Opasraportti

LuTK - Physical Sciences 2007-2008 (2007 - 2008)

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

765693S: Advanced astronomy studies at other universities, 0 op
763699S: Advanced course, 6 - 10 op
763622S: Advanced course in quantum mechanics, 10 op
764626S: Advanced laboratory exercises in biophysics, 5 op
763698S: Advanced special course:, 6 - 8 op
762332A: Airborne geophysics, 3 op
762661S: An advanced level course from another Finnish university, 0 op
762663S: An advanced level course from another university abroad, 0 op
762361A: An intermediate level course from another Finnish university, 0 op
762363A: An intermediate level course from another university abroad, 0 op
763310A: Analytical mechanics, 6 op
761669S: Applications of NMR spectroscopy, 6 op
761650S: Applications of atom physics, 6 op
766646S: Applications of quantum mechanics in SR based spectroscopy, 6 op
766320A: Applied Electromagnetism, 6 op
765638S: Areology, 6 op
765336A: Astronomical observing techniques, 5 op
761105P: Atomic and Nuclear Physics, 3 op
766326A: Atomic physics, 6 op
761649S: Auroral physics, 6 op
765356A: B.Sc. thesis, 10 op
763330A: B.Sc. thesis, 10 op
761385A: B.Sc. thesis and seminar, 10 op
764306A: B.Sc. thesis and seminar, 10 op
762382A: B.Sc. work (thesis and seminar), 10 op
765637S: Basaltic volcanism on terrestrial planets, 6 op
761101P: Basic Mechanics, 4 op
761102P: Basic Thermodynamics, 2 op
761322A: Basics of electronics, 5 op
761353A: Basics of plasma physics, 5 op
766355A: Basics of space physics, 5 op
764660S: Bioelectronics, 5 op
764325A: Biophysical laboratory exercises, 5 op
764631S: Bioprocess dynamics, 4 op
764364A: Biosystems analysis, 6 op
765304A: Celestial mechanics, 5 - 8 op
764323A: Cell membrane biophysics, 7 op
763629S: Classical field theory, 6 op
761668S: Computational physics and chemistry, 6 op
765617S: Computer simulations, 5 op
763628S: Condensed matter physics, 10 op
766655S: Cosmic Rays, 8 op
765135P: Data processing in astronomy, 2 op
766309A: Demonstrations in Physics and Chemistry, 2 op

761112P: Development of the physical world view, 3 op
762624S: Electrical research methods of rock and soil, 5 op
761103P: Electricity and Magnetism, 4 op
763626S: Electro-weak interactions, 10 op
761632S: Electromagnetic radiation, 6 op
766321A: Electromagnetism I, 4 op
766322A: Electromagnetism II, 4 op
761673S: Electron and ion spectroscopy, 8 op
763696S: Electronic transport in mesoscopic systems, 6 op
762684S: Excursion, 2 op
761671S: Extension course in atomic physics, 8 op
766648S: Extension course in electron spectroscopy, 8 op
762644S: Field course in applied geophysics, 6 op
764115P: Foundations of cellular biophysics, 4 op
761666S: Fourier transform with applications, 6 op
761648S: Fundamentals of incoherent scatter radar, 8 op
765330A: Galaxies, 6 op
765671S: Gasdynamics and interstellar medium, 8 op
763695S: General relativity, 6 op
762322A: Geomagnetism, 5 op
762304A: Geophysical data processing, 6 op
762303A: Geophysical field theory, 8 op
762629S: Geophysical properties of the crust and upper mantle in Fennoscandia, 4 op
762612S: Gravimetric and magnetic methods, 5 op
762616S: Ground Penetrating Radar Sounding, 5 op
766656S: Heliospheric physics, 8 op
764620S: Hemodynamics, 4 op
765106P: History of astronomy, 3 op
763654S: Hydrodynamics, 6 op
762660S: Ice & Snow Physics & Chemistry & Glaciology, 3 op
764628S: Identification of linear and nonlinear systems, 8 op
765660S: Impact craters, 4 op
761662S: Infrared spectroscopy, 8 op
762605S: Interpretation theory, 6 op
764640S: Intracellular recordings, 3 op
765101P: Introduction to astronomy I, 4 op
765102P: Introduction to astronomy II, 8 op
764162P: Introduction to biophysics, 3 op
761645S: Introduction to experimental physical research, 6 op
762135P: Introduction to global environmental geophysics, 6 op
762193P: Introduction to hydrology and hydrogeophysics, 4 op
762187P: Introduction to information retrieval and scientific writing in geophysics, 2 op
763621S: Introduction to particle physics, 10 op
763114P: Introduction to programming, 4 op
763102P: Introduction to relativity, 3 op
766115P: Introduction to the physical sciences, 1 op
761658S: Ionospheric physics, 8 op
766107P: Laboratory exercises in physical sciences, 6 op
761308A: Laboratory exercises in physics, 4 op
761675S: Laser and synchrotron radiation physics, 6 op
761664S: Laser physics, 6 op
762681S: M.Sc. work (thesis and seminar), 30 op
761657S: Magnetospheric physics, 8 op
762625S: Magnetotellurics, 5 op
765645S: Mapping the planets, 4 op
763101P: Mathematics for physics, 6 op
761386A: Maturity test, 0 op
763685S: Maturity test, 0 op
761686S: Maturity test, 0 op
765657S: Maturity test, 0 op
762679S: Maturity test, 0 op
765357A: Maturity test, 0 op
763385A: Maturity test, 0 op
762379A: Maturity test, 0 op

764395A: Maturity test for BSc, 0 op
764695S: Maturity test for MSc, 0 op
766323A: Mechanics, 6 op
764369A: Medical Equipments, 3 op
764633S: Medical Physics, 4 op
765677S: Meteorites, 4 op
763694S: Methods in material physics, 6 op
762630S: Modelling of electromagnetic fields, 5 op
764619S: Molecular biophysics, 4 op
761661S: Molecular quantum mechanics, 8 op
763624S: Monte Carlo and simulation methods, 6 op
766661S: NMR Imaging, 8 op
761663S: NMR spectroscopy, 8 op
761670S: NMR spectroscopy in solids, 6 op
764680S: Neural information processing, 5 op
763315A: Numerical modelling, 4 op
763616S: Numerical programming, 6 op
761665S: Optics, 6 op
761011Y: Orientation course for new students, 2 op
762085Y: Orientation course for new students, 2 op
764641S: Patch-clamp techniques, 3 op
761121P: Physical Measurements I, 3 op
762327A: Physical Properties of Rocks, 5 op
761644S: Physical measurements, 6 op
766338A: Physics for teachers, 4 op
764117P: Physics, Biology and Safety Radiation, 3 op
765303A: Planetology, 7 op
765339A: Planetology II, 5 op
761653S: Plasma physics, 8 op
762652S: Practical training, 6 op
764337A: Practical training, 3 - 9 op
761337A: Practical training, 3 - 6 op
765334A: Practical work in astronomy, 4 - 8 op
763650S: Practice, 3 - 5 op
761684S: Pro gradu thesis, 20 op
764697S: Pro gradu thesis, 35 op
763682S: Pro gradu thesis, 20 op
765624S: Pro gradu thesis, 35 op
761683S: Pro gradu thesis, 35 op
765621S: Pro gradu thesis, 20 op
763683S: Pro gradu thesis, 35 op
763641S: Programming, 6 op
763625S: Quantum field theory, 10 op
763312A: Quantum mechanics I, 10 op
763612S: Quantum mechanics I, 10 op
763313A: Quantum mechanics II, 10 op
763693S: Quantum optics in electric circuits, 6 op
761117P: Radiation physics, 2 op
764317A: Radiation physics, biology and safety, 3 op
765676S: Radiative Processes in Astrophysics, 8 op
765648S: Relativistic Astrophysics, 8 op
762315A: Remote sensing, 5 op
765655S: Research project, 6 op
764651S: Research project in biophysics, 10 op
766651S: Research project in physics, 6 op
762321A: Seismology and the structure of the earth, 5 op
765609S: Selenology, 6 op
762636S: Shallow seismic soundings, 6 op
764668S: Simulation of biosystems, 5 op
766654S: Solar physics, 8 op
762192P: Solid Earth Geophysics, 3 op
763333A: Solid state physics, 4 op
764606S: Special advanced course, 5 - 9 op
765394A: Special course, 7 op

765694S: Special course, 7 op
765692S: Special course given by a visiting lecturer, 4 - 6 op
765385A: Special course given by a visiting lecturer, 4 - 6 op
762662S: Special courses in geophysics, 0 op
764359A: Spectroscopic methods, 5 op
765666S: Statistical methods in astronomy, 5 op
765366A: Statistical methods in astronomy, 5 op
763620S: Statistical physics, 10 op
765673S: Stellar atmospheres, 7 op
765608S: Stellar dynamics, 7 op
765343A: Stellar structure and evolution, 7 op
765643S: Stellar structure and evolution, 7 op
765661S: Structure and kinematics of galaxies, 6 op
766334A: Structure of matter II, 2 op
761013Y: Student tutoring, 2 op
763645S: Superconductivity, 6 op
765373A: Theoretical astrophysics, 7 op
762611S: Theory of electromagnetic methods, 5 op
762628S: Thermal processes of the earth, 5 op
766328A: Thermophysics, 6 op
762627S: Time-domain electromagnetic research methods, 3 op
762086Y: Tutoring, 2 op
762617S: VLF-method, 5 op
765683S: Venus: geology and geophysics, 6 op
764327A: Virtual measurement environments, 5 op
761104P: Wave Motion, 3 op
766329A: Wave motion and optics, 6 op
761672S: X-ray physics, 6 op

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

765693S: Advanced astronomy studies at other universities, 0 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

ECTS Credits:
0 credits
Contents:
Courses in Astronomy completed in other institution.
Person responsible:
Juri Poutanen

763699S: Advanced course, 6 - 10 op

Opiskelumuoto: Advanced Studies

Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

ECTS Credits:
10 credits
Contents:
With changing topic.
Person responsible:
Erkki Thuneberg and Kari Rummukainen

763622S: Advanced course in quantum mechanics, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
10 credits
Timing:
3.-4. autumn
Contents:
Advanced course on quantum mechanics.
Symmetry in quantum mechanics, Clebsch-Gordan-coefficients, 6-j and 9-j symbols, spherical tensors, measurement of spin, hyperfine structure of hydrogen, Stark effect, time independent perturbation, Rayleigh-Schrödinger- and Brillouin-Wigner-methods, Closure approximation, time dependent Schrödinger equation, spin precession, spin resonance, time dependent perturbation, interaction picture, Fermi golden rule, interaction of radiation and matter, absorption and emission, spontaneous emission, multipole radiation, relativistic quantum mechanics.
Learning activities and teaching methods:
Lectures 50 h, exercises 30 h. One written examination.
Target group:
Optional.
Recommended optional programme components:
763313A.
Recommended or required reading:
G. Baym: Lectures on Quantum Mechanics (1969), J.J. Sakurai: Modern Quantum Mechanics (1985).
Person responsible:
Pekka Pietiläinen

764626S: Advanced laboratory exercises in biophysics, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

763698S: Advanced special course:, 6 - 8 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

ECTS Credits:
6 credits
Contents:
With changing topic.
Person responsible:
Erkki Thuneberg and Kari Rummukainen

762332A: Airborne geophysics, 3 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
3 credits
Language of instruction:
Finnish
Timing:
3. year
Contents:
The course provides basic knowledge on airborne geophysical investigation methods. Airborne geophysics includes magnetic, electromagnetic and radiometric measurements made above the ground surface using an airplane, for example. The course considers the geophysical methods, the practical arrangements, auxiliary measurements, navigation, data processing and interpretation. The exercises focus on the use of modelling and interpretation software.
Learning activities and teaching methods:
Lectures 25 h, demonstrations. Exam.
Target group:
Compulsory for students of geophysics in the B.Sc. degree. Recommended for all students of geosciences.
Recommended or required reading:
Lecture notes; Peltoniemi, M., 1998: Aerogeofysikaaliset menetelmät.
Person responsible:
Markku Pirttijärvi
Other information:
Course home page: http://www.gf.oulu.fi/~mpi/opetus/762332A_Aerogeofysiikka.html.

762661S: An advanced level course from another Finnish university, 0 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

ECTS Credits:
0 credits

Contents:
Courses taken at other Finnish universities.
Person responsible:
Pertti Kaikkonen

762663S: An advanced level course from another university abroad, 0 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

ECTS Credits:
0 credits
Contents:
Courses taken, e.g.,during international exchange programs (Erasmus, Nordplus, etc.).
Person responsible:
Pertti Kaikkonen

762361A: An intermediate level course from another Finnish university, 0 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

ECTS Credits:
0 credits
Contents:
Courses taken at other Finnish universities.
Person responsible:
Pertti Kaikkonen

762363A: An intermediate level course from another university abroad, 0 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

ECTS Credits:
0 credits
Contents:
Courses taken, e.g.,during international exchange programs (Erasmus, Nordplus, etc.).
Person responsible:
Pertti Kaikkonen

763310A: Analytical mechanics, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
2. autumn
Contents:
Introduction to the Lagrange and Hamilton formalisms of mechanics. For all interested in mathematical physics, compulsory for theoretical physicists.
The main content is to present mechanics using Lagrange and Hamilton formalisms. This means that the familiar Newton's equations are written in a mathematically new form. The advantage of the new formulation is that it serves as a basis in deriving more general theories, especially quantum mechanics and classical field theory. The new formalism is illustrated by applying it to different problems of mechanics. In mathematical sense this course represents an application of vector calculus, partial differentiation, and calculus of variations.
Learning activities and teaching methods:
Lectures 26 h, exercises 24 h. Written examination.
Target group:
Compulsory for theoretical physics students.
Recommended optional programme components:
763101P, 766323A.
Recommended or required reading:
A. Fetter and J. Walecka: Theoretical mechanics of particles and continua; H. Goldstein: Classical Mechanics, E. Thuneberg: Analyyttinen mekaniikka (lecture notes).
Person responsible:
Erkki Thuneberg

761669S: Applications of NMR spectroscopy, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
Not every year
Contents:
The course deals with topical subject matters in nuclear magnetic resonance spectroscopy (NMR spectroscopy), such as spin density matrix theory, NMR in liquid crystals, and nuclear magnetic relaxation.
Learning activities and teaching methods:
Lectures 35 h, exercises 20 h, one written examination.
Target group:
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Recommended optional programme components:
761663S NMR spectroscopy is helpful, but not necessary.
Recommended or required reading:
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Person responsible:
Juhani Lounila

761650S: Applications of atom physics, 6 op

Voimassaolo: - 31.07.2009
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
Not every year
Contents:
Exercising applications of atom physics.
Learning activities and teaching methods:
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Target group:
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Recommended optional programme components:
761326A
Recommended or required reading:
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Person responsible:
Helena Aksela

766646S: Applications of quantum mechanics in SR based spectroscopy, 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
Not every year
Contents:
The course deals with various interactions between radiation and matter using quantum mechanical models of scattering. The fundamental phenomena discussed are the absorption and emission of photons and electron scattering and emission (photoionization and the Auger effect). The course starts with discussion of photoabsorption, where the concepts of cross section and oscillator strength are introduced. Next comes discussion of elastic electron scattering using potential scattering theory. As examples, scattering at low energies using the effective range theory, resonances, and scattering by the Coulomb potential are discussed. The interactions between electrons and photons are treated using the quantized electromagnetic field. Applications include derivation of the Fermi's golden rule using the time-independent scattering theory, where the concept of lifetime of metastable states is shown to arise from interactions between bound and continuum states. Other applications include discussion of the effect of the polarization state of photons on the angular distributions of photoelectrons, to show the utility of statistical description of scattering using density matrices. The last part of the course deals with inelastic photon scattering (Raman and Compton scattering) and the Auger effect.
Learning activities and teaching methods:
Lectures 35 h (incl. exercises), one examination.
Target group:
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Recommended optional programme components:
766326A, 763612S
Recommended or required reading:
Lecture notes.

Person responsible:
Sami Heinäsmäki

766320A: Applied Electromagnetism, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766325A	Electromagnetism (TTK)	4.0 op
761398A	Theory of Electricity	6.0 op

ECTS Credits:
6 credits
Timing:
Second autumn
Contents:
This lecture course consists of electromagnetic field theory and its applications. The course contains three parts: a) lectures, problem classes of field theory and four mini exams and one end exam b) home problems c) project with a report. Each part must be passed at an acceptable level. The marks of the whole course are given by a weighted average of the marks of parts a), b) and c) with weights 50 %, 25 % and 25 %, respectively.
a) Lectures of field theory and problem classes
The field theory starts with Maxwell's equations and their experimental justification. They are then used in deriving the electrostatics, stationary currents, magnetostatics, theory of dynamic electromagnetic fields and the propagation of electromagnetic waves in space. This theory makes the foundation of all electrical technology, but it is essential especially in understanding the working of antennas, transfer lines and wave guides. The problems given to students are brief and consist of simple cases which can be solved using the theory.
b) Home problems
These problems are more extensive than those on problem classes and solving them requires more profound reasoning. Each person will receive 6 problems to be solved.
c) Project
The project works are meant to act as concrete examples of electromagnetic phenomena. No detailed instructions are given, but the task is described in a loose way. The project group has to invent the experimental arrangement by themselves using the available tools. The group will also write a project report.
Learning activities and teaching methods:
Lectures 36 h, exercises 24 h, four mini examinations and one end examination or one final examination. Home problems. Project.
Target group:
Student in electrical engineering.
Recommended optional programme components:
Courses 761103P, 031011P
Recommended or required reading:
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Grading:
Each part must be passed.
Person responsible:
Tuomo Nygrén

765638S: Areology, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Contents:
An introduction to Mars studies.
Martian climate, atmosphere, polar caps, wind erosion. Tharsis bulge, chaotic terrain, canyon systems, Valles Marineris, permafrost, signs of water. Mars missions. Surface chemistry, possibility of life on Mars.
Learning activities and teaching methods:
Lectures 30 h, exercises. Written final examination, independent practicals and writings.
Target group:
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Recommended optional programme components:
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Recommended or required reading:
Recently published books and review articles.
Background from Cattermole: Mars: The story of the red planet, Greeley & Iversen: Wind as a geological process, Papike (ed.): Planetary materials (Mars).
New readings M. Carr (2006) The surface of Mars and M. Chapman (2007): The Geology of Mars - Evidence from Earth-Based Analogs.
Additional information from new publications, books and review articles.
See also the web pages of NASA (MGS, MO, MRO ja MER) and ESA (MEX).
Person responsible:
Jouko Raitala

