COMILLAS
UNIVERSIDAD PONTIFICIA
ICAI ICADE CIHS

Syllabus
2025 - 2026

GENERAL INFORMATION

Data of the subject

Subject name	Biomedical Electronics and Instrumentation
Subject code	DEA-GITT-316
Mainprogram	Bachelor's Degree in Engineering in Telecommunication Technologies
Involved programs	Grado en Ingeniería en Tecnologías de Telecomunicación [Third year]
Credits	6,0 ECTS
Type	Optativa (Grado)
Department	Department of Electronics, Control and Communications

Teacher Information

Teacher

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DESCRIPTION OF THE SUBJECT

Contextualization of the subject

Prerequisites

- Electronics: amplification and filtering concepts. Operational amplifiers and their applications.
- Signals and systems: Fourier transforms, signal spectra, time and frequency domain relationships.
- Statistics / Telecommunication theory: random signals, power spectral density.

Course contents

Contents

Section 1: INTRODUCTION

1.1 Historical introduction; the evolution of medical instrumentation.

1.2 Physiology of signals produced by the human body.

1.3 Interaction of electromagnetic fields and human tissue.

Section 2: ELECTRONIC SYSTEMS

2.1 Instrumentation and differential amplifiers.

2.2 Digital instrumentation: conversion from analog to digital and vice versa.

2.3 Noise and extraneous signal pickup; analysis and countermeasures.

2.4 Electrodes and biomedical sensor examples.

Section 3: SAFETY AND PROTECTIONS

3.1 Safety in biomedical instrumentation; classes of instruments.
3.2 Isolation amplifier.
3.3 Circuit breakers and safety systems.
3.4 Uninterruptible power supply systems.

Section 4: COOPERATIVE WORK

The students, in groups of 3-4 members and guided by the teacher, prepare a lecture on a topic of their choice among the following:

4.1 Electrocardiography.
4.2 Ultrasound.
4.3 Biomaterials and biomechanics.
4.4 Cardiac assist systems.
4.5 Electroencephalography.
4.6 MRI (magnetic resonance imaging).
4.7 Tomography.

There will also be room for other topics proposed by the students that will be presented to the rest of the students and from which they will extract some questions for the final exam.

Section 5: LABORATORY

Design, assembly and testing of an electronic circuit for measuring biological signals, such as an optical photoplethysmographic detector.

Translated with www.DeepL.com/Translator (free version)

EVALUATION AND CRITERIA

The use of AI to produce full assignments or substantial parts thereof, without proper citation of the source or tool used, or without explicit permission in the assignment instructions, will be considered plagiarism and therefore subject to the University's General Regulations.

Grading

Continuous evaluation EC:

- Partial P: written exam with test part and development part. 25% of the grade
- Group work G: grade for group and cross-evaluation. 35% + 5% of the grade
- Continuous evaluation: tests. 20%.
- Laboratory (group): 15%.

If the final exam grade is higher than 4: 30% of the exam grade plus 70% of the continuous evaluation grade above. If it is lower than 4, the course will be failed with the final exam grade.

The re-sit evaluation is the same as in the ordinary exam, with the extraordinary exam (minimum grade 4) that substitutes the ordinary final exam.

Class attendance is mandatory, according to the Academic Regulations of the School of Engineering (ICAI). Attendance requirements
The attendance requirements will be applied independently for theory and laboratory sessions:
In the case of theory sessions, failure to comply with this rule may prevent taking the exam in the ordinary call.

In the case of the laboratory sessions, failure to comply with this rule may prevent the student from sitting for the exam in the ordinary and extraordinary
and in the extraordinary exam. In any case, unexcused absences to laboratory sessions will be penalized in the evaluation.

BIBLIOGRAPHY AND RESOURCES

Basic References

We will use a collection of notes prepared for the course without a reference textbook.

Nevertheless, various books will be used during the course, depending on the specific subject(s). The most important one is the following one (and its newer editions)

- John G. Webster (editor), "Medical Instrumentation : application and design", New Delhi : Wiley, 2015. ISBN 9788126553792

Complementary references:

- Joseph Bronzino, Susan~M. Blanchard, and John Enderle., *Introduction to Biomedical Engineering*. Academic Press, 1999. ISBN: 0122386604.
- B.H. Brown, R.H. Smallwood, D. Hose, et al., *Medical Physics and Biomedical Engineering*. The Institute of Physics, 1999, ISBN: 0750303689.
- Michael Domach., *Introduction to Biomedical Engineering*. Prentice Hall, 2003. ISBN: 0130619779.
- Leonard Johnson, editor, *Essential Medical Physiology.* Academic Press, 2003. ISBN: 0123875846.
- Robert Northop, *Signal and System Analysis in Biomedical Engineering.* CRC press, 2003. ISBN: 0849315573.
- Reinaldo Perez, *Design of Medical Electronic Devices.* Academic Press, 2002. ISBN: 0125507119.
- Ajit Sadana, *Engineering Biosensors: Kinetics and Design Applications*. Academic Press, 2001. ISBN: 0126137633.
- Daniel J. Schneck,Joseph D. Bronzino, *Biomechanics: Principle and Applications.* CRC Press, 2002. ISBN: 0849314925.