SUBJECT TEACHING GUIDE

1012 - BIOSENSORS

University Master's Degree in the Science and Engineering of Light

Academic year 2023-2024

1. IDENTIFYING DATA					
Degree	University Master's Degree in the Science and Engineering of Light			Type and Year	Optional. Year 1
Faculty	School of Industrial Engineering and Telecommunications				
Discipline	SPECIALIZING IN LIFE SCIENCES AND HEALTH Specialisation Module				
Course unit title and code	1012 - BIOSENSORS				
Number of ECTS credits allocated	3	Term		Semester based (2)	
Web					
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. TECNOLOGIA ELECTRONICA E INGENIERIA DE SISTEMAS Y AUTOMATICA
Name of lecturer	FELIX FANJUL VELEZ
E-mail	felix.fanjul@unican.es
Office	E.T.S. de Ingenieros Industriales y de Telecomunicación. Planta: - 4. DESPACHO PROFESOR (S4003)
Other lecturers	JOSE LUIS ARCE DIEGO YAEL GUTIERREZ VELA

3.1 LEARNING OUTCOMES

- Knowledge of the main biophysical signals of the biological systems susceptible to be measured by means of biosensors.
Knowledge of the foundation of the process of transduction and measurement of biophysical signals, including the fundamental parameters.
Ability to obtain the requirements of a biosensor for a specific application, given its basic characteristics.
Knowledge of the instrumentation systems necessary for the operation of biosensors, mainly electronic.
Ability to design instrumentation systems that allow the proper functioning of biosensors.
Knowledge of the main techniques of analysis and processing of the signals coming from biosensors.
Ability to select and apply techniques for analyzing and processing biosensor signals.
Knowledge of the main types of biosensors, mainly electrical, chemical or optical.
Knowledge of optical biosensors based on reflectrometry, including NIR and Raman spectrometric biosensors, fluorescence and ellipsometric biosensors.
Knowledge of optical biosensors based on interferometry, including diffraction gratings and spectroscopic interferometry.
Knowledge of optical biosensors based on evanescent field, including Resonance of Surface Plasmons and optical waveguides.
Knowledge of optical nanobiosensors and optical biosensors in probes and optical fibers.
Knowledge of biosensor integration systems based on Lab-on-a-chip and microfluidics.
Knowledge of medical applications such as flow cytometry, genomic analysis, performing immunological tests, sepsis analysis, early detection of cáncer.
Ability to design and / or select optical biosensors according to the requirements of a medical application.
Knowledge of the systems of use of ICT platforms in biosensors, mainly to form networks of sensors and remote sensing.
Ability to choose the information transmission system of the biosensor signal in a specific application.

4. OBJECTIVES

To know the main signals and biophysical systems.
To know the basics of transduction and sensing systems.
Tp know the main types of biosensors, including optical.
To know the optical biosensors based on reflectometry, interferometry and evanescent field.
To know the nanobiosensors and optical biosensors in probes and optical fibers.
To know the biosensor integration techniques based on Lab-on-a-chip and microfluidics.
To know the main medical applications of optical biosensors.
To know the requirements and typology of ICT systems to form networks of biosensors and remote sensing systems.
Ability to design and / or select biomedical instrumentation for biosensors.
Ability to design and / or select techniques for analysis and treatment of biosensor signals.
Ability to design and / or select optical biosensors for a specific medical application.
Ability to design and / or select integration strategies for biosensors based on Lab-on-a-chip and microfluidics.
Ability to design and / or select ICT systems in biosensor networks and remote sensing.

6. COURSE ORGANIZATION

CONTENTS	
1	Introduction. Signals and biophysical systems.
2	Fundamentals of sensing and transduction. Biomedical instrumentation systems for biosensors. Analysis and processing of biosensor signals.
3	Typology of biosensors. Optical biosensors based on Reflectometry. Optical biosensors based on Interferometry and Polarimetry. Optical biosensors based on Evanescent field. Optical biosensors based on probes and fiber optic guides.
4	Integrated Lab-on-a-chip and microfluidics systems. Medical applications: flow cytometry, genomics, immunological tests, sepsis, cancer. Biosensors and ICT.

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Group work	Work	No	Yes	30,00
Practice memories	Work	No	Yes	40,00
Final written test	Written exam	Yes	Yes	30,00
TOTAL				100,00

Observations

The final mark will be the sum of the marks of each evaluation method. Attendance to lab and delivery of lab reports is mandatory.
Remote evaluation is considered, including reports, exercises, laboratory work and written tests, in case a new COVID-19 emergency alert makes it impossible to be implemented in person.

Observations for part-time students

Part-time students will receive a mark composed of mandatory lab work and lab reports (40%), and a specific final exam (60%).

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

Tuan Vo-Dinh, “Biomedical Photonics Handbook”, CRC Press, 2003.
Jeong-Yeol Yoon, Introduction to Biosensors, Springer, 2013.
Angela Leung , P. Mohana Shankar, Raj Mutharasan,”A review of fiber-optic biosensors”, Sensors and Actuators B 125 (2007) 688–703.