Course guides
340086 - MAPR-D3O17 - Layout and Prototyping

Unit in charge: Vilanova i la Geltrú School of Engineering
Teaching unit: 717 - DEGD - Department of Engineering Graphics and Design.
Degree: BACHELOR’S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2009). (Compulsory subject).
Academic year: 2021  ECTS Credits: 6.0  Languages: Catalan

LECTURER

Coordinating lecturer: 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:
D21. Ability purchasing power to take decisions related to graphic representation of concepts.
D41. Control of tools related to design processes.
D42. Knowledge of design tools to apply them in design and redesign projects.
D48. Ability to know and apply creative process and its organization.
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

Theory sessions will expose the contents of the subject, introducing the subject, concepts, methods and techniques, with examples and practical cases to facilitate understanding and using audiovisual media (slides 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 tools / machines of digital prototyping existing in the laboratory.

The start of the 2020/21 academic year is planned with theory sessions taught online (non-face-to-face sessions) and face-to-face and guided laboratory practice sessions, which will monitor the achievement of the objectives proposed by the teacher in each one of the sessions.

All the assessment tests of the subject are expected to be face-to-face.

Depending on the evolution of the COVID-19 and what the center dictates at each moment, it will be possible to go to a totally face-to-face or totally non-face-to-face teaching, but the start of the course of this subject is expected to be in the hybrid scenario exposed in the previous paragraph.

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>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

1. Introduction

Description:
1.1. DIY / DIWO
1.3. The digital manufacturing laboratory.

Full-or-part-time: 8h

Theory classes: 8h
2. Models and prototypes: Understand models and prototypes as a fundamental element of design in the process of developing a product.

Description:
2.1. Know the difference between a model, a prototype and a short series of products.
2.2. Understand the basic stages of making a model and a prototype.
2.3. Know the materials, techniques of construction and finishing of a model and/or prototype.

Full-or-part-time: 2h
Theory classes: 2h

3. 3D Scanned

Description:
3.1. Introduction.
3.2. Type.
3.3. Reverse engineering.

Full-or-part-time: 2h
Theory classes: 2h

4. Rapid prototype

Description:
4.1. What is rapid prototype?
4.2. Additive manufacturing vs. subtractive manufacturing
4.3. Additive manufacturing: historical and future review of 3D printing.

Full-or-part-time: 4h
Theory classes: 4h

5. Additive manufacturing. 3D printing technology for extrusion of material: FFF / FDM

Description:
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.

Full-or-part-time: 4h
Theory classes: 4h
6. Additive manufacturing. Other technologies and 3D printing processes

Description:
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.

Full-or-part-time: 4h
Theory classes: 4h

GRADING 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% on the note. final.

The evaluation of the theoretical part will be done by means of two test-type tests. The first of the tests (test 1) will be held during the week of partial exams and will include the subject seen in topics 1 to 4. The second of the tests (test 2) will include the subject seen in topics 5 and 6 and will be held on the date set by the center during the final exam week.

In the test that will take place in the week of final exams, those students who have obtained a grade of less than 5 in test 1 (the one taken during the week of partial exams), will be able to choose to repeat this test.

For the evaluation of the practical part, the work developed in the laboratory practice sessions will be taken into account. This practical part of the subject will be divided into 5 laboratory practices, each of which will have a certain weight in the laboratory note of the subject as indicated below:

- Practice 1.- Introduction to the practices of Layout and digital prototyping: Basic norms of behavior and security for the laboratory of digital prototyping (MAPR) and of use of the machines and instruments of the laboratory of MAPR. The percentage of this practice in the qualification of laboratory practices is 5%.
- Practice 2.- Laser cutting. This practice aims to know the possibilities of the laser cutter in the laboratory of MAPR and put the student in contact with this technique by designing an object that will later be cut. The percentage of this practice in the qualification of laboratory practices is 10%.
- Practice 3.- 3D scanning. In this practice, the 3D scanning technique will be taught with the existing scanner in the MAPR laboratory, practicing with its use. The percentage of this practice in the qualification of laboratory practices is 10%.
- Practice 4.- 3D printing. This practice aims to put you in touch with the world of 3D printing by proposing the design of a small piece that will later be printed on one of the existing 3D printers in the MAPR laboratory. The percentage of this practice in the qualification of laboratory practices is 15%.
- Practice 5.- Design and construction of a prototype / model. The aim of this practice is to design a prototype / model using the existing digital prototyping machines in the MAPR laboratory. The percentage of this practice in the qualification of laboratory practices is 60%.

EXAMINATION RULES.

If a student for any reason, justified or not, is unable to attend one of the assessment tests on the set day he will have a grade of 0 (not presented).

There will be no re-evaluation of the practical part of the subject, ie only the theory part of the subject will be re-evaluated (30% by weight). Only those students who have not passed the subject and the final grade is higher than 3, that is, the final grade of the subject is between 3 and 5 will be able to go to the re-evaluation. assessment must be requested by e-mail to the coordinating professor of the subject 5 days in advance of the date provided in the academic calendar for the re-assessment exam.
**BIBLIOGRAPHY**

**Basic:**

**Complementary:**