Course guide
340086 - MAPR-D3O17 - Layout and Prototyping

Last modified: 19/06/2024

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: 2024 **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.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
D21. D21. Ability purchasing power to take decisions related to graphic representation of concepts.
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 INFORMATI0N 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

The theory sessions will present the contents of the subject, 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 and guided sessions with exposition of concepts, techniques and procedures for the resolution of practical work using the existing digital prototyping tools in the laboratory, in which the monitoring will be monitored. achievement of the objectives proposed by the teacher in each of the sessions.
All assessment tests for the subject are expected to be face-to-face.
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

Type	Hours	Percentage
Hours large group	30,0	20.00
Hours small group	30,0	20.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

1. Introduction

Description:
1.1. DIY / DIWO
1.2. Makers: The new industrial revolution.
1.3. The digital manufacturing laboratory and its machinery.

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. Difference between a model and a prototype.
2.2. Basic stages of making a model and/or a prototype.
2.3. Materials, techniques of construction and finishing of a model and/or prototype.

Specific objectives:
2.1. Know the difference between a model and a prototype.
2.2. Understand the basic stages of making a model and/or 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 Scanning

Description:
3.1. Introduction.
3.2. Types of 3D scanners.
3.3. Contactless 3D scanning techniques.
3.4. 3D scanner settings
3.5. Examples of 3D scanners.
3.6. Reverse engineering.

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

4. Rapid prototype

Description:
4.1. What is rapid prototyping?
4.2. Subtractive manufacturing vs. additive manufacturing.
4.3. Additive manufacturing vs. 3D printing.
4.4. Additive manufacturing and industry 4.0.
4.5. 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 Material Extrusion 3D Printing.
5.2. Tips and limitations.
5.3. The 3D printing process.
5.4. Testing and calibrating a 3D printer.
5.5. Possible errors in the parts.
5.6. Parts of a 3D printer.
5.6.1. Head of a 3D printer
5.6.2. Bed or printing platform
5.6.3. Mechanical structure
5.6.4. Electronic part
5.6.5. Firmware
5.7. 3D printing materials:
5.7.1. What is a thermoplastic.
5.7.2. Material processing: extrusion.
5.7.3. Material characteristics: ABS, PLA, HIPS, PVA, PC, Nylon, Elastomers, PET, composites and conductive filaments.
5.8. Post-printing surface treatments.
5.8.1. Mechanical treatments
5.8.2. Heat treatments
5.8.3. Chemical treatments
5.9. Applications of 3D printers: medicine, engineering and robotics, toys, art, textile, jewelry and imitation 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 3. The second of the tests (test 2) will include the subject seen in topics 4 to 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).

BIBLIOGRAPHY

Basic:
- Bryden, Douglas. CAD y prototipado rápido en el diseño de producto. Barcelona: Promopress, 2014. ISBN 9788415967088.
- Hallgrimsson, Bjarki. Diseño de producto : maquetas y prototipos. Barcelona: Promopress, 2013. ISBN 9788492810529.
- Anderson, Chris. Makers : la nueva revolución industrial. Argentina ; España [etc.]: Empresa Activa, 2013. ISBN 9788496627703.
- Thompson, Rob. Prototyping and low-volume production. London: Thames & Hudson, 2011. ISBN 9780500289181.

Complementary:
- Thompson, Rob. Manufacturing processes for design professionals. New York [NY]: Thames & Hudson, 2007. ISBN 9780500513750.
- Lefteri, Chris. Making it : manufacturing techniques for product design [on line]. 2nd ed. London: Laurence King, 2012 [Consultation: 13/02/2024]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=1876117. ISBN 9781856697491.