Course Guide [Codi UD] – [Sigles UD] – DEMU - Medical Device Design: Wearable Technologies in Healthcare

Unit in charge	Escola d'Enginyeria de Barcelona Est
Teaching unit:	*Electronic engineering*
Academic year	2025
Lenguages	

Credits	*6*
	Spanish, Catalan and English

Lecturer

Coordinating lecturer:	Lexa Nescolarde (710: Department of Electronic Engineering) Juan José Ramos Castro (710: Department of Electronic Engineering)
Others:	Lexa Nescolarde Juan José Ramos Castro Georgina Company Se

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.

TEACHING METHODOLOGY

· AF.1.- Lectures.
· AF.2.- Cooperative work activities.
· AF.4.- Independent learning.
· AF.5.- Project-based learning.

LEARNING OBJECTIVES OF THE SUBJECT

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

STUDY LOAD

Type	Hours	Percentage
Hours large group	42,0	28.00 %
Hours small group	14,0	9.00 %
Self-study	94	63.00 %
Total learning time:	150h	

CONTENTS

Content 1:	Introduction

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

Related activities:

Dedication: total hours
Large group/Theory: 4h
Self-study: 10h

Content 2:	Feeding systems

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

Related activities:
- Laboratory: session 1

Dedication: total hours
Large group/Theory: 6h
Guided activities: 2h
Self-study: 12h

Content 3:	Controller

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

Related activities:
- Laboratory: session 2

Dedication: total hours
Large group/Theory: 6h
Guided activities: 2h
Self-study: 12h

Content 4:	Communications protocols

Description:
1. RFID.
2. NFC.
3. Bluetooth.
4. LoRa.
5. Sigfox.
6. Wi-Fi.

Related activities:
- Laboratory: session 3

Dedication: total hours
Large group/Theory: 5h
Guided activities: 2h
Self-study: 12h

Content 5:	Sensors

Description:
1. Temperature.
2. Humidity.
3. Pressure.
4. ECG.
5. EEG.
6. EMG.
7. Motion.
8. Radiation.
9. Dust oximetry.

Related activities:
- Laboratory: session 4

Dedication: total hours
Large group/Theory: 5h
Guided activities: 2h
Self-study: 12h

Content 6:	Development

Description:
1. Development stages.
2. Regulations.
3. Risk management.
4. Hardware.
5. Software.
6. Project management.

Related activities:
- Project: session 1

Dedication: total hours
Large group/Theory: 6h
Guided activities: 2h
Self-study: 12h

Content 7:	Cloud Services

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

Related activities:
- Project: session 2

Dedication: total hours
Large group/Theory: 5h
Guided activities: 2h
Self-study: 12h

Content 8:	Work environment

Description:
1. Development board.
2. Programming environment.
3. Repository.
4. Cloud access.

Related activities:
- Project: session 3

Dedication: total hours
Large group/Theory: 5h
Guided activities: 2h
Self-study: 12h

GRADING SYSTEM

Laboratory notes (L) = 20%
Project (P) = 30%
Final Exam (FE) = 50%
Final grade (FG): 0.20*L + 0.30*P + 0.50*EF

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:
1. Dey, Nilanjan; Ashour, Amira S.; Fong, Simon James and Bhatt, Chintan. Wearable and implantable medical devices : applications and challenges [en línia]. 7th ed. Academic Press, 2019 [Consulta: 26/05/2020]. Disponible a: https://www.elsevier.com/books/wearable-and-implantable-medical-devices/dey/978-0-12-815369-7. ISBN 9780128153697.
2. Delabrida Silva, Saul Emanuel; Rabelo Oliveira, Ricardo Augusto and Ferreira, Antonio Alfredo. Examining developments and applications of wearable devices in modern society [en línia]. 2017 [Consulta: 26/05/2020]. Disponible a: https://www.igi-global.com/book/examining-developments-applications-wearable-devices/180229. ISBN 9781522532903.
3. Sazonov, Edward. Wearable sensors : fundamentals, implementation and applications [en línia]. Academic Press, 2015 [Consulta: 26/05/2020]. Disponible a: https://www.sciencedirect.com/book/9780124186620/wearable-sensors#book-info. ISBN 978-0128192467.
4. Deitel, Harvey and Deitel, Paul. C How to Program [en línia]. 8th ed. Pearson, 2016 [Consulta: 30/06/2020]. Disponible a: https://www.pearson.com/us/higher-education/program/Deitel-C-How-to-Program-Plus-My-Lab-Programming-with-Pearson-e-Text-Access-Card-Package-8th-Edition/PGM265656.html?tab=order. ISBN 9780133978476.
5. Wilson, Denise. Wearable solar cell systems [en línia]. CRC Press, 2019 [Consulta: 26/05/2020]. Disponible a: https://www.routledge.com/Wearable-Solar-Cell-Systems/Wilson/p/book/9780367023478?utm_source=crcpress.com&utm_medium=referral. ISBN 9780367023478.

Complementary:
1. Ghoreishizadeh, Sara; de Jager, Kylie. Circuits and systems for wearable technologies IEEE UKCAS 2019 [en línia]. River Publishers, 2019 [Consulta: 26/05/2020]. Disponible a: https://www.riverpublishers.com/book_details.php?book_id=757. ISBN 9788770221320.
2. Mackenzie, Brian; Galpin, Andy and White, Phil. Unplugged : evolve from technology to upgrade your fitness, performance & consciousness [en línia]. Victory Belt Publishing, 2017 [Consulta: 26/05/2020]. Disponible a: https://www.simonandschuster.com/books/Unplugged/Brian-MacKenzie/9781628602616. ISBN 9781628602616.
3. Sullivan, Scott. Designing for wearables : effective UX for current and future devices [en línia]. O'Reilly Media, 2016 [Consulta: 30/06/2020]. Disponible a: http://shop.oreilly.com/product/0636920047544.do. ISBN 9781491944158.
4. McCann, Jane; Bryson, David. Smart clothes and wearable technology. Boca Raton: Woodhead Publishing Ltd, 2009. ISBN 9781845693572.
5. Wearable [en línia]. [Consulta: 26/05/2020]. Disponible a: https://www.wareable.com/.

RESOURCES

Other resources:

Class material available at ATENEA