

## Course guides

# 205069 - 205069 - Photonics Sensors and Laser Technology

**Last modified:** 29/05/2020

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

**Degree:** 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).

**Academic year:** 2020    **ECTS Credits:** 3.0    **Languages:** Catalan, English, Spanish

### LECTURER

**Coordinating lecturer:** Ramon Vilaseca Alavedra  
Ferran Laguarda Bertran

**Others:** Cojocarú, Crina Maria

### TEACHING METHODOLOGY

Some exposition classes and, mainly, visits to a technological research center and research laboratories, and devices/experiments manipulation.

### LEARNING OBJECTIVES OF THE SUBJECT

#### GENERAL OBJECTIVES OF THE SUBJECT

1. Provide a minimum knowledge to understand why light is useful for technological applications, particularly for engineering. It will be considered how the light is generated, in particular by means of lasers, how it is controlled and detected, and what properties have to make it more and more useful today.
- 2.- To illustrate the practical potentials of light through the detailed knowledge of the research and knowledge transfer activities that are carried out on the Terrassa Campus, in particular the CD6 (Center for the Development of Sensors, Instruments and Systems, <https://www.cd6.upc.edu/>) and the DONLL Group (Non Linear Dynamics, Nonlinear Optics and Lasers Research Group, <https://donll.upc.edu/>), through explanations, visits to laboratories , manipulations, etc.
3. Analyze the criteria of design and use of the electro-optical sensors, in order to introduce them into control systems and automated production environments. Also know the current operation and applications, especially in materials processing and industrial metrology, of the different types of lasers with industrial interest, their specifications, their control systems and their integration in automatic systems.  
Also know, to a certain extent, other current investigations, in nonlinear optics, characterization of materials and biomedicine.

### STUDY LOAD

Type	Hours	Percentage
Hours large group	27,0	36.00
Self study	48,0	64.00

**Total learning time:** 75 h



## CONTENTS

### 1. Optical Radiation. What is light, and basic properties

**Description:**

More useful properties of light and electromagnetic waves in general (in relation to technological applications). Interaction of light with materials.

**Specific objectives:**

Learn about the most useful properties of light, which will allow us to understand the applications and experiments of laboratories that we will visit.

**Related activities:**

All

**Full-or-part-time:** 10h

Theory classes: 1h 30m

Guided activities: 1h 30m

Self study : 7h

### 2. Photonic sensors, metrology. Related research activities, on the Campus de Terrassa.

**Description:**

Description, visit and handling of photonic sensors, for measurements, optimization, detection of presence, detection of defects, etc.

**Specific objectives:**

To know the different types of photonic sensors and different applications that are developed on the Campus, and manipulate some of them. Acquire the ability to find out and select the most suitable type of sensor, depending on the application.

**Related activities:**

All

**Full-or-part-time:** 25h

Guided activities: 9h

Self study : 16h

### 3. Laser systems for the materials processing.

**Description:**

Study of laser systems that are used for the processing of materials, from welding in cars and industrial companies to marking and 3D laser printing. Numerical control practice.

**Specific objectives:**

Understand the type of laser systems that exist and their potentialities, as well as the handling of one of them and the practice of numerical control.

**Related activities:**

All

**Full-or-part-time:** 16h

Theory classes: 1h

Guided activities: 5h

Self study : 10h



#### 4. Applications of Photonics in other fields. Research activities on the Terrassa Campus.

**Description:**

Applications of Photonics to nonlinear optics (generation of new frequencies, etc.), structural analysis and study of processes in materials, medicine, communications, nonlinear dynamics, generation, measurement and applications of pulses of ultra short duration, etc. . Visit of experiments in the research laboratories of the Campus.

**Specific objectives:**

Learn about other applications of lasers and photonic technologies, in different fields, knowing what is done on the campus and participating in its manipulation, to the extent possible.

**Related activities:**

All

**Full-or-part-time:** 24h

Guided activities: 9h

Self study : 15h

## ACTIVITIES

### A1 Lecture classes (through examples)

**Description:**

Lectures given by the professor, giving examples

**Specific objectives:**

To know the minimum bases on the concepts, phenomena, devices and systems that will be observed in the laboratories.

**Material:**

Bibliography, internet, technical information.

**Delivery:**

Evaluation through delivery of a small summary, or through active participation in visits and manipulations in laboratories.

**Full-or-part-time:** 6h 30m

Theory classes: 2h 30m

Self study: 4h

### A2 Practice classes and supervised work

**Description:**

Consideration of examples that will be visited, and direction / advice for the realization, on the part of the students, of a small summary or work in relation to the laboratories visits or the design of a photonic system for a certain type of application, proposed by the student.

**Specific objectives:**

Foster creative and entrepreneurial skills to design new technical applications.

**Material:**

Bibliography, internet, technical information, laboratory material .

**Delivery:**

Delivery of a small summary or report in electronic format. Evaluation of the quality of this homework.

**Full-or-part-time:** 35h 30m

Theory classes: 9h 30m

Self study: 26h

### A3. Laboratory visits

**Description:**

Visit of Campus laboratories, demonstration of experiments, and participation whenever possible.

**Specific objectives:**

To know materials, devices and real photonic systems, in particular lasers, and learn how to handle them.

**Material:**

Laboratory equipment.

**Delivery:**

The evaluation will be based on active attendance at the sessions.

**Full-or-part-time:** 33h

Theory classes: 15h

Self study: 18h

## GRADING SYSTEM

Attendance to classes and explanations about campus laboratories (30%) and active assistance to visits to laboratories and research groups (20%+20%+20%). Conducting a small report or work (10%).

## EXAMINATION RULES.

(No exam will be held)

## BIBLIOGRAPHY

**Basic:**

- Friedman, E.; Miller, J.L. Photonics rules of thumb: optics, electro-optics, fiber optics, and lasers. 2nd ed. New York: McGraw-Hill, cop. 2004. ISBN 0071385193.
- Steen, W. M.; Mazumder, J. Laser material processing. 4th ed. New York: Springer, 2010. ISBN 9781849960618.
- Uiga, Endel. Optoelectronics. Englewood Cliffs (N.J.): Prentice-Hall, cop. 1995. ISBN 0024221708.
- Hecht, Eugene. Óptica [on line]. 5ª ed. Madrid: Pearson, 2017 [Consultation: 11/11/2020]. Available on: [http://www.ingebook.com/ib/NPcd/IB\\_BooksVis?cod\\_primaria=1000187&codigo\\_libro=6557](http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=6557). ISBN 9788490354926.
- Hecht, Jeff. Understanding lasers: an entry-level guide. 3rd ed. Hoboken, NJ: Piscataway, NJ: John Wiley & Sons; IEEE Press, 2008. ISBN 9780470088906.
- Albella, J.M.;Martínez-Duart, J.M.; Agulló-Rueda, F. Fundamentos de microelectrónica, nanoelectrónica y fotónica. Madrid: Prentice Hall, 2005. ISBN 8420546518.

**Complementary:**

- Pinson, L.J. Electro-optics. New York: John Wiley & Sons, 1985. ISBN 0471881422.
- Powell, John. CO2 laser cutting. 2nd ed. London [etc.]: Springer-Verlag, 1998. ISBN 1852330473.
- Saleh, B.E.A.; Teich, M.C. Fundamentals of photonics. 2nd ed. New York: John Wiley & Sons, 2007. ISBN 9780471358329.
- Hitz, C.B.; Ewing, J.J; Hecht, J. Introduction to laser technology. 3rd ed. Piscataway, NJ: IEEE Press, cop. 2001. ISBN 0780353730.
- Wolfe, W.L. Introduction to radiometry. Bellingham, Wash.: SPIE Optical Engineering Press, cop. 1998. ISBN 0819427586.

## RESOURCES

**Other resources:**

Visit to Campus research laboratories.