Course syllabus

Physics of Semiconductor Devices

an advanced course for doctoral students

Course responsible: Shili Zhang (018-471 7247; shili.zhang@angstrom.uu.se)
Number of credits: 10 ECTS (hp)
Main fields of study: Electronics, engineering sciences, physics, engineering physics
Course period: 4th academic period starting from the end of March or beginning of April
Availability: Max. 16 students
Language for instruction: English
Requirements: MSc education or equivalent in physics, engineering physics, electrical engineering or electronics
Grading system: Pass or fail
Aim and scope

Semiconductor devices constitute the building blocks of modern electronics that in turn is the foundation of information and communication technology. The family of semiconductor devices is large with over 100 different members ever explored and many of which implemented for real applications. Despite this large number of family members, the device architecture and operation are all based on a handful of physical principles.

This course will cover these physical principles, by starting with introducing the concepts of energy bands and semiconductor doping. The most important and prevailing semiconductor devices, i.e. p-n diodes, metal-semiconductor junctions, metal-insulator-semiconductor capacitors (MIS-C), bipolar junction transistors (BJT) and metal-oxide-semiconductor field-effect transistor (MOSFET) will then be treated in great detail. This treatment will be followed by examining several other important semiconductor devices including light-emitting diodes, solar cells and various semiconductor-based detectors or sensors. In order to reinforce the learning, lecturing will be intimately integrated with hands-on problem-solving and topical student seminars.

After completing the course, the student should be able to:

- discuss device operations in the framework of energy band diagram;
- analyse device functions by recourse to available physical models;
- quantify device behaviours with the assistance of established mathematical models;
- motivate and establish connections between or among different devices.

Scheme and requirements

- Sessions: 16 × 2 hours
- Take-home written exam
- Individual oral exam (max 4 hours each)

Course literature

- Hand-outs