Modern Physics

Programme course

6 credits

Modern fysik

TFYA67

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
- Biomedical 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
Mathematics, Calculus, Mechanics, Wave Motion and Electromagnetic Field Theory.

Intended learning outcomes
The primary goal of this introductory course is to give an understanding of the fundamentals of quantum mechanics and the theory of relativity. After completing the course the student should be able to:

- describe the main ideas and theories of modern physics
- solve problems in the context of modern physics, choose suitable methods and judge the reasonableness of obtained results
- formulate and assess mathematical models describing physical problems in mordern physics
- explain the Swedish and English terms and concepts used in this field

Course content

Modern physics is mainly the twentieth century's physics and has a huge range, from the smallest building blocks of matter to the whole universe. The large accumulated body of knowledge naturally makes a delineation of the course necessary, which roughly looks like this:

- Relativity: The Lorentz transformation. The Doppler effect for electromagnetic waves. Relativistic mechanics. Rest mass and rest energy. Introduction to general relativity.
- Nuclear physics: The nuclear structure and binding, nuclear models. Nuclear magnetic resonance. E = mc2 applied to nuclear processes. Radioactive decay. Nuclear reactions, fission and fusion.
- Quantum Physics: Wave-particle duality. The uncertainty principle. The Bohr model of the atom. The Schrödinger equation. Bound and unbound states. Quantum-mechanical operators, expectation values and eigenvalues. Stationary and non-stationary state.
- Atomic physics: The Schrödinger equation applied to one-electron system. Energy levels, quantum numbers, orbitals, spectra. Spin, magnetic moment and the influence of magnetic fields. Multi-electron systems: the Pauli exclusion principle, the periodic table, approximate energy levels.
- Statistical Mechanics: Classical distributions (the Boltzmann distribution, the Maxwell velocity distribution). Quantum Distributions (the Bose-Einstein distribution, the Fermi-Dirac distribution).
- Molecular Physics: Molecular orbitals, molecular bonds. Vibrations, rotations, molecular spectra.
- Solid State Physics: Electronic structure. Band theory. Semiconductor physics and semiconductor devices.
- Introduction to elementary particle physics (Standard Model).

Teaching and working methods

Lectures, problem solving sessions and laboratory work.

Examination

KTR1	Optional assignments	0 credits	U, G
LAB1	Laboratory work	1 credits	U, G
TEN1	Written examination	5 credits	U, 3, 4, 5

The optional assignments may give bonus points on the written exam

Grades

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

Other information
Supplementary courses: Medical Radiation Physics

Department
Institutionen för fysik, kemi och biologi

Director of Studies or equivalent
Magnus Johansson

Examiner
Mats Eriksson

Course website and other links

Education components
Preliminary scheduled hours: 60 h
Recommended self-study hours: 100 h

Course literature

Additional literature

Books

Randy Harris, (2008) *Modern Physics* 2
ISBN: 978-0-321-52667-0
Pearson international edition

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.