UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Physics of Semiconductors

2627-1-F1703Q035

Aims

The course will provide fundamental knowledge in the area of “MATERIALS”, in particular of the class of semiconductor materials. The aims of this course are: 1) to provide knowledge and understanding in some key areas of semiconductor physics: nanoelectronics, spintronics, optoelectronics, quantum technologies, sensors, energy harvesting and production; 2) to provide adequate tools to analyze complex phenomena from the fundamental point of view; 3) to help students develop a critical thinking in the analysis of semiconductor properties; 4) to support students in learning how to interact with academic and research professionals in the field of semiconductor physics, i.e. by means of appropriate technical and scientific language, presentation tools and related skills; 5) to master scientific competences to enable students to critically analyze the scientific literature and engage with modern avenues of semiconductor physics.

After a summary of technologically relevant materials and their properties and a reminder of solid-state physics concepts, such as crystal structure, lattice vibrations and band structure, semiconductor specific topics such as effective mass and its experimental determination, point defects and their structural, thermodynamic and electronic properties optical properties, charge transport, semiconductors in equilibrium and nonequilibrium conditions will be presented as the core of the course.
For the interested reader some additional topics (e.g. quantum heterostructures, 2D materials) are included to offer an overview of some highlights in semiconductor physics current trends and stimulate further reading. To follow efficiently the course pre-existing knowledge in quantum mechanics and solid-state physics is necessary.

Contents

Semiconductor physics: electronic, optical, and transport properties

Detailed program

Fundamentals Properties
• Crystals
• Defects
• Mechanical Properties
• Band Structure
• Electronic defect states
• Transport
• Optical Properties
• Heterostructures
• Nanostructures
• 2D materials
Growth
• Thermodynamics and Atomistics of Epitaxial Layer Growth
• Methods of Epitaxy
• Doping, Diffusion and Contacts

Prerequisites

Quantum Mechanics. Solid State Physics.

Teaching form

The teaching will be of type "erogativa", carried out in the context of frontal lessons with blackboard and slides: 26 2-hour lessons held in presence mode.

Textbook and teaching resource

- M. Grundmann, The Physics of Semiconductors: An Introduction Including Devices and Nanophysics, Springer
- Udo W. Pohl, Epitaxy of Semiconductors, Springer

Copies of the slides used during lectures

Semester

II Semester

Assessment method

The students' knowledge will be assessed through an oral test. The interview will focus on the topics covered in class. The understanding of the topics and the skills acquired will be evaluated.

Office hours

at the end of the lessons or by appointment

Sustainable Development Goals

QUALITY EDUCATION | AFFORDABLE AND CLEAN ENERGY | INDUSTRY, INNOVATION AND INFRASTRUCTURE