765336A: Astronomical observing techniques, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
5 credits
Contents:
The course is an introduction to astronomical observing techniques. It begins with the effects of the atmosphere, especially in the visual wavelengths. Several telescope and observatory designs are studied. The primary detector in the visual wavelengths, the CCD camera, and basic image reduction techniques are introduced. Techniques such as photometry, interferometry, spectroscopy, polarimetry and astrometry are described. Finally, the instruments and detectors of other electromagnetic wavelengths and also cosmic rays and neutrinos are introduced.
Atmosphere and its effects on observations, telescopes and observatories, CCD camera, image reduction, photometry, spectroscopy, polarimetry, astrometry, detectors in other wavelength bands, cosmic ray and neutrino detectors.
Learning activities and teaching methods:
Lectures 32 h, exercises. One written examination.
Target group:
*
Recommended optional programme components:
Introduction to astronomy I & II (recoomended)
Recommended or required reading:
Recommended reading: Kitchin, C.R.: Astrophysical Techniques.
Person responsible:
Pertti Rautiainen

761105P: Atomic and Nuclear Physics, 3 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766326A	Atomic physics	6.0 op

ECTS Credits:
3 credits
Timing:
Spring term
Contents:
The microscopic building blocks of matter, for example atoms and their nuclei, do not obey the laws of classical physics. The fundamental theories of modern physics, the theory of relativity and quantum mechanics, are required to describe them. Both theories involve some radical changes in our views of the physical world, especially of the nature of space, time, matter and radiation. This course is an introduction to these two theories that underlie our modern world view, and to their application to the description of atoms, nuclei, and fundamental particles. Topics will include: Relativity. Photons, electrons, and atoms. The wave nature of particles. Quantum mechanics. Atomic structure. Nuclear physics. Particle physics.
Learning activities and teaching methods:
Lectures 28 h, 4 exercises (8 h), 2 written intermediate examinations or one final examination.
Target group:
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Recommended or required reading:
Textbook: H. D. Young and R. A. Freedman: University Physics, 12 th edition, Pearson Addison Wesley, 2008 (in part), or earlier editions.
Lecture notes: Juhani Lounila: 761105P Atomi- ja ydinfysiikka, Oulun yliopisto, 2008.
Person responsible:
Juhani Lounila

766326A: Atomic physics, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761313A	Atomic physics 1	5.0 op
761326A	Atomic physics	6.0 op
761105P	Atomic and Nuclear Physics	3.0 op

ECTS Credits:
6 credits
Timing:
Second autumn term
Contents:
A course on atomic physics. Compulsory for physics, theoretical physics and biophysics students.
The Bohr atomic model. Quantum mechanics. Hydrogen atom. Electronic structures. Optical spectra. Electron and X ray spectra. Molecular physics.
Learning activities and teaching methods:
Lectures 46 h, exercises 24 h. Two written intermediate examinations.
Recommended optional programme components:
Follow-up courses: Advanced courses in atomic and molecular spectroscopy.
Recommended or required reading:
R. Eisberg and R. Resnick: Quantum physics of atoms, molecules, solids, nuclei and particles. Wiley & Sons, J.J. Brehm and W.J. Mullin: Introduction to the structure of matter, a course in modern physics, Wiley & Sons.
Person responsible:
Helena Aksela

761649S: Auroral physics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
If foreign students take part in the course, the course will be given in English.
Timing:
Not every year
Contents:
The charged particles from the Sun, known as the solar wind, expand outwards to the space. Close to the Earth they interact with the magnetosphere, which guides part of them in a complex way into the upper atmosphere of the Earth at high latitudes. When the charged accelerated particles collide with the atmospheric particles they produce light, which create aurora (northern lights). The auroral particles penetrate typically down to an altitude of 100 km. In this course we study formation of aurora as an ionoshperic process as well as from the viewpoint of magnetosphere-ionosphere coupling.
Contents in brief: Atmospheric models, neutral atmosphere, electron collisions, ionization, excitations, ionization rate. The excitations of atoms and molecules, lifetimes and emissions. Aurora generated by electrons and protons and morphology of aurora. The solar wind-magnetosphere-ionosphere coupling, acceleration of auroral particles and electrodynamics of aurora.
Learning activities and teaching methods:
Lectures 36 h, exercises 10 h. End exam.
Target group:
This course is useful especially for students who study space physics.
Recommended optional programme components:
Recommended courses: 766355A Avaruusfysiikan perusteet and 761658S Ionosfäärifysiikka.
Recommended or required reading:
Parts of the book M.H. Rees: Physics and chemistry of the upper atmosphere (Cambridge, 1989), A. Vallance Jones: Aurora (D. Reidel Publ., 1974), G.Paschmann, S. Haaland and R. Treumann (Eds.): Auroral Plasma Physics (Kluwer Academic Publishers 2003).
Lecture material (in English) is available on the web page of the course.
Person responsible:
Kari Kaila and Anita Aikio

765356A: B.Sc. thesis, 10 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
10 credits
Contents:
A research project in astronomy under supervision of the course leader or another researcher on a given subject. A report on the project (about 20 pages long) should be written. A presentation (prepared with power-point or similar software) is given at the separate LuK seminar. Participation in at least 75% of the astronomy seminars is required.
Learning activities and teaching methods:
A supervised project in astronomy, written report and oral presentation.
Person responsible:
Juri Poutanen

763330A: B.Sc. thesis, 10 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
10 credits
Timing:
3. spring
Contents:
Participation on a seminar series, presentation of a seminar talk, and writing of an essay.
Learning activities and teaching methods:
A seminar talk and an essay.
Target group:
Compulsory for theoretical physics students.
Recommended optional programme components:
Basic and intermediate studies in physics.
Person responsible:
Erkki Thuneberg
Other information:
*

761385A: B.Sc. thesis and seminar, 10 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
10 credits
Timing:
3 th spring
Contents:
A course on the use of literature and other sources of information and on scientific writing and presentation.
Learning activities and teaching methods:
Lectures 16 h, seminar talks, writing an essay.
Target group:
Compulsory.
Recommended optional programme components:
Intermediate physics courses.
Grading:
*
Person responsible:
Jukka Jokisaari and Kalevi Mursula

764306A: B.Sc. thesis and seminar, 10 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
10 credits
Language of instruction:
English if needed.
Timing:
6 th semester (Spring term)
Contents:
Final thesis of B.Sc. studies, based on literature or some experimental or theoretical work done either in biophysics research or in some extramural institute or private company. The length and extent of the work depends on the amount of content, for which the student is personally responsible (i.e. novelty value etc.). Oral presentation, which is required for passing the course, aims for training the ability to tell others about your own work in formal setting. The studies contain also a short part, where information searches, writing and reporting, grant applications and employment possibilities are being taught.
Learning activities and teaching methods:
Participation in a project work.
Target group:
Biophysics students.
Recommended or required reading:
To be agreed with students individually.
Person responsible:
Matti Weckström

762382A: B.Sc. work (thesis and seminar), 10 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
10 credits
Timing:
3 rd year
Contents:
The aim of this course is to teach the student how to use scientific literature and to write a scientific paper. A deeper going study of a certain subject in the field of geophysics. A seminar talk on a thesis.
Target group:
Compulsory for students of geophysics.
Person responsible:
Pertti Kaikkonen

765637S: Basaltic volcanism on terrestrial planets, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Contents:
Basaltic volcanism on terrestrial planets.
Features of volcanism on terrestrial planets.
Learning activities and teaching methods:
Lectures 30 h, exercises. Written examination based on lectures or independent study.
Target group:

*

Recommended optional programme components:
765103A
Recommended or required reading:
Basaltic volcanism on terrestrial planets, Basaltic volcanism study project, 1981.
Carr & Greeley: Volcanic features of Hawaii: A basis for comparison with Mars.
Mursky: Introduction to planetary volcanism.
Sigurdsson, Houghton, McNutt, Rymer & Stix (ed.): Encyclopedia of volcanoes (part of).
Zimbelman & Gregg (eds.): Environmental effects of volcanic eruptions: From the deep ocean to the deep space.
R. Lopes (2005), The Volcano Adventure Guide, Cambridge University Press.
G.R. Foulger et al. (2005), Plates, Plumes, and Paradigms, Geological Society of America (GSA Special Paper 388).
Person responsible:
Jouko Raitala

761101P: Basic Mechanics, 4 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761118P	Mechanics 1	5.0 op
761118P-01	Mechanics 1, lectures and exam	0.0 op
761118P-02	Mechanics 1, lab. exercises	0.0 op
761111P-01	Basic mechanics, lectures and exam	0.0 op
761111P-02	Basic mechanics, lab. exercises	0.0 op
761111P	Basic mechanics	5.0 op
761101P2	Basic Mechanics	4.0 op

ECTS Credits:
4 credits
Language of instruction:
The lectures will be in Finnish. The textbook is in English and exercises are selected from the textbook. For further information, contact the responsible person of the course.
Timing:
Autumn
Contents:
We encounter many phenomena related to mechanics in our everyday life. Most engineering sciences are based on mechanics and mechanics forms the basics for many other fields of physics, also for modern physics.
In the beginning of the mechanics course there is a short presentation of vectors and vector algebra. The mechanics part begins with kinematics where one, two and three diemnsional motion is studied, including the projectile and circular motion. Newton’s laws of motion start the dynamics part. Work, different forms of energy and conservation of energy are studied. Momentum, impulse and collisions are discussed. Rotational motion and related quantities like moment of inertia are studied. Dynamics of rotational motion include discussion of torque and angular momentum and its conservation. Solving rigid body equilibrium problems is practised. Gravitation with Newton’s law of gravitation and circular satellite motion is studied. Periodic motion and fluid mechanics are the final parts of the course.
Learning activities and teaching methods:
Lectures 32 h, 8 exercises (16 h), four mini examinations and end examination or final examination.
Target group:
Secondary subject students.
Recommended optional programme components:
Knowledge of vector calculus and basics of differential and integral calculus would be desirable.
Recommended or required reading:
Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 12th edition, 2008, chapters 1-14. Also 11th and 10th editions can be used.
Lecture material: Finnish lecture material will be available on the web page of the course.

Person responsible:
Anita Aikio

761102P: Basic Thermodynamics, 2 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766348A	Thermophysics	7.0 op
766328A	Thermophysics	6.0 op

ECTS Credits:
2 credits
Language of instruction:
Finnish
Timing:
Every Fall term
Contents:
Basics concepts of thermodynamocs: temperature, heat, calorimetry, thermal properties of matter, kinetic theory of ideal gases, thermodynamic laws, heat engines, refridgerators, Carnot cycle, entropy.
Learning activities and teaching methods:
Lectures 16 h, 4 exercises (8 h), 2 intermediate examinations (in Fall) or final examination.
Target group:
For students with physics as a minor subject.
Recommended or required reading:
Young and Freedman; University Physics, Addison Wesley (Edition 10, Chapters 15-18, or Editions 11-12, Chapters 17-20). Similar material can also be found in H. Benson: University physics, Wiley & Sons, New York (Chapters 18-21).
Lecture notes: Basic thermodynamics (in Finnish) by K. Mursula.
Person responsible:
Kalevi Mursula

761322A: Basics of electronics, 5 op

Voimassaolo: - 31.07.2009

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Contents:
Basics on analog and digital electronics.
Learning activities and teaching methods:
No lectured any more. See the course 521431A.
Target group:
*
Recommended optional programme components:
Basics on semiconductors.
Person responsible:
Seppo Alanko

761353A: Basics of plasma physics, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
If needed, this course can be lectured in English.
Timing:
Roughly every second Spring term.
Contents:
Most normal matter in the universe is in plasma state, i.e., consists of charged particles interacting electromagnetically. Plasma physics studies what kind of phenomena appear in such a system. Plasma physics is the most important theory of space physics, which is applied to describe, e.g., ionospheric, magnetospheric, solar and heliospheric phenomena.
Contents briefly: Plasma state, plasma conditions, motion of charged particles, adiabatic invariants, collisions, conductivity, convection and corotation, ionospheric currents, substorms, foundations of kinetic theory and magnetohydrodynamics.
Learning activities and teaching methods:
Lectures 40 h, 10 exercises (20 h), final examination.
Target group:
Optional for physics students. Recommended for students of space physics, astronomy and theoretical physics. Gives important background to all advanced courses on space physics, especially Plasma physics 761653S.
Recommended optional programme components:
Recommended courses: 766321A Electromagnetism I and 766322A Electromagnetism II, or equivalent knowledge.
Recommended or required reading:
Baumjohann-Treumann: Basic Space Plasma Physics, Imperial College Press, 1997 (Chapters 1-7).
Other books: H. Koskinen, Johdatus plasmafysiikkaan ja sen avaruus¬sovellutuksiin. Limes, 2001; F.F. Chen: Plasma Physics and Controlled Fusion, 2nd ed., Vol. 1, Plasma Physics, Plenum Press; J. A. Bittencourt: Fundamentals of plasma physics, Pergamon Press, 1986. Lecture notes: K. Mursula: Plasmafysiikan perusteet.
Person responsible:
Kalevi Mursula
Other information:
Course web page http://physics.oulu.fi/fysiikka/oj/761353A/

766355A: Basics of space physics, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766345A	Basics of space physics	6.0 op

ECTS Credits:
5 credits
Timing:
Not every year
Contents:
This lecture course gives the basic view on the near space around the Earth. The solar wind is a continuous plasma flow emerging from the Sun. It compresses the magnetic field of the Earth into a region with a cometary shape, called the magnetosphere. The solar radiation and charged particles precipitating from the magnetosphere ionise the upper part of the atmosphere thus creating the ionosphere. The lecture course contains the physics of

the Sun, the solar wind, the magnetosphere and the ionosphere, as well as the effects of the the Sun and the solar wind on the magnetosphere and the ionosphere. There are plasma bursts in the Sun causing disturbances in the surrounding space. These phenomena create the varying space weather. The space weather may affect e. g. telecommunication links, electrical power networks and operation of satellites. It may also cause health hazards for astronauts. Since the near space contains ionised gas in magnetic field, plasma physics is used in explaining the phenomena.
Learning activities and teaching methods:
Lectures 40 h, exercises 20 h. 2 written intermediate examinations or one final examination.
Target group:
*
Recommended optional programme components:
Courses 766321A, 766322A
Recommended or required reading:
Lecture notes.
Person responsible:
Tuomo Nygrén

764660S: Bioelectronics, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

764325A: Biophysical laboratory exercises, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

764631S: Bioprocess dynamics, 4 op

Voimassaolo: - 31.07.2009
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

764364A: Biosystems analysis, 6 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764664S Analysis and simulation of biosystems 6.0 op

Ei opintojaksokuvauksia.

765304A: Celestial mechanics, 5 - 8 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Contents:
Basic course on laws of planetary and stellar motion.
One and two body problem. Perturbation theory. N-body problem.
Learning activities and teaching methods:
Lectures 32 h, exercises. One written examination.
Target group:
*
Recommended or required reading:
A. E. Roy: Orbital motion, Adam Hilger, 1988.
Person responsible:
Heikki Salo

764323A: Cell membrane biophysics, 7 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764623S Cell membrane biophysics 7.0 op

Ei opintojaksokuvauksia.

763629S: Classical field theory, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Contents:
The course studies the electromagnetic field and continuous matter field (gases, liquids and solids). The Lagrange and Hamilton formalism is generalized to apply to continuous fields and relativistic particles. The Lagrangian of the electromagnetic field is justified. Based on that, the fundamental equations of electromagnetism are derived

(Maxwell equations and Lorentz force). Using these we study conservation laws, time-independent field, polarizable matter and electromagnetic waves.
Learning activities and teaching methods:
Lectures 26 h, exercises 24 h. One written examination.
Target group:
Optional. Especially for theoretical physicists. Because the course is lectured only occasionally, it is recommended whenever the prerequisites are done.
Recommended optional programme components:
763102P Introduction to relativity and 763310A Analytic mechanics,(763654S).
Recommended or required reading:
L. Landau and E. Lifshitz, The classical theory of fields; A. Fetter and J. Walecka: Theoretical mechanics of particles and continua; E. Thuneberg: Klassinen kenttäteoria (lecture notes).
Person responsible:
Erkki Thuneberg

761668S: Computational physics and chemistry, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
Not every year
Contents:
The course gives basic knowledge on computer simulation methods of microscopic systems used in physics, chemistry and molecular biology.
Revision of statistical mechanics basics, molecular dynamics, Monte Carlo -methods, stochastic simulation, quantum mechanical simulation, error estimation.
Learning activities and teaching methods:
Lectures 35 h, 4 practical works. One written examination.
Target group:
Advanced undergraduate students in physics, chemistry and physical information technology and graduate students.
Recommended optional programme components:
Atomic physics (766326A) and Thermophysics (766328A) cum laude courses or comparable knowledge, basics of numerical analysis, basics of some programming language.
Recommended or required reading:
M.P. Allen and T.J. Tildesley, Computer Simulation of Liquids. W.H. Press, S.A. Teukolsky, W.T. Vetterling and B. P. Flannery, Numerical Recipes in Fortran/ C.
Person responsible:
Professors of atomic- and molecular spectroscopy

765617S: Computer simulations, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Contents:

Astronomical simulations. Monte Carlo -method. Generation of random numbers. Calculation of definite integral. Applications to light scattering. N-body simulation methods. Applications to dynamics of galaxies and planetary rings.

Learning activities and teaching methods:
Lectures 20 h, exercises, demonstrations 16 h. Written examination or independent exercise.

Recommended optional programme components:
*

Recommended or required reading:
Yu. A. Schreider: The Monte Carlo Method.

Person responsible:
Heikki Salo

763628S: Condensed matter physics, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763636S Condensed matter physics 5.0 op

ECTS Credits:
10 credits

Timing:
4. year

Contents:
The course starts with crystal structure of solids and its studies by scattering experiments. Surfaces and more complicated structures are discussed briefly. The electronic structure is first studied using free electron picture. The effect of crystal lattice is studied as small perturbation as well as starting from localized atomic states. The Coulomb interaction between electrons is studied using Hartree-Fock equations. Lattice vibrations are studied using simple models and the lattice specific heat is calculated. Electron dynamics is studied using semiclassical equations. Electrical and thermal conduction is solved using Boltzmann equation.

Learning activities and teaching methods:
Lectures 50 h, exercises 24 h. One written examination.

Target group:
Optional. For all interested in theoretical condensed matter physics.

Recommended optional programme components:
763333A, 763312A, 766328A.

Recommended or required reading:
Michael P. Marder: Condensed Matter Physics. N.W. Ashcroft & N.D. Mermin: Solid state Physics.

Person responsible:
Erkki Thuneberg

766655S: Cosmic Rays, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits

Language of instruction:
If needed, this course can be lectured in English.

Timing:
Roughly every third year.

