UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Spettroscopia Ottica dello Stato Solido

2021-1-F1701Q110

Aims

The main goal of the course is giving the tools for the description of the optical properties of solids, to complete the overall picture of solid state physics.

Specific aims of the course:

- discussing light propagation in solids
- introducing the proper concepts and physical quantities for the description of the optical properties of solids
- discussing the characteristic optical properties of different solid materials
- illustrating the main optical spectroscopy techniques and the working principles of instruments

Contents

- Light propagation in solids

- Dielectric response of solids and models

- Optical spectroscopy techniques

Detailed program

Maxwell's equations; electromagnetic spectrum; propagation of light in materials; complex dielectric function and refractive index; dielectric tensor and anisotropy.

Interface and multiple interfaces; reflection and refraction laws; Brewster angle; total reflection; reflectance, transmittance, absorbance.

Dielectric (optical) response of solids. Microscopic origin of the optical response; Lorentz and Drude models; dispersion relations, Kramers-Kronig relations, local field, Clausius-Mossotti equation, quantum treatment of optical transitions.

Characteristic response of ideal and real metals; response of insulators and semiconductors, absorption edge, doping, excitons; organic semiconductors.

Optical spectroscopy techniques: sources, dispersive elements, filters, polarizers, detectors. Principles of the Fourier transform instruments; measurements of R, T, A; Jones matrices and spectroscopic ellipsometry; Raman and luminescence spectroscopies.

Prerequisites

Classical electromagnetism and basic concepts of condensed matter physics.

Teaching form

Lessons and examples.

Textbook and teaching resource

1. H. Kuzmany, *Solid State Spectroscopy* (Springer, 2009)

2. G. Giusfredi, *Manuale di ottica* (Springer, 2015)

3. O Stenzel, *The Physics of Thin Film Optical Spectra* (Springer, 2005)

4. J. Peatross and M. Ware, *Physics of Light and Optics* (2015), available at optics.byu.edu

5. M. Fox, *Optical Properties of Solids* (Oxford University Press, 2010)

6. N.V. Tkachenko, *Optical spectroscopy* (Elsevier, 2006)

7. M. Born and E. Wolf, *Principles of Optics* (Pergamon Press, 1989)

8. F. Wooten, *Optical Properties of Solids* (Academic Press, 1972)

9. J. Garcia Solé, L.E. Bausà, and D. Jaque, *An Introduction to the Optical Spectroscopy of Inorganic Solids* (Wiley, 2005)

See also: The Feynman Lectures on Physics, at www.feynmanlectures.caltech.edu/

NOTE: textbooks 1, 2 and 3 can be downloaded as pdf files from the library website; textbook 4 is also freely available.

Semester

II semester

Assessment method

Oral exam.

Office hours

Upon request, by e-mail: adele.sassella@unimib.it