Opasraportti

LuTK - Physics 2009 - 2010 (2009 - 2010)

THE STUDY UNITS OF PHYSICS:

Courses in Physics

General Courses

761011Y Orientation course for new students 2 cu
761013Y Tutoring 2 cu
030005P Introduction to information retrieval 1 cu

General Courses in Physics

761112P Development of the physical world view 3 cu
766115P Introduction to the physical sciences 1 cu
763102P Introduction to relativity 3 cu
761117P Radiation physics 2 cu

Basic Courses in Physics

761105P Atomic and nuclear physics 3 cu
766107P Laboratory exercises in physical sciences 6 cu
763101P Mathematics for physics 6 cu
761121P Physical measurements I 3 cu
761102P Basic thermodynamics 2 cu
761101P Basic mechanics 4 cu
761103P Electricity and magnetism 4 cu
761104P Wave motion 3 cu

Intermediate Courses in Physics

766329A Wave motion and optics 6 cu
763333A Structure of matter I 4 cu
766334A Structure of matter II 2 cu
766326A Atomic physics 6 cu
766355A Basics of space physics 5 cu
761322A Basics of electronics 5 cu
761308A Laboratory exercises in physics 4 cu
766309A Demonstrations in Physics and Chemistry 2 cu
766338A Physics for teachers 4 cu

763311A Mathematical methods 6 cu
761386A Maturity test 0 cu
766323A Mechanics 7 cu
761353A Basics of plasma physics 5 cu
761385A Seminar and B.Sc. thesis 10 cu
766320A Applied electromagnetism 6 cu
764359A Spectroscopic methods 5 cu
766321A Electromagnetism I 4 cu
766322A Electromagnetism II 4 cu
766328A Thermophysics 6 cu
761337A Practical training 3-6 cu

Advanced Courses in Physics:

Compulsory Courses

766651S Research project in physics 6 cu
763612S Quantum mechanics I 10 cu
761686S Maturity test 0 cu
761683S Pro gradu thesis 35 cu
761684S Pro gradu thesis 20 cu

Optional Courses:

General

761644S Physical measurements II 6 cu
761668S Computational physics 6 cu
761632S Electromagnetic radiation 6 cu
761645S Introduction to experimental physical research 6 cu

Space Physics

766654S Solar physics 8 cu
761648S Fundamentals of incoherent scatter radar 8 cu
766656S Heliospheric physics 8 cu
763654S Hydrodynamics 6 cu
761658S Ionospheric physics 8 cu
766655S Cosmic Rays 8 cu
761657S Magnetospheric physics 8 cu
761653S Plasma physics 8 cu
761649S Auroral physics 6 cu

Atom, Molecule and Material Physics ***Infrared spectroscopy and Optics***
NMR spectroscopy

761666S Fourier transform with applications 6 cu
761662S Infrared spectroscopy 8 cu
761670S NMR spectroscopy of solid state 6 cu
761664S Laser physics 6 cu
761661S Molecular physics 6 cu
766661S NMR Imaging 6 cu
761663S NMR spectroscopy 8 cu
761669S Applications of NMR spectroscopy 6 cu
761665S Optics 8 cu

Atom, Molecule and Material Physics ***Electron spectroscopy***

761671S Extension course in atomic physics 8 cu
761650S Applications of atom physics 6 cu
761673S Electron and ion spectroscopy 8 cu
766648S Extension course in electron spectroscopy 8 cu
766646S Applications of Quantum Mechanics in Spectroscopy 6 cu

766647S Quantum Information 6 cu
761672S X-ray physics 6 cu
761675S Physics of lasers and synchrotron radiation 6 cu

Courses in Theoretical Phys-ics

Basic Courses in Theoretical Physics

763114P Introduction to C-programming 4 cu
763101P Mathematics for physics 6 cu

763102P Introduction to relativity 3 cu

Intermediate Courses in Theoretical Physics

763333A Structure of matter I 4 cu
763310A Analytical mechanics 6 cu
763315A Numerical modelling 4 cu
763312A Quantum mechanics I 10 cu
763313A Quantum mechanics II 10 cu
763385A Maturity test 0 cu
763330A B.Sc. thesis 10 cu

Advanced Courses in Theoretical Physics

763641S Hardware oriented programming 6 cu
763616S Numerical programming 6 cu
763621S Introduction to particle physics 10 cu
763654S Hydrodynamics 6 cu
763625S Quantum field theory 10 cu
763629S Classical field theory 6 cu
763628S Condensed matter physics 10 cu
763622S Advanced course in quantum mechanics 10 cu
763612S Quantum mechanics I 10 cu
763693S Quantum optics in electric circuits 6 cu
763685S Maturity test 0 cu
763694S Methods in material physics 6 cu
763624S Monte Carlo and simulation methods 6 cu
763682S Pro gradu thesis 20 cu
763683S Pro gradu thesis 35 cu
763620S Statistical physics 10 cu
763645S Superconductivity 6 cu
763698S Advanced course 6 cu
763699S Advanced course 10 cu
763626S Electro-weak interactions 10 cu
763696S Electronic transport in mesoscopic systems 6 cu
763650S Practice 3 cu
763695S General relativity 6 cu

Courses in Astronomy

Basic Courses in Astronomy

765135P Data processing in astronomy 4 cu
766107P Laboratory exercises in physical sciences 6 cu
765101P Introduction to astronomy I 4 cu
765102P Introduction to astronomy II 8 cu
765106P History of astronomy 3 cu

Intermediate Courses in Astronomy

765334A Practical work in astronomy 4-8 cu
765330A Galaxies and cosmology 5 cu
765357A Maturity test 0 cu
765356A B.Sc. thesis 10 cu
765303A Planetology I 5 cu
765339A Planetology II 5 cu
765304A Celestial mechanics 5 cu
765373A Theoretical astrophysics 7 cu
765366A Statistical methods in astronomy 5 cu
765343A Stellar structure and evolution 8 cu
765336A Astronomical observing techniques 5 cu
765394A Special course 0 cu
765385A Special course given by a visiting lecturer 4-6 cu

Advanced Courses in Astronomy

765638S Areology 6 cu
765671S Gasdynamics and interstellar medium 8 cu
765657S Maturity test 0 cu
765661S Structure and kinematics of Milky Way 6 cu
765677S Meteorites 4 cu
765645S Mapping the planets 4 cu
765624S Pro gradu thesis 35 cu
765621S Pro gradu thesis 20 cu
765676S Radiative Processes in Astrophysics 8 cu
765648S Relativistic Astrophysics 8 cu
765609S Selenology 6 cu
765637S Basaltic volcanism on terrestrial planets 6 cu
765673S Theoretical astrophysics 7 cu
765617S Computer simulations 5 cu
765666S Statistical methods in astronomy 5 cu
765655S Special practical work 6 cu
765643S Stellar structure and evolution 8 cu
765608S Stellar systems 7 cu
765660S Impact craters 4 cu
765683S Venus: geology and geophysics 6 cu
765694S Special course 4-10 cu
765693S Courses completed in other institution 0 cu
765692S Special course given by a visiting lecturer 4-6 cu

Courses in Biophysics

Basic Courses in Biophysics

764162P Introduction to biophysics 5 cu
764115P Basic cellular biophysics 2 cu
764117P Physics, biology and safety radiation 3 cu

Intermediate Courses in Biophysics

764325A Biophysical laboratory exercises 5 cu
764364A Biosystems analysis 4 cu
764395A Maturity test 0 cu
764306A B.Sc. thesis and seminar 10 cu
764369A Mecidal equipment technics 3 cu

764338A Basic neuroscience 5 cu
764323A Cell membrane biophysics 6 cu
764359A Spectroscopic methods 5 cu
764317A Radiation physics, biology and safety 3 cu
764337A Practical training 3-9 cu
764327A Virtual measurement environments 5 cu

Advanced Courses in Biophysics

764660S Bioelectronics 4 cu
764626S Advanced laboratory exercises in biophysics 5 cu
764651S Research project in biophysics 10 cu
764631S Bioprocess dynamics 4 cu
764668S Biosystems simulation 4 cu
764620S Hemodynamics 4 cu
764680S Neutral information processing 5 cu
764640S Intracellular registrations 3 cu
764695S Maturity test 0 cu

764628S Identification of linear and nonlinear systems 8 cu
764633S Mecidal physics 4 cu
764619S Molecular biophysics 4 cu

764638S Basic neuroscience 5 cu
764641S Patch-clamp techniques 3 cu
764697S Pro gradu thesis 35 cu
764606S Special advanced course 3-9 cu

Courses in Geophysics

General Courses

762085Y Orientation course for new students 2 cu
762086Y Tutoring 2 cu

Basic Courses in Geophysics

766107P Laboratory exercises in physical sciences 6 cu
762196P GIS in geosciences 5 cu
762193P Introduction to hydrology 4 cu
762135P Introduction to global environmental geophysics 5 cu
762192P Introduction to Solid Earth Geophysics 5 cu
762102P Geophysical research methods of rock and soil 8 cu
762187P Introduction to information retrieval and scientific writing in geophysics 2 cu

Intermediate Courses in Geophysics

762332A Airborne geophysics 3 cu
762303A Geophysical field theory 8 cu
762322A Geomagnetism 5 cu
762315A Remote sensing 5 cu
762379A Maturity test 0 cu
762304A Geophysical data processing 6 cu
762361A An intermediate level course from another Finnish university 0 cu
762363A An intermediate level course from another university abroad 0 cu
762382A B.Sc. work (thesis and seminar) 10 cu
762327A Physical Properties of Rocks 5 cu
762321A Seismology and the structure of the earth 5 cu

Advanced Courses in Geophysics

762627S Time-domain electromagnetic research methods 3 cu
762629S Geophysical properties of the crust and upper mantle in Fennos-candia 4 cu
762662S Special courses in geophysics 0 cu
762660S Ice & Snow Physics & Chemistry & Glaciology 3 cu
762679S Maturity test 0 cu
762624S Electrical research methods of rock and soil 5 cu
762628S Thermal processes of the earth 5 cu
762616S Ground penetrating radar sounding 5 cu
762625S Magnetotellurics 5 cu
762636S Shallow seismic soundings 6 cu
762661S An advanced level course from another Finnish university 0 cu
762663S An advanced level course from another university abroad 0 cu
762681S M.Sc. work (thesis and seminar) 35 cu
762684S Excursion 2 cu
762612S Gravimetric and magnetic methods 5 cu
762644S Field course in applied geophysics 6 cu
762630S Modelling of electromagnetic fields 5 cu
762611S Theory of electromagnetic methods 5 cu
762605S Interpretation theory 6 cu
762652S Practical training 6 cu
762617S VLF-method 5 cu

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
764364A: Analysis of biosystems, 6 op
763310A: Analytical mechanics, 6 op
761669S: Applications of NMR spectroscopy, 6 op
766650S: Applications of SR physics, 5 op
761650S: Applications of atom physics, 6 op
766643S: Applications of atom physics, 4 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
763655S: Astroparticle physics, 6 op
761105P: Atomic and Nuclear Physics, 3 op
766326A: Atomic physics 1, 6 op
761671S: Atomic physics 2, 8 op
761649S: Auroral physics, 6 op
765356A: B.Sc. thesis and seminar, 10 op
763330A: B.Sc. thesis and seminar, 10 op
762382A: B.Sc. thesis and seminar, 10 op
761385A: B.Sc. thesis and seminar, 10 op
764306A: B.Sc. thesis and seminar, 10 op
765637S: Basaltic volcanism on terrestrial planets, 6 op
761101P: Basic Mechanics, 4 op
764638S: Basic Neuroscience, 5 op
764338A: Basic Neuroscience, 5 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
765304A: Celestial mechanics, 5 - 8 op
764623S: Cell membrane biophysics, 7 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
762620S: Computers in geophysics, 3 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
766632S: Electromagnetic waves, 6 op
766319A: Electromagnetism, 7 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
764632S: Electrophysiological methods, 6 op
762684S: Excursion, 2 op
766648S: Extension course in electron spectroscopy, 8 op
762644S: Field course in applied geophysics, 6 op
762645S: Field course in bedrock mapping and applied geophysics, 3 op
762646S: Field course in environmental geology and applied geophysics, 3 op
764115P: Foundations of cellular biophysics, 4 op
761666S: Fourier transform with applications, 6 op
765104P: Fundamentals of astronomy, 8 op
761648S: Fundamentals of incoherent scatter radar, 8 op
762106P: GIS and spatial data 1, 3 op
762606S: GIS and spatial data 2, 3 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
762603S: Geophysical field theory, 8 op
762153P: Geophysical laboratory experiments, 2 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
764629S: Identification of linear systems, 5 op
764630S: Identification of nonlinear systems, 6 op
765660S: Impact craters, 4 op
761662S: Infrared spectroscopy, 8 op
762605S: Interpretation theory, 6 op
764640S: Intracellular recordings, 3 op
765103P: Introduction to astronomy, 2 op
765101P: Introduction to astronomy I, 4 op
765102P: Introduction to astronomy II, 8 op
764103P: Introduction to biophysics, 2 op
764162P: Introduction to biophysics, 3 op
761645S: Introduction to experimental physical research, 6 op
762103P: Introduction to geophysics, 2 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
763105P: Introduction to relativity 1, 2 op
763306A: Introduction to relativity 2, 2 op
766115P: Introduction to the physical sciences, 1 op
761658S: Ionospheric physics, 8 op
761121P: Laboratory Exercises in Physics 1, 3 op
766107P: Laboratory exercises in physical sciences, 6 op

761308A: Laboratory exercises in physics, 4 op
766106P: Laboratory exercises in physics 2, 4 op
766308A: Laboratory exercises in physics 3, 2 - 6 op
764625S: Laboratory projects of biophysics, 3 - 6 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
763311A: Mathematical methods, 6 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
766334A: Nuclear and particle physics, 2 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
762327A: Physical Properties of Rocks, 5 op
761644S: Physical measurements, 6 op
762607S: Physical properties of rocks, 6 op
766338A: Physics for teachers, 4 op
764117P: Physics, Biology and Safety Radiation, 3 op
765303A: Planetology I, 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
762352A: Practical training, 5 op
763684J: Practical training for PhD studies, 2 - 8 op
762684J: Practical training for PhD studies, 2 - 8 op
765684J: Practical training for PhD studies, 2 - 8 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
766647S: Quantum Information, 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
764116P: 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
761359A: Spectroscopic methods, 5 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
765608S: Stellar dynamics, 7 op
765343A: Stellar structure and evolution, 7 op
765643S: Stellar structure and evolution, 7 op
766649S: Strong- and short-pulse atomic physics, 6 op
765661S: Structure and kinematics of galaxies, 6 op
765333A: Study project in astronomy 1, 7 op
763645S: Superconductivity, 6 op
766684J: Teaching tasks, 2 - 8 op
764684J: Teaching tasks, 2 - 8 op
765673S: Theoretical astrophysics, 7 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
761013Y: 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 Physics
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 Physics
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 Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
10 credits
Timing:
3. - 4. autumn
Learning outcomes:

The course teaches the fundamental connection between symmetries and quantum mechanics including handling of angular momentum in few particle systems, the quantum mechanical pictures useful in practical calculations and familiarizes with relativistic quantum mechanics.

Contents:
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 and 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), J.J. Sakurai: Advanced Quantum Mechanics.

Person responsible:
Pekka Pietiläinen

764626S: Advanced laboratory exercises in biophysics, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

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

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

3 credits
Language of instruction:
Finnish
Timing:
2 nd or 3 rd spring term
Learning outcomes:
After completion the student knows the special characteristics of airborne geophysical methods and how to utilize aerogeophysical data in different ways.
Contents:
The course provides basic knowledge on airborne geophysical investigation methods that are made above ground surface from airplane, for example. The course focuses on the aerogeophysical mapping made by the Geological Survey of Finland. The course considers the theoretical principles of the magnetic, electromagnetic and radiometric measurements, practical measurement arrangements, auxiliary measurements, navigation, data processing and interpretation and the special characteristics of magnetic and electromagnetic anomalies. Modelling and interpretation software are used in computer exercises to emphasize the lectures.
Learning activities and teaching methods:
Lectures 30 h, demonstrations, exam.
Target group:
Compulsory in BSc studies of geophysics, recommended to students of geosciences.
Recommended or required reading:
Lecture notes and Peltoniemi, M., 1998: Aerogeofysikaaliset menetelmät.
Person responsible:
Markku Pirttijärvi
Other information:
Course homepage: http://www.cc.oulu.fi/~mpi/MPopetus.html

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

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
Variable 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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
Variable 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 Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

ECTS Credits:
Variable 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 Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

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

764364A: Analysis of biosystems, 6 op

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

764664S	Analysis and simulation of biosystems	6.0 op

ECTS Credits:
4 credits
Timing:
2nd spring
Learning outcomes:
The student is able to use modelling in the analysis of simple biosystems, with the utilization of the concept of analogies between different types of systems.
Contents:
Models and analogies are studied as tools to analyse biological systems. Also the foundations of system identification and feedback are considered, and especially the utilization of transfer function and impedance in identification and analysis.
Learning activities and teaching methods:
Lectures 30 h, calculation exercises 15 h, final exam.

Target group:
Compulsory in biophysics major (BSc) and 25 cu (approbatur) minor.
Recommended optional programme components:
Introduction to biophysics (764162P) is recommended before this course. Knowing Laplace transform is useful.
Recommended or required reading:
Lecture handouts; W.B. Blesser, A Systems Approach to Biomedicine, McGraw-Hill, New York 1969 (partly) or some corresponding literature.
Person responsible:
Matti Weckström

763310A: Analytical mechanics, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
2. autumn
Learning outcomes:
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.
Newton's laws, systems of particles, perturbation theory, Lagrange equation, calculus of variations, conservation laws, two-body problem, small oscillations, rigid body dynamics, Hamilton's equations, connection to quantum mechanics.
Contents:
Newton's laws, systems of particles, perturbation theory, Lagrange equation, calculus of variations, conservation laws, two-body problem, small oscillations, dynamics of a rigid body, Hamilton's equations, connection to quantum mechanics.
Learning activities and teaching methods:
Lectures 26 h, 12 exercise sessions (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). http://physics.oulu.fi/teoreettinen_fysiikka/oj/763310A
Person responsible:
Erkki Thuneberg

761669S: Applications of NMR spectroscopy, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:

Not every year
Learning outcomes:
The course introduces the student to topical subject matters in nuclear magnetic resonance spectroscopy (NMR spectroscopy).
Contents:
The course may deal with, e.g., the spin density matrix theory, NMR in liquid crystals, or nuclear magnetic relaxation.
Learning activities and teaching methods:
Lectures 35 h, exercises 20 h, one written examination.
Recommended optional programme components:
761663S NMR spectroscopy is helpful, but not necessary.
Person responsible:
Juhani Lounila

766650S: Applications of SR physics, 5 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
4 credits
Timing:
Not lectured every year.
Learning outcomes:
Course support the MSc and PhD works in the group.
Contents:
Research methods based on the use of synchrotron radiation and their applications. Timely topics are introduced every year.
Learning activities and teaching methods:
Lectures 24 h, exercises 10 h, one written examination.
Person responsible:
Helena Aksela

761650S: Applications of atom physics, 6 op

Voimassaolo: - 31.07.2009

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
Not every year
Contents:
Exercising applications of atom physics.
Recommended optional programme components:
761326A
Recommended or required reading:
Study material: http://physics.oulu.fi/fysiikka/oj/761650S
Person responsible:
Helena Aksela

766643S: Applications of atom physics, 4 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
4 credits
Timing:
Not lectured every year.
Learning outcomes:
The student will understand the basic research targets and research methods used in current spectroscopic atomic physics. The student can search information about current research topics.
Contents:
The development of computational atomic physics and the advances in instrumentation and measurement techniques have greatly affected atomic physics in recent years. The expansion and refinement of available information allows for more applications. The course deals with the research methods in atomic physics, the most recent results of research and their applications. The themes in the course vary depending on the current topics in research.
Learning activities and teaching methods:
Lectures 24 h, exercises 10 h, one written examination.
Target group:

Person responsible:
Helena Aksela

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

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

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
Not lectured every year.
Learning outcomes:
The student understands the fundamentals of photon induced spectroscopy and can apply the knowledge in the interpretation and analysis of experimental data. Especially the student will learn the basics of the density matrix theory and understands the concepts of cross section and angular distribution. The student is able to understand and design experiments where photon induced spectroscopy is used to investigate the structure of atoms and molecules.
Contents:
The course deals with interactions of synchrotron radiation and matter from the point of view of quantum mechanical scattering models. The basic phenomena are absorption and emission of photons, and electron scattering and emission. The course begins with introduction to density matrices and their theory with examples. Then follows photoabsorption and the introduction of the concepts of cross section and oscillator strength. The next topic is elastic electron scattering using the potential scattering approach. The Fermi's golden rule is introduced via the time-independent scattering theory, and the concept of metastable states and their lifetimes is introduced in connection with interactions between discrete states and continua. In the end the effect of the polarization state of the photons on the angular distributions in fluorescence and photoionization is discussed.