Contents:
This is an optional physics course at an advanced level on cosmic rays. Cosmic rays are energetic particles from space that can pass through the geomagnetic field and the atmosphere and cause radiation even on the ground. Cosmic rays are energized, e.g., in supernova shocks and solar bursts. Cosmic rays can be used to study the Sun, the heiiosphere and the more distant universe.
Contents briefly: Components of cosmic rays, composition, energy spectrum and origin of galactic cosmic rays, acceleration of cosmic rays, solar cosmic rays and their production in flares and coronal mass ejections, modulation of cosmic rays in the heliosphere, Parker's theory, temporal variation of cosmic rays, reactions in the atmosphere and possible climatic effects, detection of cosmic rays in Oulu and elsewhere.
Learning activities and teaching methods:
Lectures 44 h, 10 exercises (20 h), final examination.
Target group:
Recommended especially for students of space physics, astronomy and theoretical physics. The course supports, e.g., the courses 766654S Solar physics and 766656S Heliospheric physics.
Recommended optional programme components:
Recommended courses: 766355A Basics of space physics and/or 761353A Basics of plasma physics, or equivalent knowledge.
Recommended or required reading:
Parts from: T.K. Gaisser, Cosmic rays and particle physics, Cambridge Univ. Press; P.K.F. Grieder, Cosmic rays at the Earth, Elsevier, 2001.
Lecture notes: K. Mursula ja Ilya Usoskin: Cosmic rays.
Person responsible:
Kalevi Mursula
Other information:
Course web page http://physics.oulu.fi/fysiikka/oj/766655S /

765135P: Data processing in astronomy, 2 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

765307A-01	Research Project of Astronomy I: Data processing in astronomy	0.0 op
765307A	Research Project of Astronomy I	5.0 op
765332A	Study project in astronomy 1	5.0 op
765332A-01	Data processing in astronomy	0.0 op

ECTS Credits:
4 credits
Contents:
Basics of using Macintosh and Unix/Linux. Workstations and X-Windows. Software packages, especially IDL, NIH Image and other image analyse and GIS applications, applied in planetology and astronomy.
Learning activities and teaching methods:
Lectures 20 h, exercises 20 h, practicals.
Recommended optional programme components:
Basic knowledge on using a computer.
Recommended or required reading:
IDL Manual
Person responsible:
Jouko Raitala

766309A: Demonstrations in Physics and Chemistry, 2 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

780396A Demonstrations in Physics and Chemistry 2.0 op

ECTS Credits:
2 credits
Timing:
3 rd year in teachers education
Contents:
The course includes 33 hours of the secondary school physics and chemistry demonstrations. These laboratory works are made in groups mainly in Normaalikoulu, the training school of Educational faculty.
Target group:
Compulsory for students becoming teachers.
Person responsible:
Kari Kaila

761112P: Development of the physical world view, 3 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Spielberg, Nathan , , 1995

Opintokohteen kielet: Finnish

Leikkaavuudet:

761108P Physical world view 5.0 op

ECTS Credits:
3 credits
Timing:
Autumn
Contents:
Physics, the former Natural philosophy, is one of the main sciences, which has dramatically promoted the development and technology. A review of seven great revolutionary ideas, which have changed our physical world view, will be looked through during the course. Not only those ideas, but also their backgrounds in historical point of view. Several important discoveries are deeper looked through. Every physicist should know the ideas of these backgrounds.
Learning activities and teaching methods:
Lectures 26 h, exercises 14 h. One written examination.
Target group:
One of the introductory courses.
Recommended optional programme components:
No prerequisite courses.
Recommended or required reading:
N. Spielberg ja B.D. Anderson: Seven ideas that shook the universe, John Wiley & Sons,
Lecture booklet: K.Kaila, Fysikaalisen maailmankuvan kehittyminen.
Person responsible:
Kari Kaila

762624S: Electrical research methods of rock and soil, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
3 rd - 5 th year
Contents:
The course familiarizes students with the electric methods based on direct current theory in surveying the near-surface earth. Electric methods in surveying the earth. Electric properties of rocks and sediments. Electrical resistivity methods. Self-potential method. Charged-body potential (mise-à-la-masse) method. Induced polarization method. Multiple electrode measurements. Electric surveying in boreholes. Interpretation. About software for interpretation. Case studies.
Learning activities and teaching methods:
Lectures 30 h, an independent exercise (field measurement and its interpretation) and a final examination.
Target group:
Optional for students of Geophysics (compulsory for students of the FM-y-line).
Recommended optional programme components:
762102P Geophysical research methods of rock and soil (Introduction to applied geophysics).
Recommended or required reading:
A handout. Parts of the following: Telford, W.M., Geldart, T.M. & Sheriff, R.E., 1990: Applied geophysics; Zhdanov, M.S. & Keller, G.V., 1994: The geoelectrical methods in geophysical exploration; Reynolds, J.M., 1997: An introduction to applied and environmental geophysics; Sharma, P.V., 1997: Environmental and engineering geophysics.
Person responsible:
Pertti Kaikkonen

761103P: Electricity and Magnetism, 4 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761119P	Electromagnetism 1	5.0 op
761119P-01	Electromagnetism 1, lectures and exam	0.0 op
761119P-02	Electromagnetism 1, lab. exercises	0.0 op
761113P-01	Electricity and magnetism, lectures and exam	0.0 op
761113P-02	Electricity and magnetism, lab. exercises	0.0 op
761113P	Electricity and magnetism	5.0 op
766319A	Electromagnetism	7.0 op

ECTS Credits:
4 credits
Language of instruction:
The lectures will be in Finnish. The textbook is in English and exercises are selected from the textbook. For further information, contact the responsible person of the course.
Timing:
Spring
Contents:
Electromagnetic interaction is one of the four fundamental interactions in physics and many phenomena like light, radio waves, electric current, magnetism and formation of solid matter are based on electromagnetism. The current technological development is largely based on applications of electromagnetism in energy production and transfer, telecommunications and information technology.
Contents in short: Electric field and potential, Coulomb's law, Gauss law, capacitors and dielectrics, electric current, resistivity, electromotive force, DC circuits, magnetic field, magnetic forces and its applications, Ampere’s

law, Biot-Savart law, electromagnetic induction and Faraday's law, inductance and inductors, R-L-C circuits, alternating current and AC circuits.
Learning activities and teaching methods:
Lectures 32 h, 6 exercises (12 h), four mini examinations and end examination or final examination.
Target group:
Secondary subject students.
Recommended optional programme components:
Knowledge of vector calculus and basics of differential and integral calculus are needed.
Recommended or required reading:
Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 12th edition, 2008, chapters 21-31. Also 11th and 10th editions can be used.
Lecture material: Finnish lecture material will be available on the web page of the course.
Person responsible:
Anita Aikio

763626S: Electro-weak interactions, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
10 credits
Language of instruction:
English/Finnish
Timing:
3. - 5. year
Contents:
The properties of the Standard Model of particle physics: electromagnetic, weak and strong interactions, local gauge symmetry and gauge groups, spontaneus symmetry breaking and Higgs mechanism, neutrino physics.
Learning activities and teaching methods:
Lectures 50 h, exercises 30 h, one written examination.
Target group:
Students of theoretical physics (optional).
Recommended optional programme components:
Introduction to particle physics.
Recommended or required reading:
F. Halzen, A.D. Martin: Quarks & Leptons, luvut 12-15, K. Grotz ja H. V. Klaptor: The Weak Interaction in Nuclear, Particle and Astrophysics (osittain), C. Burgess, G. Moore: The standard model: A Primer.
Person responsible:
Kari Rummukainen

761632S: Electromagnetic radiation, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
If needed, this course can be lectured in English.
Timing:
Roughly every third year.

Contents:
This is an optional physics course at an advanced level on the properties, theory and applications of electromagnetic radiation.
Contents briefly: Maxwell equations, electromagnetic waves, reflection and transmission of waves at boundaries, waveguides, generation of waves, Hertz dipole, simple antennas, detection of electromagnetic radiation, relativistic description of electromagnetic fields, Lorentz transformation.
Learning activities and teaching methods:
Lectures 35 h, 10 exercises (20 h), final examination.
Target group:
Optional for physics students.
Recommended optional programme components:
Recommended courses: 766321A Electromagnetism I and 766322A Electromagnetism II, or equivalent knowledge.
Recommended or required reading:
Parts from I.S. Grant and W.R. Phillips, Electromagnetism, Second edition, Wiley & Sons; F.H. Read: Electromagnetic Radiation, 1980.
Lecture notes: K. Mursula: Sähkömagneettinen säteily.
Person responsible:
Kalevi Mursula
Other information:
Course web page http://physics.oulu.fi/fysiikka/oj/761632S/

766321A: Electromagnetism I, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766319A Electromagnetism 7.0 op

ECTS Credits:
4 credits
Timing:
Spring
Contents:
Electromagnetism is a physical theory which was developed later than mechanics, mainly in the 1800's. A central concept in electromagnetism is field. Electromagnetism has joined the theories of electricity and magnetism into a unified theory and, finally, merged optics in the same framework. It also contains a clue to the theory of relativity and therefore it has had a great impact on the later development of physics. Our present society is largely affected by the applications of electromagnetism, since both electricity and magnetism have a profound role e.g. in the production and transport of energy, in domestic lightning, in telecommunications and in information technology. The lecture course is divided into two parts. The first one contains electrostatics and the foundations of magnetostatics.
Contents in brief: Mathematical tools, electric charge, Coulomb's law and electric field, potential and potential energy, Gauss' law, dielectric media, volume polarisation and induced charges, conductors, capacitors, energy density of electric field, boundary value problems in electrosatatics, Laplace's and Poisson's equations, electrostatic images, magnetic field, Lorentz-force, the absence of magnetic monopoles, induction, Ampère's and Biot-Savart's laws, vector potential, magnetic moment.
Learning activities and teaching methods:
Lectures 30 h, exercises 14 h. four mini examinations and one end examination or one final examination.
Target group:
*
Recommended optional programme components:
*
Recommended or required reading:
Lecture notes.
I.S. Grant ja W.R. Phillips: Electromagnetism (2nd ed., Wiley & Sons)
Person responsible:
Tuomo Nygrén

766322A: Electromagnetism II, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766319A Electromagnetism 7.0 op

ECTS Credits:
4 credits
Timing:
Second autumn
Contents:
This course comprises the latter part of the theory of electromagnetism and it is continuation of the lecture course 766321A Sähkömagnetismi I. This part completes the theory of magnetostatics and then continues with electromagnetic induction and the theory of direct and alternating currents. Finally the basic laws of electricity and magnetism are collected into Maxwell’s equations, which are used to develop the theory of electromagnetic waves.
Contents in brief: Magnetic field vector, magnets, electromagnetic induction, Faraday’s law, inductance, magnetic energy, alternating currents, impedance and admittance, power in AC circuits, resonance, transients, three-phase lines, linear circuits, Kirchhoff’s laws, AC bridges, input- and output impedances, Thévenin’s and Norton’s theorems, filters, continuity equation, displacement current, Maxwell’s equations, electromagnetic plane waves in free space, wave polarisation, electromagnetic plane waves in dielectrics, dispersion and group velocity, energy of electromagnetic waves, Poynting’s theorem, absorption of electromagnetic waves, skin effect.
Learning activities and teaching methods:
Lectures 30 h, exercises 14 h, four mini examinations and one end examination or one final examination.
Target group:
*
Recommended optional programme components:
766321A
Recommended or required reading:
Lecture notes.
I.S. Grant ja W.R. Phillips: Electromagnetism (2nd ed., Wiley & Sons)
Person responsible:
Tuomo Nygrén

761673S: Electron and ion spectroscopy, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Timing:
Not every year
Contents:
The course gives an introduction to the basics of electron and ion spectroscopy research of the department. The main goal is the understanding of the electron structure and its dynamics when atoms or molecules are excited by energetic photon or electron beam. Besides the fundamentals of electron spectroscopy, experimental set ups are described as well as the theoretical methods used in the interpretation of experimental spectra.
Learning activities and teaching methods:

Lectures 44 h, exercises 20 h as well as practical measurements of spectra in the home laboratory. One written examination.
Target group:
*
Recommended optional programme components:
Basic knowledges of atomic physics.
Recommended or required reading:
Lecture notes.
Person responsible:
Seppo Aksela and Helena Aksela

763696S: Electronic transport in mesoscopic systems, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Contents:
Introduction to electronic transport phenomena on mesoscopic length scales, where the quantum and classical descriptions of Nature meet.
The introduction discusses two-dimensional electron gas. The main content is a formalism that can describe electrical conductivity in small structures. This is applied to quantum Hall effect, localization and tunneling through a double barrier. Mostly a simple quantum mechanical description is used, but also some more complicated calculations are made using Green's functions.
Learning activities and teaching methods:
Lectures 26 h, exercises 24 h. One oral examination.
Target group:
Especially for theoretical physicists.
Recommended optional programme components:
Quantum mechanics I (763312A), Thermal physics (766328A) and Structure of matter (766330A).
Recommended or required reading:
The course follows closely the book Supriyo Datta: Electronic transport in mesoscopic systems, no lecture notes available.
Person responsible:
Erkki Thuneberg

762684S: Excursion, 2 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Korja, Toivo Johannes

Opintokohteen kielet: Finnish

ECTS Credits:
2 credits
Language of instruction:
Finnish
Timing:
Arranged on demand.
Contents:
The students at their final stage of studies make a guided excursion and visit companies and research institutions applying geophysical techniques.

Learning activities and teaching methods:
Two to three days long excursion arranged by teachers. After the excursion participants write a common report or prepare a poster. Participation in the excursion and completion of the report.
Target group:
M.Sc. students in geophysics.
Person responsible:
Toivo Korja
Other information:
Travel costs and major part of accommodation costs are covered by the section of geophysics. Participants cover other costs (e.g. meals).

761671S: Extension course in atomic physics, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Timing:
Not every year
Contents:
Advanced course on atom physics. Quantum mechanical formalism for atoms with bigger amount of electrons, quantum mechanics for spectroscopy applications.
Learning activities and teaching methods:
Lectures 44 h, exercises 20 h. One oral examination.
Target group:
*
Recommended optional programme components:
761326A, 763612S
Recommended or required reading:
R.D. Cowan: The theory of atomic structure and spectra.
Person responsible:
Helena Aksela

766648S: Extension course in electron spectroscopy, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Timing:
Not every year
Contents:
The course goes deeper into the subjects discussed in the course 761673S Electron and ion spectroscopy. The calculation codes used in the quantum mechanical calculations for electronic structure of atoms and molecules are discussed, and students will also practise computation by using different programs. The structure and design of the experimental equipment of electron spectroscopy are acquainted in the course. The planning of research as well as the data handling issues are dealt with by discussion and practical exercise.
Learning activities and teaching methods:
Lectures 44 h, exercises 20 h. One written end examination.
Target group:

Students who concentrate on electron spectroscopy.
Recommended optional programme components:
This course is a continuation of the course 761673S Electron and ion spectroscopy. The basic knowledge of quantum mechanics and atom physics is advantage.
Recommended or required reading:
Handouts will be given at lectures.
Assessment methods and criteria:
Attendance at lectures and exercises is compulsory as well as passing the exam.
Person responsible:
Helena Aksela

762644S: Field course in applied geophysics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
Finnish
Timing:
3. - 5. year
Contents:
The course applies the geophysical methods for example to mineral exploration, geological mapping, till and ground water studies, and investigation of eskers and moraine formations. Seismic, electrial, electromagnetic and magnetic measurements are made, the data are interpreted and written reports are prepared. The course is preferably arranged together with the courses 772662S ja 773673S of the Department of Geosciences, thus having separate parts of surficial and bedrock geology.
Learning activities and teaching methods:
Lectures 10 h, field work 60 h, and the processing and interpretation of the measured data. Approved written report.
Target group:
Students interested in field work. The course is compulsory in M.Sc. studies of geophysics. The course is arranged in fall season every two or three years.
Recommended optional programme components:
Prior completion of course 762102P.
Person responsible:
Markku Pirttijärvi
Other information:
Course homepage: http://www.gf.oulu.fi/~mpi/opetus/762644S_Sov.geof_maastokurssi.html

764115P: Foundations of cellular biophysics, 4 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764125P Foundations of cellular biophysics 5.0 op

Ei opintojaksokuvauksia.

761666S: Fourier transform with applications, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
Not every year
Contents:
Mathematical background on Fourier and Laplace transformations and their application in various spectroscopies. Fourier series, Fourier transformation and its properties, application of Fourier transformation for various spectroscopies and optics.
Learning activities and teaching methods:
Lectures 35 h, exercises 20 h. One written examination.
Target group:
*
Recommended optional programme components:
Knowledge of basic mathematics
Recommended or required reading:
R.M. Bracewell, The Fourier Transform and Its Applications, McGraw-Hill, Inc., USA, 1965. J. Kauppinen and J. Partanen, Fourier Transforms in Spectroscopy, Wiley-VCH, 2001.
Person responsible:
Jukka Jokisaari

761648S: Fundamentals of incoherent scatter radar, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Timing:
Not every year
Contents:
Various methods based on radio waves are used in investigating the ionosphere of the Earth. One of them is incoherent scatter, which is based on scattering of radio waves from thermal fluctuations of the ionospheric plasma. Incoherent scatter is very weak, and therefore it can only be observed by means of a powerful radar. The transmitting power must be of the order of a megawatt and the antenna beam must be very narrow. The spectrum of the scattered radiation allows the determination of ionospheric electron density, ion- and electron temperatures, plasma flow velocity and some other physical parameters. In this sense, incoherent scatter radar is the most efficient tool in ionospheric research. Incoherent scatter radars use sophisticated modulation methods and the analysis of the measured data is more complicated than that of any other ionospheric measurement. This lecture course gives the basic knowledge for understanding of the incoherent scatter method. A research project of 6 credit points can be made after passing this course.
Contents in brief: Incoherent scatter from thermal fluctuations of the plasma, the principles of mono- and multistatic radar, high-power transmitter, the radiation pattern of the antenna, superheterodyne receiver, mixing the signal, stochastic processes, signal spectrum, signal sampling and digital signals, ambiguity functions, classical modulation methods, alternating codes.
Learning activities and teaching methods:
Lectures 44 h, exercises 20 h. One written examination.
Target group:
*
Recommended optional programme components:
(761658S)

Recommended or required reading:
T. Nygrén: Introduction to incoherent scatter measure-ments (Invers Publications, 1996).
Person responsible:
Tuomo Nygrén

765330A: Galaxies, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

765309A	Galaxies	5.0 op
765630S	Galaxies	6.0 op

ECTS Credits:
5 credits
Contents:
We begin with the classification of galaxies, which introduces many of the concepts needed in the course. Most of the large galaxies are either spiral galaxies or elliptical galaxies. We study the structure and kinematics in both these galaxy types, including the theories of spiral formation. Especial emphasis is placed on our own galaxy, the Milky Way. We also examine the structure in larger scale: groups and clusters of galaxies. We discuss several distance measurement methods, which lead us to the expansion of the universe and the principles of cosmology. We also discuss the recent results from microwave background surveys. The last part of the course covers the exotic world of active galactic nuclei.
Classification of galaxies, the Milky Way, stellar orbits, Local Group of galaxies, spiral galaxies, elliptical galaxies, clusters of galaxies, large scale structure and cosmology, active galactic nuclei.
Learning activities and teaching methods:
Lectures 32 h, exercises. One written examination.
Target group:
*
Recommended optional programme components:
Introduction to astronomy I & II (recommended)
Recommended or required reading:
Sparke, L., Gallagher, J.: Galaxies in the Universe, Cambridge, 2 nd ed., 2007.
Person responsible:
Pertti Rautiainen

765671S: Gasdynamics and interstellar medium, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
8 credits
Language of instruction:
English
Contents:
Basics of radiative transfer. Spectral lines. Physics of HII regions. Cooling and heating of the gas and dust. Multiphase interstellar medium. Basics of gasdynamics. Shock waves. Evolution of photoionized nebulae. Stellar winds. Supernovae explosions. Star formation.
Learning activities and teaching methods:
Lectures 32 h, exercise sessions 8 h, home exercises (30% of the final score), short essay and a presentation (20%), final exam (50%).

