340086 - MAPR-D3O17 - Layout and Prototyping

**Coordinating unit:** 340 - EPSEVG - Vilanova i la Geltrú School of Engineering
**Teaching unit:** 717 - EGE - Department of Engineering Presentation
**Academic year:** 2019
**Degree:** BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
**ECTS credits:** 6
**Teaching languages:** Catalan

### Teaching staff

**Coordinator:** Vilà Martí, Frederic
**Others:** Vilà Martí, Frederic
Martinez Antunez, Nora Isabel

### Prior skills

Knowledge of graphic representation and 3D modeling tools (Autocad, NX and / or SolidWorks).

### Requirements

Previous subject as a requirement: Graphic Expression in Engineering.

### Degree competences to which the subject contributes

**Specific:**
- D41. D41. Control of tools related to design processes.
- D42. D42. Knowledge of design tools to apply them in design and redesign projects.
- D48. D48. Ability to know and apply creative process and its organization.
- D54. D54. Ability to analyze, design and project in design workshops.

**Transversal:**
- 04 COE N1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
- 04 COE N3. 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.
- 06 URI N3. 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.
- 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.
**Teaching methodology**

In the theory sessions, the contents of the subject will be presented, introducing the subject, concepts, methods and techniques, with examples and practical cases to facilitate their compression and using audiovisual media (transparencies and videos).

The practical work sessions (laboratory practices) will be face-to-face sessions with exposition of concepts, techniques and procedures for the resolution of practical works using the existing digital prototype tools in the laboratory.

All the sessions will be present and guided and the achievement of the objectives proposed by the teacher in each of the sessions will be monitored.

**Learning objectives of the subject**

Models and prototypes are a fundamental element of design in the process of developing a product. The course explains the existing professional techniques and tools, applicable to the design process and its stages until obtaining a model and / or prototype. The course aims to introduce and practice the new CAD / CAM design technologies and the use of numerical control machines for rapid prototyping. We will integrate technology as a tool for the designer, maintaining the importance of working with the sensibility of the designer, the care of the presentation and the correct use in the study materials.

**Study load**

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group:</th>
<th>30h</th>
<th>20.00%</th>
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<tr>
<td></td>
<td>Hours medium group:</td>
<td>0h</td>
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<tr>
<td></td>
<td>Hours small group:</td>
<td>30h</td>
<td>20.00%</td>
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<td>Guided activities:</td>
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<td>Self study:</td>
<td>90h</td>
<td>60.00%</td>
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## Content

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Learning time</th>
<th>Theory classes</th>
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</thead>
<tbody>
<tr>
<td><strong>1. Introduction</strong></td>
<td><strong>DIY / DIWO</strong>&lt;br&gt;1.2. Makers: The new industrial revolution.&lt;br&gt;1.3. The digital manufacturing laboratory.</td>
<td><strong>6h</strong>&lt;br&gt;Theory classes: 6h</td>
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<tr>
<td><strong>2. Models and prototypes: Understand models and prototypes as a fundamental element of design in the process of developing a product.</strong></td>
<td>2.1. Know the difference between a model, a prototype and a short series of products.&lt;br&gt;2.2. Understand the basic stages of making a model and a prototype.&lt;br&gt;2.3. Know the materials, techniques of construction and finishing of a model and / or prototype.&lt;br&gt;2.4. Rapid prototyping</td>
<td><strong>2h</strong>&lt;br&gt;Theory classes: 2h</td>
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<tr>
<td><strong>3. 3D Scanned</strong></td>
<td>3.1. The digital manufacturing laboratory and its machinery.&lt;br&gt;3.2. Plate cutting: Cut by leaves, laser cutting, water jet, milling machine, CNC lathe and plasma.&lt;br&gt;3.3. 3D printing: Filament, liquid, powder.&lt;br&gt;3.4. Scanned 3D</td>
<td><strong>2h</strong>&lt;br&gt;Theory classes: 2h</td>
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5. **Additive manufacturing. 3D printing technology for extrusion of material: FFF / FDM**

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<tr>
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| 5.1. Introduction to the 3D printing of extrusion of material.  
5.2. Concepts and limitations.  
5.3. The 3D printing process.  
5.4. Material processing: extrusion.  
5.5. Test and calibration of a 3D printer.  
5.6. Possible errors in the pieces.  
5.7. 3D printing materials:  
  5.7.1. What is a thermoplastic?  
  5.7.2. Material processing: extrusion.  
  5.7.3. Characteristics of the materials: ABS, PLA, HIPS, PVA, PC, Nylon, Elastomers, PET, Composites and conductive filaments.  
5.8. Surface post-impression treatments:  
  5.8.1. Mechanical treatments  
  5.8.2. Thermal treatments  
  5.8.3. Chemical treatments  
5.9. Applications of 3D printers:  
  5.9.1. Applications of 3D printers: medicine, engineering and robotics, toys, art, textiles, jewelry, food, architecture and other applications. |

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<tr>
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<td>4h</td>
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6. **Additive manufacturing. Other technologies and 3D printing processes**

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| 6.1. Photopolymerization: SLA and DLP.  
6.2. Pole bed fusion: SLS, SLM and EBM  
6.3. Injection of binder: PBIH and PP.  
6.4. Injection of material: MJM, PJ and MJF  
6.5. Lamination of sheets: LOM and UC  
6.6. Direct energy deposition: DMD, LMD and LAM. |

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<td>4h</td>
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7. **Subtractive manufacturing**

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| 7.1. Laser cutting machine.  
7.2. CNC Milling Machine  
7.3. Others: CNC lathe, plasma and water jet. |

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Qualification system

The evaluation of the subject will be formed by the qualification of the theoretical part that will have a weight of 30% of the final qualification and the evaluation of the laboratory practices that will have a weight of 70% of the final mark.

Regulations for carrying out activities

The evaluation of the theoretical part will be by means of the continuous evaluation consisting in the accomplishment of 5 tests type test in time of class of theory. Thus, a test will be performed for topic 1, one for topics 2 and 3, one for themes 4 and 5, one for topic 6 and the last one to complete topic 7. If a student for any reason, justified or not, can not attend one of the assessment tests, it will not be repeated and will have a score of 0 (not shown). For the evaluation of the practical part, the model / prototype developed in practical classes will be taken into account with a continuous evaluation of this work and the use of laboratory tools - 3D scanner, 3D printers and laser cutter - (30%), the submitted documentation that will include memory, renderings and video (25%) and the exhibition of the work done as well as the evaluation of it for the rest of the classmates (15%). The exhibition of the practical work will be compulsory to be carried out in the final evaluation period of the subject to be evaluated of this 70%. The final grade of the subject will be the one that is obtained from applying a percentage of 30% to the theoretical part and 70% to the practical part. In the case that the student has obtained a final grade of less than 5, the student will have the right to go to the final exam of the theory with the aim of obtaining a qualification superior to that obtained during the continuous evaluation of the part theoretical, although it will be necessary to request it by email to the coordinating professor of the subject 7 days in advance to the date envisaged in the academic calendar for the final exam. Therefore, this final exam of theory can only be carried out by students who have obtained a final grade of the subject less than 5, that is to say, it is not useful to note students who have already passed the subject (equal grade equal or greater than 5). There will be no re-evaluation of the practical part of the subject, that is, only the part of theory of the subject (30% of weight) will be re-evaluable. Only those students who have not passed the subject and the final qualification can go to the re-evaluation are greater than 3, that is, the final grade of the subject is between 3 and 5.

Bibliography

Basic:

Complementary: