Teaching guide

IDENTIFICATION DETAILS

Degree:	Biomedical Engineering
Field of Knowledge:	Science
Faculty/School:	Experimental Science
Course:	EXPERIMENTAL METHODS II
Type:	Compulsory
ECTS credits:	6
Year:	3
Code:	2459
Teaching period:	Sixth semester
Area:	Experimental Methods
Module:	Disciplinary Training
Teaching type:	Classroom-based
Language:	English
Total number of student study hours:	150

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SUBJECT DESCRIPTION

Experimental Methods II is an advanced hands-on laboratory course focused on the development of research

processes, medical technology understanding, and projects related to Biomedical Engineering. This course provides insight into multidisciplinary areas of biomedical engineering and gives the students experience, instruction, training, and interdisciplinary teamwork. The course has been designed for students to gain solving-problem skills in simulated real-life hospital environments and state-of-the-art biotech research laboratories. All these together consolidate the degree's theoretical contents offered during the 3rd year of the Biomedical Engineering degree program.

This course is intended for students to integrate solutions based on their basic knowledge of physiology, biology, engineering, and math. This course will provide the students with design-thinking skills, technical communication, ethical behavior, and research tools.

Experimental Methods II is a compulsory, 150 hours semester course that is taught in English during the third year of the Biomedical Engineering Degree. This course is part of the Practicum subjects, which belongs to the Experimental Methods in Bioengineering basics module.

Experimental Methods II focuses on strengthening the fundamental skills necessary for students to prepare for a career in the biomedical sciences. This course emphasizes the theoretical as well as the applied aspects of basic methodologies in research. The majority of class time will be designed to provide students with ample hands-on time in the lab that provides them with practical experience in the topics covered in the preceding lectures, and to practice their skills in the presence of the course instructor.
The course focuses on providing students with a set of basic laboratory skills, such as safety practices, laboratory physics and mathematics, design and rapid prototyping, documentation, biomedical instrumentation, biomaterials, tissue engineering, ethics, and good laboratory practices.

GOAL

The general objective of this course is to provide third-year college students with a thorough understanding and hands-on experience in the design, development, and testing of different biomedical devices. This includes a comprehensive study of electronics and sensors, control systems, biomaterials, cells and tissues, and simulation techniques. The course aims to integrate theoretical knowledge with practical skills to prepare students for advanced research or professional practice in biomedical engineering.

The specific aims of the subject are:

To understand the principles of rapid prototyping of Prosthetic and Orthotic Devices.

To gain proficiency in the use of electronics and sensors essential for the development and operation of biomedical devices.

To understand the fundamentals of analog control systems and their applications in biomedical engineering.

To explore the properties and applications of various biomaterials used in biomedical devices.

To study the interaction between biomaterials and biological tissues, and understand the principles of biocompatibility and tissue engineering.

To learn to use simulation software and its application in biomedical engineering and in biomedical devices.

To understand the fundamental principles of design, including the creation of prototypes and circuits.

To develop skills in designing, building, and testing different systems for biomedical application.

PRIOR KNOWLEDGE

Students in this course are expected to have a fundamental knowledge of:

1. Laboratory Safety Rules
2. Microsoft Office Suite, G Suite, or similar programs for written documents and oral presentations.
3. Data processing (e.g..MatLab, Python, Excel)
4. Technical or Intermediate Level of English

It is strongly recommended that students have satisfactorily completed Experimental Methods I, Electronic Engineering (Ingeniería Electrónica), Control Systems (Sistemas de Control), Anatomy and Physiology.
Also, it is strongly recommended that students be enrolled in the Tissue Engineering and Biomaterials courses.

COURSE SYLLABUS

The course is focused on hands-on training to introduce students to various engineering designs and testing techniques used in biomedical engineering laboratories. These different abilities will provide them insights into multidisciplinary areas of biomedical engineering and give them experience and instruction in interdisciplinary teamwork, technical communication, understanding the principle of work, and in-laboratory experimentation.
The content covered in this course includes:

- Laboratory Environment and Laboratory Safety
- Orthesis Design and Rapid Prototyping User's Needs and Design ThinkingAnthropometric MeasurementsDesing and 3D Printing
- Tissue Engineering Cell Viability to a biomaterial (Viability, growth, live/dead, cytotoxicity)
- Biomaterials Testing Techniques and Analysis TensionCompresion
- Bioinstrumentation and Control Systems Electronic Circuit Design and AnalysisSensors and Control SystemBioinstrument design and construction
- Simulation and XR technologies

In addition, in this course, students are expected to act as active members of the scientific community, who will plan, design, prepare, and develop biomedical engineering solutions in the form of mini-projects.
All these together in accordance with laboratory notebook for record-keeping, data analysis and report, basic laboratory material and devices, safety, and general regulations for biomedical equipment.

EDUCATION ACTIVITIES

Course topics will be covered with different learning methodologies that include laboratory practices, flipped-classroom, discussions, and team-based experimental approaches. Students are expected to perform autonomous work by reading, asking questions, participating in class, performing background research, and preparing laboratory practices and activities. For lab sessions, the goal is for students to acquire the knowledge, skills, and tools to finish the lab assignments. The instructor will give demonstrations and short lectures to build students' skills, and students will spend the remaining time working on the laboratory assignments.
The majority of class time will be designed to provide students with ample hands-on time in the lab to practice their skills in the presence of the course instructor.

