PH5025 - Nanophotonics

Credits: 15  
Number of Lectures: 27  
Available: 2017-18  
Semester: 1  
Lecturer: Dr Andrea Di Falco, Dr William Whelan-Curtin

Overview

Nanophotonics deals with the physics and applications of light-matter interaction at the nanoscale. Structuring materials and devices at a fraction of the wavelength of light offers unique opportunities for the advanced manipulation of light. This module provides the tools to understand and design such structures and discusses the applications based on them. In particular, the module covers the topics of photonic crystal, plasmonics and metamaterials and applications in light guiding and confinement, nonlinear optics, imaging and sensing.

Aims & Objectives

The aim of the module is to introduce students to advanced methods to manipulate light, by structuring materials and devices at the nanoscales. The key modern relevant technologies are photonic crystals and plasmonic metamaterials. Many of the properties of these nanostructured materials can be understood from their dispersion diagram or optical bandstructure, which is a core tool that will be explored in the module. The course uses familiar concepts such as optical waveguides and cavities, multilayer mirrors and interference effects to explain more complex features, such as slow light propagation and high Q cavities in photonic crystal waveguides. Propagating and localised plasmons will be explained and will include applications on sensing, super-lensing, enhanced nonlinear optics effect and advanced phase control in metamaterials.

Learning Outcomes

Students will be able to:

- Understand and design basic integrated optics devices, including waveguides and cavities
- Use coupled mode theory in time domain to model the interaction of light in integrated devices
- Understand the physics and application of photonic crystals, plasmonic nanostructures and metamaterials

Synopsis

Topics covered include:

- Light propagation in optical waveguides and cavities
- Coupled mode theory
- Photonic crystals
- Applications of photonic crystal technology
- Optics of metals
- Surface plasmon polaritons
- Localised plasmons
- Applications of nanoplasmonics
- Metamaterials and applications

Prerequisites

PH3061, [PH3081 or PH3082], [PH4027 or PH4034 or PH4035]

Anti-requisites

PH5183
Assessment

Coursework = 20% (problem solving questions) 2-hour Written Examination = 80%

Additional information on continuous assessment etc

The continuous assessment will be based on 3 assessed tutorials. The solutions will be discussed in class.

Recommended Books


General information

Please also read the general information in the School's honours handbook.