Coordinating unit: 370 - FOOT - Terrassa School of Optics and Optometry  
Teaching unit: 731 - OO - Department of Optics and Optometry  
Academic year: 2019  
Degree: MASTER'S DEGREE IN OPTOMETRY AND VISION SCIENCES (Syllabus 2012). (Teaching unit Compulsory)  
ECTS credits: 4.5  
Teaching languages: Spanish, English

Teaching staff

Coordinator: MARIA SAGRARIO MILLAN GARCIA VARELA  
(http://futur.upc.edu/MariaSagrarioMillanGarciaVarela)  
Others: Elisabet Pérez Cabré (http://futur.upc.edu/ElisabetPerezCabre)  
Fidel Vega Lerín (http://futur.upc.edu/FidelVegaLerin)

Degree competences to which the subject contributes

Transversal:
2. 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.  
3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.  
4. 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.

Teaching methodology

MD1.- Lecture with active participation of students  
MD2.- Laboratory Practical Sessions  
MD3.- Exercises, Teamwork  
MD4.- Seminar and / or conferences given by visiting professors

Learning objectives of the subject

Course objective: Acquisition of theoretical and practical knowledge of the principles and advanced optical techniques on which the instruments used for visual attention are based (characterization of wave fronts, optical image quality, optical coherence tomography). Knowledge of recent advances in the subject and lines of research of interest in the international scene.

Specific objectives:
1 Wave Fronts. Adaptive Optics  
• Know the definition of Wavefront and its use in visual optics.  
• Know the main Aberrations associated with the human visual system.  
• Description of the aberrations of a wavefront in terms of Zernike polynomials.  
• Measurement in the aberration clinic. Aberrometers  
• Know the basics of adaptive optics systems and their application to the study of eye aberrations.  
• Experimental performance in laboratory with wavefront sensor.
2. OPTICAL IMAGE QUALITY. EVALUATION
• Know the main parameters used to evaluate the optical quality in an optical system in general, and in the visual system in particular.
• Evaluate the quality of a system through the impulse response or PSF and the modulation transfer function or MTF.
• Experimentally measure the MTF of an optical system and compare the quality of two systems using this metric.

3. OPTICAL COHERENCE TOMOGRAPHY (OCT)
• Know what the OCT is, its main characteristics
• Know the optical principles on which this imaging technique is based (low optical coherence interferometry, media reflectivity, optical fiber for compact designs, spectral distribution of the light source)
• Know the evolution of the technique and the progress achieved in resolution, penetration, field, etc. Image: Time domain - OCT, Spectral Domain (Fourier domain) - OCT, Swept Source - OCT, recent advances.
• Reproduction and experimental analysis of the principles of OCT in optical laboratory
• Experimentation with images obtained with clinical OCT equipment.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 108h 06m</th>
<th>Hours large group: 0h 0.00%</th>
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<tbody>
<tr>
<td>Hours medium group: 23h 54m 22.11%</td>
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<tr>
<td>Hours small group: 12h 12m 11.29%</td>
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<tr>
<td>Guided activities: 0h 0.00%</td>
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<td>Self study: 72h 66.60%</td>
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### Wavefronts and adaptive optics

**Learning time:** 18h  
Theory classes: 8h  
Self study: 10h

**Description:**  
- Measurement and characterization of the wavefront, implications for vision  
- Wavefront sensors. Principles on which they are based and types.  
- Decomposition of the wavefront function in Zernike polynomials.  
- Relationship of Zernike coefficients with the weight of geometric aberrations.  
- Principles of adaptive optics and justification of its application in vision  
- Compensating mechanisms of the wavefront.  
- Applications.  

**Related activities:**  
Problem-Laboratory practice: Hartman sensor and wavefront reconstruction

### Optical quality of an image forming system

**Learning time:** 18h  
Theory classes: 8h  
Self study: 10h

**Description:**  
- The image as information transmitted by light through an optical system.  
- The image of a point: Impulse response in a linear system  
- Space frequency expression: Optical transfer function  
- Modulation transfer function (MTF). Concept and measure.  
- Relationship of MTF with the magnitudes of the optical quality of the eye  
- Apodization in an optical system. Natural apodization of the eye and its implications.  

**Related activities:**  
Two laboratory practices: determine the PSF and MTF of various optical systems (meniscus-cornea, photographic objective, mobile camera, intraocular lens), cameras.
## Optical Coherence Tomography (OCT) and associated techniques

<table>
<thead>
<tr>
<th>Description:</th>
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<tr>
<td>- Principle (Michelson interferometer)</td>
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<td>- Optical coherence tomography (OCT) in the eye.</td>
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<td>- In-depth (axial) resolution of the OCT image and its relation to the coherence of the illuminant.</td>
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<td>- Light sources in the evolution of the OCT.</td>
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<td>- Contributions of the waveguide (fiber optic) to the OCT.</td>
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<tr>
<td>- Clinical OCT instruments for eye examination. Technical characteristics. Scanning mechanisms and associated resolution.</td>
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<table>
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<tr>
<th>Related activities:</th>
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<tr>
<td>Laboratory practices and practical exercises:</td>
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<tr>
<td>- Michelson Interferometer as the basis of the OCT: from coherent illumination (laser) to white illumination</td>
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<tr>
<td>- Interpretation of OCT images of various modalities obtained with a clinical team. Measures and resolutions.</td>
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### Learning time: 18h
- Theory classes: 8h
- Self study: 10h

### Bibliography

**Basic:**


Artes de y material que se actualiza cada curso en la plataforma docente.

**Others resources:**

Articles from scientific journals that are renewed and updated each course.