Recommended optional programme components:
Fits well together with Theoretical Astrophysics and Tähtien rakenne ja evoluutio / Stellar structure and evolution.
Recommended or required reading:
Dyson J. E., Williams D. A.: The physics of the interstellar medium, 2nd ed., Institute of Physics Publishing, 2003; compendium.
Person responsible:
Juri Poutanen

763695S: General relativity, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Contents:
Introduction to the general theory of relativity. The general theory is an extension of special theory of relativity to include gravitation. It is one of the most beautiful theories of physics.
The course begins with an exposition of those aspects of tensor calculus and differential geometry needed for a proper treatment of the subject. The discussion then turns to the spacetime of general relativity and to geodesic motion, comparisons and contrasts with Newton's theory being drawn where appropriate. A brief consideration of the field equations is followed by a discussion of physics in the vicinity of massive objects, including an elementary treatment of black holes. Particular attention is paid to those aspects of the theory that have observational consequences. The course concludes with introductory discussion on cosmology.
Learning activities and teaching methods:
Lectures 26 h, exercises 24 h. One written examination.
Target group:
For all interested physics students.
Recommended optional programme components:
Introduction to relativity (763102P). The following courses are helpful: Analytical mechanics (763310A) and Classical field theory (763629S).
Recommended or required reading:
The course follows accurately the book J. Foster and J.D. Nightingale: "A short course in general relativity", no lecture notes are available.
Person responsible:
Erkki Thuneberg

762322A: Geomagnetism, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish (optionally English).
Timing:
4. - 5. year
Contents:

Introduction. History of geomagnetism. The origin of the Earth's magnetic field and its present state. Magnetometers. Temporal and spatial variations of the geomagnetic field. Mathematical representation of Earth's magnetic field. Magnetic field of sun and other planets in our solar system. Magnetic properties of Earth materials. Geomagnetic methods. Palaeomagnetism.
Learning activities and teaching methods:
Lectures 24 h, homework exercises 12 h. Examination (form to be selected during the course).
Target group:
Optional for M.Sc. students in Geophysics and suitable to all interested on the magnetic field of the Earth.
Recommended or required reading:
Handouts. Nevanlinna, H., 2006. Avaruussää. Auringosta tuulee. Ursa. Jacobs, J.A., (ed.), 1987: Geomagnetism. Vols 1-4; Merrill, R.T., McElhinny, M.W. & McFadden, P.L., 1996: The Magnetic field of the Earth: Paleomagnetism, the core and the deep mantle.
Person responsible:
Toivo Korja

762304A: Geophysical data processing, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
Finnish
Timing:
3 rd year
Contents:
Processing of geophysical field data. Digital signal processing. Classification of geophysical (physical) data. Collecting the samples and digital processing of data in time and frequency level. Fourier series, Fourier transform, linear systems and error analysis.
Learning activities and teaching methods:
Lectures 30 h, 20 h of math exercises, an independent exercise work and a final examination.
Target group:
Compulsory for students of geophysics.
Recommended or required reading:
A handout. Parts of the following: Al-Sadi, H.N., 1980: Seismic exploration: technique and processing, Bendat, J. & Piersol, A., 1971: Random Data: Analysis and Measurement Procedures. Karttunen, H. 2001: Datan käsittely, 2nd Ed.
Person responsible:
Pertti Kaikkonen

762303A: Geophysical field theory, 8 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Language of instruction:
Finnish
Timing:
3. - 5. spring

Contents:
The course provides knowledge of the mathematical formulation and solution of the field problems behind geophysical investigation methods. The course considers electrostatic, static electric current, magnetostatic, electromagnetic and gravity fields and continuum mechanics. Course also considers the basics of vector and tensor analysis, relationship between the geophysical fields and physical material properties, equations of continuity, solutions to equations of Laplace, Poisson, and Maxwell and the diffusion and wave equations.
Learning activities and teaching methods:
Lectures 30 h, demonstrations 30 h and practical work. Two interim exams or final exam, approved report.
Target group:
The course is compulsory in M.Sc. studies of geophysics.
Recommended or required reading:
Lecture notes; Eloranta, E., 2003: Geofysiikan kenttäteoria.
Person responsible:
Markku Pirttijärvi
Other information:
Course homepage: http://www.gf.oulu.fi/~mpi/opetus/762303A_Geofys_kentat.html

762629S: Geophysical properties of the crust and upper mantle in Fennoscandia, 4 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
4 credits
Language of instruction:
Finnish (optionally English).
Timing:
4. - 5. year
Contents:
Introduction to geophysical properties and structure of the Earth’s crust and upper mantle in Fennoscandia and in surrounding regions. The students will get familiar with tectono-geological interpretation of models from seismic, electrical and electromagnetic, gravimetric, geodetic, magnetic, thermal and rheological research of the lithosphere in Fennoscandia. Independent studies in small groups are an essential part of studies.
Learning activities and teaching methods:
Lectures 20 h, homework exercises 20 h in small groups. Examination (form to be selected during the course) and completion of homework exercises.
Target group:
Recommended for all students in Earth Sciences.
Recommended or required reading:
Handouts and other material delivered in lectures. Selected articles from geophysical and geological literature.
Person responsible:
Toivo Korja

762612S: Gravimetric and magnetic methods, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Elena Kozlovskaya

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:

Finnish
Timing:
3. - 5. year
Contents:
The course aims to provide basic knowledge for the interpretation of geophysical gravity and magnetic field measurements. The course considers the physical background of the methods, practical measurement arrangement, processing and interpretation methods and the anomalies of various kinds of geological targets. The exercises focus on the use of modelling and interpretation software.
Learning activities and teaching methods:
Lectures 20 h, demonstrations 20 h and practical work. Exam and approved report.
Recommended or required reading:
Lecture notes; Selected articles from geophysical journals and Blakely, R.J., 1995: Potential theory on gravity and magnetic applications.
Person responsible:
Markku Pirttijärvi
Other information:
Course homepage: http://www.gf.oulu.fi/~mpi/opetus/762612S_Painovoima_ja_magn.html

762616S: Ground Penetrating Radar Sounding, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Moisio, Kari Juhani

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
3. - 4. year
Contents:
The course provides students with the basic knowledge and skills on ground penetrating radar (GPR) as a geophysical investigation method. The course considers theoretical background, practical measurement arrangements, data processing, presentation and analysis. Several case examples and their interpretations are considered. The course includes a compulsory practical work, where the students process and interpret GPR data that they measure themselves.
Learning activities and teaching methods:
Lectures 20 h, demonstrations 20 h and practical work. Exam and approved report.
Target group:
Students with background knowledge on surficial geology and geophysics. Students of environmental geophysics.
Recommended or required reading:
Lecture notes; Maatutkarengas r.y., 2000: Maatutkarengas RY:n 10-vuotisjuhlaseminaari 15.-16.2.2000 Kuopio.
Person responsible:
Markku Pirttijärvi
Other information:
Course homepage: http://www.gf.oulu.fi/~mpi/opetus/762616S_Maatutkaus.html

766656S: Heliospheric physics, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Language of instruction:
If needed, this course can be lectured in English.
Timing:
Roughly every third year.
Contents:
This is an optional physics course at an advanced level on heliospheric physics. The space controlled by the solar magnetic field is called the heliosphere, extending beyond the planetary system. Solar magnetic field is carried by the solar wind, a particle stream originating in the solar corona. The properties of the solar wind and its magnetic field change with solar activity and affect the planetary magnetospheres and atmospheres, causing for example magnetic storms.
Contents briefly: Properties of solar wind, Parker's theory of solar wind, solar wind acceleration, the three-dimensional structure of the heliosphere, heliospheric current sheet, corotating shocks, coronal mass ejections and magnetic clouds, merged interaction regions, termination shock, heliopause, solar magnetic cycle and its effects in the heliosphere, north-south asymmetry, space weather and space climate.
Learning activities and teaching methods:
Lectures 44 h, 10 exercises (20 h), final examination.
Target group:
Recommended especially for students of space physics, astronomy and theoretical physics. The course supports, e.g., the courses 766654S Solar physics and 766655S Cosmic rays.
Recommended optional programme components:
Recommended courses: 766355A Basics of space physics and/or 761353A Basics of plasma physics, or equivalent knowledge.
Recommended or required reading:
Parts of books: Kivelson-Russell, Introduction to Space Physics, Cambridge Univ. Press, 1995; J.R. Jokipii et al, Cosmic winds and the heliosphere, Univ. Arizona, 1997; Prölss, Physics of the Earth's space environment; K. Scherer et al., The outer heliosphere: Beyond the planets, Copernicus, 2000.
Lecture notes: K. Mursula: Heliospheric physics.
Person responsible:
Kalevi Mursula
Other information:
Course web page http://physics.oulu.fi/fysiikka/oj/766656S /

764620S: Hemodynamics, 4 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

765106P: History of astronomy, 3 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

765308A History of astronomy 5.0 op

765107P-02 Astronomical world view (part 2): History of astronomy 0.0 op

765107P-01 Astronomical world view (part 1): Introduction to astronomy 0.0 op

ECTS Credits:

3 credits
Contents:
Historical background of present day astronomy. First historical astronomical observations. Development of cosmological theories until today.
Naked eye observations. Naming of stars and constellations. Calendar. Ancient astrocultures. Greek astronomy. Navigational instruments. Telescopes.
Learning activities and teaching methods:
One written examination.
Target group:
*
Recommended or required reading:
B. L. Van der Waerden: Die Anfänge der Astronomie or Science Awakening, Leyden Noordhoff Intl. Publishing, 1975; O. Pederson: Early physics and astronomy; G. Abetti: The history of astronomy, Abelard-Schuman, 1952.
Person responsible:
Heikki Salo

763654S: Hydrodynamics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Contents:
Introduction to hydrodynamics. Useful for all physicists, including bio-, geo-, space, astro- and theoretical physicists.
Continuity equation, hydrostatics, Navier-Stokes equation of motion, flow in simple cases, sound waves, surface waves on liquids.
Learning activities and teaching methods:
Lectures 26 h, exercises 24 h. One written examination.
Target group:
*
Recommended optional programme components:
763101P, 766323A.
Recommended or required reading:
A. R. Paterson: A first course in fluid dynamics, E. Thuneberg, Hyrdodynamiikka (lecture notes).
Person responsible:
Erkki Thuneberg

762660S: Ice & Snow Physics & Chemistry & Glaciology, 3 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
3 credits
Language of instruction:
English
Contents:

An introduction to ice and snow as materials, and their impact on the evolution of the Earth's surface and climate. Ice atomic structure, different phases of ice – ice in the Solar System. Glacier ice, transformation of snow into ice. Rheology of ice, glacier flow and models. Impurities in ice, ice core chemistry and the paloeclimate record. There is a possible field course to be arranged later.
Learning activities and teaching methods:
Lectures 24 h and a final examination.
Target group:
Master's students all disciplines; numerical disciplines at undergraduate level.
Recommended or required reading:
Handout. Paterson, W.S.B., 1994: Physics of Glaciers, 3 rd edition.
Person responsible:
John Moore

764628S: Identification of linear and nonlinear systems, 8 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

765660S: Impact craters, 4 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
4 credits
Contents:
An introduction to impact craters.
The frequency and occurrence of impact craters. Impacts and processes involved in them. Post-impact deformation. Identification and research of impact craters. Effects of impacts on target planet.
Learning activities and teaching methods:
Lectures 26 h, exercises. One written examination.
Target group:
*
Recommended optional programme components:
765303A
Recommended or required reading:
Latest books and review articles.
Person responsible:
Jouko Raitala

761662S: Infrared spectroscopy, 8 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Timing:
Not every year
Contents:
Molecular rotation-vibration spectroscopy
Learning activities and teaching methods:
Lectures 44 h, exercises 20 h, one written examination.
Recommended optional programme components:
*
Recommended or required reading:
Infrapunaspektroskopia ed. by R. Anttila (1996), Infrapunaspektroskopia ed. by S. Alanko (2003), Spectra of Atoms and Molecules by P. F. Bernath, Oxford University Press, 1995
Person responsible:
Seppo Alanko

762605S: Interpretation theory, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
Finnish
Timing:
4 th or 5 th year.
Contents:
Systematic introduction to inversion of geophysical field data. Principles of inversion, selecting inversion models and methods. Inversion nomograms. Linear parameter inversion: genuine linear parameters, linearization, generalized inversion, principles of tomographic nonlinear inversion: one- and multidimensional optimization. Special methods of inversion: analytic inversion, function theoretical methods, statistical methods. Principles of probability density and entropy maximum. Error analysis.
Learning activities and teaching methods:
Lectures 30 h, 20 h math exercises, an independent exercise.
Target group:
Compulsory for students of Geophysics.
Recommended or required reading:
A handout. Parts of the following: Hjelt, S.E., 1992: Pragmatic inversion of geophysical data sekä soveltuvin osin Menke, W., 1989: Geophysical data analysis: discrete inverse theory; Sen, M. & Stoffa, P.L., 1995: Global optimization methods in geophysical inversion; Scales, J.A., Smith, M.L. & Treitel, S., 2001: Introductory geophysical inverse theory.
Person responsible:
Pertti Kaikkonen

764640S: Intracellular recordings, 3 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

765101P: Introduction to astronomy I, 4 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

765103P Introduction to astronomy 2.0 op

ECTS Credits:
4 credits
Timing:
Autumn
Contents:
Basic introductionary topics in astronomy: coordinate systems, observations, stars and other astronomical objects, areas of specialization. This course is recommended to students aiming at becoming lower secondary school teachers if they want to specialize in natural sciences.
Learning activities and teaching methods:
Lectures 32 h. One written examination.
Target group:
*
Recommended or required reading:
Part of the book H. Karttunen, K.-J. Donner, P. Kröger, H. Oja and M. Poutanen (eds.): Tähtitieteen perusteet, Ursa, 1995; English edition: Fundamental astronomy, Springer, 1996.
Person responsible:
Jouko Raitala

765102P: Introduction to astronomy II, 8 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Contents:
A more comprehensive view on current astronomy.
Basics of radiative processes, celestial mechanis, stellar structure and evolution, structure of the Milky Way Galaxy, and basics of cosmology.
Learning activities and teaching methods:
Lectures 32 h, exercises 12 h. One written examination.
Target group:
*
Recommended or required reading:
H. Karttunen, K.-J. Donner, P. Kröger, H. Oja and M. Poutanen (eds.): Tähtitieteen perusteet, Ursa, 1995; English edition of the book: Fundamental astronomy, Springer, 1996.
Person responsible:
Heikki Salo

764162P: Introduction to biophysics, 3 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

764163P-02 Basic biophysics (part 2) 0.0 op
764163P Basic biophysics 5.0 op
764163P-01 Introduction to Biomedical Physics (part 1) 0.0 op

Ei opintojaksokuvauksia.

761645S: Introduction to experimental physical research, 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Contents:
*
Learning activities and teaching methods:
Exercises 120 h. Working in a research group. Written report about research.
Target group:
Students in Information Technology in Physics, Space Physics or Atom, Molecule and Material Physics.
Recommended optional programme components:
Advanced physics course related to the field of research to be carried out.
Assessment methods and criteria:
Written report about research in a research group.
Person responsible:
Professors

762135P: Introduction to global environmental geophysics, 6 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
2 nd – 3 th year
Contents:
An overview of the physical principles of global environmental issues and the use of geophysical methods in environmental case studies. The structure of the Earth and its geophysical processes: solid earth, oceans, atmosphere, glaciers, groundwater, nuclear waste disposal and natural disasters. Follow-up measurements of environment. Principles of modeling the environment: the Earth as a system. Climate change and its consequences.
Learning activities and teaching methods:
Lectures 30 h and a written exercise and a final examination.
Target group:
Compulsory for students of geophysics in the B.Sc. degree. The course is suitable for all students interested in environmental issues.

Recommended or required reading:
A handout. Kakkuri, J. & Hjelt, S.-E., 2000: Ympäristö ja geofysiikka and parts of the following: Houghton, J., 2004: Global warming: The complete briefing (3 rd ed.).
Person responsible:
Pertti Kaikkonen

762193P: Introduction to hydrology and hydrogeophysics, 4 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
4 credits
Language of instruction:
Finnish (It is possible to do the course in English, although all the lectures and exercises will be given in Finnish).
Timing:
1. year. Lectures on spring semester.
Contents:
Introduction to hydrology. The course presents properties and behaviour of water in hydrosphere in general and sub-surface water in particular. The latter includes introduction to geohydrology and to hydrogeophysics. Part I: Hydrological cycle, its different components (evaporation, precipitation and runoff), their relation to each other, observations and spatial and temporal variation of each component in Finland. Part II: Geohydrology and hydrogeophysics. Water in soil and bedrock. Formation and flow of groundwater. Geophysical methods in ground water surveys. Case histories.
Learning activities and teaching methods:
Lectures 30 h, exercises 10 h. Examination.
Target group:
Recommended for all interested in environmental subjects. Compulsory for B.Sc. students in geophysics.
Recommended or required reading:
Handouts and lecture notes: Yliniemi, J. and Salmirinne, H., 1995. Hydrology. (in Finnish). Selected parts from: Hooli, J. & Sallanko, J., 1996: Hydrologia luentomoniste, Mustonen, S. (eds.) 1986: Sovellettu hydrologia.
Person responsible:
Toivo Korja

762187P: Introduction to information retrieval and scientific writing in geophysics, 2 op

Voimassaolo: - 31.07.2009

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
2 credits
Language of instruction:
Finnish
Timing:
2. year, spring
Contents:
Course introduces methods to retrieve and evaluate scientific information and to write scientific reports including thesis. Contents: Information retrieval and related matters are taught in the course “Tiedonhankintakurssi (020005P, 1cp) given by the Tellus science library. Scientific writing (1 cp) includes lectures on the process of scientific writing and special requirements of scientific texts, scientific communication, publication medium, form and content of reports and thesis, styles and techniques of writing, figures, tables, citations.

