

BIOELECTRICITY

Code: 10004

Main Scientific Area: Electronics and Instrumentation

Lecturer: Nuno Sérgio Mendes Dias

Language of Instruction: Portuguese

Regime: S1

Contact Hours: 60h Total Workload: 100h

ECTS: 6,0

Objectives

The course of Bioelectricity studies the electrical phenomena that occur in biological tissue. This course is interdisciplinary and combines the life sciences to physical sciences and engineering, whose concepts are originally from the following disciplines: biophysics, bioengineering, biotechnology, medical electronics, medical physics and biomedical engineering. These phenomena include: the behavior of excitable tissue; currents and electric potentials in a volume conductor, the response of excitable tissue to stimulation by electric fields, the electrical properties intrinsic to biological tissue.

Learning Outcomes

In the end of this course students should be able to understand:

electrical behavior of the difference between passive and excitable biological tissues;

the origin of bioelectric signals;

the relationship between measurement, stimulation and impedance in biological tissue;

the clinical value and limitations of bioelectrical methods;

identify and understand the use of different types of electrodes for biopotentials.

Course Contents

1. Vector analysis
2. Sources and fields
3. Bioelectrical potentials
4. Channels, Action Potential and Propagation of Impulses
5. Electrical Stimulation and Excitable Tissue
6. Extracellular Field Potentials
7. Functional Organization of the Nervous System and Cardiovascular biopotentials

8. Biopotentials

9. Electrodes for biopotentials

Recommended Bibliography

1. Bioimpedance and Bioelectricity Basics, S. Grimnes e O. G. Martinsen, 2ª edição, Academic Press, 2008.
2. Bioelectricity: a quantitative approach, Robert Plonsey e Roger C. Barr, 3ª edição, Springer, 2007
3. Medical Instrumentation: Application and Design, John G. Webster, Wiley, 4ª edição, 2009.

Learning and Teaching Methods

Since the main objective of the course is to understand the electrical phenomena that underpin the various techniques used in bioelectric medical practice, the syllabus was organized to allow a gradual acquisition of knowledge from the fundamentals to the applications. The program begins with a review/deepening of knowledge about sources and electric fields and then are studied the electrical characteristics of the various types of biological tissues, where a comparison is made between biological behavior and electrical circuits. In the end, it is studied/demonstrated the use of electrical phenomena in medical diagnosis (ie bioelectrical signal measurement), intervention/medical therapy (ie electrical stimulation of biological tissue) and biopotential electrodes.

Assessment Methods

The course evaluation should include 3 written tests (TE) to be held during the school year and 1 practical assignment (TP). The final classification (CF) should result from the following weighted average:

$$CF = 25\% \times TE1 + 25\% \times TE2 + 25\% \times TE3 + 25\% \times TP$$

minimum score: $\text{average}(TE1, TE2, TE3) > 10,0$ points and $TP > 10.0$ points

The student will be approved to the course when his rank is equal to or higher than 9.5/20 points. If the student did not get approved on regular season, he can always be submitted to appeal and be evaluated on the TE1, TE2 and TE3 parts at once. The practical assignment (TP) is only evaluated on regular season and the score on normal season is kept to other evaluation seasons.