INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Bioelectricity			Field of study	Physics		
Bachelor in	Biomedical Technology			School	School of Technology and Management		
Academic Year	2022/2023	Year of study	1	Level	1-1	ECTS credits	6.0
Type	Semestral	Semester	1	Code	9600-752-1102-00-22		

Workload (hours)	162	Contact hours	T -	TP 60	PL -	TC -	S -	E -	OT -	O -

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): Fernando Jorge Coutinho Monteiro, Arlindo dos Santos Machado Pascoal

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Apply the proper concepts and fundamental laws related to Electrostatics and Electromagnetism.
2. Understand the concepts and fundamental laws of DC and AC systems.
3. Apply properly the fundamental techniques analysis of circuits in DC and AC.
4. Understand the mechanisms of bioelectricity in the human body.
5. Relate electrical concepts and applications to the field of Biomedical Technology.
6. Use laboratory equipment in the implementation, test and analysis of basic electric circuits.

Prerequisites

Before the course unit the learner is expected to be able to:
Know the basic mathematical formalisms.

Course contents

Mathematical revisions. Electrostatics. The energy. Direct current. Bioelectricity. Alternate current.

Course contents (extended version)

1. Mathematical revisions
   - Operations with vectors.
2. Electrostatics
   - General concepts and electric charge.
   - Force, potential and electric field.
   - Discrete and continuous charge distribution.
   - Electric flux and Gauss´s law.
3. Energy
   - Ways and transformation of energy.
   - Economy and energy use.
   - Advantages of electric energy.
4. Direct current
   - Ohm's and Joule´s laws.
   - Electric resistance and resistances association.
   - Electric power.
   - Real and ideal voltage and current sources.
   - Association and equivalence of sources.
   - Kirchhoff's laws. Matrix methods for complex circuits resolution.
   - Superposition theorem, Thévenin and Norton theorems.
   - Duality and equivalence.
   - Transient and forced response. RC and RL circuits.
5. Bioelectricity
   - Electrical phenomena in cells.
   - Membrane resistance and capacity.
   - Electrical resistance of the human body.
   - Physiological effects due to the passage of electrical current by the human body.
6. Alternating current
   - Steinmetz transform.
   - Ohm's law, induction and charge laws.
   - Impedance, admittance and power factor.
   - Series and parallel RLC circuits.
   - Kirchhoff's Laws and matrix methods for complex circuits resolution.
   - Superposition theorem and Thévenin and Norton theorems.
   - Active, reactive and apparent power.

Recommended reading

1. Fernando Monteiro, "Apontamentos de Bioeletricidade", ESTiG - IPB, 2020.
2. O'Malley John, "Análise de Circuitos", McGraw- Hill, 1983.
3. Gussow Milton, "Electricidade Básica", McGraw-Hill, 1985.
4. Acácio Amaral, "Eletrónica Analógica: Princípios, Análise e Projectos", Edições Sílabo, 2017.

Teaching and learning methods

Lectures and problem-solving classes: presentation of the course contents, problem solving and realization of laboratory experiments, in order to consolidate and integrate the knowledge acquired.

Assessment methods

- Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
  - Laboratory Work - 40%
  - Final Written Exam - 60%

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Fernando Jorge Coutinho Monteiro	José Luís Sousa de Magalhaes Lima	Joana Andrea Soares Amaral	Paulo Alexandre Vara Alves
04-10-2022	16-10-2022	31-10-2022	05-11-2022