Makeademy

Makeademy - Makers Academy:
Developing Future Engineer's Skills

# Everything about prototyping

## *Course description*

Fab Lab Barcelona

*www.makeademy.com*

Funded by
the European Union

# Everything about prototyping

## Course Objective

The maker mindset and the encompassing digital fabrication technologies offer versatile tools and approaches to prototype innovative solutions for real-life problems. This course is a multi-disciplinary and hands-on learning experience that empowers students to learn-by-doing. The objective is to transfer the basic understanding of (1) product design, (2) digital fabrication and (3) electronics in three modules. Each module is divided into chapters that dive deeper into the respective areas of knowledge and invites the student to directly apply their gained knowledge.

## Learning Outcomes

Participants will gain a basic understanding of a variety of making techniques and will be invited to put into practice their knowledge and skills in physical projects. By the completion of the course, participants will have learned how to use digital fabrication tools, machines, and skills such as 2D design and 3D design, Computer-controlled cutting, 3D printing, Computer-controlled machining and Electronics. Furthermore, they will:

- Deepen their knowledge and gain new skills and competencies.
- Have access to a curated list of open and closed source programs, including links to external tutorials.
- Review a collection of best practice examples from the maker community that applies digital fabrication technologies in innovative projects.
- Self-assess their learning process by applying their knowledge in practical individual or group projects.

## Course structure details

The course “Everything about prototyping” is divided into three modules. The modules are (1) product design, (2) digital fabrication and (3) electronics in four modules. Each of these modules builds on top of the other, hence following a logical order. However, each of the modules can be separately conducted based on interests and the existing knowledge of participants. It is

recommended to allocate one week time for each chapter to give the students the most possible immersive experience with the newly introduced topics, tools, and skills. However, the format and time intensity of the course can be adapted by the instructor.

For example, one module can take place over two weeks, including a 2-hour lecture for the module, and 2-hour of introductions to each chapter with additional allocated hours for group and individual work.

## Example Module in one week:

| Monday | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|
| Module introduction<br><br>Introduction chapter 1 | Introduction chapter 2 | Free working time for participants | Free working time for participants | Free working time for participants |
| Free working time for participants | Free working time for participants | Introduction chapter 3 | Introduction chapter 4 | Project presentation |

## Example Module, with one week per chapter:

| Week 1 | Week 2 | Week 3 | Week 4 | Week 5 |
|---|---|---|---|---|
| Module introduction<br><br>Introduction chapter 1 | Introduction chapter 2 | Introduction chapter 3 | Introduction chapter 4 | Collective revision of work and finalizing projects |
| Free working time for participants | Free working time for participants | Free working time for participants | Free working time for participants | Project presentation |

This course can be designed modular and contextualized based on the availability of resources, types of machinery, and skills of the facilitator and participants at the training location.

**Course coordinator:** Fab Lab Barcelona, info@fablabbcn.org.

**Academic prerequisites:** On the level of Bachelor's degree in engineering or equivalent. No prior knowledge of digital fabrication is required for this course.

**Form of instruction:** Self-instructional or part of curriculum instructed by a local facilitator of the course.

**Comments on form of instruction:** Individual work or lectures, group work and group assignments.

**Course requirements forinstructor:** Access to a local Makerspace and or Fab Lab is highly recommended. Instructors of this course should be familiar with the modules that are presented in this course or ideally have a maker profile themselves.

**Exam details:** Optional online assignments after each module, a showcase of individual or group projects using the learned knowledge, and prototypes can be showcased in a classroom setting.

**Prerequisites for examination of participation:** Following the learning by-doing methodology the participants of the course will be invited to put their newly developed skills directly into practice. Participants can develop projects that use digital fabrication technology either in individual or group work.

**ECTS:** 5

**Level:** Bachelor or Master

**Language ofinstruction:** English

**Access link:** https://makeademy.eu/e-learning-platform/.

**Modules:**

## MODULE 1 Product Design

### 1 2D Design

- 2D design principles in CAD
- 2D design in digital fabrication
- Vector vs raster
- 2D computer-aided design softwares
- Additional notes
- Case study: Tattie Toys
- Activities and Assessment
- Quiz

### 2 3D Design

- 3D design in digital fabrication
- 3D design software
- Parametric design
- Modelling formats
- Additional notes
- Case study: Light_00
- Activities

## MODULE 2 Digital Fabrication

### 1 3D Printing

- History of 3D printing
- Types of 3D printing technology
- Chemical use in FDM vs SLA
- Advantages and limitations of 3D printing
- Materials used in 3D printing
- Preparing for 3D printing
- Design consideration
- Slicing
- Helpful resources for learning more about 3D design and printing
- Case study: Light_00
- Activities
- Quiz

### 2 Laser Cutting

- Principles and technology of laser cutting
- Why & when to use laser cutting
- How it works
- Safety rules
- Design consideration
- Case study: Tattie Toys
- Activities and Assessment
- Quiz

### 3 CNC Machining

- History and context
- Use case
- Materials
- CNC Machine Setup
- CAM Software
- CNC Machining Process
- Choosing the right tool
- Tool speed and feed
- Finishing and Post-Processing
- Conclusion
- Case Study: Open Desk
- Activities
- Quiz

## MODULE 3 Electronics

### 1 Introduction

- Brief history of Electronics
- Electronic vs Electric
- Microcontroller
- Arduino Project
- Common microcontrollers today
- Some key concepts
- Case Study: IoT Gardening Station
- Activities
- Quiz

### 2 Programming

- Introduction
- Basics concepts
- Understanding the logic of what we are trying to achieve
- Libraries
- Examples of Arduino programs
- Case Study: IoT Gardening Station
- Activities
- Quiz

### 3 Input/Output

- Introduction
- The interaction between inputs and outputs
- Signal types
- Inputs: example and purpose
- Outputs: example and purpose
- Voltage levels
- Voltage level conversion
- Case Study: IoT Gardening Station
- Activities
- Learnlife Workshop Plan
- Quiz

# Makeademy

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