Emerging Electronic Device Technologies, 9.0 credits

Framväxande elektroniska komponentteknologier, 9.0 hp

Third-cycle education course

6FIFMA5

Department of Physics, Chemistry and Biology

Valid from: First half-year 2025

Approved by **Approved**

Registration number

Entry requirements

Entry requirement for studies on third-cycle education courses

- second-cycle degree,
- 240 credits in required courses, including at least 60 second-cycle credits, or
- acquisition of equivalent knowledge in some other manner

Learning outcomes

The overall aim of this course is to give students fundamental knowledge and trends of some emerging electronic devices using innovative and advanced technologies, which are crucial for the sustainable development of society.
On completing the course, the student should be able to:

- Understand the working principle and physics limit of various emerging electronic and photonic devices, and basic relationship between material properties and device performance.
- Explain and implement some key equations, which determine main characteristics of electronic and photonic devices.
- Be skillful to calculate/analyze some parameters that are important for the device performance
- Apply the knowledge to a selected device, and find connections between the structure design, mode of operation and characteristics, and eventual performance optimization using COMSOL simulation tools

Contents

Review of fundamentals
Basic quantum physics and semiconductors
Basic device building blocks: p-n junctions, metal-semiconductor contacts, and MOS structures
Devices based on semiconductors
Nanoelectronics: State of the art nm-MOS technology, Moore's law, and the future trend
Chips and architectures for AI hardware
Spintronic devices and ABC of quantum computing
Power electronics: Basic issues and power limits
Light emitting diodes and displays
Solid-state laser diodes
Photodetectors
Photovoltaic technologies
Far infrared and Tera-Hz electronics
Device modeling and simulations
General introduction about COMSOL and Semiconductor module
Application examples using COMSOL
Devices based of emerging materials
Carbon-based electronics
Organic and molecular electronics
Perovskite-based electronics

Educational methods

The course will be given in the form of lectures on the listed scientific and technologic topics, in-lecture interactive quiz tests, problem/question discussion classes, as well as project work in small groups and final presentation of their results.

Examination

Written exam and completion of the project work

Grading

Two-grade scale

Course literature

S.M. Sze: Physics of Semiconductor Devices / Wiley; 4th edition (12 Feb. 2021)
ISBN: 978-1119429111, 1119429110.
Together with lecture notes and necessary review articles, distributed during lectures

General information

The course is planned and carried out according to what is stated in this syllabus. Course evaluation, analysis and suggestions for improvement should be fed back to the Research and PhD studies Committee (FUN) by the course coordinator.