1. Semester

Module title: *Advanced Physics*

Module summary
Module code: SSTM110
Module coordinator: Prof. Dr. Christian Karnutsch
Credits (ECTS): 6
Semester: *1*
Pre-requisites with regard to content: Basic knowledge in mathematics and physics (Bachelor level)
Pre-requisites according to the examination regulations: --
Learning outcomes and competencies: After successful completion of the module • Students understand the causes and effects of electromagnetic interactions • They know the phenomena of classical electrodynamics and understand their general mathematical descriptions (Maxwell laws) as well as their applications • Students have an understanding of the quantized form of electromagnetic waves (photons) and their interaction with matter • Students have knowledge of the description of quantum mechanical systems • Students will be able to understand and analyze sensor principles based on theoretical models, giving them a deeper understanding of the underlying physical mechanisms • Students are able to link different phenomena with the help of theoretical models and thus structure the field of knowledge • Students are qualified for more complex tasks in the development of sensors
Assessment: Written exam of 120 min plus Lab

Course: Physics
Module code: SSTM111
Lecturer: Dr. Weidler
Contact hours: *4*
Semester of delivery: 1
Type/mode: Lecture
Language of instruction: English
Content: • Mathematical foundation of Electrodynamics: Vector Analysis / Introduction of del-operator / Scalar and Vector Potentials • Electrostatics / Electromagnetic Fields (Gauss's Law) / Networks

- Magnetostatics /. Magnetic Fields (Ampere's Law) / mag. Dipole
- DC and AC Circuits
- Maxwell Equations / Solution of Maxwell Equations

Recommended reading:

- **Feynman, Leighton, Sands**: Lectures on Physics Electromagnetism and Matter, Vol. II, Part I, Addison Wesley, R. Oldenbourg Verlag, 1965
- **Serway, Jewett**: Physics for Scientists and Engineers (9th ed.), Brooks/Cole Thomson, 2014
- **Griffiths**: Introduction to Electrodynamics (5th ed.), Pearson Cambridge University Press, 2023
- **Shadowitz**: The electromagnetic field, Dover Publications, 1975

Comments:
The lecture requires a good knowledge of basic calculus, basics of analytical geometry and physics equivalent to secondary/grammar school graduation

Course: Solid State Physics

Module code: SSTM112

Lecturer: Prof. Dr. Christian Karnutsch

Contact hours: 2

Semester of delivery: 1

Type/mode: Lecture

Language of instruction: *English*

Content:

- Atoms & Electrons
- Crystal properties and growth of semiconductors
- Doping of semiconductors
- Charge carrier transport
- Physics of p-n-junctions
- Metal-semiconductor interfaces
- Optical processes in semiconductors
- Introduction to quantum mechanics

Recommended reading:

- "Introduction to Solid State Physics" by Charles Kittel,
  Covers fundamental concepts with a clear structure
- "Solid State Physics" by Neil W. Ashcroft and N. David Mermin
  More in-depth and rigorous than Kittel
- "Solid State Physics: An Introduction" by Philip Hofmann
  Modern and concise, with clear explanations and good illustrations
- "Principles of the Theory of Solids" by J. M. Ziman
  Focuses on the theoretical foundations of solid-state physics.
- More mathematical and conceptual—ideal for those interested in theory
- "Electronic Properties of Materials" by Rolf E. Hummel
  Connects solid-state physics with materials science and electronic engineering
- "Fundamentals of Semiconductors" by Peter Y. Yu and Manuel Cardona
  Especially useful for solid-state physics of semiconductors

Comments: