Teaching guide

IDENTIFICATION DETAILS

Degree:	Biotechnology
Scope	Biology and Genetics
Faculty/School:	Experimental Sciences
Course:	BIOENGINEERING
Type:	Compulsory
ECTS credits:	3
Year:	3
Code:	2053
Teaching period:	Sixth semester
Subject:	Biotechnological Process Engineering
Module:	Biotechnology Tools
Teaching type:	Classroom-based
Language:	English
Total number of student study hours:	75

SUBJECT DESCRIPTION

The subject has been designed to equip the student with a sound knowledge on aspects of engineering that are relevant to its relationship with biotechnology. Particular emphasis is placed on the issues related to engineering materials applied in biological or biotechnological systems, including synthetic materials inspired by natural (biomimetic) ones. An extensive introduction is also given to two fields of growing interest: nanotechnology and early detection (biosensors), in particular, appreciating the influence of both fields in the development of biotechnology.

To achieve the knowledge, the subject is structured in three independent modules:

Biomaterials and biomimetics

Biosensors and Surface functionalization
Introduction to Nanotechnology

The combination of the three modules, offers a general picture of diverse scientific areas such as Engineering, Materials Science, Biochemistry or Microelectronics, among others. The course is organized so that the three modules complement and improve each other, highlighting the importance of interdisciplinarity in the present science.
This subject belongs to the module “Biotechnological tools” and it consists of 30 hours of master class and 75 hours of total student work. Within the curriculum, this subject is related to Fundamentals of Physics and Chemistry, Fundamentals of Biochemistry and Fundamentals of Mathematics. With regard to its relationship with subjects of higher courses, it is necessary to emphasize its connection with Bioreactors and with Chemistry and Engineering of Proteins.

GOAL

This subject belongs to the Biotechnological Tools Module. The objective is to make students familiar with the main applications of materials in Biotechnology, in particular biomimicry, surface modification and its applications in the development of devices for early disease detection and nanotechnology.
Likewise, the objective is that students can understand the importance of interdisciplinarity in the development of current science and its biotechnological applications.

The specific aims of the subject are:

Use of tension and deformation concepts in the description of the mechanical behavior of the materials.

Classification of biomaterials in metallic, ceramic, polymeric and natural.

Identification of the interactions responsible for conformations in biomolecules.

Use of self-assembly and hierarchical microstructure concepts in the context of Biomimicry.

Learn the concept of Biosensor and identify its constituent parts.

Understand the different classification categories of biosensors.

Study of the different biosensors classified by transducer.

Know the fundamental properties that characterize the behavior of materials at the nanoscale.

Know, identify and classify nanometric structures manufacturing techniques.

Knowing the applications of structures and devices in the biotechnology sector.

Understand the social and environmental implications of the progress of nanotechnology.

PRIOR KNOWLEDGE

The previous knowledge required to follow the subject corresponds to the basic subjects of previous courses related to Fundamentals in Physics, Biochemistry and Biology.

COURSE SYLLABUS

The subject is divided into three different modules: Biomaterials and biomimetics, Biosensors and Surface functionalization and Introduction to Nanotechnology.

PART I: BIOMATERIALS AND BIOMIMETICS (36%)
Unit 1: Biomaterials: Metals and Ceramics. Biological Polymers and Biomaterials
Unit 2: Biological fibers. Protein fibers. Polysaccharide fibers. Cellular fibers.
Unit 3: Biological materials: hard and soft materials.
Unit 4: Biomimetics. Self-assembly. Hierarchical structures.

PART II: FUNCTIONALIZATION AND BIOSENSORS (36%).
Unit 1: Biosensor. Definition. Differences with Chemical Sensors. Components of a Biosensor. Biosensors classification. Characteristics of a Biosensor.
Unit 2: Bioreceptors. Immobilization. Development of a biosensor. Surface Functionalization and Fabrication.
Unit 3: Electrochemical biosensors.
Unit 4: Optical biosensors.
Unit 5: Mass and nanomechanical biosensors.

PART III: INTRODUCTION TO NANOBIOTECHNOLOGY (28%)
Unit 1: Nanoscience and Nanotechnology.
Unit 2: Imaging and Manipulation Instruments.
Unit 3: Nanomaterials: Nanoparticles, Nanofibers, Dendrimers, Nanostructures, Nanotubes.
Unit 4: Nanobiotechnology in Biosensors for Diagnosis.
Unit 5: Nanobiotechnology in Regenerative Medicine.
Unit 6: Nanobiotechnology in Drug Release.
Unit 7: Nanotechnology and Society.

