INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Biomedical Instrumentation			Field of study	Instrumentation and Biomedical Signals		
Bachelor in	Biomedical Technology			School	School of Technology and Management		
Academic Year	2022/2023	Year of study	2	Level	1-2	ECTS credits	6.0
Type	Semestral	Semester	1	Code	9600-752-2104-00-22		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			30	-	30	-	-	-	-	-

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

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. describe the principles, applications and projects of instrumentation commonly used in hospitals for research and development in Biomedical Technology;
2. design and implementation of systems for measurement of biomedical signals;
3. select the appropriate transducers for each type of measurement;
4. understand the appropriated signal conditioning circuits;
5. carry through the interface between the medical staff and the medical instrumentation companies;
6. provide technical support in the field of electronical medical instrumentation.

Prerequisites

Before the course unit the learner is expected to be able to:
1. know the fundamentals of electrical and electronics engineering;
2. know the concepts of human physiology.

Course contents

Basic concepts of biomedical instrumentation. Characterization of biomedical signals. Basic concepts of sensors and transducers. Electrodes and amplifiers of biopotential. Instruments for measuring bioelectric signals. Instruments for measuring blood pressure and sounds. Instrumentation for evaluating the respiratory system. Integrated concept of security in biomedical instrumentation.

Course contents (extended version)

1. Basic concepts of biomedical instrumentation:
   - terminology of medical instrumentation;
   - classification of biomedical instruments;
   - regulation of medical devices.
2. Characterization of biomedical signals:
   - transduction and measurement of physiological events;
   - biopotencials: bioelectrical phenomena, biomedical and bioelectrical signals diverse;
   - origin of the biopotencials, ranges of frequencies and amplitudes;
   - bioelectrogenese: ECG, EEG, EMG.
3. Basic concepts of sensors and transducers:
   - displacement sensors;
   - resistive sensors;
   - inductive sensors;
   - capacitive sensors;
   - piezoelectric sensors;
   - radiation sensors;
   - temperature measurements.
4. Electrodes and amplifiers of bio-potential:
   - electrode-electrolyte interface;
   - polarization;
   - behavior of the electrodes and types of circuits;
   - electrode surface-invasive electrodes;
   - basic requirements of a bio-potential amplifier;
   - analysis of a general bio-potential amplifier.
5. Instruments for measuring bio-electric signals:
   - Electrocardiogram (ECG);
   - Electroencephalogram (EEG);
   - Electromyogram (EMG).
6. Instruments for measuring blood pressure and sounds:
   - systems for measuring blood pressure;
   - phonocardiography and heart sounds;
   - systems for measuring blood flow and volume.
7. Instrumentation for evaluating the respiratory system:
   - measure of pressure;
   - measure of gas flow;
   - lung volume;
   - respiratory plethysmography;
   - measures of concentration of gases.
8. Integrated concept of security in biomedical instrumentation:
   - physiological effects of electric and magnetic fields;
   - micro-shock and macro-shock hazards;
   - safety standards.

Recommended reading

1. Medical Instrumentation, Application and Design (4th edition), John G. Webster, Editor, John Wiley and Sons, 2008.
2. Introdução à Instrumentação Médica, J. H. Correia e J. P. Carmo, LIDEL, 2013.
3. Design and Development of Medical Electronic Instrumentation: A Practical Perspective of the Design, Construction, and Test of Medical Devices, D. Prutchi and M. Norris, John Wiley and Sons Inc, 2004.
4. Introduction to Biomedical Engineering (2nd edition), John Enderle, Susan Blanchard, Joseph Bronzino, Elsevier Academic Press, 2005.
5. Measurement Instrumentation and Sensors Handbook, John G. Webster, CRC, 1999.

Teaching and learning methods

Lecture classes set out the foundations of medical instruments which are frequently used in hospitals and their applications. The problem-solving, project or laboratory classes have high experimental component, with the completion of several experimental works.

Assessment methods

- Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
  - Practical Work - 40% (These works will focus on the implementation of laboratory works with Arduino.)
  - Final Written Exam - 60% (Without consulting notes.)

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

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28-09-2022	16-10-2022	31-10-2022	07-11-2022