



# UNIVERSITÀ DI PAVIA

Anno Accademico 2020/2021

## NONLINEAR OPTICS

<b>Anno immatricolazione</b>	2020/2021
<b>Anno offerta</b>	2020/2021
<b>Normativa</b>	DM270
<b>SSD</b>	FIS/03 (FISICA DELLA MATERIA)
<b>Dipartimento</b>	DIPARTIMENTO DI INGEGNERIA INDUSTRIALE E DELL'INFORMAZIONE
<b>Corso di studio</b>	ELECTRONIC ENGINEERING
<b>Curriculum</b>	Photonics
<b>Anno di corso</b>	1°
<b>Periodo didattico</b>	Secondo Semestre (08/03/2021 - 14/06/2021)
<b>Crediti</b>	6
<b>Ore</b>	45 ore di attività frontale
<b>Lingua insegnamento</b>	English
<b>Tipo esame</b>	ORALE
<b>Docente</b>	TARTARA LUCA (titolare) - 6 CFU
<b>Prerequisiti</b>	Basics of electromagnetic theory and photonics
<b>Obiettivi formativi</b>	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.
<b>Programma e contenuti</b>	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 exam

#### Altre informazioni

Oral exam

#### Obiettivi Agenda 2030 per lo sviluppo sostenibile

[Gli obiettivi](#)