

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

Last modified: 19/09/2025

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.
- ${\sf K8} \;.\; {\sf Demonstrate} \; {\sf advanced} \; {\sf knowledge} \; {\sf of} \; {\sf digital} \; {\sf and} \; {\sf mobile} \; {\sf health} \; {\sf applications} \; ({\sf mHealth}).$
- 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.
- ${\sf S6}$. 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.

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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

Туре	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

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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

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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) = 20%

Project (P) = 30%

Seminars (S) = 15%

Final Exam (FE) = 35%

Final grade (FG): 0.20*L + 0.30*P + 0.15*S + 0.50*FE

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: A c a d e m i c Press, 2021 [Consultation: 10/09/2025]. A vailable 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=4773 464. 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

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