



Dottorato di Ricerca in Fisica

Title:	<i>Fourier and Physical Optics</i>
Lecturers:	Prof. Giulia Fulvia Mancini (UNIPV, IT) Prof. Daniel E. Adams (Colorado School of Mines, USA) - guest lecturer in 2026
Duration:	20 - 26 hours of frontal lectures
Period:	Spring Semester on even years, every other year (2024, 2026, ...)
Content:	Overview: This course covers the principles of scalar diffraction theory applied to optical systems. The primary analytic and computational tools of the subject rely on Fourier analysis. Consequently, the introductory material is a review of Fourier transforms and related theorems. After reviewing Fourier analysis, we examine approximate solutions to Maxwell's equations related to wave mechanics. The resulting diffraction formalism provides a layer of abstraction that links Fourier and linear systems analysis to the physics of optics. The same principles are applied to analyze the spatiotemporal evolution of ultrashort pulses. Program and contents: 1) Fourier transforms 2) Fourier theorems 3) Scalar diffraction theory: Kirchhoff formulation 4) Beam propagation methods 5) Analysis of complex optical systems 6) Frequency analysis of optical imaging systems 7) Scattering theory approach 8) Fourier analysis applied to ultrafast optics Expected results: The student shall be capable of solving a computational project applied to a concrete problem and application of Fourier Optics Teaching Methods: Frontal, interactive lectures with homework Learning verification methods: Exam: Computational project and its discussion.
Materials	Introduction to Fourier Optics Joseph W. Goodman, Fourth Edition 2017 ISBN: 9781319119164 Computational Fourier Optics: A MATLAB Tutorial David G. Voelz 2011 ISBN: 9780819482044 Supplemental Reading Diffraction Physics John M. Cowley, Third Edition 1995 ISBN: 0444822186