Last update: 11-07-2019

370554 - BIOFOTONIC - Introduction to Biophotonics

Coordinating unit: 370 - FOOT - Terrassa School of Optics and Optometry
Teaching unit: 731 - OO - Department of Optics and Optometry
Academic year: 2019
Degree: BACHELOR'S DEGREE IN OPTICS AND OPTOMETRY (Syllabus 2009). (Teaching unit Optional)
ECTS credits: 3 Teaching languages: Catalan, Spanish, English

Teaching staff

Coordinator: Vilaseca Ricart, Meritxell (http://futur.upc.edu/MeritxellVilasecaRicart)

Others: Royo Royo, Santiago (http://futur.upc.edu/SantiagoRoyoRoyo)

Degree competences to which the subject contributes

Specific:

2.3.5. Interpret the registers obtained with different techniques. Determine the status of ocular structures.

0.9. Being able to perform literature searches.

0. Applying the scientific basis needed for the development of the profession.

0.8. Being able to take, treat, represent and interpret experimental data. "Use basic laboratory equipment and techniques"

Generical:

T3.0.1. Being able to participate in multidisciplinary working groups, multicultural and multilingual

T2. Effective communication (oral and written). (in Catalan, Spanish and English)

T4.0.2. Expand and upgrade skills for professional practice and knowledge through continuing education

T4.2.2. Value and incorporate technological necessary improvements for the proper development of the profession

T4.2.3. Working with evidence, methodology and rigour.

T5. Use reliable information resources. Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty and critically evaluate the results of this management.
T4. Work independently and with initiative

T6. Third language. To learn a third language, which is mainly English, with an adequate level of oral and written according to the needs of graduates have the qualifications.
T4.3.1. Reflect and be able to make a critic of the knowledge and developed skills and the level of achievement.

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Teaching methodology

- Lectures and problem solving classes
- Activities: - Laboratory/Research center visits
  - Lab skills with photonic instrumentation
  - Seminars

The student will have the possibility of performing measurements using experimental setups and commercial instruments.

Learning objectives of the subject

Many governments of industrialized countries have recognized the great potential of biophotonics as a key technology with the goal of developing innovative light-based systems that can be transferred into the medical practice seeking to understand and treat diseases. Accordingly, the use of photonic tools is becoming standard practice in several medical fields, in particular in the visual health or cancer.
Firstly, the objective of this course is to describe the fundamentals of photonics: what is light, how is detected with sensors and cameras, how is generated from light sources and displays, and how it can be modulated through optical devices. Also, the light-matter interaction will be analyzed and, in particular, tissue optics (propagation and scattering of light in human tissue).
Finally, we will study all the photonic tools for diagnosis and therapy (laser) currently available that are used in the field of biomedicine and, in particular, of ophthalmology and optometry. Examples include absorption and Raman spectroscopy, scanning laser ophthalmoscopy, OCT, photocoagulation for diabetic retinopathy, laser refractive surgery, among others.

Study load

Total learning time: 75h	Hours large group:	0h	0.00%
	Hours medium group:	24h	32.00%
	Hours small group:	6h	8.00%
	Guided activities:	0h	0.00%
	Self study:	45h	60.00%

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Content

FUNDAMENTALS OF PHOTONICS

Learning time: 23h

Practical classes: 9h
Self study : 14h

Description:
Light. Spatial and spectral measurements and color features (2h)
Light generation. Light sources, types and applications of LED and laser systems (1h)
Displaying and detecting light. Sensors and cameras, displays and screens (2h)
Light modulation. Liquid crystal displays and deformable mirrors (1h)
Light-matter interaction and light propagation (2h)
Tissue optics: absorption and scattering coefficients (1h)

BIOMEDICAL PHOTONICS

Learning time: 35h

Practical classes: 15h
Self study : 20h

Description:
Photonic tools for diagnosis:
Reflectance and fluorescence spectroscopy (2h)
Raman spectroscopy (1h)
Scanning laser ophthalmoscopy and OCT (Optical Coherence Tomography) (2h)
DOT (Diffuse Optical Tomography), pulsioximetry, photoacoustic imaging (2h)

Photonic tools for laser therapy:
Thermal effects (retinal photocoagulation for diabetic retinopathy, retinal detachment, tumors,...) (2h)
Photoablation (laser refractive surgery PRK, LASIK, epi-LASIK, LASEK,...) (2h)
Mechanical effects: plasma and photodisruption (posterior capsulotomy, laser phacoemulsification, laser corneal flap corneal, ...) (2h)
Chemical effects (photodynamic therapy) (2h)

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Planning of activities

APPLICACIONS AND RESEARCH IN THE FIELDS OF OPTICAL ENGINEERING AND BIOPHOTONICS	Hours: 6h Laboratory classes: 6h

Description:

Laboratory skills and guided research center visits where applications related with the following áreas will be seen: optical metrology, visual optics, spectroscopy, color technology and spectral imaging science.

Students will have the possibility of performing measurements using experimental setups and commercial instruments.

Qualification system

- Homework assessments (35%)
- Written exam (50%)
- Oral presentation of a scientific journal paper (15%)

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