Cell culture and biotechnology for tissue engineering

Academic Year: (2020 / 2021) **Review date: 18-03-2018**

Department assigned to the subject: Bioengineering and Aeroespace Engineering Department

Coordinating teacher: GARCIA DIEZ, MARTA

Type: Electives ECTS Credits : 6.0

Year : 4 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

The student must have coursed Introduction to Bioengineering, Cell and Molecular biology, Biochemistry, Biomechanics of continuum media I (solids), Biomechanics of continuum media II (fluids) Fundamentals of Tissue engineering and Regenerative
medicine, Transport phenomena in Biomedicine, and Introduction to Biomaterials.

OBJECTIVES

Regenerative Medicine (RM) and Tissue Engineering are multidisciplinary fields that apply the principles of life science, engineering, and basic science to the development of viable substitutes which restore, maintain, or improve the function of human tissues.
This course is designed to provide an advanced knowledge of tissue and organ regeneration and a practical point of view to tissue engineering, understanding the biotechnological tools to generate each component.
Students will be required to learn and gain expertise from analysis of primary literature about the design of tissue functional units.
The student will acquire the ability to design biological tissues by using advanced techniques in bioengineering and biotechnology from the developmental point of view. The students will acquire the ability to understand the importance of stem cells and gene therapy in order to succeed in the generation of a tissue, even in pathological situations.

DESCRIPTION OF CONTENTS: PROGRAMME

PROGRAM:

1.Tissue¿s organization and development. Concepts of Embryogenesis and Morphogenesis.

2. Tissue/Organ Engineering Paradigm. Biotechnology.

3. Bioreactors for biotechnology.

4. Use of recombinant technologies in Tissue Engineering.

5. Gene therapy.

6. Gene delivery systems (viral and non-viral).

7. Next-generation Gene-therapy: Gene Editing.

8. Transgenic organisms as biofactories.

Organ reconstruction

9.Transplantation and rejection.
10. Stem cells.

11. Practical examples for organ reconstruction.

Regulations and Clinical use:

12 Advance therapy medicinal products.

13. Government regulations for engineered tissues.

LABORATORY EXPERIMENTS:
Cell Culture Laboratory for Biotechnology and Tissue Engineering.

a. Experimental design and methods that will be useful for tissue characterization and development

b. Understand biomaterial generation for organ bioengineering.

c. Stem cell harvest and isolation.

d. Tissue/organ bioengineering.

d. Tissues histological and molecular characterization using biotechnological tools.

e. Critical evaluation of scientific results.

LEARNING ACTIVITIES AND METHODOLOGY

The program will be divided into master classes, seminars and laboratory practical sesions.
Students are required to read or resolve assigned chapters, articles, problems, etc., before the corresponding classes.
To facilitate learning, students will receive the slide of each class and the bibliography.
The seminars will contain the discussion of relevant scientific articles and problems that will be presented by the students.
In the laboratory classes, students divided in 2-3 students small groups will perform a reduced experimental design with the help of the teaching team.
The student will be familiar with ethical and regulatory issues related to tissue engineering and regenerative medicine.
Students will be required to elaborate a report discussing the experiments performed, the obtained results, the relevance and applications in biomedicine and the experience and skills gained. These classes includes the problems and discussion sections.

ASSESSMENT SYSTEM

TEACHING METHODOLOGY
Teaching methodology will be mainly based on lectures, seminars and practical sessions.
Students may be required to read assigned documentation before lectures and seminars. Lectures will be used by the teachers to stress and clarify some difficult or interesting points from the corresponding lesson, previously prepared by the student.
Grading will be based on continuous evaluation tests and a final exam covering the whole subject. Help sessions and tutorial classes will be held prior to the final exam upon student's request.
Attendance to lectures and seminars is not compulsory. However, failure to attend any test will result in a mark of 0 in the corresponding continuous evaluation block (see below).
The practical sessions will consist on laboratory work (5 sessions) and a report will be presented at the end of the course.
The attendance to 80 % of practical sessions is mandatory otherwise the score will be 0 in this item.
GRADING:
Total score: 10 points
Continuos evaluation: 4 points out of 10
Final exam: 6 points out of 10
CONTINUOUS EVALUATION: It accounts for up to 40% of the final score of the subject (4 points of the TOTAL SCORE), and includes two components:
1) Continuos evaluation test and students presentations: (2.5 points of THE TOTAL SCORE).
2) Experimental development: 1.5 point of the TOTAL SCORE.
Attendance to at least 80% of the practical sessions is mandatory; otherwise the score will be 0 in this item.

FINAL EXAM: The final exam will cover the whole subject (and may include the laboratory sessions) and

will
account for the 60 % of the final score. The minimum score in the final exam to pass the subject is 4.5 over 10, not with standing the mark obtained in continuous evaluation.

EXTRAORDINARY EXAM: The mark for students attending any extraordinary examination will be:
a) 100% exam
b) 60% exam and 40% continuous evaluation if it is available in the same course
ACADEMIC CONDUCT: Unless specified all exams will be closed-book, closed-notes, no PC or mobile phone, or anything else other than a writing implement and the exam itself. Plagiarism, cheating or other acts of academic dishonesty will not be tolerated. Any infractions what so ever will result in a failing grade.

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- Atala A, Allickson J. Translational Regenerative Medicine. 1st edition, Elsevier, 2014
- Baptista PM, Atala A, Laurence J. Translating Regenerative Medicine to the Clinic, 1st Edition., Elsevier, 2015
- Guilak F, Butler, DL, Goldstein SA, and Mooney DJ Functional Tissue Engineering, Springer, 2003
- Lanza RP, Langer R, Vacanti J Principles of Tissue Engineering. Third edition, Academic Press, 2007
- Mescher AL JUNQUEIRA'S BASIC HISTOLOGY: TEXT AND ATLAS, Mc Graw Hill, 2013
- Palsson BO, Bhatia SN Tissue Engineering, Upper Saddle River: Pearson Prentice Hall, 2004
- Saltzman MW Tissue Engineering: Engineering Principles for the Design of Replacement Organs and Tissues, Oxford University Press, 2004
- Vunjak-Novakovic G, Freshney RI Culture of Cells for Tissue Engineering (Culture of specialized Cells), Springer, 2006