



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## COURSE SYLLABUS

### Embedded Systems for Biomedical Applications

2324-2-F9102Q013

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#### Aims

The course will address all the fundamental elements of embedded systems in the healthcare domain: design principles, types of sensors with main characteristics, data acquisition and signal processing, visualization systems, patient safety and data analytics. Key solutions in various application fields are presented: electrocardiography, electroencephalography, ultrasounds for clinical diagnosis and wearables. LabVIEW and Python programming are introduced for practical exercises and laboratories on the topics explained in the lessons.

#### Contents

Main components of biomedical embedded systems. Data acquisition and signal processing of biomedical instrumentation. Examples of solutions in different healthcare contexts.

Lab classes on embedded systems design, test and data analytics principles with LabVIEW and Python.

#### Detailed program

- Overview of biomedical embedded systems
- Biomedical embedded systems design
- Performance parameters of signals and systems for biomedical applications
- Sensors
- Architectures
- Visualization systems
- Patient safety
- Principles of Networked biomedical embedded systems
- Security, privacy and data protection

- Examples: electrocardiography, electroencephalography, ultrasounds for clinical diagnosis and wearables
- LabVIEW for the design, development and simulation of biomedical embedded systems
- Python for data analytics applied to biomedical signals

## **Prerequisites**

Basics of programming, algorithms; linear algebra, differential and integral calculus; descriptive statistics, probability, inference, linear models; elements of statics, dynamics, energy and electromagnetism.

## **Teaching form**

Lectures (hours/year in lecture theatre): 32

Laboratory (hours/year in lecture theatre): 24

Practicals/Workshops (hours/year in lecture theatre): 0

It is recommended that students take part in lessons and laboratories.

## **Textbook and teaching resource**

G. Avanzolini, E. Magosso. Strumentazione Biomedica – Progetto e Impiego dei Sistemi di Misura. Patron Editore, 2015.

For consultation: A.G. Webb. Principles of Biomedical Instrumentation. Cambridge University Press, 2018. DOI: 10.1017/9781316286210

P.A.H. Williams, A.J. Woodward. Cybersecurity vulnerabilities in medical devices: a complex environment and multifaceted problem. Medical Devices: Evidence and Research, pages 305-316, 2015. [Available online] DOI: 10.2147/MDER.S50048

Slides available on the course website.

Notes taken during lessons.

## **Semester**

First

## **Assessment method**

The exam consists in a written test regarding all topics covered during lessons and laboratories, In case of positive evaluation of the written test, an optional oral examination can be sustained to improve the final rank.

No intermediate tests are planned.

## **Office hours**

Contact by mail to arrange an appointment.

## **Sustainable Development Goals**

GOOD HEALTH AND WELL-BEING

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