Universidad Zaragoza

Academic Year/course: 2023/24

69714 - Nanodiagnostics

Syllabus Information

Academic year: 2023/24
Subject: 69714 - Nanodiagnostics
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 633 - Master's Degree in Biomedical Engineering
ECTS: 3.0
Year:
Semester: Second semester
Subject type: Optional
Module:

1. General information

Early diagnosis and monitoring of relevant biomarkers during therapy significantly improve patient prognosis, particularly in heterogeneous diseases such as cancer or infections that may be caused by antibiotic-resistant pathogens.

Consequently, there is a continuous development of new diagnostic techniques and research into new biomarkers. The objective of the subject is that students learn how nanomaterials are being used to improve the sensitivity, precision and speed of biosensors and diagnostic imaging techniques.

Different types of nanobiosensors based on nanostructured materials will be described. Nanobiosensors based on magnetic nanoparticles, gold nanoparticles, etc. will also be introduced. The different types of biological materials that can be used as sensor elements and how to attach them to the nanomaterial will also be discussed.

The approach and objectives are aligned with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agendahttps://www.un.org/sustainabledevelopment/es/): Goals 3, 9 and 14.

2. Learning results

The student, in order to pass this subject, must demonstrate the following results:

Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context (CB. 6)

To know how to apply their acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study (CB.7).

To integrate knowledge and face the complexity entailed by the formulation of judgments based on incomplete or limited information that includes reflections on the social and ethical responsibilities linked to the application of their specialized knowledge and judgments (CB.8)

To communicate their conclusions and the ultimate knowledge and rationale behind them to specialized and non-specialized audiences in a clear and unambiguous manner (CB.9)

To possess the learning skills that will enable the students to continue studying in a largely self-directed or autonomous manner (CB.10).

To possess the aptitudes, skills and methods necessary to carry out multidisciplinary research and/or development work in any area of Biomedical Engineering (CG.1).

To be able to use engineering techniques, skills and tools necessary to solve biomedical and biological problems (CG.2).

To understand and critically evaluate scientific publications in the field of Biomedical Engineering (CG.3).

To be able to learn continuously and develop autonomous learning strategies (CG.4).

To be able to manage and use bibliography, documentation, legislation, databases, software and hardware specific to biomedical engineering (CG.5).

To be able to develop sufficient autonomy to participate in research projects and multidisciplinary scientific or technological collaborations in the field of Biomedical Engineering (CG.6).

To be able to analyse, design and evaluate solutions to biomedical problems through advanced knowledge and technologies in biomechanics, biomaterials and tissue engineering (CO.3)

To have knowledge in the field of biosensors and applied nanotechnology for their improvement.

To manage the basic terminology of the biosensor field, to understand the concepts and to relate them.

To appreciate the importance of nanobiosensors in the fields of clinical diagnosis and environmental control.

To choose the most appropriate biological recognition element for the design of a biosensor.

To choose the most suitable nanostructured transduction element for the design of a nanobiosensor according to its application.

To detect the weaknesses and strengths of a biosensor in order to know how to position it in the most appropriate branch of the

diagnostic market.

To write a scientifically valid report on an example of a nanobiosensor similar to those described during the term.

3. Syllabus

Theory

Topic 1. Introduction to biosensors: components, characteristics and classification. Advantages of nanobiosensors.

Topic 2. Biosensors based on nanostructured materials. Optical, electrical and mechanical nanobiosensors. Integration in microfluidic platforms or *lab on a chip*.

Topic 3. Biosensors based on nanoparticles.

Topic 4. Applications of nanobiosensors in clinical diagnostics.

Topic 5. Applications of nanobiosensors in environmental control.

Topic 6. Market aspects. Commercial nanobiosensors and companies that manufacture or market them. Examples of transfer from the laboratory to the market.

Practice

Practical sessions (4 h): synthesis of gold nanoparticles, characterization and detection of ionic strength changes in the sample.

4. Academic activities

Expository and participative lessons (all students). Presentation of contents by teachers, external experts or by students themselves, viewing of videos/discussions, etc.: 26 hours

Laboratory practices(in small groups). Synthesis and characterization of gold nanoparticles: 4 hours

Tutorial work(individual or group): 8 hours (non face-to-face).

Autonomous work(student): 34 hours

Assessment tests: 3 hours

5. Assessment system

Continuous assessment system:

E1: final exam (grade from 0 to 10): written exam with multiple choice, true or false, short development, multiple choice, etc. questions (50% of the final grade).

E2: Presentation and discussion of a paper (grade from 0 to 10): individually or in groups. A tutored bibliographic research on a nanobiosensor or an application will be carried out according to the student's or the teacher´s proposal. A written report will not be handed in but a presentation will be made in class. The knowledge about the subject of the work, the oral presentation and the performance in the questions and answers time will be assessed (50% of the final grade).

In order to average both assessment activities, it will be necessary to obtain at least 4 points out of 10 in each of them.

Overall assessment system

Students who do not pass the subject or do not opt for the previous assessment system, will be entitled to take a global test in each of the established calls for exams, on the dates and times determined by EINA.