Introduction to Biomaterials

Academic Year: (2020 / 2021) **Review date: 10-07-2020**

Department assigned to the subject: Bioengineering and Aeroespace Engineering Department

Coordinating teacher: VELASCO BAYON, DIEGO

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Cell and Molecular Biology
Biochemistry

OBJECTIVES

This course is designed to provide a comprehensive understanding of the multidisciplinary field of biomaterials, focusing on the biological responses to materials and the clinical context of their use. Through lectures, paper reviews, in class discussions and invited lectures, students will be introduced to the Biomaterials Science and the physiological interactions between body environment and biomaterials. Students will be required to acquire understanding and expertise from analysis of primary literature and will complete group presentations on the status of state-of-the-art biomaterial applications, including medical implants, artificial organs, and scaffolds for tissue engineering.

DESCRIPTION OF CONTENTS: PROGRAMME

This course is intended to provide a general understanding of the multidisciplinary field of biomaterials. Specifically, different types of biomaterials and the body¿s natural responses to biomaterial implantation will be studied. In addition, biomedical applications of biomaterials as well as design and development of commercial products will be addressed.

1. Introduction to Biomaterials. Basic concepts
2. Polymers and hydrogels for biomedical applications
3. Ceramics for biomedical applications
4. Biomaterial degradation
5. Designing biomaterials for 3D printing
6. Surface modification of biomaterials
7. Extracellular matrix-based biomaterials
8. Biomaterial implantation: acute inflammation and wound healing
9. Immune response to biomaterials
10. Infection, tumorigenesis and calcification of biomaterials
11. Blood-biomaterial interactions

LEARNING ACTIVITIES AND METHODOLOGY

The program will be divided into master classes (lectures) and discussion/problem classes (seminars). For specific subjects, there will be invited lectures given by prestigious professionals in the field. The topics covered by the invited speakers are part of the subject and will be evaluated in the continuous evaluation blocks and in the final exam as well. Students may be required to read assigned chapters/articles before the lectures and seminars. In the discussion classes, relevant scientific articles and problems will be presented and discussed by the students and the teaching team.

ASSESSMENT SYSTEM

Grading will be based on continuous evaluation and a final exam covering the whole subject, including invited lectures and seminars. Help sessions and tutorial classes will be held prior to the final exam upon students´ request. Attendance to lectures and seminars is not compulsory. However, failure to attend any test or submit the exercises before the deadline will result in a mark of 0 in the corresponding continuous evaluation block (see below).

GRADING:
Total score: 10 points
Continuous evaluation: 7.1 points out of 10
Final exam: 2.9 points out of 10

CONTINUOUS EVALUATION: It accounts for up to 71% of the final score of the subject (7.1 points of the TOTAL SCORE), and includes two components:
1) Two tests: 5.8 points of THE TOTAL SCORE (2.9 points each). These tests will take place mostly during lectures and will be announced at least one week in advance. If a student passes each continuous evaluation test (minimum score: 5 over 10), topics included in the corresponding test will not be included in the final exam.
2) Scientific paper presentation: 1.3 points of THE TOTAL SCORE.

FINAL EXAM: it will account for the 29 % of the final score (2.9 points of the TOTAL SCORE). The minimum score in the final exam to pass the subject is 5 over 10, notwithstanding the mark obtained in continuous evaluation

EXTRAORDINARY EXAM: there are two possibilities:
a) Examination of all the topics of the course (100% extraordinary exam mark)
b) Examination of the topics included in the continuous evalution tests and/or the final exam when failing any/both of those tests. The weights of those test will be kept (2.9 points).

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 whatever will result in a failing grade.

% end-of-term-examination:	29
% of continuous assessment (assigments, laboratory, practicals…):	71

BASIC BIBLIOGRAPHY

- Chee Kai Chua, Wai Yee Yeong Bioprinting: Principles and Applications, World Scientific Publishing Company, 2015

- David Williams Essential Biomaterials Science, Cambridge University Press, 2014

- Jason A. Burdick and Robert L. Mauck Biomaterials for Tissue Engineering Applications: A Review of the Past and Future Trends, Springer Verlag, 2011

- Johnna S. Temenoff and Antonios G. Mikos Biomaterials: The Intersection of Biology and Materials Science, Prentice Hall, 2009

ADDITIONAL BIBLIOGRAPHY

- Abul K. Abbas, Andrew H. Lichtman and Shiv Pillai Cellular and Molecular Immunology, Saunders, 2011

- Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen and Jack E. Lemons Biomaterials Science: An Introduction to Materials in Medicine, Academic Press , 2012

- Clark R.A.F. and Henson P.M. The Molecular and Cellular Biology of Wound Repair, Plenum Press, 1996

- Kay C. Dee, David A. Puleo and Rena Bizios An Introduction to Tissue-Biomaterial Interactions, Wiley-Liss, 2002

- María Vallet-Regí Bio-Ceramics with Clinical Applications, Wiley, 2014