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"

General:
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.
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

<table>
<thead>
<tr>
<th>Total learning time: 75h</th>
<th>Hours large group:</th>
<th>0h</th>
<th>0.00%</th>
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<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>24h</td>
<td>32.00%</td>
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<tr>
<td></td>
<td>Hours small group:</td>
<td>6h</td>
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<td></td>
<td>Guided activities:</td>
<td>0h</td>
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<tr>
<td></td>
<td>Self study:</td>
<td>45h</td>
<td>60.00%</td>
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### FUNDAMENTALS OF PHOTONICS

**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)

**Learning time:** 23h  
Practical classes: 9h  
Self study: 14h

### BIOMEDICAL PHOTONICS

**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)

**Learning time:** 35h  
Practical classes: 15h  
Self study: 20h
Planning of activities

| APPLICATIONS 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 areas 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%)
Bibliography

Basic:


Complementary:


