



IDENTIFYING DATA

Biomedical Applications of Lasers: Physical Fundamentals

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|---------------------|---|----------|------|------------|
| Subject | Biomedical Applications of Lasers: Physical Fundamentals | | | |
| Code | 001M117V01101 | | | |
| Study programme | (*)Máster Universitario en Fotónica e Tecnoloxías do Láser | | | |
| Descriptors | ECTS Credits | Choose | Year | Quadmester |
| | 6 | Optional | 1st | 1st |
| Teaching language | | | | |
| Department | | | | |
| Coordinator | Michinel Álvarez, Humberto Javier | | | |
| Lecturers | Bara Viñas, Salvador Xurxo Michinel Álvarez, Humberto Javier | | | |
| E-mail | hmichinel@uvigo.es | | | |
| Web | http://laserphotonics.org | | | |
| General description | In this subject are explained the physical basis of the applications of the lasers in the fields of biology, optometry and medicine, and its main uses in diagnose and therapeutic applications with a particular emphasis in Sciences of the Vision. We study the properties of the lasers which are relevant since this perspective, the new technologies of transformation and control of the beams and a specific section is devoted to security issues in the work with laser sources. | | | |

Competencies

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|------|--|
| Code | |
| C1 | Ability to understand the physical basis of the applications of lasers in various fields of particular relevance, such as metrology, biomedicine, industry and environment. Identification and recognition of new technologies, applications, business systems, regulations on lasers and the development of processes and systems for analysis. |
| C6 | Ability to use optical instrumentation and the manufacture and assembly of experiments based on techniques of laser and photonics technologies and their applications, autonomously. |
| D2 | Ability to work in multidisciplinary and multilingual teams, in an international context. |
| D4 | Capacity for independent learning, self-organization and self-scheduling of work, and to maintain continuous training in their field of work. |
| D5 | Initiative and entrepreneurship, stimulated by training in the field of photonics and laser technology. |

Learning outcomes

| | |
|---|-------------------------------|
| Expected results from this subject | Training and Learning Results |
| Recognize the diverse mechanisms of interaction go in the radiation laser and the tissues, related with the C1 interactions that occur to molecular level. | |
| Provide to the and to the students training of postgraduate envelope the physical principles of the biomedical applications of lasers, including the mechanisms of laser-tissue interaction, the physical principles of his use in diagnose and therapy, the new technologies of adaptive control of beams, the specific applications in the field of the sciences of the vision and an introduction to the security in the work with lasers, so that they have of a wide panoramic of the possibilities of this technology and of the main pending challenges in this field. | D2 |
| Describe the basic aspects of the main therapeutic applications of the lasers in function of the his characteristic (length of wave, power, frequency of repetition, energy by pulse...), and formulate its effects. | D5 |
| Calculate powers and doses absorbed, as a function of the characteristics of the sources, of the systems controlling the beam and of the optical properties of the tissues. | C6 D4 |

| Contents | |
|--|---|
| Topic | |
| Laser-Tissue interactions | Introduction. Radiation-Matter interaction. Modelization: Photonic migration. |
| Physical principles of the therapeutic use of the lasers | Mechanisms of laser-tissue interactions. Laser-tissue interactions at molecular level: Photochemical interactions. Photothermal interactions. Photoablation. Ablation induced by reflection. Photodisruption. Optical tweezers. Applications. |
| The lasers in the instrumentation *optoelectrónica for diagnostic no invasive | Confocal microscopy. Oftalmic laser scanning. Optical coherence tomography (OCT). Laser spectroscopy (by absorption, reflection, split induced, Raman, fluorescence). Doppler velocimetry. Tomography. Interferometry by point diffraction. |
| Technologies for transformation and control of laser beams | Beam transformation. Adaptive optics (AO). Stars guide laser. Basic AO of the human eye. Wavefront sensing. Elements and devices for compensation of aberrations: plates of phase, deformable mirrors, light modulators. Biological systems of adpative optics. |
| Applications in Vision Science | Measure of the optical quality of the eye: Metric of optical quality. Scheiner's disk. Refractometry with space resolution. Laser ray tracers. Aberrometers of Tscherning. Hartmann-Shack aberrometers. Image of high space resolution: Helmholtz oftalmoscope. High resolution bottom-eye cameras. Laser scanning confocal oftalmoscopes of high resolution. OCT of high resolution. |
| Introduction to laser security | It deals with...?. Relevant properties of lasers. Mechanisms of damage. Dangers for the eye. Dangers for the skin. Security standards. Ranking of dangerous lasers. Warning signals. Danger and risk: how focus on security. Controls of engineering, and administrative personal. Why are produced the accidents with lasers? Laser security in different fields. |

Planning

| | Class hours | Hours outside the classroom | Total hours |
|---|-------------|-----------------------------|-------------|
| Autonomous troubleshooting and / or exercises | 0 | 100 | 100 |
| Troubleshooting and / or exercises | 10 | 0 | 10 |
| Master Session | 38 | 0 | 38 |
| Multiple choice tests | 2 | 0 | 2 |

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

| | Description |
|---|--|
| Autonomous troubleshooting and / or subject exercises | The student will resolve autonomously the problems and exercises proposed by the teacher of the |
| Troubleshooting and / or exercises | The professor will resolve the exercises and problems that will serve as model for the students to resolve them autonomously |
| Master Session | The professor will explain the main concepts of the subject with the support of the teaching materials available online for the students |

Personalized attention

| Methodologies | Description |
|---|--|
| Autonomous troubleshooting and / or exercises | *Titorías Voluntary. *Asesoramento In the realization of the different proofs well of individual form us time of *titoría or well through the was of debate *online. |

Assessment

| | Description | Qualification | Training and Learning Results |
|---|---|---------------|-------------------------------|
| Autonomous troubleshooting and / or exercises | Periodic delivery of collections of problems done autonomously. | 50 | |
| Multiple choice tests | Test with multiple option questions. | 50 | |

Other comments on the Evaluation

*Exámenes08/01/15 16:00 Seminar of *fotónica. Empower of Sciences (1º SEMESTER)29/06/15 16:00 Seminar of *fotónica. Empower of Sciences (JULY)

Sources of information

Recommendations