DISTRIBUTION OF WORK TIME

CLASSROOM-BASED ACTIVITY	INDEPENDENT STUDY/OUT-OF-CLASSROOM ACTIVITY

60 hours	90 hours

SKILLS

Basic Skills

Students must have demonstrated knowledge and understanding in an area of study that is founded on general secondary education. Moreover, the area of study is typically at a level that includes certain aspects implying knowledge at the forefront of its field of study, albeit supported by advanced textbooks

Students must be able to apply their knowledge to their work or vocation in a professional manner and possess skills that can typically be demonstrated by coming up with and sustaining arguments and solving problems within their field of study

Students must have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgments that include reflections on pertinent social, scientific or ethical issues

Students must be able to convey information, ideas, problems and solutions to both an expert and non-expert audience

Students must have developed the learning skills needed to undertake further study with a high degree of independence

General Skills

to understand, apply, adapt and develop tools, techniques and experimental protocols with methodological rigour and safety, understanding the limitations of the experimental approach.

Specific skills

To know the fundamentals and applications of the principal experimental techniques and clinical equipment used in monitoring, diagnosis and treatment in biomedicine, as well as employing and analysing the results with scientific rigour and a humanistic perspective.

To know the fundamentals of the design, control, optimisation, simulation, installation and maintenance of biomedical devices, equipment, systems and processes.

LEARNING RESULTS

To understand the physic principles of biomedical signal acquisition.

To identify the materials and use of the main equipment used in basic experimental science laboratories.

To understand correctly and with scientific rigor the experimental results obtained in the laboratory.

To communicate adequately the procedures and results obtained in experiments related with the Biomedical Engineering field both in a written and oral way.

To get a global vision on the different knowledge areas which conform the Biomedical Engineering field, identifying the link between them.

Being able to use helping tools in design and adjustment control systems with applications in biological systems and biomedical devices.

To learn the basics for prototype design and improvement with the goal of product, device and equipment implementation in the biomedicine area under economic viability criteria.

LEARNING APPRAISAL SYSTEM

Attendance to all sessions is mandatory (regardless of the location: including laboratories, computer lab, FabLab, etc.). Absences must be justified to the Professor in Charge of the Course (PEC). Unjustified non-attendance to any of these sessions will result in failing the course in the ordinary period. The instructor(s) may not allow any student to enter the laboratory after the session has started.

EVALUATION SYSTEM DURING ORDINARY PERIOD

- The evaluation system of Experimental Methods II includes the assessment of all the activities covered during teaching-learning process of the course. A minimum grade of 5 (out of 10) is required to pass this course.
- The final grade will be determined by the distribution of 100% across different tasks including assignments, laboratory practices and reports, exams, and in-lab activities.
- Grades are numerical and range from a minimum of 0 (Zero) to a maximum of 10 (Ten), including one decimal value.
- Late submissions will NOT be accepted and represent a grade of zero (0) for that specific assignment or evaluation.
- The final grade for the course will be the sum of percentages obtained in each category.
- To pass this course students must obtain a minimum grade of 5 (out of 10) in each module of each evaluation activity AND an overall average final grade of 5 (out of 10).
- There will be no rounding!

The final grade will be calculated based on the following percentages corresponding for each evaluation activity:

EV1 -Exams (ES1) and Assignments (ES2): 60%.

The goal of this assessment is to evaluate the overall learning of the course content. Students will demonstrate the integration, comprehension, and ability to relate the content covered in this course; as well as analysis, calculation and problem-solving skills.

To pass this course, students must obtain a minimum grade of 5 (out of 10) in each module of EV1.

EV2 – Lab Work and Lab reports (ES3): 40%.

This assessment evaluates the student's understanding of experimental procedures and techniques applied in the laboratory sessions, their connection with the theoretical concepts, the required calculations, the experimental work, the interpretation and discussion of the experimental results, and the clarity and presentation of the report, and the correctness of the written expression.

To pass the course, students must obtain a minimum grade of 5 (out of 10) in each module of EV2.

EVALUATION SYSTEM DURING EXTRAORDINARY PERIOD

From the above contributions and for the extraordinary evaluation, only those grades with a minimum of 5 (out of 10) will be kept.

ALTERNATIVE EVALUATION SYSTEM

Due to laboratory-based nature of this course, alternative evaluation system does not apply.

Plagiarism, fabrication, falsification, or the use of illegitimate methods for presenting data, documents, reports, or any task related to the course, will be penalized as written in the Normativa de Evaluación and the Normativa de Convivencia of the University.
-(ES) evaluation system

BIBLIOGRAPHY AND OTHER RESOURCES

Basic

Michael F. Robbins Ultimate Electronics: Practical Circuit Design and Analysis First Edition

U. A. Bakshi and S. C. Goyal Control Systems Engineering Second Edition

Joon B. Park and Joseph D. Bronzino Biomaterials First Edition

Additional

Instructors Additional Information CANVAS
Relevant additional reference texts, library resources, and freely accessible internet sites related to this course will be provided. Additional course materials could also include research articles and readings posted on the virtual classroom portal (CANVAS).