Learning activities and teaching methods:
Lectures, homework exercises.
Target group:
Compulsory for B.Sc. students in geophysics.
Recommended or required reading:
Handouts and other material delivered in lectures.
Assessment methods and criteria:
Accepted reports on homework exercises.
Grading:
Passed/failed.
Person responsible:
Science Library Tellus and Toivo Korja (geophysics)

763621S: Introduction to particle physics, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
10 credits
Language of instruction:
English/Finnish
Timing:
3. - 4. year
Contents:
Elementary particles are the foundation of all matter, and behind every physical process there are interactions between elementar particles. This course gives an introduction to the Standard Model of the elementary particle physics: the particles it contains, interactions, and the symmetries behind the classification of the particles and interactions. The main part of the course is the calculation of the elementary scattering processes in quantum electrodynamics, QED, using diagrammatic Feynman rules. The strong and electroweak interactions of the standard model are also introduced.
Learning activities and teaching methods:
Lectures 50 h, exercises 30 h and one written examination.
Target group:
Students of theoretical physics and astrophysics (optional).
Recommended optional programme components:
Special theory of relativity (763102P), Quantum mechanics I (766312A).
Recommended or required reading:
F. Halzen, A. Martin: Quarks and Leptons, D. Griffiths: Introduction to elementary particles, Lecture notes.
Person responsible:
Kari Rummukainen

763114P: Introduction to programming, 4 op

Voimassaolo: - 31.07.2014

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

521141P	Elementary Programming	5.0 op

ECTS Credits:
4 credits

Timing:
2. autumn
Contents:
Basic course for programming. C-coding and general programming.
Learning activities and teaching methods:
Lectures 24 h, 12 exercises, 3 homework projects. Written examination.
Target group:
Compulsory for theoretical physics, biophysics and physics students.
Recommended optional programme components:
Upper secondary school education.
Recommended or required reading:
Lecture notes.
Person responsible:
Mikko Saarela

763102P: Introduction to relativity, 3 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763105P Introduction to relativity 1 2.0 op

ECTS Credits:
3 credits
Timing:
First spring
Contents:
This course is an introduction to the special theory of relativity. The elegance of the theory and the simple consequences which go beyond our everyday experiences make this course an interesting one and motivate the students for further physics studies. The theory is based on the constancy of the speed of light, leading inevitably to non-absolute time and space.
The course contains an empirical introduction to the history of the relativity, the postulates and the Lorentz transformations. The four-vector formalism is used throughout the course. An important application is the relativistic kinematics of the scattering processes.
Learning activities and teaching methods:
Lectures 22 h, exercises 20 h, one written examination.
Target group:
Required for the students of theoretical physics and physics. Optional for the students of biophysics, geophysics and astronomy.
Recommended optional programme components:
Upper secondary school physics and mathematics.
Recommended or required reading:
Course material is available on the course home page.
Person responsible:
Kari Rummukainen

766115P: Introduction to the physical sciences, 1 op

Voimassaolo: - 31.07.2009

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
1 credits
Timing:
Autumn
Contents:
This course will introduce the research areas of the Department of physical sciences. The research is made in physics: space physics, electron, infrared and NMR spectroscopy as well as in biophysics, theoretical physics, astronomy and geophysics. One 3 hours period is reserved for each field. During one period also educational studies and the employment of the physicists are looked through.
Learning activities and teaching methods:
Lectures 27 h, 75 % present.
Target group:
Compulsory for student in physical sciences.
Recommended optional programme components:
*
Recommended or required reading:
*
Person responsible:
Kari Kaila

761658S: Ionospheric physics, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English, Finnish

ECTS Credits:
8 credits
Language of instruction:
If foreign students take part in the course, the course can be given in English.
Timing:
Not every year
Contents:
The topic of this course is the ionised part of the upper atmosphere of the Earth, which is called the ionosphere. Ionosphere is created mainly by the ionising radiation from the Sun. The ionosphere at high latitudes is much more dynamic than at mid or low latitudes. That’s because the high-latitude ionosphere is magnetically connected to the magnetosphere of the Earth, which in turn is connected to the solar wind in a complex way. Intense electric currents are flowing in the high-latitude ionosphere and aurora (northen lights) appear. The ionosphere was originally found because of its effect on the propagation of radio waves (radio connections around the Earth without satellites are only possible due to the ionosphere). On the other hand, the most important methods of ionospheric research are based on radio waves. Therefore, the physics of the ionosphere has also prcatical applications and consequences.
Contents in brief: Solar radiation, the atmosphere of the Earth and its dynamics, formation of the ionosphere and ion chemistry, plasma motion and diffusion in the ionosphere, ionospheric electrical currents and electric fields, aurora, some selected phenomena of the ionosphere (e.g. electrojets in the equatorial and auroral regions, sporadic-E layers and polar wind).
Learning activities and teaching methods:
Lectures 40 h, 20 h exercises, end examination.
Target group:
This course is useful especially for students who want to continue studies and do research in the space physics group, but is suitable also for those aiming at teachers.
Recommended optional programme components:
No prequisities are required, but useful basics are given in course 766355A Avaruusfysiikan perusteet. The course itself provides background information for courses 761649S Revontulifysiikka, 761648S Epäkoherentin sirontatutkan perusteet ja 761657S Magnetosfäärifysiikka.
Recommended or required reading:
A. Aikio ja T. Nygren: Physics of the Ionosphere of the Earth, will be distributed on the web-page of the course. The textbooklet by A. Aikio and T. Nygren is partly based on the textbook: A. Brekke, Physics of the Upper Atmosphere, John Wiley & Sons, 1997.

Person responsible:
Anita Aikio and Tuomo Nygrén

766107P: Laboratory exercises in physical sciences, 6 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
1 st Spring – 3 rd Autumn
Contents:
Laboratory exercises associated with the first and second year courses.
Learning activities and teaching methods:
Laboratory 52 - 56 h (13 x 4 - 14x4)
Target group:
Compulsory for physics, biophysics, geophysics and astronomy students.
Recommended optional programme components:
761121P Physical measurements I.
Recommended or required reading:
761107P Fysiikan harjoitustyöt I, 1994. English material is given from laboratory.
Assessment methods and criteria:
Written reports of the experiments.
Person responsible:
Seppo Alanko, Toivo Korja (geophysics), Petri Kostama (astronomy)

761308A: Laboratory exercises in physics, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
4 credits
Timing:
Autumn & spring
Contents:
Laboratory exercises associated with the 2 nd and 3 rd year courses.
Learning activities and teaching methods:
Laboratory 32 h (8x4).
Target group:
Compulsory for physics students.
Recommended optional programme components:
766107P Laboratory exercises in physical sciences.
Recommended or required reading:
761308A Fysiikan harjoitustyöt II. English material is given from laboratory.
Assessment methods and criteria:
Written reports of the experiments.
Person responsible:
Jukka Jokisaari

761675S: Laser and synchrotron radiation physics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766675S Laser and synchrotron radiation physics 10.0 op

ECTS Credits:
6 credits
Timing:
Not every year
Contents:
The course deals with the fundamentals of synchrotron radiation, its generation, special aspects of radiation and types of interaction between the radiation and matter. In addition, design of beam lines and measurement instrumentation is discussed as well as interpretation of experimental data. The studies with laser and synchrotron radiations, so called two color experiments, are also described.
Learning activities and teaching methods:
Lectures 35 h, exercises 20 h. One written examination.
Target group:
*
Recommended optional programme components:
*
Recommended or required reading:
Lecture notes and parts from the book: G. Margarindonto: Elements of Synchrotron Light, Oxford University Press (2002)
Person responsible:
Seppo Aksela

761664S: Laser physics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
Not every year
Contents:
Introduction to laser physics
Fundamental wave properties of light, fundamental quantum properties of light, laser amplifiers, laser resonators, specific laser systems.
Learning activities and teaching methods:
Lectures 35 h, exercises 20 h, one written examination.
Recommended optional programme components:
761329A,761324A
Recommended or required reading:
W.T. Silfvast:Laser fundamentals, O. Svelto: Principles of lasers.
Person responsible:
Seppo Alanko

762681S: M.Sc. work (thesis and seminar), 30 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
35 credits
Timing:
5th year
Contents:
The student must demonstrate ability to scientific thinking, to define a research problem, choose the research methods and be able to use to methods to solve the problem. In addition the student must show adequate familiarity with the literature related to the subject of thesis and skills in scientific writing. The subject must be chosen with the professor of geophysics.
Target group:
Compulsory for students of geophysics.
Grading:
The departmental council grades the thesis (approbatur,…, laudatur).
Person responsible:
Pertti Kaikkonen

761657S: Magnetospheric physics, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Language of instruction:
If needed, this course can be lectured in English.
Timing:
Roughly every third year.
Contents:
This is an optional physics course at an advanced level on magnetospheric physics. A magnetosphere is made by the interaction between a planet’s internal magnetic field and the interplanetary magnetic field carried by the solar wind. This interaction forms a comet-like magnetic bubble, whose size, shape and structure vary constantly, depending on the conditions of solar wind and the interplanetary magnetic field.
Contents briefly: Formation of a magnetosphere, Chapman-Ferraro model, magnetospheric boundaries, tail and cusp, magnetospheric plasmas and current systems, reconnection of magnetic fields, magnetosphere-ionosphere coupling, magnetospheric dynamics (magnetic activity, auroras, substorm process, magnetic storms), other planetary magnetospheres.
Learning activities and teaching methods:
Lectures 44 h, 10 exercises (20 h), final examination.
Target group:
Recommended especially for students of space physics, astronomy and theoretical physics. The course supports, e.g., the courses 766656S Heliospheric physics and 761649S Auroral physics.
Recommended optional programme components:
Recommended courses: 766355A Basics of space physics and/or 761353A Basics of plasma physics, or equivalent knowledge.
Recommended or required reading:
Parts of books: H. Koskinen, Johdatus plasmafysiikkaan ja sen avaruus¬sovellutuksiin. Limes, 2001; Prölss, Physics of the Earth’s space environment, Springer, 2004; G. Parks, Physics of space plasmas. An introduction, Addison-Wesley, 1991; Kivelson-Russell, Introduction to space physics, Cambridge Univ. Press, 1995.
Lecture notes: K. Mursula: Magnetosfäärifysiikka.
Person responsible:

Kalevi Mursula
Other information:
Course web page http://physics.oulu.fi/fysiikka/oj/761657S /

762625S: Magnetotellurics, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Korja, Toivo Johannes

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish (optionally English).
Timing:
4. – 5. years
Contents:
Magnetotelluric method is one of a few geophysical methods suited to investigate crustal and upper mantle structure. Recently, due to methodological and instrumental improvements, magnetotelluric method is coming common in studies of near-surface targets. In these cases the method is usually called radiomagnetotelluric and audiomagnetotelluric method. Contents: Theoretical background of magnetotelluric method. Survey design. Instruments. Time series processing. Impedance tensor and its internal properties. Distortions. Inversion in 1D-, 2D- and 3D-environment. Electrical anisotropy. Visualization of data and results. Conductivity mechanisms. Interpretation of conductivity models. Examples.
Learning activities and teaching methods:
Lectures 20 h, exercises 20 h, homework exercise coevally with lectures. Examination (form to be selected during the course) and completion of the report on homework exercise.
Target group:
Recommend for students interested in lithospheric research as well as applied work.
Recommended optional programme components:
It is recommended that the lectures of the courses ”Theory of electromagnetic methods” (762611S) and ” Modelling of electromagnetic fields” (762630S) have been attended.
Recommended or required reading:
Handouts. Simpson, F. & Bahr, K., 2005: Practical magnetotellurics; Vozoff, K. (ed.), 1986: Magnetotelluric methods.
Person responsible:
Toivo Korja

765645S: Mapping the planets, 4 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
4 credits
Contents:
Planetary missions provide advanced new data of planetary bodies. History and different approaches to map the planetary bodies. Cartography, map projections, thematic mapping. Lectures, readings, practicals.
Learning activities and teaching methods:
Lectures 30 h, exercises. One written examination.
Target group:
*

Recommended optional programme components:
Planetology I.
Recommended or required reading:
For the background cf. Batson: Planetary mapping, Whitaker: Mapping and naming the Moon: A history of lunar cartography and nomenclature ja muut vastaavat teokset.
R.A. Hanel et al. (2003), Exploration of the Solar System by Infrared Remote Sensing, Cambridge University Press.
B. Bussey & P. Spudis (2004), The Clementine Atlas of the Moon, Cambridge University Press.
C.J. Byrne (2005), Lunar Orbiter Photographic Atlas of the Near Side of the Moon, Springer etc.
Person responsible:
Jouko Raitala

763101P: Mathematics for physics, 6 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766101P Mathematics for physics 5.0 op

ECTS Credits:
6 credits
Timing:
First autumn
Contents:
Integral and differential calculus, complex variables and functions, introduction to differential equation
Learning activities and teaching methods:
Lectures 36 h, exercises 30 h. Two written intermediate examinations.
Target group:
Compulsory.
Recommended optional programme components:
Basic course following up the upper secondary school mathematics.
Recommended or required reading:
Lecture notes.
Person responsible:
Pekka Pietiläinen

761386A: Maturity test, 0 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
0 credits
Contents:
Written test about a subject of the B.Sc. Thesis. The length of the text is recommended to be one exam paper.
Target group:
Compulsory for student of physics.
Grading:
Pass.
Person responsible:
Professors

763685S: Maturity test, 0 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

ECTS Credits:
0 credits
Contents:
An essay written only with pen and paper (and eraser) on topics related to master thesis.
Target group:
A compulsory part the degree, students of theoretical physics.
Recommended optional programme components:
After completed master thesis.
Grading:
Pass.
Person responsible:
Erkki Thuneberg

761686S: Maturity test, 0 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
0 credits
Contents:
Written test about a subject of the M.Sc. Thesis. The length of the text is recommended to be one exam paper.
Target group:
Compulsory for student of physics.
Grading:
Pass.
Person responsible:
Professors

765657S: Maturity test, 0 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
0 credits
Contents:
*
Target group:
Compulsory in M.Sc. studies.
Grading:

Pass.
Person responsible:
Juri Poutanen

762679S: Maturity test, 0 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
0 credits
Timing:
5 th year
Contents:
Written test about a subject of the pro gradu (M.Sc.) thesis. The student must demonstrate perfect skills in Finnish or Swedish. The length of the text is recommended to be one exam paper. Approved maturity test is required for graduating.
Target group:
Compulsory for students of geophysics.
Person responsible:
Pertti Kaikkonen

765357A: Maturity test, 0 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
0 credits
Contents:
*
Target group:
Compulsory in B.Sc. studies.
Grading:
Pass.
Person responsible:
Juri Poutanen

763385A: Maturity test, 0 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
0 credits
Contents:

An essay written only with pen and paper (and eraser) on topics related to candidate thesis. A compulsory part the degree for students of theoretical physics.
Target group:
Compulsory.
Recommended optional programme components:
After completed candidate thesis.
Grading:
Pass.
Person responsible:
Erkki Thuneberg

762379A: Maturity test, 0 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
0 credits
Timing:
3 rd year
Contents:
Written test about a subject of the B.Sc. thesis. The student must demonstrate perfect skills in Finnish or Swedish. The length of the text is recommended to be one exam paper.
Target group:
Compulsory for students of geophysics.
Recommended optional programme components:
Approved maturity test is required for graduating.
Person responsible:
Pertti Kaikkonen
Other information:
Approved maturity test is required for graduating.

764395A: Maturity test for BSc, 0 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

764695S: Maturity test for MSc, 0 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

766323A: Mechanics, 6 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

761118P Mechanics 1 5.0 op
761118P-01 Mechanics 1, lectures and exam 0.0 op
761118P-02 Mechanics 1, lab. exercises 0.0 op
761323A Mechanics 6.0 op

ECTS Credits:
7 credits
Timing:
Autumn continuing to spring
Contents:
The development in physics started from mechanics. This is due to the mechanical phenomena like motion which has fundamental significance in our environment. Several mechanical phenomena can be studied with rather simple instruments. The research of mechanics has conducted to invariant laws, which are essential in all physical research. Also the basic theories of modern physics are based to mechanics. The study of mechanics helps to understand the other fields of physics. Motion and dynamics of motion, motion in three dimension, fields and energy, many-body interactions, gravitation, rigid-body dynamics, relative motion, special relativity, mechanics of fluids.
Learning activities and teaching methods:
Lectures 62 h, exercises 30 h (15 x 2 h). Three written intermediate examinations or one final examination.
Target group:
*
Recommended optional programme components:
Needs a course 763101P Fysiikan matematiikkaa, especially vectores, differential and integral calculus as well as matrice calculus. This course includes the basic mechanics.
Recommended or required reading:
M. Mansfield and C.O'Sullivan: Understanding Physics, John Wiley & Sons, Praxis Publishing, 1999 and additional parts of M. Alonso and E. Finn: Physics, Pearson (earlier Addison-Wesley, Fundamental University Physics).
Person responsible:
Kari Kaila

764369A: Medical Equipments, 3 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

764633S: Medical Physics, 4 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

765677S: Meteorites, 4 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
4 credits
Contents:
Meteorite classes and the differences in between them. Events that influence the birth and development of meteorites and how to study these events. Meteorite type relationships. Origin and development of meteorite materials. Meteorite impacts.
Learning activities and teaching methods:
Lectures 32 h, exercises, demonstrations, an essay. One written examination.
Target group:
*
Recommended optional programme components:
Basics in Planetology I, planetological ang geological studies.
Recommended or required reading:
V. F. Buchwald: Handbook of iron meteorites; R. T. Dodd: Meteorites; J. F. Kerridge, M. S. Matthews (eds.): Meteorites and the early Solar System.
Norton: Rocks from space: meteorites and meteorite hunters, Papike (toim.): Planetary materials (soveltuvin osin) ja kurssikirjoiksi H.Y. McSween (1999): Meteorites and their parent planets, Cambridge University Press. R.O. Norton (2002), The Cambridge Encyclopedia of Meteorites, Cambridge University Press. D.S. Lauretta & H.Y. McSween (eds., 2006), Meteorites and the early Solar System II, University of Arizona Press.
Person responsible:
Jouko Raitala

763694S: Methods in material physics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
Autumn
Contents:
Methods of numerical simulations in physics.
Advanced methods for theoretical investigations of strongly correlated quantum systems. The course has three sections:
Variational method based on the correlated wave function and the microscopic Hamiltonian for system like quantum fluids.
Exact diagonalization method for systems with small number of particles like quantum dot, rings etc.
Monte Carlo methods based on metropolis-algorithm. Fixed node-method for Fermions is introduced. The method is applied to the liquid helium and electron gas.
Learning activities and teaching methods:
Lectures 42 h, exercises, project work.
Target group:
Optional.

