# Course guide
# 295623 - 295MB023 - Design of Medical Devices: Usable Health Technologies

**Last modified:** 27/01/2026

**Unit in charge:** Barcelona East School of Engineering
**Teaching unit:** 710 - EEL - Department of Electronic Engineering.

**Degree:** MASTER'S DEGREE IN ADVANCED BIOMEDICAL TECHNOLOGIES (Syllabus 2025). (Compulsory subject).

**Academic year:** 2025 **ECTS Credits:** 6.0 **Languages:**

## LECTURER

**Coordinating lecturer:** Nescolarde Selva, Lexa Digna

**Others:** Nescolarde Selva, Lexa Digna
Ramos Castro, Juan Jose

## PRIOR SKILLS

Knowledge of C programming, Python, basic electronics, electronic instrumentation and biomedical signal processing.
It is recommended to have completed Sensors and Signal Conditioners, Hospital Security, Physiology and Biomedical Signal Processing.

## LEARNING RESULTS

**Knowledges:**
K4 . Describe advanced knowledge of biomedical instrumentation for designing wearable technologies, smart sensors and biosensors.
K8 . Demonstrate advanced knowledge of digital and mobile health applications (mHealth).
K3 . Relate advanced knowledge of healthcare products and technological innovation concepts.
K2 . Recognise advanced data analysis and modelling structures.
K7 . Infer advanced knowledge of digital biomarkers and artificial intelligence techniques in health technologies.

**Skills:**
S3 . Design medical equipment that can be used according to the principles, design, risk analysis and validation of medical equipment.
S10 . Use common analysis tools in technological innovation to evaluate business opportunities and develop innovation proposals in the field of biomedical technologies.
S9 . Plan the stages, tasks and activities involved in designing and developing biomedical devices and sensors or processing biomedical data.
S5 . Propose digital biomarkers through advanced analysis of biomedical signals, artificial intelligence techniques and bioinformatics.
S6 . Interpret biomedical data using data analysis, machine learning and deep learning techniques.

**Competences:**
C2 . Apply management methodologies to projects, teams and biomedical products and technologies that are appropriate to the type of project.
C3 . Identify and analyse problems that require making autonomous, informed and reasoned decisions in order to act with social responsibility following ethical values and principles.
C1 . Assume responsibilities in work teams in production management, as just another member or in a leadership role.
C4 . Use information resources effectively, manage the acquisition, structure, analysis and visualisation of data and information in the area of specialisation and critically assess the results.
C5 . Use scientific and technical information to respond to any demand for modification, innovation or improvement of devices, products and processes linked to biomedical engineering for new scientific or technological applications.
C7 . Develop the ability to evaluate inequalities based on sex and gender to design solutions that resolve them.

## TEACHING METHODOLOGY

- Lectures.
- Cooperative work activities.
- Independent learning.
- Project-based learning.

## LEARNING OBJECTIVES OF THE SUBJECT

Know the principles, design, risk analysis and validation of wearable medical equipment.

## STUDY LOAD

| Type | Hours | Percentage |
|---|---|---|
| Self study | 94,0 | 62.67 |
| Hours small group | 14,0 | 9.33 |
| Hours large group | 42,0 | 28.00 |

**Total learning time:** 150 h

## CONTENTS

### Introduction

**Description:**
1. Definition.
2. Types of wearables.
3. Structure/characteristics of a wearable medical device.

**Full-or-part-time:** 14h
Theory classes: 4h
Self study : 10h

### Power sources

**Description:**
1. Batteries.
2. Solar energy.
3. Thermal energy.
4. Kinetic energy.
5. Electromagnetic.

**Related activities:**
Laboratory: session 1

**Full-or-part-time:** 20h
Theory classes: 6h
Guided activities: 2h
Self study : 12h

## Programmable control systems

**Description:**
1. Microprocessor.
2. Microcontroller.
3. FPGA.
4. SoC.

**Related activities:**
Laboratory: session 2

**Full-or-part-time:** 24h
Theory classes: 8h
Guided activities: 2h
Self study : 14h

## Communication systems

**Description:**
1. Short range
-RFID, NFC
2. Mid range
-Bluetooth, Wi-Fi
3. Long range
-LoRa, Sigfox, 4G, 5G

**Related activities:**
Laboratory: session 3

**Full-or-part-time:** 23h
Theory classes: 6h
Guided activities: 2h
Self study : 15h

## Sensors

**Description:**
1. Physical magnitudes
-Temperature, humidity, pressure, motion, radiation
2. Physiological magnitudes
- ECG, EEG, EMG, SpO2

