Teaching guide

IDENTIFICATION DETAILS

Degree:	Biomedical Engineering
Field of Knowledge:	Science
Faculty/School:	Experimental Science
Course:	TISSUE ENGINEERING
Type:	Compulsory
ECTS credits:	6
Year:	3
Code:	2461
Teaching period:	Sixth semester
Area:	Bioengineering
Module:	Disciplinary Training
Teaching type:	Classroom-based
Language:	English
Total number of student study hours:	150

Teaching staff	E-mail
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SUBJECT DESCRIPTION

La ingeniería de tejidos es un tema interdisciplinario en rápido desarrollo que se basa en diferentes aspectos de las ciencias de la vida, la ingeniería y las ciencias físicas para abordar el mantenimiento, la reparación y el reemplazo de tejidos dañados o enfermos. Por lo general, esto implicará el uso de un andamio de biomaterial para hacer crecer células en construcciones de tejido 3D que se pueden trasplantar al paciente para mejorar su salud.

En vista de la importancia de la ingeniería de tejidos en la Ingeniería Biomédica, esta asignatura tiene como objetivo desarrollar competencias que un futuro ingeniero biomédico podrá desarrollar en las áreas descritas anteriormente, ya sea desde un punto de vista científico o desde un punto de desarrollo tecnológico.

Tissue engineering is a rapidly evolving interdisciplinary field aimed to maintain, repair, recover, create, or replace the function of damaged or diseased tissue. The main aspects included in this field are related to cell biology, material sciences, and engineering. Typically, engineered tissues are created using specific cell types and growing them on different materials, this involves the use of a biomaterial as a scaffold which allows cell attachment and growth into a 3D structural constructs that can be later transplanted into the patient. All these together, to recover any lost functionality and to improve patient's health.
Students will focus on learning and understanding different strategies to repair, replace and regenerate various tissues and organs to solve major clinical problems, from a scientific point of view and from a technological development point of view, gaining insights into various topics including stem cells, tissue/organ biofabrication, cell and gene therapies, commercialization and clinical translation of regenerative therapies.

GOAL

The general goal of the Tissue Engineering course is to provide students with a comprehensive understanding of the principles, methodologies, and applications of tissue engineering. This includes strategies to repair, replace, and regenerate various tissues and organs to solve important clinical problems. Students will gain insight into state-of-the-art topics such as stem cells and biofabrication, including 3D bioprinting, and acquire knowledge of biomaterials, cell biology, and bioengineering techniques to develop biological substitutes that can restore, maintain, or improve tissue function.
In this course, students will learn to identify major clinical needs and propose novel therapeutic solutions in the field of biomedical engineering.

The specific aims of the subject are:

To understand the fundamentals of Tissue Engineering.

To understand the importance of stem cells to succeed in generating a tissue, even in pathological situations.

To analyze clinical applications and case studies.

To know the different types of celular cultures.

To acquire skills in cell culture techniques, understand the factors affecting cell proliferation and differentiation, and explore methods for engineering different types of tissues.

PRIOR KNOWLEDGE

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

- Cellular and Molecular Biology
- Basic principles of procaryotic cells, cell culture, and manipulation
- Cell response, biochemical and biophysical mediators
- Human and living organism physiology
- Understanding of laboratory materials and manufacturing techniques
- Microsoft Office Suite, G Suite, and similar programs for written documents and oral presentations.
- Technical or Intermediate Level of English

It is recommended that the student has approved all these subjects: Chemistry, Physics, Physiology, and Cellular

and Molecular Biology.

COURSE SYLLABUS

This course is designed to familiarize the students with the tissue engineering concepts, and current practices. Topics covered in this course include lectures, literature reviews, practical sessions, case studies, assignments, and a project, and are divided into the following topics:

- Block I: Cell culture Introduction to cell cultureRequirements for the culture of mammalian cellsAssessment techniques in mammalian cultures (growth and live cell studies)Isolation and establishment of primary cell cultures and cell linesGeneration of genetically modified cell cultures
- Block II: Introduction to Tissue Engineering Fundamentals of Tissue EngineeringFundamentals of Regenerative MedicineStem cellsCell types, cell plasticityEthical Issues and Regulations
- Block II: Methodologies in Tissue Engineering Decellularization and RecellularizationCharacterization and preparation of biological scaffoldsBiocompatible materials3D BioprintingMicrofluidics and organ-on-a-chipOrganoids
- Block III: Clinical Applications in Tissue Engineering and Regenerative Medicine Cell Gene and Cell TherapyExtracellular matrix and relevance of the environment3D cell culture platformsTissue RegenerationOrgan Regeneration

In addition, this course offers Laboratory Practices.

EDUCATION ACTIVITIES

Course topics will be covered with different learning methodologies that include lectures, tutorials, practical sessions, flipped-classroom, discussions, and a team-based project. The course also includes in-class discussions and debates for tissue engineering and regenerative medicine therapies that include design, selection, assessment, implementation, follow-up, publication, and clinical translation.
As part of the learning activities of this course, students are expected to act as constructive critical members of the scientific community, who review scientific articles to investigate different tissue engineering technologies and their application and to include ethical considerations. Moreover, students are expected to perform autonomous work by reading, asking questions, participating in class, performing background research, preparing assignments and activities to diffuse the acquired knowledge, and keeping up to date with classes.
For practical sessions (laboratory), 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 tasks.

