Universitat Autònoma de Barcelona

2019/2020

Biomedical Engineering and Application of Electronics

Code: 101923
ECTS Credits: 6

Degree	Type	Year	Semester
2501230 Biomedical Sciences	OT	4	0

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

Teachers

Xavier Navarro Acebes
Elena Valderrama Vallés
Jaume del Valle Macia

Prerequisites

No pre-requisites

Objectives and Contextualisation

The objective of this course (optional) is to introduce the student to the world of Biomedical Engineering so that at the end of the course it is capable of:

Identify the different branches of Biomedical Engineering and learn through analyzing practical cases and examples which tools and solutions can bring engineering to biomedicine
Understand the where and how Biomedical Engineering can contribute to solving problems related to Biomedical Sciences.
Understand the importance and scope of multidisciplinary and of converging technologies to understand and propose ways of solving already posed biomedical problems.
Communicate with an engineer in terms of defining the problems in terms that are understandable to both, understand the limitations of engineering, contribute to establish the product specifications, contribute to plan a project, analyze together with engineers the results obtained and propose lines of improvement
Understand, familiarize yourself with and use tools, methodologies and ways of doing common in all engineering and that are part of the engineering skills.

Competences

- Contribute to public discussions on cultural matters.
- Develop independent learning habits and motivation to continue training at postgraduate level.
- Develop scientific knowledge, critical reasoning and creativity.

- Display knowledge of engineering methodologies in nanotechnology and electronics with the aim of applying them to biomedicine.
- Identify and understand the advances and challenges of research.
- Read and critically analyse original and review papers on biomedical issues and assess and choose the appropriate methodological descriptions for biomedical laboratory research work.
- Show respect for the ethical and legal aspects of research and professional activities.
- Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Learning Outcomes

1. Classify the principles and applications of electronics to biomedicine.
2. Contribute to public discussions on cultural matters.
3. Develop independent learning habits and motivation to continue training at postgraduate level.
4. Develop scientific knowledge, critical reasoning and creativity.
5. Discern the methodologies of bioengineering and their applications.
6. Display knowledge of engineering methodologies in nanotechnology and electronics with the aim of applying them to biomedicine.
7. Identify and understand the advances and challenges of research.
8. Read specialised texts both in English and ones own language
9. Search for and manage information from various sources
10. Show respect for the ethical and legal aspects of research and professional activities.
11. Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.

Content

1. Biomedical engineering. Definition. Methodologies and tools. References.
2. Generic areas of bioengineering
    1. Modeling and simulating biological phenomena
    2. Biomechanics. Instrumentation. Clinical Engineering. Prosthesis. Rehabilitation.
    3. Cell cultures. Tissue engineering. Biomaterials.
    4. Wellness, mental and emotional disorders: health promotion, prevention, support to the diagnostic,follow-up.
3. Electronic Bases
    1. Basics of electricity and electronics.
    2. Electricity and biological environments. Neural electrical activity. Neural models.
    3. Systems: Transduction. Treatment. Sensing. Electrodes. Actuators.
    4. Signals: Decomposition. Harmonics, Acquisition. Amplification. Filters.
    5. Microelectronics, Microsystems and nanotechnologies.
4. Electronic applications
    1. Visualization of the fisiology: ECG, EMG, EEG. Electrophysiological signal analysis.
    2. Acting on physiology I: Pacemaker, cochlear implants, functional electrical stimulation.
    3. Acting on Physiology II: Implantable devices (technology, biocompatibility, telemetry).
5. Micro-Nano-Bio-Info technologies and their applications.
    1. Implantable systems
    2. Functional recovery: Prosthetics and neuroprostheses
    3. Multimodal analysis
6. Engineering tools, methodologies and tasks
    1. Intellectual property. Patents & Regulations
    2. Preparation of reports and projects. Feasibility analysis

Methodology

The development of the course is based on a series of formative activities that require the presence of the student in the classroom or laboratory (directed activities), the study of a case to be carried out under the supervision of a teacher (supervised activities), and an important part of the student's personal work (autonomous activities).

The directed activities include theoretical classes, three practices in the laboratory, and a series of seminars in which the topics discussed in the lectures will be expanded and worked on.

A few hours are reserved for the presentation of a series of cases. Each student will choose one of these cases that he must prepare and defend.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Case studies	4	0.16	
Laboratory	9	0.36	
Lectures	30	1.2	
Seminars	8	0.32	
Type: Supervised			
Tutorials	5	0.2	
case study	20	0.8	
Type: Autonomous			
Study by yourself	68	2.72	

Assessment

The achievement of the learning results by the student is evaluated based on the practices carried out in the laboratory (10%), the study and presentation of a case (20%) and two tests of synthesis of the knowledge acquired in different aspects of the subject (35% + 35%). To pass the subject it is necessary to obtain a minimum grade of 5 in each of these activities. The final grade will be the weighted average of activities 1, 2, 3 and 4 (see table "Evaluation activities"). In case this condition is not met, the student will have the option to recover this part in a recovery test.

To participate in the recovery, students must have been previously evaluated in a set of activities the weight of which equals a minimum of two thirds of the total grade of the subject or module. Therefore, the students will obtain the "Not Evaluable" qualification when the evaluation activities carried out have a weight lower than 67% in the final grade.

Attendance at practical sessions is mandatory. The students will obtain the grade of "Not Evaluable" when the absence is superior to 20% of the programmed sessions

Not evaluable: The student who, at the end of the course, has not submitted to any evaluation activity, will be graded with a "not evaluated".

Review of evidence and claims: Along with the publication of the grades in the virtual campus will indicate the dates, times and place in which the student can review the tests and comment the grades with the teacher.

Claims that may arise from this review will be evaluated, in the first instance, by the professor responsible for the subject.

Second (and subsequent) enrollments: Students who do not enroll for the first time in the subject and who have been evaluated in previous editions have the option of only presenting to the synthesis test if and only if they obtained a grade equal to or greater than 5 in activities 1 and 2. In this case, the final grade will be the grade obtained in the synthesis test, without taking into account any ofthe grades previously obtained. The student must apply for this option to the teacher responsible for the subject, sending a message through the Virtual Campus of the subject before October 15.

(Explanatory note: Some evaluation activities have no assigned hours since their implementation has been included in the table of teaching and training activities)

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Laboratory	10%	0	0	6, 4
Practical work, case studies and oral and/or written presentation	20	2	0.08	9, 2, 3, 7, 8, 11
Synthesis test II	35%	2	0.08	4, 5, 7
Synthesis test II	35	2	0.08	10, 1, 6, 4

Bibliography

Introduction to Bioengineering. A. Berger, W. Goldsmith, E.R. Lewis. Oxford Univesity Press 1996.
Biomedical Engineering: Bridging Medicine and Technology.W. Mark Saltzman Published by Cambridge University Press 2009.
Biomedical Engineering Handbook. J.D. Bronzino. CRC Press 2006.