Modern Physics

Programme course

6 credits

Modern fysik

TNE041

Valid from: 2017 Spring semester

Determined by
Board of Studies for Electrical Engineering, Physics and Mathematics

Date determined
2017-01-25

Main field of study
Applied Physics, Physics

Course level
First cycle

Advancement level
G2X

Course offered for
- Electronics Design Engineering, M Sc in Engineering

Entry requirements
Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites
Multivariable calculus,Mechanics and Wave physics or similar courses

Intended learning outcomes

The course shall give an introduction to and an overview of modern physics, especially areas in statistical physics, quantum mechanics and solid state physics that are important in semiconductor technology. After completing this course students should be able to do the following:

- Apply basic relations in relativistic dynamics
- Describe basic phenomena that motivated the transition from classical physics to quantum physics and the formulation of the Bohr model
- Describe the uncertainty relations and the different ways of interaction between electromagnetic radiation and matter, and apply these in problem solving
- Solve the Schrödinger equation in some special cases; be able to interpret and describe the solutions (wave functions) physically, and to calculate physically measurable quantities using wave functions.
- Describe non-classical concepts like tunnel effect and spin and their applications, and apply these concepts in simple model calculations
- Describe the Pauli principle and explain how it determines the electron configuration in atoms, and its importance for the principles of the buildup of the periodic system
- Apply basic statistical mechanics, especially being able to calculate physical quantities starting from distribution functions
- Give an account for the main steps in the derivation of the Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein distributions, and give examples of applications.
- Describe different types of crystal structures and chemical bonds in solid materials
- Give an account for what characterizes conductors, semiconductors and insulators, especially with respect to the electrical conductivity, and the meaning and importance of energy bands.
- Describe central concepts in semiconductor physics like doping, acceptor,donor,effective mass, and make simple model calculations using them
- Explain and evaluate results obtained from assignments in computer simulation and communicate by presenting written accounts of these

Course content

Relativistic dynamics, Quantum mechanics: interaction between electromagnetic radiation and matter, wave-particle dualism, the uncertainty principle. The Schrödinger equation with applications on simple systems. The Pauli principle and the periodic system. Statistical physics:Maxwell-Boltzmann,Fermi-Dirac and Bose-Einstein distributions with applications.
Solid state physics: Crystal structures, lattices, electrical conductivity of semiconductors, band theory.

Teaching and working methods

Lectures, tutorials and computer laboratory sessions.

Examination

UPG1	Optional hand-in assignments	0 credits	U, G
LAB1	Laboratory work	1.5 credits	U, G
TEN1	Written examination	4.5 credits	U, 3, 4, 5

Optional homework problems are given that may give a bonus on the written examination, the bonus is valid until the examination in August immediately after the course is finished.

Grades

Four-grade scale, LiU, U, 3, 4, 5

Other information

Supplementary courses: Semiconductor technology, organic electronics

Department

Institutionen för teknik och naturvetenskap

Director of Studies or equivalent

Adriana Serban

Examiner

Ulf Sannemo

Course website and other links

http://www2.itn.liu.se/utbildning/kurs/

Education components

Preliminary scheduled hours: 46 h
Recommended self-study hours: 114 h

Course literature

Randy Harris: Modern Physics. Nordling,Österman: Physics Handbook

Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.