295116 - 295II231 - Advanced Manufacturing

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 712 - EM - Department of Mechanical Engineering
702 - CMEM - Department of Materials Science and Metallurgy
710 - EEL - Department of Electronic Engineering
707 - ESAII - Department of Automatic Control

Academic year: 2019
Degree: MASTER'S DEGREE IN INTERDISCIPLINARY AND INNOVATIVE ENGINEERING (Syllabus 2019).
(Teaching unit Optional)
ECTS credits: 6
Teaching languages: English

Teaching staff

Coordinator: Travieso Rodriguez, Jose Antonio
Jimenez Piqué, Emilio

Others: Lluma Fuentes, Jordi
Cabrera Marrero, Jose Maria
Sanchez Soto, Miguel Angel
Travieso Rodriguez, Jose Antonio

Prior skills

Knowing about the different groups of materials used to manufacture parts, as well as their properties and how to characterize them.

Requirements

After completed a degree in engineering from the industrial branch, engineering or degree in physics

Degree competences to which the subject contributes

Specific:
CEMUEII-14. Design and manage production processes that include quality control systems using advanced characterization techniques. (Specific competence of the Advanced Manufacturing Systems specialty).

General:
CGMUEII-01. Participate in technological innovation projects in multidisciplinary problems, applying mathematical, analytical, scientific, instrumental, technological and management knowledge.
CGMUEII-05. To communicate hypotheses, procedures and results to specialized and non-specialized audiences in a clear and unambiguous way, both orally and through reports and diagrams, in the context of the development of technical solutions for problems of an interdisciplinary nature.

Transversal:
05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
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**Teaching methodology**

The subject will be developed through theoretical classes of content exhibition, laboratory practices and the development of a team project.

**Learning objectives of the subject**

The subject aims to transmit to students the ability to:
1. Take decisions on the appropriate techniques to characterize the properties of the products obtained by different processes.
2. Design and manufacture functional parts and/or prototypes based on reverse engineering techniques.
3. Design the manufacturing process and manufacture parts using new non-conventional methods.
4. Use tools to determine the best values for the different parameters that act as variables in a manufacturing process.
5. Analyze the quality of a process based on the functional properties of the manufactured parts.

**Study load**

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 22h</th>
<th>14.67%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group: 0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group: 22h</td>
<td>14.67%</td>
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<tr>
<td></td>
<td>Guided activities: 4h</td>
<td>2.67%</td>
</tr>
<tr>
<td></td>
<td>Self study: 102h</td>
<td>68.00%</td>
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</table>

The subject will be developed through theoretical classes of content exhibition, laboratory practices and the development of a team project.
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### Content

#### Additive manufacturing

<table>
<thead>
<tr>
<th>Description:</th>
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<tbody>
<tr>
<td>• Additive Manufacturing Techniques (AM).</td>
</tr>
<tr>
<td>• Materials used in the Additive manufacturing of plastics, metals and ceramics.</td>
</tr>
<tr>
<td>• Design of the manufacturing process.</td>
</tr>
<tr>
<td>• Definition of the different manufacturing parameters.</td>
</tr>
<tr>
<td>• Mechanical, electronic and computer operation of machines for the manufacture of additives.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Specific objectives:</th>
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</thead>
<tbody>
<tr>
<td>1. Know the different AM techniques available on the market</td>
</tr>
<tr>
<td>2. Know the different materials that are used to make pieces for AM</td>
</tr>
<tr>
<td>3. Learn to design the manufacturing process of a piece through different AM techniques</td>
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</table>

<table>
<thead>
<tr>
<th>Learning time: 8h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 4h</td>
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<tr>
<td>Practical classes: 4h</td>
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</table>

#### Subtractive Manufacturing processes

<table>
<thead>
<tr>
<th>Description:</th>
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<tbody>
<tr>
<td>• Superfinance operations: operations used for the different groups of materials, characteristics, manufacturing parameters.</td>
</tr>
<tr>
<td>• Advanced tool materials. Efficiency and ecological impact of the materials of the tool. Composites CMC-MMC. Coatings Selection of tool materials. Answer of the materials to the conformation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specific objectives:</th>
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<tbody>
<tr>
<td>1. Deepen the knowledge of different non-conventional substratum manufacturing processes and their characteristics</td>
</tr>
<tr>
<td>2. Learn to evaluate the manufacturing parameters of these processes</td>
</tr>
<tr>
<td>3. Know advanced materials to manufacture cutting tools, as well as their characteristics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Learning time: 10h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 6h</td>
</tr>
<tr>
<td>Practical classes: 4h</td>
</tr>
</tbody>
</table>
### Plastic deformation processes

**Learning time:** 8h  
Theory classes: 4h  
Practical classes: 4h

**Description:**  
- Moderate and severe plastic forming processes.  
- Rotary and incremental process.  
- Severe conformation of plastics

**Specific objectives:**  
1. To learn more about the techniques of forming based on the plastic deformation of the materials  
2. Understand the microstructural evolution of materials subjected to plastic forming  
3. Technological applications of plastic forming

### Advanced characterization of materials techniques

**Learning time:** 10h  
Theory classes: 4h  
Practical classes: 6h

**Description:**  
- Advanced techniques for characterizing the properties of different groups of materials. Microscopes and spectroscopies.  
- Advanced techniques for the characterization of dimensional and surface properties of manufactured products.

**Specific objectives:**  
1. Deepening in the knowledge of different techniques used in the characterization of the properties of the different groups of materials used in the manufacture of pieces  
2. Increase knowledge about the characterization of dimensional and surface properties of products manufactured by different technologies.

### Optimization and quality control of manufacturing processes

**Learning time:** 8h  
Theory classes: 4h  
Practical classes: 4h

**Description:**  
- Experiment design techniques (DOE).  
- Statistical analysis of the results.  
- Methods and techniques for modeling the manufacturing processes.

**Specific objectives:**  
1. Learn to use DOE techniques for the conception, realization and analysis of experiments in the manufacture of pieces  
2. Introduction to knowledge about other manufacturing process modeling techniques
A continuous evaluation system will be followed, taking into account the different activities to be carried out and its weight within the entire subject. The following formula describes the different evaluation activities of the subject and its weight within the final grade.

\[ N_f = 0.5 \cdot N_p + 0.3 \cdot N_{pr} + 0.2 \cdot N_i \]

- \( N_f \): Subject final mark
- \( N_p \): Lab mark
- \( N_{pr} \): Project mark
- \( N_i \): Submitted reports mark

This subject does not have re-evaluation test.

**Bibliography**

**Basic:**


