2010-11 academic year

Optical Engineering (12466)

Degree/study: Bachelor's degree in Audiovisual Systems Enginnering
Year: 2nd
Term: 2nd
Number of ECTS credits: 4 credits
Hours of studi dedication: 100 hours
Teaching language or languages: Spanish
Teaching Staff: Marcelo Bertalmio

1. Presentation of the subject

The subject includes physical and geometrical fundamentals of optics, optical systems with their components and features and properties of digital photography and video cameras.

2. Previous requirements to follow the formative itinerary

It is advisable to have a good knowledge of mathematics, programming and waves.

3. Competences to be attained

- Knowledge of the operation of optical systems, its possibilities and limitations.
- Implementation of methods to real applications.
- A review of mathematical tools (geometry, algebra and analysis).
- Practice in programming (efficient and clear documentation).
- Bibliographic research and understanding of scientific articles.
- Teamwork: organization and communication.

4. Evaluation

Evaluation: practical activities (50%) and theory (50%). Each part has to be passed.

There are three practical activities and they are evaluated successively during the term. These activities will be performed in teams of three people and they are evaluated through deliveries (report and commented code) and orally (individual questions). In the case that the practical activities are not passed during the term, the student must make an individual practical work for the examination sitting in September.
The theory is evaluated on a written exam at the end of the term. If the practical activities are passed but the theory is failed, the mark of the practical activities is kept for the examination sitting in September, but not for the following year.

5. Contents

5.1. Theoretical Optics

Light and power
Wave-particle duality, electromagnetic spectrum, light-matter interaction and ray diagrams.

Formation of images by reflection
Virtual images, curved mirrors, pictures, images, focal length and magnification.

Formation of images by refraction
Refractive properties of materials and Snell's law.

5.2. Optical systems

Optical systems components
Lenses, mirrors, prisms, fiber optics, LCDs, LEDs and CCDs.

Aberrations
of surface, spherical, coma, astigmatism, curvature, distortion and lens design.

Characteristics and properties of a lens
Stops, pupils, window, vignetting, covering power, power resolution, focal length, aperture, field of vision, form and performance.

Some types of optical systems
Systems copying, printing, projection, photometry, photography and video.

5.3. Cameras

Calibrate a camera
Location of the principal point, principal distance and laboratory methods.

Focus
Methods of focusing an optical system and depth of field.

Dynamic Range
Definition, response curve of the camera, time of exposure, bracketing, HDR imaging and tone mapping.

Viewfinders
Direct and screen systems and Reflex cameras.

Artefacts in digital images
Aliasing, mosaicking, compression artefacts and interlacing.

Optical 3D images
Visual perception of space, stereo photography and stereo projection.

6. Bibliography and teaching resources

Information resources from different sources: from library or other sources; as well as other teaching resources that are needed for the learning process.
They have to be classified according to several criteria: the type of resource and the degree of impact in the proposed learning in the subject.

6.1. Information sources for the learning. Basic bibliography (on paper or electronic media)

"Applied photographic optics", 3rd Edition. Sidney F. Ray. Focal Press, 2002.
"Optics". http://www.lightandmatter.com/area1book5.html

7. Metodology

7.1. Methodology for lectures

In lectures, the presentations with PowerPoint are avoided deliberately.

7.2. Methodology for seminar sessions

In small groups, activities are solved, scientific articles are commented on or the works done in the practical sessions are presented.

7.3. Methodology for practical sessions

It will consist of the acquisition of images in the laboratory and processing these images using the existing software or created by students. All used software is open source and practical activities have to be programmed in C ++ with Linux. This decision has been taken with the understanding that students should not be required to do practical activities using a proprietary or payment software, because it would involve the fact that it could only work on computers from the university (which pays license for these programs), with the consequent restriction as regards the possibilities to work comfortably in practical activities; or would be a stimulus of software piracy because it would invite the students that if they want to work from home, they have to buy the software or obtain illegal copies.