UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Solid State Physics Laboratory

2627-3-E3001Q064

Aims

The aim of the course is to present some experiments in solid state physics. A significant amount of time is devoted to semiconductors due to their importance from an application point of view.

The main training objectives are:

- knowledge and ability to understand the instrumentation and techniques of a solid state physics laboratory;
- knowledge and ability to understand the physical properties of solids applied to the main applications;
- autonomy of judgment (making judgments) in the analysis of physical properties and in the setting up of scientific experiments;
- communication skills in drafting scientific experiment reports and in the orderly description of a measurement procedure;
- ability to learn independently from additional teaching material, manuals and technical specifications of the instrumentation (learning skills).

Contents

The course consists of a series of laboratory experiences aimed at the electrical and optical characterization of semiconductors (conductivity and Hall effect, characteristics of the p-n junction, absorption and photovoltaic conversion of light energy, etc.).
The laboratory activity will be preceded by a short cycle of lessons in which the different experiences will be introduced.

Detailed program

The theoretical introduction section presents the following topics:

Semiconductors

- Crystalline structure;
- Band structure;
- Transport;
- Optical absorption;
- Pn junction.

Instruments

- Sources;
- Detectors;
- Monochromators;
- Generators;
- Multimeters;
- Magnets.

Safety in the laboratory

The laboratory part instead includes the following contents.

Experiences in the teaching laboratory

- Hall effect in semiconductors;
- Solar cell power response;
- Spectral response of a photodiode;
- Determination of life time in silicon;
- Semiconductor transmittance and reflectance measurements;
- Photoluminescence measurements;
- Voltage-current characteristic of a diode as a function of temperature.

Prerequisites

Physics courses and physics laboratories of the previous years.

Teaching form

- 12 2-hour lessons held in presence;
- 18 4-hour laboratory activities carried out in interactive mode in presence;
  The introductory lectures on the main topics of solid state physics are intended to allow a complete understanding of the experiences carried out in the laboratory.
  During the laboratory the students are divided into groups of 3-4 people. There are generally 5 or 6 groups so that all 6 pre-prepared experiences can be carried out in rotation, each of which lasts three afternoons. If necessary, 1-2 new experiences can be added.

Textbook and teaching resource

The main teaching resource consists of handouts on the theory and the implementation of the experiences provided by the teachers. As in all laboratories, the instrument manuals and the technical specifications of the material used are also fundamental.
We indicate a couple of recommended texts for further information:

- M. Guzzi, “Principles of semiconductor physics”, Hoepli
- C. Kittel, “Introduction to Solid State Physics”, Zanichelli

Semester

Second semester

Assessment method

In summary the tests consist of:

- Interviews on the topics covered in class;
- Interview on the laboratory report;
- Interview on laboratory experiences.
  Below is a more detailed description.
  At the end of the experiences, the students must submit a written report on one of the experiences chosen by the students. It is requested that the report is not particularly extensive (more or less max 6 pages per experience). The report must include a brief description of the topic of the experience, the instrumentation used and the data collection procedure, an analysis of the data and finally a brief comment on the results.
  In the oral exam, the reports submitted are discussed and questions are asked about the results obtained in other experiences. Students are required to show up for the test with the laboratory notebook where the results of all the experiments are reported.
  Availability to take exams in English for Erasmus students (for those who wish).

Office hours

At the end of lessons or by appointment.

Sustainable Development Goals

QUALITY EDUCATION | AFFORDABLE AND CLEAN ENERGY | CLIMATE ACTION