



Course syllabus

Fasta tillståndets fysik Solid State Physics

FFFF05, 7,5 credits, G2 (First Cycle)

Valid for: 2023/24

Faculty: Faculty of Engineering, LTH

Decided by: PLED N

Date of Decision: 2023-04-17

General Information

Main field: Technology.

Compulsory for: F3

Language of instruction: The course will be given in Swedish

Aim

Studies of the physics of solids, and in particular of properties of semiconducting materials, forms the basis of all the microelectronic devices and applications that is present everywhere in today's society and technology. The course uses concepts from statistical physics, electromagnetic field theory, quantum mechanics and atomic physics. The origin of the electronic structure of solids is discussed based on theories developed in previous courses. Emphasis is on the bandstructure and electrical properties of semiconductors, which naturally leads to the introduction of the pn junction. Some components, e. g. transistors, are briefly discussed and their development and future challenges are outlined. The course syllabus also includes an overview of some optical properties of solids. Concepts treated in the course are relevant for instance in the rapidly developing fields of optoelectronics and semiconductor components, as well as being a basis for fundamental research and development in the field.

Learning outcomes

Knowledge and understanding

For a passing grade the student must

- be able to describe the physical models used in the course as well as their prerequisites, possible applications and limitations.

- be able to explain what affects electrical properties of solids and of semiconductors in particular.
- be able to discuss possibilities and limitations of semiconductor materials.
- be able to describe the pn junction and some semiconductor-based electronic components.
- describe some electronic and optical properties of solids and discuss these properties based on the models included in the course.

Competences and skills

For a passing grade the student must

- be able to choose relevant models with elements of quantum mechanics to describe the electronic structure of solids.
- be able to carry out and evaluate experiments.
- be able to present and discuss problems and experimental results in writing and in oral presentations.

Contents

Crystalline materials. Classical vs. quantum mechanical description of electrons in metals. Electronic structure: the free-electron model and bandstructure. Electrical properties of metals, semiconductors and isolators. Optoelectronic and electronic components: the pn junction, light-emitting diodes and an introduction to field effect transistors. Brief discussion of the optical properties of solids.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)

Assessment: Written examination and completed laboratory work.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Parts

Code: 0110. **Name:** Solid State Physics.

Credits: 6,5. **Grading scale:** TH. **Assessment:** Written examination.

Code: 0210. **Name:** Laboratory Exercises.

Credits: 1. **Grading scale:** UG. **Assessment:** Presentation, in writing and orally, of laboratory exercises and the results. **Contents:** Laboratory exercises.

Admission

Assumed prior knowledge: FMFF40 Quantum Mechanics, General Course and FMFF06 Thermodynamics with Applications.

The number of participants is limited to: No

The course overlaps following course/s: FFF100, FFFF01

Reading list

- Compendium.

Contact and other information

Course coordinator: Carina Fasth, carina.fasth@ftf.lth.se

Course homepage: <http://canvas.education.lu.se>

Further information: Some elements may be taught and assessed in English. This includes a maximum of 1.5 hp, in the form of laboratory sessions or written assignments.