Modern Physics I

Programme course

4 credits

Modern fysik I

TFYA73

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
- Physics and Nanotechnology
- Applied Physics and Electrical Engineering - International, M Sc in Engineering
- Applied Physics and Electrical 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 course provides an understanding of the fundamentals of quantum mechanics and the theory of relativity and, with this as a foundation, give a basic description of atomic physics and nuclear physics. After completing the course the student should be able to:

- describe the main ideas and theories within the subject
- solve problems in the context of the subject, choose suitable methods and judge the reasonableness of obtained results
- formulate and judge mathematical models describing physical problems
- explain the Swedish and English terms used in the field

Course content

Modern physics is essentially the twentieth century's physics and has a huge range, from the smallest building blocks of matter to the entire universe and everything in between. In this course we focus on the basics of relativity and quantum physics and apply them in atomic physics and nuclear physics.

- Theory of Relativity: The Lorentz transformation. The Doppler effect for electromagnetic waves. Relativistic mechanics. Rest mass and rest energy. Introduction to general relativity.
- Quantum Physics: The 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 states.
- Atomic physics: The Schrödinger equation applied to one-electron systems. 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.
- Nuclear Physics: Structure and binding, nuclear models. Nuclear magnetic resonance. E = mc2 applied to nuclear processes. Radioactive decay. Nuclear reactions, fission and fusion.

Teaching and working methods

Lectures, exercises and one laboratory exercise.

Examination

LAB1	Laboratory work	0.5 credits	U, G
TEN2	Written examination	3.5 credits	U, 3, 4, 5

Grades

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

Other information

Supplementary courses: Modern Physics II, Nanotechnology, Physics of Condensed Matter, Experimental Physics, Semiconductor Technology, Surface Physics, Analytical Mechanics, Theory of Relativity, Quantum Mechanics, Cosmology, Medical Radiation Physics

Department

Institutionen för fysik, kemi och biologi

Director of Studies or equivalent
Magnus Johansson

Examiner
Mats Eriksson

Education components
Preliminary scheduled hours: 40 h
Recommended self-study hours: 67 h

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.