



UNIVERSITÀ DI PAVIA

Anno Accademico 2021/2022

NONLINEAR OPTICS

Anno immatricolazione	2021/2022
Anno offerta	2021/2022
Normativa	DM270
SSD	FIS/03 (FISICA DELLA MATERIA)
Dipartimento	DIPARTIMENTO DI INGEGNERIA INDUSTRIALE E DELL'INFORMAZIONE
Corso di studio	ELECTRONIC ENGINEERING
Curriculum	Photonics
Anno di corso	1°
Periodo didattico	Secondo Semestre (07/03/2022 - 17/06/2022)
Crediti	6
Ore	45 ore di attività frontale
Lingua insegnamento	English
Tipo esame	ORALE
Docente	TARTARA LUCA (titolare) - 6 CFU
Prerequisiti	Basics of electromagnetic theory and photonics
Obiettivi formativi	The subject of the course is the description of nonlinear interaction of laser with matter aimed to the understanding of the working principles of integrated optical devices performing wavelength conversion, modulation, and logical functions. The applications of nonlinear optics to information technology, environmental monitoring, and biomedical sciences are also treated.
Programma e contenuti	Second-order nonlinear phenomena Nonlinear propagation in the paraxial approximation. Phase-matching conditions. Second harmonic generation. Parametric amplification and oscillation. Wavelength conversion of ultrashort pulses: spectral acceptance, temporal walk-off. Materials for nonlinear optics. Phase-matching techniques.

Third-order nonlinear phenomena

Third harmonic generation. Optical Kerr effect, self focusing, self phase modulation. Four-wave mixing: wavelength conversion, optical phase conjugation.

Ultrashort pulses

Relation between pulsewidth and spectral bandwidth. Nonlinear propagation of ultrashort pulses in optical fibers. Temporal solitons. Measurement of pulsewidth via correlations.

Coherence and correlation

Classical definition of temporal and spatial coherence. Measurement techniques. Definition by Glauber: higher-order correlation functions. Heterodyne technique. Comparison between lasers and conventional light sources.

Spontaneous and stimulated light scattering

Static and dynamic Rayleigh scattering. Raman and Brillouin scattering. Scattering by Brownian and flowing particles. Doppler velocimetry. LIDAR techniques for environmental monitoring. Laser trapping. Biomedical applications. Stimulated Raman and Brillouin scattering. Raman amplifiers and oscillators. CARS technique.

Metodi didattici

Lectures (hours/year in lecture theatre): 45

Practical class (hours/year in lecture theatre): 0

Practicals / Workshops (hours/year in lecture theatre): 0

Testi di riferimento

G. New. Introduction to Nonlinear Optics. Cambridge University Press, 2011.

R.W. Boyd. Nonlinear Optics. Academic Press, London, 2003.

A. Yariv. Quantum Electronics. Wiley, New York, 1989.

Modalità verifica apprendimento

Oral examination about the topics of the course aimed at assessing the degree of comprehension of the student.

Altre informazioni

Oral examination about the topics of the course aimed at assessing the degree of comprehension of the student.

Obiettivi Agenda 2030 per lo sviluppo sostenibile

Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

[Gli obiettivi](#)