**Related activities:**
Laboratory: session 4

**Full-or-part-time:** 22h
Theory classes: 5h
Guided activities: 2h
Self study : 15h

**Systems Development**

**Description:**
1. Development stages.
2. Regulations.
3. Risk management.
4. Hardware and SW development
- Development board.
-Programming environment.
-Repository.
-Cloud access.
5. Project management.

**Related activities:**
Project: session 1 and 2

**Full-or-part-time:** 28h
Theory classes: 8h
Guided activities: 4h
Self study : 16h

**Cloud Services**

**Description:**
1. Introduction.
2. Protocols.
3. Security.

**Related activities:**
Project: session 3

**Full-or-part-time:** 19h
Theory classes: 5h
Guided activities: 2h
Self study : 12h

## GRADING SYSTEM

Laboratory (L) = 17.5%
Seminars (S) = 17.5%
Middle course control (MC) = 30%
Final Project (FP) = 35%
Final grade (FG): 0.175*L + 0.175*S + 0.30*MC + 0.35*FP

## EXAMINATION RULES.

1. There will be an evaluation of guided activities (in-person or non-in-person) corresponding to the delivery of laboratory work (type L).
2. There will be a final exam (FE), of a maximum duration of 2 hours, which will consist of questions related to theoretical knowledge of the Content of the subject and aimed at assessing the learning objectives achieved by the student.
3. There will be a project developed throughout the semester on the design and development of usable medical devices from the conception of the device, market study, applicability, regulations and implementation.

There will be no re-evaluation exam in this subject.

## BIBLIOGRAPHY

**Basic:**
- Dey, Nilanjan; Ashour, Amira S.; Fong, Simon James; Bhatt, Chintan. Wearable and implantable medical devices : applications and challenges [on line]. London, England: Academic Press, [2020] [Consultation: 10/09/2025]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/9780128153697/wearable-and-implantable-medical-devices. ISBN 9780128156377.
- Delabrida Silva, Saul Emanuel; Rabelo Oliveira, Ricardo Augusto; Ferreira, Antonio Alfredo. Examining developments and applications of wearable devices in modern society [on line]. Hershey: IGI Global, 2018 [Consultation: 10/09/2025]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=4983644. ISBN 9781522532903.
- Sazonov, Edward. Wearable sensors : fundamentals, implementation and applications [on line]. Second edition. London, England: Academic Press, 2021 [Consultation: 10/09/2025]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/9780128192467/wearable-sensors. ISBN 978-0128192467.
- Deitel, Paul J.; Deitel, Harvey M. C ++ : how to program. Ninth edition. Boston: Pearson Education, 2014. ISBN 9780133378795.
- Wilson, Denise. Wearable solar cell systems [on line]. Boca Raton: CRC Press, 2019 [Consultation: 10/09/2025]. Available on: https://www-taylorfrancis-com.recursos.biblioteca.upc.edu/books/mono/10.1201/9780429399596/wearable-solar-cell-systems-denise-wilson. ISBN 9780429399596.

**Complementary:**
- Circuits and systems for wearable technologies : IEEE UKCAS 2019. Aalborg, Denmark: River Publishers, 2019. ISBN 9788770221320.
- Mackenzie, Brian; Galpin, Andy; White, Phil. Unplugged. Las Vegas: Victory Belt Publishing, 2017. ISBN 9781628602616.
- Sullivan, Scott. Designing for wearables : effective UX for current and future devices [on line]. Sebastopol: O'Reilly, 2017 [Consultation: 10/09/2025]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=4773464. ISBN 9781491944158.
- McCann, Jane; Bryson, David. Smart clothes and wearable technology. Boca Raton : Cambridge: CRC, 2009. ISBN 9781845693572.

## RESOURCES

**Other resources:**
Class material available at ATENEA