Recommended optional programme components:
Analytical mechanics and quantum physics courses.
Recommended or required reading:
*
Person responsible:
Mikko Saarela

762630S: Modelling of electromagnetic fields, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
4 th or 5 th year
Contents:
To familiarize students with methods in getting the theoretical anomalies for one- or multidimensional earth structures. Electromagnetic fields: field equations, boundary conditions. Layered model. Multidimensional model: physical modelling, integral equation method, transmission surface analogy, finite-difference method, finite-element method. Thin sheet approximation. Solving the set of linear equations. On the errors.
Learning activities and teaching methods:
Lectures 35 h, 10 h demonstrations and exercise, an independent work and a final examination.
Target group:
Optional for students of geophysics.
Recommended or required reading:
Lecture material. Selected papers. Parts of the following: Nabighian, M. N. (ed.), 1988: Electromagnetic methods in applied geophysics, Volume 1, Theory, s. 313-363 ja 365-441.
Person responsible:
Pertti Kaikkonen

764619S: Molecular biophysics, 4 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

761661S: Molecular quantum mechanics, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits

Timing:
Not every year
Contents:
The course gives the necessary basic knowledge for various molecular spectroscopies and/or molecular electronic structure calculations.
Recapitulation of basics in quantum mechanics, group theory, perturbation theory, variational theorem, molecular electronic structure and its calculation.
Learning activities and teaching methods:
Lectures 35 h, exercises 20 h. One written examination.
Target group:
*
Recommended optional programme components:
Atomic physics (766326A) and Thermophysics (766328A) cum laude -courses or comparable knowledge.
Recommended or required reading:
P.W. Atkins and R.S. Friedman, Molecular Quantum Mechanics, 3rd edition, chapters 1-9. Oxford University Press, 1997.
Person responsible:
Jukka Jokisaari

763624S: Monte Carlo and simulation methods, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
Not every year.
Contents:
Monte Carlo simulation methods are amongst the most important tools in computational physics. They are used in almost all fields of physics. In this course we will discuss the fundamentals of Monte Carlo simulation methods; the aim is to be able to write a simulation program, use it for computations, and analyse the results obtained. The methods are easily applicable to a wide variety of fields.
Contents: Monte Carlo integration, generation of random numbers, simulation of statistical lattice models, error analysis, jackknife and bootstrap methods, reweighting, collective updates, simulated annealing.
Learning activities and teaching methods:
Lectures 24 h, 4 - 5 exercises, 1 exam. The exercises require writing and using computer simulation programs.
Recommended optional programme components:
The student should have good knowledge of some programming language. The most used languages in simulations are C, C++ and Fortran. However, the exercises can be done in any programming language
Recommended or required reading:
Lecture notes: K. Rummukainen, Monte Carlo simulations in physics.
Books: Gould, Tobochnik: An Introduction to Computer Simulation Methods. Binder, Heermann: Monte Carlo simulations in statistical physics. Press, Flannery, Teukolsky, Vetterling: Numerical Recipes, where applicable.
Person responsible:
Kari Rummukainen

766661S: NMR Imaging, 8 op

Voimassaolo: 01.01.2010 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
Not every year
Contents:
The course is intended to give students an understanding of the principles of the imaging methods based on nuclear magnetic resonance (NMR) and to explain how NMR imaging can be used to characterize physical properties of various materials. Topics will include one-dimensional Fourier imaging, *k* space, gradient echoes, multidimensional Fourier imaging, continuous and discrete Fourier transform, sampling, folding, filtering, resolution, and contrast.
Learning activities and teaching methods:
Lectures 35 h, exercises 20 h. One written examination.
Target group:
*
Recommended optional programme components:
761663S NMR spectroscopy is helpful, but not necessary.
Recommended or required reading:
Textbooks: E. M. Haake, R. W. Brown, M. R. Thompson and R. Venkatesan, Magnetic Resonance Imaging. Physical Principles and Sequence Design., John Wiley & Sons, Inc., 1999 (in part). B. Blümich, NMR Imaging of Materials, Clarendon Press, 2000 (in part).
Person responsible:
Jukka Jokisaari and Juhani Lounila

761663S: NMR spectroscopy, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Timing:
Not every year
Contents:
The course introduces to the basics of nuclear magnetic resonance phenomenon and to the application of NMR for studies of properties of molecules and materials.
Macroscopic magnetization. Bloch equations. Fourier NMR. NMR parameters. Structure of 1-dimensional spectra. Pulse sequences in 1- and 2-dimensional spectroscopy.
Learning activities and teaching methods:
Lectures 44 h, exercises 20 h. One written examination.
Target group:
*
Recommended optional programme components:
Basic knowledge on quantum mechanics and atomic physics helps but is not compulsory.
Recommended or required reading:
M.H. Levitt, Spin dynamics. Basics of Nuclear Magnetic Resonance, John Wiley & Sons, Chichester, England, 2001.
D. Canet, Nuclear Magnetic Resonance. Concepts and Methods, Jowh Wiley & Sons, Chichester, England, 1996
J. Keeler, Understanding NMR Spectroscopy (John Wiley & Sons, Chichester, 2007)
Person responsible:
Jukka Jokisaari

761670S: NMR spectroscopy in solids, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
Not every year
Contents:
The course is an introduction to nuclear magnetic resonance spectroscopy (NMR spectroscopy) in the solid state. It deals with the NMR parameters in the solid state, single crystal spectra, powder patterns, sample spinning experiments (MAS, VAS, DAS and DOR), dipolar line broadening, and cross polarization.
Learning activities and teaching methods:
Lectures 35 h, 10 exercises (20 h), one written examination.
Target group:
*
Recommended optional programme components:
761663S NMR spectroscopy is helpful, but not necessary.
Recommended or required reading:
*
Person responsible:
Juhani Lounila

764680S: Neural information processing, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

763315A: Numerical modelling, 4 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
4 credits
Timing:
first spring
Contents:
A course on numerical modelling with Mathematica.
Compulsory for physics and theoretical physics students. Basic course on numerical modelling of physical phenomena using symbolic language, Mathematica. Programming with Mathematica is also introduced.
Learning activities and teaching methods:
13 exercises, 3 homework projects. One written examination.
Target group:
Compulsory.
Recommended optional programme components:
763114P.
Recommended or required reading:
Mathematica notebook.
Person responsible:
Mikko Saarela

763616S: Numerical programming, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
4. autumn
Contents:
Course on technical and scientific programming.
Programming in scientific-technical tasks, use of programme libraries and graphical presentation of results.
Fortran language is used in programming.
Learning activities and teaching methods:
Lectures 26 h, 13 exercises, 4 homework projects. One written examination.
Target group:
Optional.
Recommended optional programme components:
Basic knowledge of programming, 763114P ATK I.
Recommended or required reading:
W. H. Press, B. P. Flannery, S. A. Teukolsky and W. T. Vetterling: Numerical Recipes. The Art of Scientific Computing.
Person responsible:
Mikko Saarela

761665S: Optics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761685S Optics 5.0 op

ECTS Credits:
8 credits
Timing:
Not every year
Contents:
Advanced course on optical physics
Basics on optical physics for physicist who intend to work with optics or optical spectroscopy in research or in industry.
Learning activities and teaching methods:
Lectures 44 h, exercises 20 h, one written examination.
Recommended optional programme components:
*
Recommended or required reading:
F. L. Pedrotti, L.S. Pedrotti: Introduction to optics, E. Hecht: Optics
Person responsible:
Seppo Alanko

761011Y: Orientation course for new students, 2 op

Opiskelumuoto: General Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761010Y Orientation course for new students 3.0 op

ECTS Credits:
2 credits
Language of instruction:
Finnish
Timing:
1 st autumn
Contents:
The aim of the course is to introduce new students to the university, academic studies and the studies of physical sciences.
Learning activities and teaching methods:
Group work 10 – 15 h.
Target group:
Compulsory for students in the physical sciences.
Person responsible:
Anja Pulkkinen

762085Y: Orientation course for new students, 2 op

Voimassaolo: - 31.07.2009

Opiskelumuoto: General Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
2 credits
Language of instruction:
Finnish
Timing:
1. year, autumn
Contents:
Tutors (usually 2nd or 3rd year students) introduce new students to academic environment: Tutors give information on courses and other matters related to studies of the degree program as well as on major and minor subjects. They also help students to plan their studies.
Learning activities and teaching methods:
10-15 h working in small groups tutored by an older student.
Target group:
Compulsory for B.Sc. students in geophysics.
Person responsible:
Anja Pulkkinen (physical sciences) and Toivo Korja (geophysics)

764641S: Patch-clamp techniques, 3 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

761121P: Physical Measurements I, 3 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

761115P	Laboratory Exercises in Physics 1	5.0 op
761118P-01	Mechanics 1, lectures and exam	0.0 op
761115P-02	Laboratory Exercises in Physics 1, laboratory exercises	0.0 op
761115P-01	Laboratory Exercises in Physics 1, lecture and exam	0.0 op
761114P-01	Wave motion and optics, lectures and exam	0.0 op
761113P-01	Electricity and magnetism, lectures and exam	0.0 op

ECTS Credits:
3 credits
Timing:
Autumn, spring.
Contents:
The skill to make laboratory measurements is important for physicists. This is an introductory course how to make physical measurements and how to treat the measured data. Laboratory works are made in groups. The laboratory security is an essential part also in physics. Different measurements are made with different instruments. As a result the most probable value is determined as well as its errors. Five different works will be made during the course in groups of up to 8 students. The skills obtained during this course can be applied in the other laboratory courses “Fysikaalisten tieteiden harjoitustyöt” and “Fysiikan harjoitustyöt”.
Learning activities and teaching methods:
Lectures 12 h, exercises 20 h (5 x 4 h). Written reports of the experiments and a written examination.
Target group:
Compulsory.
Recommended optional programme components:
Upper secondary school physics and mathematics.
Recommended or required reading:
Instruction book in Finnish: J.Lounila: 761121P Fysikaaliset mittaukset, laboratoriotöiden työohje. English material is given from laboratory.
Person responsible:
Kari Kaila

762327A: Physical Properties of Rocks, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish (It is possible to do the course in English, although all the lectures and exercises will be given in Finnish).
Timing:
3. year for students in geophysics.

Contents:
Physical properties of rocks and minerals including density, magnetic, elastic, electric, thermal and radiometric properties, their mutual dependence and behaviour as a function of temperature and pressure. In practical exercises the students will e.g. carry out rock property analysis for a given set of samples using the facilities at the department.
Learning activities and teaching methods:
Lectures 30 h, exercises 14 h, homework exercise. Examination (form to be selected during the course) and completion of the report on homework exercise.
Target group:
Compulsory for B.Sc. students in geophysics and recommended for those who work with the geological interpretation of geophysical models.
Recommended optional programme components:
It is recommended that the course ”Geophysical Research Methods of Rock and Soil” (762102P) has been attended. Basics of geology (mineralogy, petrology) are also essential.
Recommended or required reading:
Lecture notes. Handouts. Schön, J.H., 1998: Physical properties of rocks, volume 18: Fundamentals and principles of petrophysics (Handbook of geophysical exploration: Seismic exploration).
Person responsible:
Toivo Korja

761644S: Physical measurements, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
Not every year
Contents:
The purpose of the course is to introduce to some more advanced experimental measurements. Typical examples are physical principles of vacuum, vacuum techniques, pumps and measuring devises. More detailed content of the course depends on the specific interest of the lecturers.
Learning activities and teaching methods:
Lectures 30 h, exercises 30 h. One written examination.
Target group:
*
Recommended or required reading:
Lecture notes.
Person responsible:
Seppo Aksela

766338A: Physics for teachers, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761316A Being a teacher in mathematical subjects 5.0 op

ECTS Credits:
4 credits
Timing:

2. - 3. spring
Contents:
The aim of the course is to orient the teacher students by giving them preliminary skills before their educational studies. Physics books of high school beside the course books of university will be used for preparation of one or two lectures. These lectures with demonstrations or experiments will be presented during the course. Part of the course will also be the tutoring of students during their physics courses. All this lowers the step to move into the teachers training. The course can be expanded to 3 ov by some extra training.
Learning activities and teaching methods:
80% present, teaching training, report.
Target group:
Compulsory for teacher students who have physics as major.
Recommended optional programme components:
Major studies over 1.5 years, 25 credits in physics.
Recommended or required reading:
High school and university level physics books
Person responsible:
Kari Kaila

764117P: Physics, Biology and Safety Radiation, 3 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

764116P	Radiation physics, biology and safety	3.0 op

ECTS Credits:
3 credits

765303A: Planetology, 7 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

ECTS Credits:
5 credits
Contents:
Basic course on structure of terrestrial planets and their geological and geophysical investigation.
Inner planets. Moons, asteroids, comets and meteorites and bolides. Small bodies of the Solar system..
Comparative planetology. Available data sets.
Learning activities and teaching methods:
Lectures 32 h, exercises. One written examination.
Target group:
*
Recommended optional programme components:
*
Recommended or required reading:
R. Greeley: Planetary landscapes; E. A. King: Space geology; J. K. Beatty, A. Chaikin (eds.): The new solar system (4 th edition, selected sections).
Lodders & Fegley: The planetary scientist's companion, N. McBride ja I. Gilmour (eds., 2004): An Introduction to the Solar System, Cambridge University Press 2004 (first half). L.-A. McFadden, P. Weissman, T. Johnson (2006): Encyclopedia of the Solar System, 2nd Edition, Academic Press (partly).

Person responsible:
Jouko Raitala

765339A: Planetology II, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Contents:
The course Planetology II deals with the gaseous planets.
Outer planets and their moons. Atmosphere physics and chemistry. Atmospheres, magnetospheres and ionospheres of terrestrial and jovian planets. Voyager. Galileo and Casini missions. Interiors, atmospheres, magnetospheres and rings of outer planets. Pluto and other dwarf planets. Icy moons.
Learning activities and teaching methods:
Lectures 32 h, exercises, demonstrations, essay and written examination.
Target group:
*
Recommended optional programme components:
*
Recommended or required reading:
J. K. Beatty, A. Chaikin (eds.): The new solar system (selected sections; 4. edition), Lodders & Fegley: The planetary scientist's companion, Yung & DeMore: Photochemistry of planetary atmospheres.
Burgess: Far encounter: The Neptune system.
P. Dasch et al. (2004), Icy Worlds of the Solar System, Cambridge University Press.
F. Bagenal et al. (2004), Jupiter: The Planet, Satellites and Magnetosphere, Cambridge University Press (Cambridge Planetary Science Series).
N. McBride ja I. Gilmour (ed., 2004): An Introduction to the Solar System, Cambridge University Press 2004 (later half).
L.-A. McFadden, P. Weissman, T. Johnson (2006): Encyclopedia of the Solar System, 2nd Edition, Academic Press (partly).
New publications and the NASA Galileo and Cassini web pages.
Person responsible:
Jouko Raitala

761653S: Plasma physics, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Language of instruction:
If needed, this course can be lectured in English.
Timing:
Roughly every third year.
Contents:
Most normal matter in the universe is in plasma state, i.e., consists of charged particles interacting electromagnetically. Plasma physics studies what kind of phenomena appear in such a system. Plasma physics is the most important theory of space physics, which is applied to describe, e.g., ionospheric, magnetospheric, solar and heliospheric phenomena. This course gives a profound treatment of plasma theories and plasma

phenomena, such as plasma waves.
Contents briefly: Kinetic theory of plasma, magnetohydrodynamic theory, plasma boundaries and shocks, MHD waves, plasma waves, Landau damping, macroinstabilities, electromagnetic instabilities.
Learning activities and teaching methods:
Lectures 44 h, 10 exercises (20 h), final examination.
Target group:
This is an optional course for physics students at an advanced level on plasma physics. Recommended for students of space physics, astronomy and theoretical physics. Gives important background especially for all other space physics courses.
Recommended optional programme components:
Recommended course 761353A Basics of plasma physics, or equivalent knowledge.
Recommended or required reading:
Parts of books: Baumjohann-Treumann: Basic Space Plasma Physics, Imperial College Press, 1997; Treumann-Baumjohann: Advanced Space Plasma Physics, Imperial College Press, 1997; H. Koskinen, Johdatus plasmafysiikkaan ja sen avaruus¬sovellutuksiin. Limes, 2001; F.F. Chen: Plasma Physics and Controlled Fusion, 2nd ed., Vol. 1, Plasma Physics, Plenum Press; J. A. Bittencourt: Fundamentals of plasma physics, Pergamon Press, 1986.
Lecture notes: T. Asikainen, Plasmafysiikka; K. Mursula: Plasmafysiikka.
Person responsible:
Kalevi Mursula
Other information:
Course web page http://physics.oulu.fi/fysiikka/oj/761653S /

762652S: Practical training, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
Finnish
Timing:
During M.Sc. studies
Contents:
The student works at least eight weeks in a company or institute acting in the field of geophysics. The employer must be accepted in advance in the discussions with the responsible person of the course.
Learning activities and teaching methods:
Training, a written report and a seminar lecture. Written report and a short seminar lecture on the training.
Target group:
Compulsory for M.Sc. students in geophysics.
Person responsible:
Toivo Korja

764337A: Practical training, 3 - 9 op

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

761337A: Practical training, 3 - 6 op

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
3 - 6 credits
Contents:
Training in the field of physical sciences. A summer job, for example. One training month gives 1.5 cu. Practical training may be included to B.Sc. and/or to M.Sc. studies.
Target group:
Optional.