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 know and assimilate scientific-technical knowledge and competencies and their application to medical and biological systems with the ability to identify and understand autonomously the continuous advances being made in biomedical technologies.

Specific skills

To use the technological and engineering tools necessary for the design of processes and the manufacture of tissue and biomaterials for application in Biomedical Engineering.

LEARNING RESULTS

To know the working principles of the main techniques used for monitoring physiological functions and diagnosis and treatment of pathologies.

To acknowledge with scientific rigor the experimental results obtained in the laboratory.

To apply main fabrication and characterization techniques in tissue engineering and biomaterials.

LEARNING APPRAISAL SYSTEM

The final grade for the course will be determined by the distribution of 100% in different activities including participation, peer review, assignments, exams, laboratory sessions, assignments preparation and presentation, exercices, and literature research.
Grades are numerical and range from a minimum value of 0 (Zero) to a maximum value of 10 (ten), including one

decimal value.
The grading in this course is meant to be transparent and to encourage continuous learning throughout the course. The student's individual final grade consists of the components listed below.

Grading System during the ordinary period:

- Exams 60% *(Minimum grade required)
- Lab, practical work, and reports 20% (No Minimum grade)
- Prep. and Pres. of Assignments 10% (No Minimum grade)
- Completion and Presentation of Activities 10% (No Minimum grade)

- Late submissions will NOT be accepted and will represent a grade of zero (0) in that specific assignment or evaluation.
- The final grade will be determined by the direct sum of percentages obtained in each distribution.
- To approve this course students are required to obtain a minimum grade in those evaluations marked with an asterisk (*) AND a minimum average final grade of 5/10.
-There will be no rounding!

Exams *

- Partial Exams will be administered during the course to assess students' performance.
- There is no minimum grade required for partial exams.
- A minimum grade of 5/10 is required to the final exam.
- It is mandatory to approve the final exam to pass the course, otherwise, the student is required to take an evaluation in the extraordinary period.

Labs, practical work, and reports

This course contains hours of practical laboratory work. Attendance is mandatory!

- Attendance to lab practices is mandatory.
- Students are expected to read the procedure of each session in advance as well as prepare a pre-lab write-up.
- Evaluations of the lab session include preparation of the pre-lab assignment, participation during lectures and discussions, following lab safety rules, a document, and the quality of data and results obtained.
- At the end of each lab session, students will be required to write a properly formatted report due on the dates established in the virtual classroom portal (CANVAS).
- There is no minimum grade.
- Justified absence: Missing lab, practical work, or report with valid justification will require direct coordination with the instructor for lab recovery.
- Although late reports will be required, the grade for the assignment will remain as late work.

Preparation and Presentation of Assignments

- The information and expectations for each assignment will be described in class. Those documents usually include literature reserach and presentation of state-of-the-art technology in tissue engineering, and possible applications in clinical therapies.
- Some weeks during the course will be allotted for assignments discussion.
- There is no minimum grade.

Completion and Presentation of Activities

- The information and expectations for each task, work, activities and/or exercises will be described in class.
- Those topics usually include literature reserach, exercises, work, and presentations of results.
- Part of the sessions could be allotted for work, examples, and exercises discussion.
- There is no minimum grade.

Attendance and Participation

- Class attendance will be checked regularly.
- Students are expected to read materials provided prior to class, attend, and be attentive.
- Review discussions of readings and assignments will take place in and out of class, or by online methods.
- Instructors may introduce pop quizzes (exams) if the discussion indicates poor student preparation.

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.
Important: Attendance to all laboratory sessions and seminars is mandatory, and it is a requisite to be eligible for final evaluation. Students must be in the audience for all assignments, exercises, work and presentations, otherwise, it will be counted as a non-justified absence. The non-attendance to any session should be justified within the next 3 calendar days. Tardies are counted for students arriving 11 minutes or more after the class has started. Students with 4 or more tardies, or 80% or less attendance, will be reported to the program coordinator and may fail the continuous evaluation and the course.
Alternative evaluation system

- There is no alternative evaluation system that applies to this course.

Evaluation during the extraordinary period (If the student fails the course):

- Those students who fail or do not attend any mandatory part to pass this course, will be required to take each missing evaluation in the extraordinary period.
- The exam in extraordinary includes all the information taught during the course.
- The minimum grade to pass the evaluation in the extraordinary period is 5/10 (for each failed or missed part).
- The final grade of the course would be calculated as stated above for the ordinary period. Therefore, students should achieve a minimum average course final grade of 5/10.

BIBLIOGRAPHY AND OTHER RESOURCES

Basic

Lanza, R., Langer, R., and Vacanti, J.P. Principles of Tissue Engineering Fourth Edition

Daniel Eberli Tissue Engineering of Tissue and Organ Regeneration First Edition

Additional

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