EDUCATION ACTIVITIES

Expository and participative teaching.
Seminars, round tables, workshops, tutorials, debates.
Evaluation.

DISTRIBUTION OF WORK TIME

TEACHER-LED TRAINING ACTIVITIES	INDIVIDUAL WORK
35 Horas	40 Horas

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

To understand the fundamental laws and principles of physics, mathematics, chemistry and biology as the foundation for the mental structure of a biotechnician.

To acquire the skills needed for experimental work: design, preparation, the compilation of results and the obtainment of conclusions, understanding the limitations of an experimental approach.

General Skills

To understand the fundamental laws and principles of physics, mathematics, chemistry and biology as the foundation for the mental structure of a biotechnician.

To acquire the skills needed for experimental work: design, preparation, the compilation of results and the obtainment of conclusions, understanding the limitations of an experimental approach.

Specific skills

Understand the foundation and applications of microarrays in biotechnology.

Study biological and biomimetic materials and their biotechnological applications.

LEARNING RESULTS

Identify the mechanical parameters relevant in the behavior of a material or structure.

Select materials suitable for use in medical treatments.

Apply the physical and biochemical principles to the development of bio-inspired materials.

Establish the connection between the microstructure and the properties of biological materials.

Identify the possibilities and applications of nanotechnology in the part of the biotechnology related to health: Regenerative Medicine, Diagnosis and Drugs release.

Establish the basis of synthetic and biological material interaction.

Identify the physical and biological mechanisms involved in biodetection.

Relation of the main concepts of biodetection with clinical reality.

Relation of basic updated knowledge of nanotechnology with the health area.

LEARNING APPRAISAL SYSTEM

The evaluation will be done through:
1. Evaluation of the theoretical content by an objective evaluation test: 100%. An ordinary theory test will be carried out, consisting of test questions (with subtraction of score in case of error). The exam will include questions from the three parts of the subject, which will be weighed in proportion to the number of hours of each part. To pass the exam, it is necessary to obtain a 5 in the global exam.
The extraordinary call will be a theory test under the same conditions as the ordinary one.

Plagiarism behaviors, as well as the use of illegitimate means in the evaluation tests, will be sanctioned in accordance with those established in the University's Assessment Regulations and Coexistence Regulations.

Alternative evaluation system: the same percentages and contributions are maintained as in the ordinary evaluation. Students in 2nd or subsequent enrollments must contact the teacher to request to take advantage of this system and find out through the virtual classroom the dates to carry out the various deliveries and activities.

ETHICAL AND RESPONSIBLE USE OF ARTIFICIAL INTELLIGENCE

1.- The use of any Artificial Intelligence (AI) system or service shall be determined by the lecturer, and may only be used in the manner and under the conditions indicated by them. In all cases, its use must comply with the following principles:
a) The use of AI systems or services must be accompanied by critical reflection on the part of the student regarding their impact and/or limitations in the development of the assigned task or project.
b) The selection of AI systems or services must be justified, explaining their advantages over other tools or methods of obtaining information. The chosen model and the version of AI used must be described in as much detail as possible.
c) The student must appropriately cite the use of AI systems or services, specifying the parts of the work where they were used and describing the creative process followed. The use of citation formats and usage examples may be

consulted on the Library website(https://www.ufv.es/gestion-de-la-informacion_biblioteca/).
d) The results obtained through AI systems or services must always be verified. As the author, the student is responsible for their work and for the legitimacy of the sources used.
2.- In all cases, the use of AI systems or services must always respect the principles of responsible and ethical use upheld by the university, as outlined in the Guide for the Responsible Use of Artificial Intelligence in Studies at UFV. Additionally, the lecturer may request other types of individual commitments from the student when deemed necessary.
3.- Without prejudice to the above, in cases of doubt regarding the ethical and responsible use of any AI system or service, the lecturer may require an oral presentation of any assignment or partial submission. This oral evaluation shall take precedence over any other form of assessment outlined in the Teaching Guide. In this oral defense, the student must demonstrate knowledge of the subject, justify their decisions, and explain the development of their work.

BIBLIOGRAPHY AND OTHER RESOURCES

Basic

edited by Jeffrey O. Hollinger. An introduction to biomaterials/Second Edition. 2012.

editors, Victor R. Preedy, Vinood B. Patel. Biosensors and environmental health/2012.

Brian R. Eggins. Chemical sensors and biosensors [electronic resource]/Chichester; Hoboken, N.J.:J. Wiley, c2002.

Jo Anne Shatkin. Nanotechnology:health and environmental risks/2013.

Additional

Jose Perez Rigueiro. Lessons from biological materials and biomaterials/Madrid:Universidad Politécnica de Madrid, [2006]