In the field of biomedicine, biomaterials have become a key component in a large number of products for clinical application. In this sense, it can be said that in modern medicine the use of medical materials and devices improves the quality of life of millions of people around the world. That is why it is considered that the last course of a degree in biotechnology, within the biotechnology module of health, students should be trained in understanding the relationship between the structure of materials. A solid knowledge in this area will allow students to interact efficiently with the industry that develops the latest advances in medical technologies, with doctors who have to use the materials in their daily practice and the regulatory bodies that decide that it can be used in medical practice.

With this idea in mind, the course has been designed to be multidisciplinary and interdisciplinary at the same time. In this line, it is intended to put, jointly within the reach of the students, different disciplines of science and classical engineering as well as new paradigms that complete the existing gaps in classical knowledge.

**COMPETENCES** (of the course placed in relation to the pre-assigned competences in the subject matter)

- That students know how to apply their knowledge to their work or vocation in a professional manner, and have acquired the competencies that allow them to elaborate and defend arguments as well as to solve problems within their area of study (CB2)
- That students have developed those learning skills necessary to undertake further studies with a high degree of autonomy (CB5)
- Be able to assess the impact of their professional activity on the sustainable development of society. (T3)
- Be able to understand and apply advanced knowledge of Biosciences and Engineering to the field of Biotechnology. (E3)
- Be able to use tools, systems or processes to carry out the activities in the field of Biotechnology according to the established requirements. (E4)
• Be able to integrate the knowledge and tools of biotechnology for their application to different industrial sectors that use, develop or produce biotechnological products or processes. (E6)

PREVIOUS REQUIREMENTS * (modules, subject matters, courses or knowledge necessary for the follow-up of the subject. State previous courses required to be completed)

The core competencies of the fundamental module.

CONTENTS (List the content of the course, with up to two level detail)

1.- Biomaterials
   1.1. Biomaterial definition
   1.2. Biomaterials interaction with the.
   1.3. Biomaterials and regenerative medicine.
   1.4. Biomaterials and Medical devices.
   1.5. Biomaterials classification.
2.- Materials science basics
   2.2. Order and disorder.
   2.3. Structure of the most important materials.
   2.4. Defects in materials structure
   2.5. Solidification
   2.6. Phase diagrams introduction
   2.7. Mechanical properties of materials
   2.8. Materials behavior on service
   2.9 Materials with medical applications description
3.- Biomaterials processing
   3.1. Metals.
   3.2. Ceramics.
   3.3. Polimers.
4.- Biocompatibility
   4.1. General introduction
   4.2. Cellular activity and biocompatibility
   4.3. Practical examples
5.- Biomaterials in regenerative medicine and Tissue engineering.
   5.1. Biomaterials within the regenerative medicine paradigm
   5.2. Design and manufacturing of scaffolds as tissue engineering platform.
   5.3 Clinical applications
6.- Biomaterials for drug and gene delivery.
   6.1. Controlled administration of active.
   6.2. Non-oral delivery systems
   6.3. Micro and nano particles in drug delivery.
   6.4. Biomaterials as therapeutic agents.

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6.4. Biomaterials for non-viral gene delivery
7.- Medical devices and artificial organs
   7.1: Orthopedic examples.
   7.2 Cardiovascular examples.
   7.3. Maxillofacial examples.
   7.4. Soft tissue repairing
8.- Regulatory and ethical problems..

METHODOLOGY

LEARNING ACTIVITIES * (Complete the table relating activities, workload in ECTS credits, and competences.)

<table>
<thead>
<tr>
<th>Learning Activities</th>
<th>ECTS Credits</th>
<th>Competences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>1,4</td>
<td>E3, E4, E6</td>
</tr>
<tr>
<td>Case and Problem-Solving Sessions</td>
<td>0,1</td>
<td>B2</td>
</tr>
<tr>
<td>Seminars</td>
<td>0,1</td>
<td>T3, E3, B2</td>
</tr>
<tr>
<td>Practical and Lab Work</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Presentations</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Personal Study</td>
<td>3,3</td>
<td>B2, B5, T3, E3, E4, E6</td>
</tr>
<tr>
<td>Assessment Tasks (Exams, Continuous Assessment...)</td>
<td>0,1</td>
<td>B2, E3, E4</td>
</tr>
<tr>
<td>TOTAL</td>
<td>5,0</td>
<td>B2, B5, T3, E3, E4, E6</td>
</tr>
</tbody>
</table>

TEACHING METHODOLOGY (justify the teaching methodology in relation to the competences and course contents. Between 100 and 200 words)

The methodology combines master classes with work in the Laboratory and interactive work using the Internet. Thus, three hours of master classes per week are carried out during a semester, which allows to progress slowly and progressively throughout the syllabus.

