Last update: 08-07-2016

230568 - PHSTELE - Photonics Systems in Telecommunications

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering

Teaching unit: 739 - TSC - Department of Signal Theory and Communications

Academic year: 2016

Degree: MASTER'S DEGREE IN PHOTONICS (Syllabus 2013). (Teaching unit Optional)
ERASMUS MUNDUS MASTER'S DEGREE IN PHOTONICS ENGINEERING, NANOPHOTONICS AND BIOPHOTONICS (Syllabus 2010). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2009). (Teaching unit Optional)
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Optional)

ECTS credits: 3 Teaching languages: English

Teaching staff

Coordinator: Francesc Rocadenbosch, UPC.

Others: Constantino Muñoz Porcar, UPC.
Michaël Sicard, UPC.

Degree competences to which the subject contributes

Basic:

CB6. (ENG) Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación

CB7. (ENG) Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio.

CB8. (ENG) Que los estudiantes sean capaces de integrar conocimientos y enfrentarse a la complejidad de formular juicios a partir de una información que, siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos y juicio.

CB10. (ENG) Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.

Specific:

CE2. (ENG) Màster en Fotònica:
Demostrar que comprende las peculiaridades que comporta el modelo cuántico para la interacción luz-materia.

CE4. (ENG) Màster en Fotònica:
Demostrar que conoce los fundamentos de la formación de imagen, de la propagación de la luz a través de los diferentes medios y de la Óptica de Fourier.

CE9. (ENG) Màster en Fotònica:
Capacidad para sintetizar y exponer los resultados de investigación en fótonica según los procedimientos y convenciones de las presentaciones científicas en inglés.

Generical:

CG1. (ENG) Màster en Fotònica:
Capacidad para proyectar, diseñar e implantar productos, procesos, servicios e instalaciones en algunos ámbitos de la fotónica como los relacionados con la ingeniería fotónica, la nanofotónica, la óptica cuántica, las telecomunicaciones y la biofotónica

CG4. (ENG) Màster en Fotònica:
Capacidad para entender el carácter generalista y multidisciplinario de la fótonica viendo su aplicación por ejemplo a la medicina, biología, energía, comunicaciones o la industria

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CG2. (ENG) Màster en Fotònica:
Capacidad para la modelización, cálculo, simulación, desarrollo e implantación en centros de investigación, centros tecnológicos y empresas, particularmente en tareas de investigación, desarrollo e innovación en todos los ámbitos relacionados con la Fotónica.

Transversal:

1. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
2. ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding how companies are organised and the principles that govern their activity, and being able to understand employment regulations and the relationships between planning, industrial and commercial strategies, quality and profit.
3. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.
4. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.

Teaching methodology

- Lectures
- Activities

Learning objectives of the subject

The course focuses on a tutorial discussion of the main techniques, systems and subsystems related to laser-radar (LIDAR) remote sensing. The course presents the grounds of the technological, physical, and signal-processing keys involved as well as the applications of these remote sensing systems. Present-day fields of application comprise the detection and monitoring of chemical species, atmospheric observation, pollution concentration and physical variables, and others, in the industrial field.
The teaching and learning methodology combines expositive classes with more interactive ones, where systems and case problems are simulated and/or discussed based on literature reviews. A guided research work (computer based) is progressively introduced during course.

BIBLIOGRAPHY:

Guidelines with specific bibliography available at ATENEA web page, https://atenea.upc.edu/moodle/login/index

' Basic
LASER REMOTE SENSING, Takashi Fujii, Tetsuo Fukuchi (Editors), CRC, Taylor&Francis, Florida, 2005.

LASER MONITORING OF THE ATMOSPHERE, E.D. Hinkley (Editor), Springer-Verlag, 1976.

' Advanced
LASER REMOTE SENSING: FUNDAMENTALS AND APPLICATIONS, R. M. Measures, John Wiley& Sons, 1984 (Reprint de Krieger Publishing Company, 1992).

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Study load

Total learning time: 75h	Hours large group:	22h 30m	30.00%
	Hours medium group:	0h	0.00%
	Hours small group:	0h	0.00%
	Guided activities:	2h 15m	3.00%
	Self study:	50h 15m	67.00%

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Content

1.- Elastic lidar systems.

Learning time: 4h
Theory classes: 4h

Description:
1.1.- Foundations and architecture.
1.2.- Basic design parameters: Elastic lidar equation. Optical overlap factor. Background radiance considerations.
1.3.- Examples of real systems.

2.- Link budget.

Learning time: 4h 30m
Theory classes: 4h 30m

Description:
2.1.-Receiving chain: Opto-electronic conversion. Temporal and spatial resolution. Signal conditioning and acquisition (transient recorders and photon counters).
2.2.- Generalised signal-to-noise ratio (noise-dominant modes).
2.3.- Example problem I.
2.4.- Lidar range estimation: Simulation.
2.5.- Elastic-Raman link budget (problem proposal).

3.- Raman systems.

Learning time: 6h
Theory classes: 6h

Description:
3.1.- Raman Lidar. Basics about the Raman effect. Atmospheric probing and system layout (temperature measurement, molecular species (gas) detection, and water-vapor measurement).
3.2.- Elastic-Raman systems (aerosol detection). Problem revision (Sect. 2.5).

4.- Wind lidar systems.

Learning time: 4h
Theory classes: 4h

Description:
4.1.- Coherent Doppler Lidar: Architecture and design considerations.
4.2.- Direct-detection Doppler systems: Edge technique and double-edge technique. Fringe technique.
4.3.- Wind measurement using incoherent techniques.

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5.- Lidar data inversion.	Learning time: 2h Theory classes: 2h

Description:
5.1.- Inversion of opto-atmospheric parameters: Elastic data inversion (range-corrected semi-quantitative methods, from the slope method to Klett's method, multi-angle inversion). The combined elastic/Raman lidar technique.
5.2.- Examples: Inversion of physical parameters (atmospheric-boundary-layer height retrieval, ceilometry, chimney-stack emission flux).

6.- Other laser-radar systems	Learning time: 2h Theory classes: 2h

Description:
6.1.- DIAL: Detection of molecular pollutants.
6.2.- Other systems.

Planning of activities

Computer based problem	Hours: 2h 18m Theory classes: 2h 18m

Qualification system

- 50 % Final exam (multiple answer test)
- 50 % Guided research work (computer based prob. 2.5 + interview).
Special weight will be given to the continuous assessment of student's progress in the discussion sessions as well as to course attendance (80% minimum).

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Bibliography

Basic:

Fujii, Takashi; Fukuchi, Tetsuo. Laser remote sensing [on line]. Boca Raton: Taylor&Francis, 2005 [Consultation: 17/06/2016]. Available on: <http://site.ebrary.com/lib/upcatalunya/docDetail.action?docID=10143572>. ISBN 0824742567.

Hinkley, E.D. Laser monitoring of the atmosphere. Berlin: Springer-Verlag, 1976. ISBN 354007743X.

Complementary:

Measures, Raymond M. Laser remote sensing : fundamentals and applications. Malabar, Fla: Krieger, 1992. ISBN 0894646192.