Course guide
205085 - 205085 - Applications of Photonic Technologies

Last modified: 11/04/2025

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 748 - FIS - Department of Physics.

Degree: MASTER'S DEGREE IN AUTOMATIC SYSTEMS AND INDUSTRIAL ELECTRONICS (Syllabus 2012). (Optional subject).
MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN AERONAUTICAL ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN SPACE AND AERONAUTICAL ENGINEERING (Syllabus 2016). (Optional subject).
MASTER'S DEGREE IN MECHANICAL ENGINEERING RESEARCH (Syllabus 2024). (Optional subject).
MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2025). (Optional subject).

Academic year: 2025 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: CRISTINA MASOLLER

Others: Primer quadrimestre:
CRISTINA MASOLLER - 1
SANTIAGO ROYO ROYO - 1

TEACHING METHODOLOGY

The course develops through lectures imparted with the aid of power-point presentations. Practical examples open to discussion will be incorporated in the lectures. The students will also visit the research laboratories of Prof. Masoller (at Gaia building) and Prof. Royo (at CD6 Center) to gain hands-on experience on the operation of laser diodes and photonic sensors.

LEARNING OBJECTIVES OF THE SUBJECT

Light-based technologies are nowadays extensively developed and employed in many intelligent manufacturing environments, such as aerospace, automotive, energy, micro-manufacturing, semiconductors, surface finish, optics, etc. Femtosecond lasers and photonic imaging sensors are just two examples of photonic devices that are being widely used in the innovative manufacturing processes of medical devices, optoelectronic sensors, health and solar cells. By providing intelligence and interconnection, such photonic devices enable the design of new efficient and adaptive production concepts for the factory of the future.

This course will provide the students with a broad overview of Photonic Technologies for Industry 4.0, introducing the basics on detectors and emitters of radiation and focusing on applications in laser processing, inspection and monitoring systems for QA (Quality Assurance), self-driven cars and robotics, medical devices, predictive diagnostics and optical sensors for the IoT. Extended practical cases on three agreed use cases with hand-on work in the lab will be implemented, being possible the development of use cases proposed by the students as small projects.

STUDY LOAD

Type	Hours	Percentage
Hours large group	18,0	24.00
Hours small group	9,0	12.00
Self study	48,0	64.00

Total learning time: 75 h

CONTENTS

Module 1: Photonic devices and properties of light for applications

Description:
1.1. Properties of light from the point of view of applications.
1.2. Introduction to light sources (different types of lasers, LEDs), photonic detectors and sensors, and light handling and light shaping components for industrial applications

Related activities:
- Lectures and discussion of examples.
- Laboratory visit and systems manipulation.

Full-or-part-time: 37h 30m
Theory classes: 9h
Laboratory classes: 4h 30m
Self study : 24h

Module 2: Applications of Photonics to Industry 4.0

Description:
2.1. Applications of Photonics to Industry 4.0: laser processing, light-measuring systems (position, critical dimensions, speed, color, shape, texture, temperature, etc.), medical devices
2.2. Case studies: laser manufacturing, sensors for IoT (vibrometry, flowmetry), self-driving cars, in-vivo health monitoring

Related activities:
- Lectures and discussion of examples
- Module 2 involves three extended theory+lab sessions on agreed use cases, including theory and practical development. Alternatively, analysis of practical cases proposed by the students may be developed as short projects.

Full-or-part-time: 37h 30m
Theory classes: 9h
Laboratory classes: 4h 30m
Self study : 24h

GRADING SYSTEM

The students will have to present a report for each module of the course. One of the reports can be a short oral presentation (depending on the number of students) that will be followed by questions. The final grade will be the average of the grades obtained in the reports. The final grade will also take into account the student's participation in class and in the visits to the laboratories.

BIBLIOGRAPHY

Basic:
- Liu, Jia-Ming. Photonic devices. Cambridde: Cambridge University Press, 2005. ISBN 9780521551953.
- Donnelly, J., Massa, N. Light: introduction to optics and photonics. 2nd ed. Pittsfield: Photonics Media Press, 2018. ISBN 9780521551953.
- Iniewski, Krzysztof. Smart sensors: for industrial applications. Boca Raton: Taylor & Francis, 2017. ISBN 9781138077645.
- Charschan, S. S. Lasers in industry. New York: Van Nostrand Reinhold Co, 2016. ISBN 0442215169.

Complementary:
- Saleh, Bahaa E. A., Teich, Malvin Carl. Fundamentals of photonics. 2nd ed. New York [etc.]: John Wiley & Sons, 2007. ISBN 9780471358329.