practices, the tests carried out via Campus Digital and the activities carried out in the classroom during the regular period of classes (problems and/or presentations of work) will not be re-evaluated.

The completion and presentation of the corresponding reports of at least 75% of the laboratory practices will be a necessary condition for the approval of the subject. It will also be a necessary condition to have participated in, at least, 75% of the presentations made in the classroom and to have made the evaluations of them.
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Bibliography

Basic:


Complementary:


Others resources:

Hyperlink

Journal of Nondestructive Testing (Ofereix articles en línia)
http://www.ndt.net/v03n12.htm

ASNT (American Society for Nondestructive Testing)
http://www.asnt.org/

Engineering Failure Analysis
http://www.sciencedirect.com/science/journal/13506307