765334A: Practical work in astronomy, 4 - 8 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
4 - 8 credits
Contents:
2 – 4 supervised assignments (each gives 2 ETCS points) based on intermediate level courses. The student is orientated into research methods on the topic through a research assignment.
Learning activities and teaching methods:
Supervised and independent work.
Target group:
Compulsory.
Recommended optional programme components:
Assignments require to follow a specific intermediate level course.
Person responsible:
Juri Poutanen

763650S: Practice, 3 - 5 op

Opiskelumuoto: Advanced Studies

Laji: Practical training

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
3 credits
Timing:
2 nd - 4 th year
Contents:
Training that is not directly related to other study accomplishments. A summer job, for example.
Learning activities and teaching methods:
An essay of the work is written.
Person responsible:
Erkki Thuneberg

761684S: Pro gradu thesis, 20 op

Opiskelumuoto: Advanced Studies
Laji: Diploma thesis
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
20 credits
Language of instruction:
Finnish, English
Contents:
*
Learning activities and teaching methods:
A written M.Sc. thesis of approximately 50 pages.
Target group:
Compulsory for subject teacher line
Recommended optional programme components:
Advanced physics studies
Grading:
The thesis is assessed by the departmental board using the scale approbatur (worst) - laudatur (best).
Person responsible:
Professors and two supervisors named by the departmental board.
Other information:
*

764697S: Pro gradu thesis, 35 op

Opiskelumuoto: Advanced Studies
Laji: Diploma thesis
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: A,B,N,C,M,EX,L
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

763682S: Pro gradu thesis, 20 op

Opiskelumuoto: Advanced Studies
Laji: Diploma thesis
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
20 credits
Timing:
4. - 5. year
Contents:
For subject teacher line based mainly on literature search. Length approximately 50 pages.
Target group:
Subject teachers in theoretical physics.
Grading:
Written thesis accepted by the department board.
Person responsible:

Erkki Thuneberg

765624S: Pro gradu thesis, 35 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
35 credits
Contents:
Guided research in the field of astronomy, writing of the thesis, and seminar presentation.
Recommended or required reading:
A guide to scientific writing
Grading:
The thesis is accepted and the grade on scale from approbatur to laudatur is given by departmental council. The inspectors of the thesis are selected by the dean on the professor’s suggestion.
Person responsible:
Juri Poutanen

761683S: Pro gradu thesis, 35 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: A,B,N,C,M,EX,L

Opintokohteen kielet: Finnish

ECTS Credits:
35 credits
Language of instruction:
Finnish, English
Contents:
*
Learning activities and teaching methods:
A written M.Sc. thesis of approximately 50 pages.
Target group:
Compulsory for space physics and atom, molecule and material physics student.
Recommended optional programme components:
Advanced physics studies
Grading:
The thesis is assessed by the departmental board using the scale approbatur (worst) - laudatur (best).
Person responsible:
Professors and two supervisors named by the departmental board.

765621S: Pro gradu thesis, 20 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: A,B,N,C,M,EX,L

Opintokohteen kielet: Finnish

ECTS Credits:

20 credits
Contents:
Guided research in the field of astronomy, writing of the thesis, and seminar presentation.
Target group:
For subject teacher.
Recommended or required reading:
A guide to scientific writing
Grading:
The thesis is accepted and the grade on scale from approbatur to laudatur is given by departmental council. The inspectors of the thesis are selected by the dean on the professor’s suggestion.
Person responsible:
Juri Poutanen

763683S: Pro gradu thesis, 35 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
35 credits
Timing:
4. - 5. year
Contents:
Written study about some special topic within theoretical physics, based on own research work and literature search. Length more than 50 pages.
Target group:
Compulsory for theoretical physics students (for subject teacher line course 763682S).
Grading:
Written thesis accepted by the department board.
Person responsible:
Erkki Thuneberg

763641S: Programming, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
3. spring
Contents:
Basic course on C++-programming and multilanguage programming.
Learning activities and teaching methods:
Lectures 30 h, exercises 30 h, 4 computer tasks. One written examination.
Target group:
Compulsory for theoretical physics students.
Recommended optional programme components:
763114P ATK I.
Recommended or required reading:
Strourstrup: The C ++ Programming language.
Person responsible:

Pekka Pietiläinen

763625S: Quantum field theory, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
10 credits
Language of instruction:
English/Finnish
Timing:
3. - 5. year
Contents:
Quantum field theories are behind all theories of particle physics, and finally they are the foundation of all known physics. This course covers the foundations of the quantum field theories, propagators, interactions and perturbation theory, Feynman rules. Renormalization is discussed in interacting scalar field theory. The physics of fermion fields and gauge fields are also discussed; these are necessary in order to understand the interactions of the Standard Model of particle physics. This course is a foundation for further studies in field theory or particle physics.
Learning activities and teaching methods:
Lectures 50 h, exercises 30 h and one written examination.
Target group:
Theoretical physics students and graduate students (optional).
Recommended optional programme components:
Analytical mechanics (763310A) and Quantum mechanics II (763313A). Recommended are Classical field theory (763629S) and Introduction to particle physics (763621S).
Recommended or required reading:
Peskin, Schroder: An Introduction to Quantum Field Theory (1997), P. Ramond: Field Theory, A Modern Primer (1982), A. Zee: Quantum Field Theory in a Nutshell (2004), Lecture notes.
Person responsible:
Kari Rummukainen

763312A: Quantum mechanics I, 10 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763612S	Quantum mechanics I	10.0 op

ECTS Credits:
10 credits
Timing:
3. autumn
Contents:
Intermediate/advanced level course on quantum mechanics.
Applications of modern nanotechnology based on quantum mechanics are part of our every day life. CD-players, computers, telecommunication units are examples of such devises. Particles in this micro world are in quantum states classified with quantum numbers and corresponding wave functions. A quantum state is a solution of the Schrödinger equation. In this course we solve the Schrödinger equation in one-dimensional problems, which have

important applications in the semiconductor physics. Classification of eigenstates of the hydrogen atom is based on angular momentum. This in mind we solve the three-dimensional Schrödinger equation. Heisenberg's uncertainty principle and its implications are studied in detail and introduction to perturbation theory is presented.
Learning activities and teaching methods:
Lectures 50 h, 13 exercises. Two written intermediate examinations.
Target group:
For all interested in modern, quantum phenomena, compulsory for physicists and theoretical physicists.
Recommended optional programme components:
Atomic physics (766326A) and knowledge of differential equations.
Recommended or required reading:
M. Saarela: Kvanttimekaniikka I (lecture notes 2005), C. Cohen-Tannoudji, L. Diu & F. Laloe: Quantum Mechanics vol. I (1977), J. J. Powell & B. Crasemann: Quantum Mechanics (1961), L.I. Schiff: Quantum Mechanics (1968).
Person responsible:
Mikko Saarela

763612S: Quantum mechanics I, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763312A Quantum mechanics I 10.0 op

ECTS Credits:
10 credits
Timing:
3. autumn
Contents:
See 763312A Quantum mechanics I.
Target group:
Compulsory for physicists.
Person responsible:
Mikko Saarela

763313A: Quantum mechanics II, 10 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763613S Quantum mechanics II 10.0 op

ECTS Credits:
10 credits
Timing:
3. spring
Contents:
Intermediate/advanced course on quantum mechanics.
Heisenberg developed representation of quantum mechanics, which is based on matrices and the theory of Hilbert space. An important example of these ideas is the two-level system which is the key element of a quantum computer. For atomic, molecular and nuclear physics the essential quantity in classifying states is the angular momentum, which we study in detail including the particle spin. As an example we calculate relativistic corrections to hydrogen atom, Zeeman effect, bound states of H^- - and He-molecules and energy levels of AB-spin systems.

We derive the Fermi golden rule to calculate radiation induced transitions between eigenstates. Finally we study interactions between particles using scattering theory. Concepts like cross section, phase shift, scattering amplitude and Green's function are introduced.
Learning activities and teaching methods:
Lectures 50 h, 14 exercises. Two written intermediate examinations.
Target group:
For all interested in modern, quantum phenomena, compulsory for theoretical physicists.
Recommended optional programme components:
Quantum Mechanics I (763312A) and knowledge of differential equations.
Recommended or required reading:
M. Saarela: Kvanttimekaniikka II (lecture notes 2004), C. Cohen-Tannoudji, L. Diu & F. Laloe: Quantum Mechanics vol. I (1977), J. J. Powell & B. Crasemann: Quantum Mechanics (1961), L.I. Schiff: Quantum Mechanics (1968).
Person responsible:
Mikko Saarela

763693S: Quantum optics in electric circuits, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763634S	Quantum devices	5.0 op

ECTS Credits:
6 credits
Language of instruction:
Lectures in English if needed.
Timing:
Not every year.
Contents:
With present nanofabrication methods it is possible to make such small electric circuits that quantum effects become essential. The circuits behave like artificial atoms and the methods to deal with them resemble those used in quantum optics and NMR rather than traditionally used by electrical engineers. This course is an introduction to the physics of such circuits. One major topic is how to include dissipation into quantum mechanics. This will be answered by deriving a master equation, and applying it to a harmonic oscillator and to a two-level system. The realization of the two-level system requires a nonlinear element, for which superconducting Josephson junctions are used. Another theme is different types of noise (thermal, shot, quantum). These can be derived by applying scattering formalism which considers electrons in a conductor like waves in a transmission line. We try to answer, among other things, if noise is present at zero temperature, is current flow noisy, and can zero-point fluctuations be measured.
Learning activities and teaching methods:
Lectures 26 h, 11 exercise sessions.
Target group:
For all interested in time-dependent quantum phenomena.
Recommended optional programme components:
Recommended prerequisites Quantum mechanics I and II and analytical mechanics.
Recommended or required reading:
E. Thuneberg, Quantum optics in electric circuits. Exercises.
Person responsible:
Erkki Thuneberg

761117P: Radiation physics, 2 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764116P Radiation physics, biology and safety 3.0 op

ECTS Credits:
2 credits
Language of instruction:
Finnish
Timing:
Spring
Contents:
Basics of radiation physics.
Basic on nuclear physics and radioactivity, interaction of radiation and matter, radiation detectors, applications of radiation, regulations of the use of radiation in Finland, monitoring radiation safety of the Finnish industry and environment.
Learning activities and teaching methods:
Lectures 16 h and exercises 8 h, one written examination.
Target group:
*
Recommended optional programme components:
*
Recommended or required reading:
STUK (Radiation and Nuclear Safety Authority in Finland) regulatory guides.
Person responsible:
Seppo Alanko

764317A: Radiation physics, biology and safety, 3 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

765676S: Radiative Processes in Astrophysics, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
8 credits
Language of instruction:
English
Contents:
The course is devoted to the classical radiation theory (Maxwell equations, retarded potentials, multipole radiation, spectral distribution, Larmor formula, relativistic effects, bremsstrahlung, synchrotron radiation, and Compton scattering) and its astrophysical applications to the emission processes in pulsars, relativistic jets, accretion-powered compact sources such as black holes and neutron stars, and clusters of galaxies.
Learning activities and teaching methods:
Lectures 30 h, exercise sessions 8 h, home exercises (30% of the final score), exam (70%).
Recommended optional programme components:

Fits well together with Relativistic Astrophysics course.
Recommended or required reading:
Shu, F.H.: The Physics of Astrophysics. Vol 1, Radiation; Rybicki, G. & Lightman, A.: Radiative Processes in Astrophysics, and compendium.
Person responsible:
Juri Poutanen

765648S: Relativistic Astrophysics, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
8 credits
Language of instruction:
English
Contents:
Introduction to the relativistic astrophysics. Black holes in the Milky Way and supermassive black holes in other galaxies. Neutron stars, pulsars, supernovae. Physics of accretion. Relativistic jets. Clusters of galaxies.
Learning activities and teaching methods:
Lectures 32 h, exercise sessions 8 h, home exercises (30% of the final score), short essay and presentation (20%) and the exam (50%).
Recommended optional programme components:
Fits well together with Radiative Processes in Astrophysics.
Recommended or required reading:
Charles P.A., Seward F.D.: Exploring the X-ray Universe, Cambridge Univ. Press, 1995; Frank J., King A., Raine D.: Accretion power in Astrophysics, 3rd ed., Cambridge Univ. Press, 2002.
Person responsible:
Juri Poutanen

762315A: Remote sensing, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Contents:
History of remote sensing. Remote sensing observations, measuirements, data, physics, data manipulation methods and applications including the use of aerial and space-borne data sets in approaching various practical thematic mapping needs. Practical excercises include the use of a remote sensing software package in performing a actual mapping based on a satellite data set.
Learning activities and teaching methods:
Lectures 30 h, exercises 10 h, demonstrations, practical mapping, essay and written examination.
Recommended or required reading:
Lillesand and Kiefer: Remote sensing and image interpretation. Soveltuvia osia kirjoista: Ulaby, Moore and Fung: Microwave remote sensing: Active and passive, vol. I-III. R.M. Haralick and Simonett: Image processing for remote sensing. Ford ym. (toim.): Guide to Magellan image interpretation, Hanel et al. (2003), Exploration of the Solar System by Infrared Remote Sensing, Cambridge University Press.
Person responsible:
Jouko Raitala

765655S: Research project, 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Contents:
Astronomical research under guidance.
Learning activities and teaching methods:
A study report
Recommended or required reading:
Recently published books and review articles.
Person responsible:
Juri Poutanen

764651S: Research project in biophysics, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

766651S: Research project in physics, 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Contents:
A research project on the topic of one advanced course.
Learning activities and teaching methods:
A written report of the project.
Target group:
Compulsory.
Recommended optional programme components:
The corresponding lecture course.
Recommended or required reading:
Depends on the lecture course.
Person responsible:
The lecturer of the advanced course.

762321A: Seismology and the structure of the earth, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Timing:
3 rd-5 th year
Contents:
The relationship between tectonics and seismology. Seismic energy sources, signals and their parameters. Seismic waves, their propagation and registration. Location and magnitudes of earthquakes and fault plane solution. Major discontinuities, global models, lateral variation of seismic velocities. The structure of crust, mantle and core in the light of seismic research. Global tomography. Reflection and refraction seismology in the study of crust. Seismic soundings in Finland and Europe.
Learning activities and teaching methods:
Lectures 30 h, exercises 15 h, and a final examination.
Target group:
Optional for students of Geophysics. Recommend for everyone interested in understanding the principles of the most important method in studying the interior of earth.
Recommended or required reading:
Lecture notes. Selected parts: Bolt, B.A., 1999: Inside the Earth. Evidence from earthquakes; Bullen, K.E. & Bolt, B.A., 1985: An introduction to the theory of seismology; Kasahara, K., 1981: Earthquake mechanics; Meissner, R., 1986: The continental crust. A geophysical approach.
Person responsible:
Kari Moisio

765609S: Selenology, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Contents:
Lunar science.
The origin of the Moon, and its evolution to the present. Lunar samples and selenophysical measurements. Remote sensing of the Moon. A review on present research and missions.
Learning activities and teaching methods:
Lectures 30 h, exercises, demonstrations, an essay. One written examination.
Target group:
*
Recommended optional programme components:
*
Recommended or required reading:
Background: Taylor: Lunar science: A post-Apollo view and Open University: Lunar geology case study.
D. E. Wilhelms: The geologic history of the Moon; W. K. Hartmann, R. J. Phillips, C. J. Taylor: Origin of the Moon. Heiken, Vaniman & French: Lunar sourcebook: A user's guide to the Moon, Papike (ed.): Planetary materials (partly). B. Bussey & P. Spudis (2004), The Clementine Atlas of the Moon, Cambridge University Press. B. L. Jolliff, M. A. Wieczorek, C. K. Shearer and C. R. Neal (eds, 2006): New Views of the Moon. Mineralogical Society of America. The WWW pages for the recent Moon missions.
Person responsible:
Jouko Raitala

762636S: Shallow seismic soundings, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Moisio, Kari Juhani

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
4 th or 5 th year
Contents:
Physical principles of seismic refraction and reflection soundings and measurement in practice. Interpretation and correction of seismic soundings. Case histories. Independent work includes refraction seismic sounding in the field and interpretation of the data.
Learning activities and teaching methods:
Lectures 30 h, exercises 15 h, an independent exercise and a final examination.
Target group:
Optional for students of Geophysics. Recommend for everyone interested in shallow seismic soundings especially for groundwater investigations.
Recommended or required reading:
Lecture notes. Selected parts: Sjögren, B., 1984: Shallow refraction seismics; Palmer, D., 1986: Refraction seismics; Al-Sadi, H.N., 1982: Seismic exploration.
Person responsible:
Kari Moisio

764668S: Simulation of biosystems, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

766654S: Solar physics, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Language of instruction:
If needed, this course can be lectured in English.
Timing:
Roughly every third year.
Contents:
This is an optional physics course at an advanced level on the structure and dynamics of the Sun. The Sun is the most important source of energy for the Earth. The Sun also makes the most dominant contribution to global climate and the conditions of life on Earth. Therefore solar research is very important. Understanding of the basic features of the Sun already belongs to general education.

Contents briefly: Solar structure and history, solar models, energy production in the Sun, solar neutrinos, solar oscillations and helioseismology, convection layer and differential rotation, solar magnetism and dynamo mechanism, solar atmosphere, solar activity.
Learning activities and teaching methods:
Lectures 44 h, 10 exercises (20 h), final examination.
Target group:
Recommended especially for students of space physics, astronomy and theoretical physics. The course supports, e.g., the courses 766656S Heliospheric physics and 766655S Cosmic rays.
Recommended optional programme components:
Recommended courses: 766355A Basics of space physics and/or 761353A Basics of plasma physics, or equivalent knowledge.
Recommended or required reading:
M. Stix, The Sun. An Introduction, 2. edition, Springer, 2004. Lecture notes: K. Mursula: Solar Physics.
Person responsible:
Kalevi Mursula
Other information:
Course web page http://physics.oulu.fi/fysiikka/oj/766654S/

762192P: Solid Earth Geophysics, 3 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish (It is possible to do the course in English, although all the lectures and exercises will be given in Finnish).
Timing:
1. year, autumn
Contents:
An overview of solid Earth geophysics: Properties, structure and dynamics of the Earth. Geophysical methods used to explore the interior of the Earth. Earth as a planet: shape, size, rotation, revolution. Gravity: Earth’s gravity field, geoid, density, gravimetry, isostasy, tides. Deformation and rheology. Seismology: seismic waves and the internal structure of the Earth. Seismics: principles of refraction and reflection methods. Earth as a magnet: geomagnetic field, spatial and temporal variations, Earth-Sun interaction, space weather, palaeomagnetism. Thermal, electrical and radioactive properties of the Earth. Dynamic Earth: plate tectonics, internal dynamics.
Learning activities and teaching methods:
Lectures 30 h, exercises 14 h. Examination.
Target group:
Recommended for all interested in the properties, structure and dynamics of the Earth. Compulsory for B.Sc. students in geophysics.
Recommended or required reading:
Handouts and lecture notes (Hjelt, S.-E., Structure of Earth). Kakkuri, J., Planeetta maa. Chapters 3, 4, 10 & 11, part of the book: Lowrie, W: 1997: Fundamentals of geophysics.
Person responsible:
Toivo Korja

763333A: Solid state physics, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763343A Solid state physics 5.0 op
766330A-01 Structure of matter, part 1: Solid state physics 0.0 op
766330A-02 Structure of matter, part 2: Nuclear and particle physics 0.0 op
766330A Structure of matter 6.0 op

ECTS Credits:
4 credits
Timing:
2. spring
Contents:
Introduction to solid state physics. The three courses, Atomic physics, Structure of matter I and II, form an introduction to topics, where quantum physics plays an essential role. Compulsory for all physics students.
The course starts with symmetry of crystal lattices and their experimental determination. Different binding forces of solids are discussed. Lattice vibrations and their contribution to specific heat are studied. Especial emphasis is put on electronic structure, and it is used to explain the electric conduction in metals, insulators and semiconductors. Also experimental methods, magnetism and superconductivity are discussed.
Learning activities and teaching methods:
Lectures 30 h, exercises 16 h. One written examination.
Target group:
Compulsory.
Recommended optional programme components:
766326A, 766321A, 766322A, (766322A).
Recommended or required reading:
M. Alonso and E. Finn: Fundamental University Physics II ja III, H.M. Rosenberg, The Solid State.
Person responsible:
Erkki Thuneberg

764606S: Special advanced course, 5 - 9 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

765394A: Special course, 7 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
0 credits
Contents:
With changing topic.
Person responsible:
Juri Poutanen

765694S: Special course, 7 op

Opiskelumuoto: Advanced Studies
Laji: Course

Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

ECTS Credits:
4 - 10 credits
Contents:
With changing topic.
Person responsible:
Juri Poutanen

765692S: Special course given by a visiting lecturer, 4 - 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English, Finnish
Voidaan suorittaa useasti: Kyllä

ECTS Credits:
4 - 6 credits
Contents:
With changing topic.
Learning activities and teaching methods:
One written examination.
Person responsible:
Juri Poutanen

765385A: Special course given by a visiting lecturer, 4 - 6 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
4 - 6 credits
Contents:
With changing topic
Learning activities and teaching methods:
One written examination.
Person responsible:
Juri Poutanen

762662S: Special courses in geophysics, 0 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
0 credits
Language of instruction:
Usually in English.
Contents:
Credit points according to the course. Lectures given by visiting scientists. Contents and assessment will be negotiated with the professor in advance. These courses are usually held in English and they will cover topical issues of current geophysical research.
Learning activities and teaching methods:
According to the course.
Target group:
Optional for students of geophysics.
Recommended or required reading:
According to the course.
Person responsible:
According to the course.

764359A: Spectroscopic methods, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Timing:
Not every year
Contents:
Intermediate course on different spectroscopic methods.
Basics of infrared, mass and NMR spectroscopy and röntgen analytics.
Learning activities and teaching methods:
Lectures 46 h, exercises 24 h. Two written examinations or one final examination.
Target group:
Compulsory for students in biophysics.
Recommended or required reading:
Material is delivered during the course.
Person responsible:
Jukka Jokisaari

765666S: Statistical methods in astronomy, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Contents:
See Statistical methods in astronomy (765366A).
Person responsible:
Heikki Salo

765366A: Statistical methods in astronomy, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Contents:
Use of statistical inference in astronomy. Probability distributions, hypothesis testing, correlation analysis, data modeling.
Learning activities and teaching methods:
Lectures 22 h, exercises, computer demonstrations 18 h. Exam.
Target group:
*
Recommended or required reading:
B. L. Van der Waerden: Die Anfänge der Astronomie or Science Awakening, Leyden Noordhoff Intl. Publishing, 1975; O. Pederson: Early physics and astronomy; G. Abetti: The history of astronomy, Abelard-Schuman, 1952.
Person responsible:
Heikki Salo

763620S: Statistical physics, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
10 credits
Language of instruction:
English/Finnish
Timing:
3 rd or 4 th autumn
Contents:
Statistical physics studies how the microscopic properties of particles are connected to the macroscopic properties of matter. The course begins with an overview of the classical thermodynamics, and continues with quantum mechanical concepts of statistical physics: the density operator, partition function etc. The statistical properties of non-interacting fermions and bosons form a central part of the course, after which some methods for studying interacting systems are introduced. The course finishes with a description of the phase transitions and critical phenomena.
Learning activities and teaching methods:
Lectures 50 h, exercises 30 h and one written examination.
Target group:
Theoretical physics students and students interested in the microscopical foundations of the properties of matter.
Recommended optional programme components:
Quantum mechanics II (763313A) and Thermodynamics (766328A), also recommended is Advanced quantum mechanics (763622S). The course is a foundation for all advanced courses of material physics, quantum field theory and many body systems.
Recommended or required reading:
J. Arponen: Statistinen fysiikka (in Finnish)
L.E. Reichl: A Modern Course in Statistical Physics
Lecture notes.
Person responsible:
Kari Rummukainen

765673S: Stellar atmospheres, 7 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

ECTS Credits:
7 credits
Contents:
See Theoretical Astrophysics (765373A)
Person responsible:
Juri Poutanen

765608S: Stellar dynamics, 7 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
7 credits
Contents:
Introduction to stellar dynamics.
Galactic dynamics and spiral structure, globular clusters.
Learning activities and teaching methods:
Lectures 32 h, exercises, demonstrations 20 h. One written examination.
Recommended optional programme components:
*
Recommended or required reading:
J. Binney, S. Tremaine: Galactic dynamics, Princeton University Press, 1987.
Person responsible:
Heikki Salo

765343A: Stellar structure and evolution, 7 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

ECTS Credits:
8 credits
Language of instruction:
English
Contents:
Star formation, structure and evolution. Interstellar medium. The course can be also taken as advanced in somewhat expanded form.
Learning activities and teaching methods:
Lectures 32 h, exercises.
Recommended or required reading:
E. Böhm-Vitense: Stellar astrophysics, vol. 3; Kippenhahn, R., Weigert, A.: Stellar structure and evolution.

Person responsible:
Juri Poutanen

765643S: Stellar structure and evolution, 7 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

ECTS Credits:
8 credits
Contents:
See 765343A.
Person responsible:
Juri Poutanen

765661S: Structure and kinematics of galaxies, 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Contents:
Locations, movements and distances of stars, the structure and kinematics of star cluster, interstellar matter, dynamics of the Milky Way.
Learning activities and teaching methods:
Lectures 32 h, exercises. One written examination.
Recommended optional programme components:
*
Recommended or required reading:
J. Binney, M. Merrifield: Galactic Astronomy, Princeton University Press, 1998.
Person responsible:
Heikki Salo

766334A: Structure of matter II, 2 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physical Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

766344A Nuclear and particle physics 5.0 op
766330A-02 Structure of matter, part 2: Nuclear and particle physics 0.0 op
766330A-01 Structure of matter, part 1: Solid state physics 0.0 op
766330A Structure of matter 6.0 op

ECTS Credits:

2 credits
Timing:
Second spring term
Contents:
This course is an introduction to nuclear and particle physics. It deals with the structure and properties of nuclei, nuclear forces, nuclear models, radioactivity, nuclear reactions, properties and interactions of fundamental particles, and unified theories of fundamental interactions.
Learning activities and teaching methods:
Lectures 20 h, exercises 10 h, one written examination.
Target group:
*
Recommended optional programme components:
766326A Atomic physics.
Recommended or required reading:
Textbooks: H. D. Young and R. A. Freedman: University Physics, 12th edition, Pearson Addison Wesley, 2008 (in part), R. Eisberg ja R. Resnick: Quantum physics of atoms, molecules, solids, nuclei, and particles, John Wiley & Sons (in part).
Person responsible:
Juhani Lounila

761013Y: Student tutoring, 2 op

Opiskelumuoto: General Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
2 credits
Language of instruction:
Finnish
Timing:
2 nd – 5 th autumn
Contents:
The advanced student quides a group of new students during the orientation course 761011Y.
Learning activities and teaching methods:
Tutoring 10 – 15 h.
Target group:
Optional.
Person responsible:
Anja Pulkkinen

763645S: Superconductivity, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
3. or 4. autumn
Contents:
Introduction to superconductivity. Superconductivity is a phenomenon where quantum mechanics becomes visible on a macroscopic scale. The BCS theory of superconductivity is known as one of the most successful theories of

condensed matter.
The course begins with experimental observations and a reminder about statistical physics. The thermodynamics of superconductivity is studied under magnetic field. The main content of the course is the Bardeen-Cooper-Schrieffer (BCS) theory, which explains the occurrence of superconductivity, and the Ginzburg-Landau theory, which can explain many of the observed phenomena. The course finishes with a short discussion of superconductivity of the second kind and Josephson effects.
Learning activities and teaching methods:
Lectures 26 h, exercises 24 h. One written examination.
Target group:
Course designed especially for theoretical physicists.
Recommended optional programme components:
Quantum mechanics I and II.
Recommended or required reading:
M. Tinkham, Introduction to Superconductivity, McGraw-Hill (1975, 1996); E. Thuneberg: Suprajohtavuus (lecture notes).
Person responsible:
Erkki Thuneberg

765373A: Theoretical astrophysics, 7 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
7 credits
Language of instruction:
English
Contents:
Stellar types, spectra, temperatures. Radiative transfer. Continuous and line spectra. Spectral analysis. Theory of line formation. The course can also be incorporated into advanced studies with some supplementary work.
Learning activities and teaching methods:
Lectures 32 h and exercises. One written examination.
Recommended or required reading:
E. Böhm-Vitense: Stellar astrophysics, vol. 2, Cambridge Univ. Press, 1989.
Person responsible:
Juri Poutanen

762611S: Theory of electromagnetic methods, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish or English
Timing:
4. – 5. year
Contents:
The course provides information on the theory and applications of the electromagnetic methods used in geophysics. The course studies electromagnetic induction, attenuation and reflection, time and frequency domain measurements, electric and magnetic dipole source in free-space, conductive wholespace, above layered earth,

and near two- and three-dimensional targets. Also various electromagnetic systems for near-surface investigations and the effect of conductive host medium and overburden layer and data interpretation are studied.
Learning activities and teaching methods:
Lectures 20 h, demonstrations 20 h and practical work. Exam and approved report.
Recommended or required reading:
Lecture notes. Ward, S.H. & Hohmann, G.W., 1988: Electromagnetic theory for geophysical applications; Frischknecht, F.C., Labson, V.F., Spies, B.R. & Anderson, W.L., 1991: Profiling methods using small sources; Spies, B.R. & Frischknecht, F.C., 1991: Electromagnetic sounding, In: Nabighian, M.N. (ed.), 1988 & 1991: Electromagnetic methods in applied geophysics. Volumes 1 and 2.
Person responsible:
Markku Pirttijärvi
Other information:
Course homepage: http://www.gf.oulu.fi/~mpi/opetus/762611S_SM_mittausten_teoria.html

762628S: Thermal processes of the earth, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Moisio, Kari Juhani

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Timing:
4 th or 5 th year
Contents:
Means of heat transport. Rheology. Sources of heat. Thermal history of the Earth. Heat flow, measuring and error sources. Thermal processes on continents, oceans and lithosphere. Thermal phenomena in the mantle.
Learning activities and teaching methods:
Lectures 24 h, exercises 15 h, an independent exercise and a final examination.
Target group:
Optional for students of Geophysics. Recommend for everyone interested in thermal phenomena in the earth.
Recommended or required reading:
Lecture notes. Selected parts: Turcotte, D. L. & Schubert, G., 2002 (2 nd Ed.): Geodynamics; Turcotte, D. L. &. Olson, P., 2001. Mantle Convection in the Earth and Planets; Lowrie, W., 1997: Fundamentals of Geophysics.
Person responsible:
Kari Moisio

766328A: Thermophysics, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761314A	Thermophysics	5.0 op
766348A	Thermophysics	7.0 op
761102P	Basic Thermodynamics	2.0 op

ECTS Credits:
6 credits
Timing:
Third autumn term
Contents:

This course is intended to give students a physically clear understanding of the basic principles of thermophysics, emphasizing the methods of statistical physics. The goal is to explain how the macroscopic properties of a system (e.g., equation of state) can be derived from its fundamental microscopic properties (e.g., from the behavior of the molecules). Topics will include: Basic concepts, The first law of thermodynamics, Thermal expansion and heat transfer, The second law, The combined law, Heat engines and refrigerators, Thermodynamic potentials, Phases of matter, Classical ideal gas, Classical and open systems, Quantal ideal gas.
Learning activities and teaching methods:
Lectures 46 h, exercises 24 h, 2 written intermediate examinations or one final examination.
Recommended optional programme components:
*
Recommended or required reading:
Textbooks: H. D. Young and R. A. Freedman: University Physics, 12 th edition, Pearson Addison Wesley, 2008 (in part), F. Mandl: Statistical Physics, second edition, John Wiley & Sons Ltd., 1988 (in part).
Lecture notes: Juhani Lounila: 766328A Termofysiikka, Oulun yliopisto, 2007.
Person responsible:
Juhani Lounila

762627S: Time-domain electromagnetic research methods, 3 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
3 credits
Language of instruction:
Finnish or English
Timing:
4. - 5. year
Contents:
The course gives detailed information on time-domain electromangetic methods (TEM). Unlike in frequency-domain methods where time-harmonic current are used, an electromagnetic pulse is generated by an abrupt change of direct current in a wire loop in TEM. The course considers the physical background, various measurement systems, response for various earth models, processing and interpretation methods for TEM methods. Practical field demonstration is included.
Learning activities and teaching methods:
Lectures 25 h, demonstrations. Exam.
Recommended or required reading:
Lecture notes; Selected articles from geophysical journals and Nabighian M.N. & Macnae J.C., 1991: Time domain electromagnetic prospecting methods, In: Nabighian M.N. (ed.), Electromagnetic methods in applied geophysics, Volume II.
Person responsible:
Markku Pirttijärvi
Other information:
Course homepage: http://www.gf.oulu.fi/~mpi/opetus/762627S_Aika-alueen_SM.html

762086Y: Tutoring, 2 op

Voimassaolo: - 31.07.2009

Opiskelumuoto: General Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

2 credits
Language of instruction:
Finnish
Timing:
Small group meetings during the autumn semester, training of tutors on previous spring semester.
Contents:
A student having geophysics as a major subject may act as a tutor for the 1 st year students in the course 762085Y.
Learning activities and teaching methods:
10-15 h working in small groups tutored by an older student.
Target group:
Students having geophysics as a major subject from 2 nd to 5 th year.
Person responsible:
Anja Pulkkinen (physical sciences) and Toivo Korja (geophysics)

762617S: VLF-method, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
4 th or 5 th year
Contents:
Deep orientation on VLF method, which is one of the most popular electromagnetic methods used to investigate the near-surface earth. Source field: transmitter stations and aerials, distant transmitters, local transmitters, propagation, polarization, attenuation. Tilt-angle measurements (VLF): tilt-angle, ellipticity, measuring principle. Resistivity measurements (VLF-R): apparent resistivity, phase, measuring principle. Basic anomalies: homogeneous earth, two-layered earth, plate conductor, prismatic body. Special anomalies. Interpretation: general remarks, qualitative interpretation, visual interpretation, filtering, quantitative interpretation, nomograms, numerical modelling, inversion, effects of different model parameters. Examples of VLF-measurements.
Learning activities and teaching methods:
Lectures 35 h, demonstrations and exercises 10 h, an independent work (field measurement and its interpretation) and a final examination.
Target group:
Optional for students of geophysics.
Recommended or required reading:
Lecture material. Selected papers. Parts of the following: Nabighian, M. N. (ed.), 1991: Electromagnetic methods in applied geophysics, Volume 2, Part B, s. 521-640.
Person responsible:
Pertti Kaikkonen

765683S: Venus: geology and geophysics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits

Contents:
Course treats the results of Venus research and latest problems encountered. The course is based on the analysis of data from Magellan radar mapping mission. New Venus Express data is included.
Telescopes, spectrographs, detectors, reduction of data, classification and interpretation of spectra, abundances of elements, turbulence in stars, stellar rotation and magnetic field, peculiar stars.
Learning activities and teaching methods:
Lectures 32 h, exercises. One written examination.
Target group:
*
Recommended optional programme components:
*
Recommended or required reading:
Reading before: R. Greeley: Planetary landscapes, 2 nd edition; P. Cattermole: Venus, A geological story; J. P. Ford et al. (eds.): Guide to Magellan image interpretation, Roth & Wall (toim,): The face of Venus. For insight: Bougher, Hunten & Phillips (toim.): Venus II, new publications and the Venus Express WWW pages.
Person responsible:
Jouko Raitala

764327A: Virtual measurement environments, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764627S	Virtual measurement environments	5.0 op

Ei opintojaksokuvauksia.

761104P: Wave Motion, 3 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761310A	Wave motion and optics	5.0 op
761310A-01	Wave motion and optics, lectures and exam	0.0 op
761310A-02	Wave motion and optics, lab. exercises	0.0 op
761114P-01	Wave motion and optics, lectures and exam	0.0 op
761114P-02	Wave motion and optics, lab. exercises	0.0 op
761114P	Wave motion and optics	5.0 op

ECTS Credits:
3 credits
Language of instruction:
Lectures and exercises in Finnish. Material in English.
Timing:
Spring
Contents:
Basic course on wave motion, and geometric and wave optics.
Wave motion and propagation. Acoustics. Geometric optics: basic principles, mirrors and lenses. Electromagnetic waves. Wave optics: interference, diffraction, and polarization. Optical instruments. Photometry. Laser.
Learning activities and teaching methods:

Lectures 32 h, exercises 10 h, four mini examinations and one end examination or a final examination.
Target group:
For students of minor subject.
Recommended optional programme components:
Upper secondary school physics and mathematics.
Recommended or required reading:
Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 12 th edition, 2008, chapters 15, 16, 32 - 36 and 38. Also 11 th and 10 th editions can be used.
Person responsible:
Sami Heinäsmäki
Other information:
See http://physics.oulu.fi/opetus/

766329A: Wave motion and optics, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761310A	Wave motion and optics	5.0 op
761310A-01	Wave motion and optics, lectures and exam	0.0 op
761310A-02	Wave motion and optics, lab. exercises	0.0 op
766349A	Wave motion and optics	7.0 op

ECTS Credits:
6 credits
Timing:
Spring
Contents:
A course on mechanical waves and geometric and physical optics. Compulsory for physics, theoretical physics and biophysics students.
Principles of wave motion, wave equation. Mechanical waves, sound and hearing. Electromagnetic waves, Geometrical optics. Matrix method in paraxial optics. Optical instruments. Physical optics. Interference. Interferometry. Polarization. Fraunhofer diffraction. Diffraction grating. Laser basics.
Learning activities and teaching methods:
Lectures 46 h, exercises 24 h, two written intermediate examinations or one final examination.
Target group:
*
Recommended optional programme components:
*
Recommended or required reading:
Pedrotti, F.L., Pedrotti, L. S.: Introduction to optics, Englewood Cliffs, Prentice-Hall and others.
Person responsible:
Seppo Alanko

761672S: X-ray physics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits

Timing:
Not every year
Contents:
The course is an introduction to X-ray physics and X-ray diffraction. X-ray spectroscopy and its applications e.g. in the chemical analysis is also discussed. A further applications is electro micro probe and micro analysis. The course is very experimentally oriented and does not presuppose knowledge of quantum mechanics.
Learning activities and teaching methods:
Lectures 35 h, exercises 20 h. One written examination.
Target group:
*
Recommended optional programme components:
*
Recommended or required reading:
Lecture notes
Person responsible:
Seppo Aksela