Learning activities and teaching methods:
Lectures 35 h (incl. exercises), one examination.
Recommended optional programme components:
766326A, 763612S
Recommended or required reading:
K. Blum: Density Matrix Theory and Applications, H. Friedrich: Theoretical Atomic Physics. Lecture notes.
Person responsible:
Sami Heinäsmäki
Other information:
http://physics.oulu.fi/fysiikka/oj/766646S/

766320A: Applied Electromagnetism, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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
Learning outcomes:
The student is familiar with the mathematics needed in field theory. He understands the experimental foundation of Maxwell's equations and the structure of the field theory based on these equations. He can apply the theory to electrostatics, magnetostatics, induction phenomena and electromagnetic radiation.
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:
Students in electrical engineering.
Recommended optional programme components:
Courses 761103P, 031011P
Recommended or required reading:
Textbooks by Ismo Lindell ja Ari Sihvola (Sähkömagneettinen kenttäteoria 1 ja 2) can be used. Lecture material on web pages in Finnish. http://physics.oulu.fi/fysiikka/oj/766320A/
Grading:
Each part must be passed.

Person responsible:
Tuomo Nygrén

765638S: Areology, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
The biennial or triennial nature of the advanced courses the student has to be aware by him/herself of the best time to take any particular course.
Learning outcomes:
The aim is that all students will master the course topics in theory and practice. The graded student achievement will show the level the student has reached this goal.
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.
Recommended or required reading:
The Martian Surface Composition, Mineralogy and Physical Properties Edited by Jim Bell. Published June 2008 | Hardback | ISBN-13:9780521866989 | Hinta: 95,00 GBP
Mars: An Introduction to its Interior, Surface and Atmosphere by Nadine Barlow. Hardback | Published January 2008 | Hinta: 95,00 GBP
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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
5 credits
Learning outcomes:
Student understands the role of observations in the formation of astronomical knowledge and knows the main observing techniques and instruments.
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:
Student of the second year or later.
Recommended optional programme components:
Fundamentals of astronomy (recommended)
Recommended or required reading:
Recommended reading: Kitchin, C.R.: Astrophysical Techniques.
Person responsible:
Pertti Rautiainen

763655S: Astroparticle physics, 6 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
The lecture notes are written in English. Lectures either in Finnish or in English.
Timing:
Advanced studies, doctoral studies.
Contents:
Basic phenomena of astroparticle physics and newest results. The course covers, for example, high-energy cosmic rays, supernova and relic supernova neutrinos, Sun and solar neutrinos, geoneutrinos, double beta decay, proton unstability, dark matter and background in underground measurements.
Learning activities and teaching methods:
Lectures 39 h (13 x 3h). The first lecture on September 15, 2009 and last on December 15, 2009 (no lecture on Tuesday September 29). Exercises 14h or 16h. The schedule of exercises is fixed at the first lecture.
Target group:
Students interested in astronomy, nuclear or particle physics.
Recommended optional programme components:
Basic skill on astronomy, nuclear and particle physics is an advantage but not required.
Recommended or required reading:
Lecture notes. Available on the internet.
Assessment methods and criteria:
Assessment methods and dates will be discussed at the first lecture.
Person responsible:
Timo Enqvist

761105P: Atomic and Nuclear Physics, 3 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766326A Atomic physics 6.0 op

ECTS Credits:
3 credits
Timing:
The course is not lectured any more. It can be completed in this form by a final examination.
Learning outcomes:
The course gives an overview of the properties of atoms, nuclei and fundamental particles.
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. From the autumn 2009 onwards, the course is a part of the course *766326A Atomic physics 1* whose first intermediate examination constitutes its concluding examination.
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, 2009.
Person responsible:
Juhani Lounila (former course) and Helena Aksela (new course)

