Imaging Systems

Academic Year: (2020 / 2021) **Review date: 14-05-2020**

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: URRUCHI DEL POZO, VIRGINIA

Type: Electives ECTS Credits : 3.0

Year : 1 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

The students are expected to have completed the mandatory courses of the Master, especially the course on Photonic Technologies I.

OBJECTIVES

Basic skills:

- Knowledge and understanding that provide a basis or opportunity for originality in developing and / or applying ideas, often in a research context (CB6).
- That the students can apply their knowledge and ability to solve problems in new or unfamiliar in wider or multidisciplinary environments related to their field of study (CB7).
- That the students can integrate their knowledge, as well as handle the complexity of making judgements from an incomplete or limited information, but which could include reflections about the social and ethic responsibilities that could be linked to the application of their judgements and knowledge (CB8).
- That the students possess learning skills that allow them following their long-life learning in a self-conducted and self-sufficient way (CB10).

General skills:

- Ability to propose, design, implement and maintain a system with photonic components for a specific application (CG2).

Specific skills:

- Handling of tools aiming to design photonic devices and systems (CE2).
- To be aware of the current trends in different applications of photonic technologies and learned experiences from real cases (CE3).
- Capacity of selecting novel photonic components, technologies and subsystems (CE5).
- Capacity of analyzing and designing photonic systems for applications in communications and sensing (CE7).
- Capacity of effectively searching information, as well of identifying the state of the art in a technological problem in the field of photonic devices and systems (CE8).

DESCRIPTION OF CONTENTS: PROGRAMME

THEORY:

0. Introduction to the course imaging systems.
1. Fundamentals of optics for imaging systems.
   - 1.1. Ray propagation (Geometric Optics)
   - 1.2. Wave propagation (Wave Optics)
2. Visual perception.
   - 2.1. Anatomy of the eye.
   - 2.2. Visual Parameters
   - 2.3. Color perception.
   - 2.4. Depth of field.
3. Imaging acquisition and storage.
   - 3.1. Fundamentals of image acquisition.
   - 3.2. The MOS cell.

- 3.3. Structure of an image sensor CCD-IT.
- 3.4. The C-MOS sensor.
- 3.5. Digital image storage.

4. Image reproduction in two-dimensional (2D) imaging systems.
- 4.1. Fundamentals of 2D displays.
- 4.2. 2D display parameters.
- 4.3. Fundamentals of driving.
- 4.4. 2D display technologies.
- 4.5. Other display technologies.
- 4.6. Display programing tools.

5. Image reproduction in three-dimensional (3D) imaging systems.
- 5.1. Fundamentals of 3D displays.
- 5.2. Human factors of 3D Displays.
- 5.3. 3D imaging systems technologies.
- 5.4. Plenoptic cameras.

6. Imaging systems applications.
- 6.1. Automotive displays.
- 6.2. Adaptive optics for imaging systems.

LABORATORY:
Some laboratory sessions are focused on the implementation of display programing tools.

LEARNING ACTIVITIES AND METHODOLOGY

Learning activities:
- Theoretical lectures (AF1)
- Theoretical-practical sessions (AF3)
- Lab Sessions (AF4)
- Group work (AF6)
- Individual student work (AF7)

Methodology:
- Teacher explanations in the classroom, with audiovisual and computer support, in which the main concepts of the subject are developed and bibliography is provided to complement the learning of students (MD1).
- Resolution of case studies, problems, etc... proposed by the teacher on an individual basis or in group (MD3).
- Development work and reports individually or in a group (MD5).

ASSESSMENT SYSTEM

Ordinary Call:
- Individual or work group, including written or oral tests carried out during the course. (SE2). 50%
- Final exam (SE3). 50%

To pass the course, the candidate must achieve an aggregate mark of 5 or higher.

Extraordinary call:
The student may follow the continuous evaluation procedure with the same structure as in the ordinary call, or go for a final exam (100% of the final grade).

% end-of-term-examination:	50
% of continuous assessment (assigments, laboratory, practicals…):	50

BASIC BIBLIOGRAPHY

- Hainich, Rolf R; Bimber, Oliver Displays: fundamentals & applications , CRC Press, 2011
- Hecht, Eugene Optics , Addison-Wesley, 2002
- Janglin Chen, Wayne Cranton, Mark Fihn Handbook of Visual Display Technology, Springer International Publishing, 2016
- Quan Li Liquid Crystals Beyond Displays: Chemistry, Physics, and Applications, John Wiley & Sons, May 29, 2012
- Saleh, Bahaa E.A. Fundamentals of Photonics, John Willey & Sons , 1991