Last update: 19-04-2018

205069 - Photonics Sensors and Laser Technology

Coordinating unit:	205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit:	748 - FIS - Department of Physics
Academic year:	2018
Degree:	MASTER'S DEGREE IN SPACE AND AERONAUTICAL ENGINEERING (Syllabus 2016). (Teaching unit Optional) MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2013). (Teaching unit Optional) MASTER'S DEGREE IN AERONAUTICAL ENGINEERING (Syllabus 2014). (Teaching unit Optional)
ECTS credits:	3
Teaching languages:	Catalan, Spanish, English

Teaching staff

Coordinator:	Ramon Vilaseca Alavedra Ferran Laguarta Bertran
Others:	Cojocaru, Crina Maria

Opening hours

Timetable: Flexible, agreement student-professor

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.

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Study load

Total learning time: 75h	Hours large group:	27h	36.00%
	Hours medium group:	0h	0.00%
	Hours small group:	0h	0.00%
	Guided activities:	0h	0.00%
	Self study:	48h	64.00%

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Content

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

Learning time: 10h

Theory classes: 1h 30m
Guided activities: 1h 30m
Self study : 7h

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

Related activities:
All

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.

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

Learning time: 25h

Theory classes: 0h
Guided activities: 9h
Self study : 16h

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

Related activities:
All

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.

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3. Laser systems for the materials processing.

Learning time: 16h

Theory classes: 1h
Guided activities: 5h
Self study : 10h

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.

Related activities:
All

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.

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

Learning time: 24h

Theory classes: 0h
Guided activities: 9h
Self study : 15h

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.

Related activities:
All

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.

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Planning of activities

A1 Lecture classes (through examples)

Hours: 6h 30m
Theory classes: 2h 30m
Self study: 4h

Description:
Lectures given by the professor, giving examples

Support materials:
Bibliography, internet, technical information.

Descriptions of the assignments due and their relation to the assessment:
Evaluation through delivery of a small summary, or through active participation in visits and manipulations in laboratories.

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

A2 Practice classes and supervised work

Hours: 35h 30m
Theory classes: 9h 30m
Self study: 26h

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.

Support materials:
Bibliography, internet, technical information, laboratory material .

Descriptions of the assignments due and their relation to the assessment:
Delivery of a small summary or report in electronic format. Evaluation of the quality of this homework.

Specific objectives:
Foster creative and entrepreneurial skills to design new technical applications.

A3. Laboratory visits

Hours: 33h
Theory classes: 15h
Self study: 18h

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

Support materials:
Laboratory equipment.

Descriptions of the assignments due and their relation to the assessment:
The evaluation will be based on active attendance at the sessions.

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

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Qualification 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%).

Regulations for carrying out activities

(No exam will be held)

Bibliography

Basic:

Hecht, Eugene. Óptica. 5ª ed. Madrid: Pearson, 2017. ISBN 9788490354926.

Albella, J.M.;Martínez-Duart, J.M.; Agulló-Rueda, F. Fundamentos de microelectrónica, nanoelectrónica y fotónica. Madrid: Prentice Hall, 2005. ISBN 8420546518.

Uiga, Endel. Optoelectronics. Englewood Cliffs (N.J.): Prentice-Hall, cop. 1995. ISBN 0024221708.

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.

Hecht, Jeff. Understanding lasers: an entry-level guide. 3rd ed. Hoboken, NJ: Piscataway, NJ: John Wiley & Sons; IEEE Press, 2008. ISBN 9780470088906.

Steen, W. M.; Mazumder, J. Laser material processing. 4th ed. New York: Springer, 2010. ISBN 9781849960618.

Complementary:

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.

Pinson, L.J. Electro-optics. New York: John Wiley & Sons, 1985. ISBN 0471881422.

Wolfe, W.L. Introduction to radiometry. Bellingham, Wash.: SPIE Optical Engineering Press, cop. 1998. ISBN 0819427586.

Powell, John. CO2 laser cutting. 2nd ed. London [etc.]: Springer-Verlag, 1998. ISBN 1852330473.

Others resources:

Visit to Campus research laboratories.