766326A: Atomic physics 1, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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
Language of instruction:
Finnish
Timing:
Second autumn term
Learning outcomes:
Student understands the differences between the classical and quantum mechanical concepts and models and knows the limitations of classical physics when investigating atom-sized particles. Student is able to describe some interaction mechanisms of electromagnetic radiation and matter. Student can describe the principles used when the wave functions and energies of some simple systems are determined. Student can take advantage of the periodic table of elements in finding the chemical and physical properties of atoms based on its electronic structure. Student knows the physical conditions necessary when molecular bonds are created and the basics of vibrational, rotational and electronical energy states of molecules.
Contents:
The quantum mechanics is one of the important theories of modern physics. Quantum mechanical theory has changed our understanding of the universe, especially the nature of matter and radiation. In the atom physics course, the quantum mechanics is examined with the aid of simple examples. The quantum mechanical phenomena occur only when investigating the microscopical elements of matter, i.e. atoms, electrons and nuclei. In the beginning of the course, the historical events which led to the development of the quantum mechanics in the early 20th century are discussed. In this context, the interaction processes between matter and electromagnetic radiation, like black-body radiation, the photoelectric effect, and scattering, are examined. In

quantum mechanics, particles are usually described with the aid of wave functions. De Broglie wavelength, the group and phase velocities of particles, and Heisenberg uncertainty principle serve as introduction to the wave properties of particles. The Bohr's atomic model, electronic transitions of atoms, and emission spectra of atoms are also discussed in the first part of the atom physics course.
The second part of the course goes deeper into the quantum mechanics. The solution of wave functions and energies for some simple systems, like hydrogen atom, are described. Additionally, many-electron atoms, molecules, and chemical bondings of atoms are discussed briefly. Some modern research methods which are used to study the atomic and molecular physics are introduced. Applications which exploit the atom physical phenomena in everyday life are also discussed.
Learning activities and teaching methods:
Lectures 46 h, exercises 24 h. Two written intermediate examinations or one final examination.
Target group:
Compulsory
Recommended optional programme components:
Follow-up courses: Advanced courses in atomic and molecular spectroscopy.
Recommended or required reading:
Books: A. Beiser: Concepts of Modern Physics, McGraw-Hill Inc., R. Eisberg and R. Resnick: Quantum physics of atoms, molecules, solids, nuclei and particles, John Wiley & Sons.
http://physics.oulu.fi/fysiikka/oj/766326A/
Person responsible:
Helena Aksela and Leena Partanen

761671S: Atomic physics 2, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Timing:
Not lectured every year.
Learning outcomes:
The student will understand the fundamentals of the numerical research in atoms, especially the Hartree-Fock type methods, and can interpret the basic features of the atomic and molecular spectra with the physical principles presented. The student will know the principal features of the existing codes in order to perform simple numerical analysis on the structure of atoms.
Contents:
The goal is to form an understanding of the structure of a many-electron atom and the spectroscopic methods used in the research of the electronic structure and dynamics. The quantum mechanical formalisms are applied onto the description of quantum states and transitions in a many-electron atom. The students will be introduced to codes used in practical simulations. Model computations will be performed whose results will be compared to the experimental ones. This will familiarize the student to the steps in actual research: the models of atomic structure are refined using the experimental and computational methods simultaneously.
Learning activities and teaching methods:
Lectures 44 h, exercises 20 h. One oral (if agreed) examination.
Recommended optional programme components:
766326A, 763612S
Recommended or required reading:
R.D. Cowan: The theory of atomic structure and spectra.
Person responsible:
Helena Aksela

761649S: Auroral physics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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
Learning outcomes:
After the course the student understands the basics of the physical processes associated with formation of aurora in the upper atmosphere and is able to solve associated problems. In addition, the student gains information of the latest findings in the auroral research field.
Contents:
The flow of charged particles from the Sun, known as the solar wind, expands outwards to the surrounding space. Close to the Earth the solar wind interacts with the magnetosphere, feeding energy and particles there. Processes taking place in the magnetosphere lead to the acceleration and precipitation of electrons and protons in the upper atmosphere of the Earth, know as the ionosphere. When the charged particles enter the atmosphere, they excite the ambient atoms and molecules, which emit light when returning to the ground state, thus creating aurora (northern lights). In this course, we study the formation of aurora as an ionospheric process as well as from the viewpoint of solar wind-magnetosphere-ionosphere coupling.
Contents in brief: Neutral atmosphere, ionization and excitation of atoms and molecules by auroral particles. Optical emissions in aurora. Auroral morphology. Magnetosphere-Ionosphere coupling, ionospheric and magnetospheric currents. Acceleration of auroral particles and electrodynamics of aurora. Magnetohydrodynamic waves, especially Alfvén waves. Solar wind energy penetration to the magnetosphere and magnetospheric substorms.
Learning activities and teaching methods:
Lectures 36 h, exercises 12 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), Baumjohann and Treumann: Basic Space Plasma Physics (Imperial College Press, 1997).
Lecture material (in English) is available on the web page of the course.
Person responsible:
Kari Kaila and Anita Aikio

