UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Physical Characterization of Materials With Laboratory

1920-1-F5302Q005

Aims

The course includes two parts with one final examination. The first part consists in lessons aimed at the presentation of the fundamental concepts of optical and vibrational spectroscopy of solids, together with the description of selected experimental techniques; the second part consists in an experimental activity.

Contents

Optical and vibrational spectroscopy of solids. Introduction to selected experimental techniques

Detailed program

Lessons (4 CFU)

Maxwell equations. Interactions between electromagnetic radiation and matter: analyses of charges and currents in a solid; polarizability, susceptibility; the complex dielectric function, complex refractive index, dielectric tensor; Lorentz and Drude models; light dispersion, absorption, reflectivity; the local field; linear response functions and Kramers-Kronig relations; fundamentals of non linear optics; neutron spectroscopy; photoemission.

Experimental techniques of optical and vibrational spectroscopy: anelastic (Brillouin, Raman) scattering; optical absorption; photoluminescence and time resolved luminescence; radio-luminescence and scintillation.

Electron paramagnetic resonance. Principles of scanning probe microscopy techniques.

Experimental activity (4 CFU)

Execution of one experimental activity among the following topics:

spectroscopy of semiconductors

micro-raman scattering

analysis of trace elements by ICP-Mass

thermoluminescence applied to archeological dating or to defect analysis

atomic force microscopy

X-ray diffraction

electron spin resonance

optical spectroscopy of insulators

X-ray fluorescence

ellipsometry

A written final report describing the experimental activity is required. The document should be prepared in word or pdf form and sent to the professor at least one week before the examination.

Prerequisites

Fundamentals of the structure of matter.

Teaching form

Lessons and lab activities. Course attendance is mandatory for the experimental part, and strongly suggested for the lessons.

Textbook and teaching resource

Suggested textbooks:

F. Wooten, “Optical properties of solids”, Academic Press

J. G. Solé, L.E. Bausà, D. Jaque, “Optical spectroscopy of Inorganic Solids”, Wiley

H. Kuzmany, “Solid State Spectroscopy”, Springer

B.E.A. Saleh and M.C. Teich, “Fundamentals of Photonics”, Wiley

Semester

November-March

Assessment method

The examination is in oral form. It consists in:

- a discussion about the topics treated during the lessons

- a discussion about the experimental activity undertaken in the laboratory, also based on the written report.

Office hours

8-18