

230694 - IBES - Introduction to Biomedical Electronic Systems

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering
Academic year: 2017
Degree: MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5 Teaching languages: English

Teaching staff

Coordinator: Riu Costa, Pere Joan
Others: Garcia Gonzalez, Miquel Angel
Riu Costa, Pere Joan

Degree competences to which the subject contributes

Specific:

CEE9. Ability to design, implement and operate high performance laboratory electronic instrumentation, with emphasis on error analysis, calibration and virtual control.

CEE21. Ability to process continuous variable signals using digital techniques.

CEE11. Ability to evaluate the quality and safety of electronic products including reliability, physical testing, electrical safety and electromagnetic compatibility.

Transversal:

CT2. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.

CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

Teaching methodology

- Lectures
- Application classes
- Laboratory practical work
- Exercises

Learning objectives of the subject

The aim of the subject is to make students aware of the different kinds of signals that can be acquired from a human body and enable them to be able to select instruments, use them and acquire signals and process the signals to obtain estimators relevant for the clinical practice.

Learning results of the subject:

Ability to understand the function of electrodes as electrical interfaces, especially for wearable applications

Ability to understand the physical functions of sensors used to build biomedical equipment.

Ability to understand the technical specifications of measurement equipment and electronic components used to design

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biomedical instrumentation.

Ability to acquire biological signals and process them to obtain clinically relevant parameters.

Ability to understand the regulations concerning biomedical systems, including safety and EMC.

Study load

Total learning time: 125h	Hours large group:	19h	15.20%
	Hours small group:	20h	16.00%
	Self study:	86h	68.80%

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Content

<p>Introduction to Biomedical Systems</p>	<p>Learning time: 5h Theory classes: 1h Self study : 4h</p>
<p>Description: Introduction to the objectives of the subject . Basic definitions. Concept of biomedical Engineering. Historical review</p> <p>Related activities: understand the complexity of signals that can be acquired from a live being, the restriction on system design and the necessary regulations associated.</p>	
<p>Endogenous electrical signals</p>	<p>Learning time: 22h Theory classes: 4h Laboratory classes: 2h Self study : 16h</p>
<p>Description: Electrobiological Phenomena. Biomedical Electrodes. Dry electrodes and non-contact electrodes for for wearable systems. Requirements for biopotential measurement systems</p> <p>Related activities: Laboratory. Acquisition of Bioelectric Signals</p> <p>Specific objectives: understand the origin of endogenous electrical signals in living beings. Understandd the function of electrodes and their impact on system design and quality of recorded signals. Ability to record and process biopotential signals from human body.</p>	
<p>Electrical, mechanical and thermal properties of Biological materials</p>	<p>Learning time: 14h Theory classes: 4h Self study : 10h</p>
<p>Description: mechanical properties. Optical properties. Thermal properties (Bioheat Thermal Equation). Dielectric properties</p> <p>Specific objectives: understand the passive properties of biological materials. Understand the sensors and excitation needed to obtain information from passive properties. Be able to make estimators of body composition and fluid shifts out of impedance measurements. Be able to obtain the cardiac rhythm from optical properties of muscle.</p>	

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<p>Diagnostic devices and systems</p>	<p>Learning time: 72h Theory classes: 6h Laboratory classes: 18h Self study : 48h</p>
<p>Description: Monitors for electric signals (ECG, EEG, EMG, ...). Blood pressure measurements. Flux, flow and cardiac output measurements. Impedance plethysmography and impedance cardiography. Respiratory flux and volume. Imaging Systems (MRI, CT, PET, ...)</p> <p>Related activities: LABORATORY - Ventilation Monitoring with Thermistor - Blood flow monitoring with photoplethysmograph - Respiratory sinus Arrhythmia quantification</p> <p>Specific objectives: Ability to understand the physical principle of sensors being used in measurements on the human body. Ability to design and customize electronic circuits for the measurement of biological signals. Ability to process signals to obtain clinically relevant information.</p>	
<p>Therapeutic Devices and Systems</p>	<p>Learning time: 12h Theory classes: 4h Self study : 8h</p>
<p>Description: Electrical Stimulation. Magnetic Stimulation. Heating (including ESU)</p> <p>Specific objectives: Ability to understand the physical principles of electrical and magnetic stimulation. Ability to understand thermal processes in the human body.</p>	

Qualification system

Final exam 50%
mid-term exam 5%
Exercises 5%
Laboratory Assessment (including reports) 40%

Regulations for carrying out activities

No devices with wireless communication capabilities will be allowed during exams.

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Bibliography

Basic:

Kramme, R.; Hoffmann, KP; Pozos, RS. Springer handbook of medical technology [on line]. Springer, 2011 [Consultation: 21/09/2016]. Available on: <<http://dx.doi.org/10.1007/978-3-540-74658-4>>. ISBN 9783540746584.

Complementary:

Plonsey, R.; Barr, R.C. Bioelectricity: a quantitative approach [on line]. 3rd ed. New York: Kluwer Academic/Plenum, 2007 [Consultation: 21/10/2016]. Available on: <<http://dx.doi.org/10.1007/978-0-387-48865-3>>. ISBN 9780387488646.

Pavlovic, M. Bioengineering, a conceptual approach [on line]. Springer, 2015 [Consultation: 21/09/2016]. Available on: <<http://dx.doi.org/10.1007/978-3-319-10798-1>>. ISBN 9783319107981.

Leitgeb, N. Safety of electromedical devices [on line]. Springer, 2010 [Consultation: 21/09/2016]. Available on: <<http://dx.doi.org/10.1007/978-3-211-99683-6>>. ISBN 9783211996836.