SUBJECT TEACHING GUIDE

1028 - Photonic Techniques for Monitoring and Control of Industrial Processes

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

Academic year 2024-2025

1. IDENTIFYING DATA			
Degree	University Master's Degree in the Science and Engineering of Light Master's Degree in Industrial Engineering	Type and Year	Optional. Year 1 Optional. Year 2
Faculty	School of Industrial Engineering and Telecommunications		
Discipline	SPECIALIZING IN ADVANCED MANUFACTURING Specialisation Module		
Course unit title and code	1028 - Photonic Techniques for Monitoring and Control of Industrial Processes		
Number of ECTS credits allocated	6	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	FRANCISCO JAVIER MADRUGA SAAVEDRA
E-mail	francisco.madruga@unican.es
Office	Edificio Ing. de Telecomunicación Prof. José Luis García García. Planta: - 3. DESPACHO PROFESORES (S324)
Other lecturers	

3.1 LEARNING OUTCOMES
- The student will recognize the importance of process monitoring and process control in the future industrial scenario and to provide solutions to what will be required in that sector.
- The student will recognize other mechanical, chemical or electronic techniques that are applied in process control and they will identify their limitations as alternative to photonic techniques for process control.
- The student will know and compare fundamentals, advantages, basic designs and limitations of laser-based systems, such as LIDAR, LIBS, LUT, Raman, Speckle, etc.
- The student will know and compare fundamentals, advantages, basic designs and limitations of systems based on 3D imaging, infrared imaging, thermal imaging, hyperspectral and multispectral imaging, structured illumination imaging, etc.
- The student will apply systems based on lasers, such as LIDAR, LIBS, LUT, Raman, Speckle, etc. to monitoring and control of processes.
- The student will apply systems based on 3D imaging, infrared imaging, thermal imaging, hyperspectral and multispectral imaging, structured illumination imaging, etc for process control and monitoring.
- The student will apply algorithms, controls or schemes for the analysis and decision-making based on data obtained with photonic techniques.

4. OBJECTIVES
To acquire a complete view of the importance of process monitoring and process control in the future industrial scenario that will habilitate the student to answer the questions and provide solutions for what is intended and required in that sector.
To know mechanical, chemical or electronic techniques that are applied in process control and to identify their limitations as alternative to photonics techniques for process control.
To understand the fundamentals, advantages, basic designs, limitations and application of systems based on lasers, such as LIDAR, LIBS, LUT, Raman, Speckle, etc., as well as systems based on 3D imaging, infrared imaging, thermal imaging, hyperspectral and multispectral imaging, etc.
To apply algorithms, controls or schemes for the analysis and decision making based on data obtained with photonic techniques

6. SUBJECT PROGRAM	
	CONTENTS
1	Introduction. What is process monitoring and control? Industrial needs
2	Non-photonic techniques for process monitoring and control (mechanical, chemical, electronic, ...)
3	Laser-based photonic techniques for process monitoring and control (LIDAR, LUT, LIBS, Raman, Speckle, ...).
4	Photonic techniques based on imaging for the process monitoring and control (3D, 2D, infrared, thermal, hyperspectral, multispectral, dual image, scanner, structured illumination, ...).
5	Data management, automatic decision making (fuzzy logic, artificial intelligence, statistical methods, etc.
6	Collaborative final work. Design of photonic systems for process control or scientific paper from practical data obtained during the lessons.
7	Final exam.

7. ASSESSMENT METHODS AND CRITERIA				
Description	Type	Final Eval.	Reassessn	%
Continuous evaluation activities	Others	No	Yes	30,00
Parcial exam (test)	Written exam	No	Yes	30,00
Final work	Work	Yes	Yes	40,00
TOTAL				100,00

Observations

The remote evaluation of the works, practical laboratory exercises and written tests is foreseen, in the case of a new health alert by COVID-19 making it impossible to carry out the evaluation in person.

Observations for part-time students

Continuous evaluation activities can be performed on virtual classroom.
Partial exams and final work in the same conditions as the rest of the students.

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

Handbook of Optical Fibre Sensing Technology (José Miguel López-Higuera (Editor)) / Wiley

An Introduction to Optoelectronic Sensors (Giancarlo C Righini, Antonella Tajani, Antonello Cutolo)

Theory and Practice of Infrared Technology for Nondestructive Testing 1st Edition (by Xavier Maldague (Author)) / Wiley-Interscience;

Laser-induced breakdown spectroscopy (LIBS): fundamentals and applications / edited by Andrzej W. Miziolek, Vincenzo Palleschi, Israel Schechter/ Cambridge University Press

OCT Made Easy /Hiram G. Bezerra, Guilherme F. Attizzani, Marco A. Costa/ CRC Press

Photonics for Safety and Security/ Edited By: Antonello Cutolo, Anna Grazia Mignani and Antonella Tajani

Smart Sensors for Industrial Applications/ Edited By Krzysztof Iniewski/ CRC Press

Infrared Thermal imaging/ M. Volmer K-P. Möllmann/ Wiley-VCH