At the end of each chapter, the student performs a self-assessment test by means of the subject's page in Moodle®. To follow its evolution, the results are sent directly to the teacher. The same happens with the work of the practices. Throughout the course, exercises are organized in wiki format. In addition, students in Groups, after each class write their version of the information received (notes) in the Moodle® blog option. After the correction and evaluation by the teachers of the subject, these chapters are available to students to prepare the exams of the subject. Within each chapter there are a series of questions that the student can answer to the teacher through the course of the subject and that allow to follow the student's learning.

Finally, the students prepare a glossary of the most outstanding concepts of each class received (Moodle® glossary option).

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ASSessment

Assessment Methods * (Complete the table relating assessment methods, competences, and weight percentage in the course qualification)

<table>
<thead>
<tr>
<th>Assessment methods</th>
<th>Weight</th>
<th>Competences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final Exam</td>
<td>40%</td>
<td>B2, E3, E4, E6</td>
</tr>
<tr>
<td>Midterm Exam/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous Assessment Activities</td>
<td>35%</td>
<td>B2, E3, E4, E6</td>
</tr>
<tr>
<td>Reports and Presentations</td>
<td>20%</td>
<td>T3, E6, B5</td>
</tr>
<tr>
<td>Lab or Field Work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Projects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Host Student Evaluation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participation</td>
<td>5%</td>
<td></td>
</tr>
</tbody>
</table>

Learning Outcomes (Explanation of the student's achievements that allow the assessment of competences, relating them to the competences and the assessment methods)

- The student will demonstrate the ability to answer the theoretical questions in the final exam. [TO] (B2, E3, E4, E6)
- The student will demonstrate a basic understanding of the relationship between structure and properties in biomaterials. [A, F] (B2, E3, E4, E6, T3, B5)
- The student will demonstrate the ability to deliver answers and share ideas electronically. [B, C] (B2, E3, E4, E6, T3, B5)
- The student will demonstrate the ability to solve "cases" in the exam. [A, G] (B2, E3, E4, E6, T3, B5)
- The student will demonstrate the ability to present their ideas in public. [D] (B2, E3, E4, E6)

Qualification (Explanation of the qualification system)

A. At the end of the course the final exam is carried out, which is compulsory to pass the subject (40% of the final grade). The minimum grade to average with the rest of the notes is a 4 (40% of the total)
   A. Tests: After each chapter a test is placed on the Blackboard® page of the subject. The results are automatically sent to the teacher.
   B. Homework: Throughout the course, 2 exercises are organized in Wiki format. Students have to write, via a web application, the answer to a topic related to the subject. In addition, the teacher proposes a specific question in class after each chapter. The student can discuss them with classmates and the teacher, using the online forum on the website of the subject on the Blackboard®. The result of these exercises corresponds to 10% of the final grade

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C. Oral presentations: Students may submit one corresponding to their work at home. The note of the oral presentation is 10% of the final grade.
D. Participation in class is promoted, but it has no influence on the final grade.
E. Two to three continuous evaluation exercises will be carried out. The grade will represent 25% of the final grade.
F. In order for the continuous assessment exercises to average with the final exam, the average grade must be higher than 7 (70%).
G. The passing of the subject is achieved when the average between the final exam and the continuous assessment exercises is greater than 6 (60%)

ASSESSMENT OF THE COMPETENCES (Describe the grading system for each competence in relation with the assessment tasks)

For the evaluation of the competences of the subject (B2, B5, T3, E3, E4, E6) in each of the evaluation activities a part of the note will reflect the competences acquired. The B2 competition will be evaluated in the elaboration of the wikis as well as in the final exam. The B5 competence will be assessed with specific aspects of the final exam questions. The E3 and E4 competences will be evaluated in the resolution of cases in the final exam, and in the programmed controls. The T3 competence will be measured by defining the ability to present and defend job reports. The E6 competence will be measured in specific sections of the final exam, the programmed controls, the project, the practices and the presentations measuring the knowledge of practical applications of the biomaterials. Each evaluation activity will have a maximum score of 100 points that will be divided into quantities that quantify the degree of acquisition of competences by the student.

BIBLIOGRAPHY (Recommended and accessible to the student.)

Books

Ashby, M.F., Jones, D. R., , P.L. Materiales para Ingeniería 1, Introducción a las propiedades, las aplicaciones y el diseño., Ed. Reverté, Barcelona, 1ª Edició 2010.

Software


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COURSE: BIOMEDICAL DEVICES AND BIOMATERIALS

SUBJECT MATTER: Biomaterials
MODULE: Biotechnology for Health
PROGRAM: Degree in Biotechnology

DOCUMENT HISTORY

PREVIOUS REVISIONS (Indicate date and author / s, first the most recent one)

CURRENT REVISION (Indicate date and author / s)
March 2019, Dr. Salvador Borrós, Dra Cristina Fornaguera

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