Quantum optical detectors

Academic Year: (2023 / 2024) **Review date: 28/04/2023 10:45:26**

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: VERGAZ BENITO, RICARDO

Type: Electives ECTS Credits : 3.0

Year : 2 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Having passed the Quantum Optics topic:
(I.e., Electromagnetic optics and photonics and Quantum optics subjects)

OBJECTIVES

One of the most challenging efforts in the evolution of Photonics is the development of efficient nanodetectors that can be integrated on chips. Photonic circuits, sensors for lab-on-chip or integrated solar cells are some examples of applications currently requiring this kind of nanodevices. Nowadays, researchers are exploring the use of quantum systems, e.g. quantum dots or quantum wells, to design functional nano-photodetectors. Moreover, 2D and 3D sub-wavelength metastructures are being explored to boost detectors¿ efficiency.

In this sense, the main objective of this subject is to explore the current state-of-the art and the near future in the research about the design and manufacturing of these devices and their potential applications.

DESCRIPTION OF CONTENTS: PROGRAMME

* Quantum Well and Quantum Cascade Detectors.
* Photodetectors based on quantum dots for UV and IR detection.
* Quantum dot solar cells.
* Integration of Quantum Detectors on photonic circuits: tunability and electronic control.
* Metasurfaces for quantum detectors.
  - The use of nanostructures to boost the detection efficiency of quantum photodetectors.
  - Nanostructures for improving solar cells efficiency.

LEARNING ACTIVITIES AND METHODOLOGY

MD1
Presentations in class by the teacher with the support of computer and audiovisual media, in which the main concepts of the subject and the bibliography is provided to complement the learning of the students.
MD2
Critical reading of texts recommended by the professor of the subject: articles, reports, manuals and/or academic articles, either for later discussion in class, or to broaden and consolidate knowledge of the subject.
MD3
Resolution of practical cases, problems, etc. raised by the teacher individually or in a group.
MD4
Presentation and discussion in class, under the moderation of the teacher, of topics related to the content of the subject, as well as practical cases.
MD5
Preparation of work and reports individually or in groups.

ASSESSMENT SYSTEM

% end-of-term-examination/test:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

- Individual or group work will be carried out during the course.
They will consist of information searches and sharing, contributions in the different subject forums, class discussions, and eventually, simulations of quantum optical detector devices.

- There will be a final exam of the knowledge acquired and its application in practical cases.

BASIC BIBLIOGRAPHY

- Bahram Nabet Photodetectors Materials, Devices and Applications, Elsevier. eBook ISBN: 9780081028766 Paperback ISBN: 9780081027950, 2023

- Pieter Kok, Brendon W. Lovett Introduction to Optical Quantum Information Processing, Cambridge University Press, 2014

- Robert W. Boyd, Svetlana G. Lukishova, Victor N. Zadkov Quantum Photonics: Pioneering Advances and Emerging Applications, Springer, 2019

- Xin Tong, Jiang Wu, Zhiming M. Wang Quantum Dot Photodetectors, Springer (SpringerLink) - https://link.springer.com/book/10.1007/978-3-030-74270-6#toc, 2021