765356A: B.Sc. thesis and seminar, 10 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
10 credits
Timing:
3. spring
Learning outcomes:
By giving the seminar talk and by writing the essay one learns important communication skills.
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 and seminar, 10 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
10 credits
Timing:
3. spring
Learning outcomes:
To learn independent research work and reporting. In the seminar one learns and discusses current topics in theoretical physics. By giving the seminar talk and by writing the essay one learns important communication skills.
Contents:
Participation in the seminars, being an opponent, presentation of a seminar talk, and writing an essay. The opponent reads in advance the material for a seminar talk and discusses it. The seminar talk follows scientific style and it includes material that is displayed by a projector. The essay is 15-20 page long scientific article prepared using a computer.
Learning activities and teaching methods:
The first meeting of the seminar group is at the end of the autumn semester, where the topics will be distributed.
Target group:
Compulsory for theoretical physics students.
Recommended optional programme components:
Basic and intermediate studies in physics.
Person responsible:
Erkki Thuneberg
Other information:
http://physics.oulu.fi/teoreettinen_fysiikka/oj/763330A/

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

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
10 credits
Timing:
3 rd year
Learning outcomes:
By giving the seminar talk and by writing the essay one learns important communication skills.
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

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

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

ECTS Credits:
10 credits
Timing:
3 th spring
Learning outcomes:
By giving the seminar talk and by writing the essay one learns important communication skills.
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 10 h, seminar talks, writing an essay.
Target group:
Compulsory.
Recommended optional programme components:
Intermediate physics courses.
Person responsible:
Jukka Jokisaari and Kalevi Mursula

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

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

Timing:
3. spring
Learning outcomes:
By giving the seminar talk and by writing the essay one learns important communication skills.
Person responsible:
Matti Weckström

765637S: Basaltic volcanism on terrestrial planets, 6 op

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

ECTS Credits:
6 credits
Timing:

The biennial or triennial nature of the advanced courses the student has to be aware by him/herself of the best time to take any particular course.

Learning outcomes:

The aim is that all students will master the course topics in theory and practice. The graded student achievement will show the level the student has reached this goal.

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.

Recommended optional programme components:

765103A

Recommended or required reading:

Volcanism by Hans-Ulrich Schmincke (Hardcover - Nov 14, 2005) Buy new 99$
Fundamentals of Physical Volcanology by Liz Parfitt and Lionel Wilson (Paperback - Feb 15, 2008). Buy new: 70$
Volcanism on Io: A Comparison with Earth (Cambridge Planetary Science) by Ashley Gerard Davies (Hardcover - Aug 20, 2007). Buy new: $142.00
The Canary Islands (Classic Geology in Europe - Paperback) by Juan Carlos Carracedo and Simon Day £17.05
Iceland (Classic Geology in Europe - Paperback) by Thor Thordarson and Armann Hoskuldsson £17.05
Italian Volcanoes (Classic Geology in Europe - Paperback) by Christopher J. Kilburn and Bill McGuire £14.20
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 Physics

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

Learning outcomes:

The student masters the basic concepts of mechanics and is able to apply those when solving the problems related to mechanics.

Contents:

We encounter many phenomena related to mechanics in our everyday life. Most engineering sciences are based on mechanics and mechanics forms the basis of many other fields of physics, also the modern physics.
Contents in brief: Short summary of vector calculus. Kinematics, projectile motion and circular motion. Newton's laws of motion. Work and different forms of energy. Momentum, impulse and collisions. Rotational motion and moment of inertia. Torque and angular momentum. Rigid body equilibrium problems. Gravitation. Periodic motion. Fluid mechanics.
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 http://physics.oulu.fi/fysiikka/oj/761101P
Person responsible:
Anita Aikio

764638S: Basic Neuroscience, 5 op

Voimassaolo: 01.01.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

764338A	Basic Neuroscience	5.0 op

ECTS Credits:
5 credits
Timing:
3. - 4. spring
Contents:
See 764338A Basic Neuroscience
Person responsible:
Mikko Vähäsöyrinki

764338A: Basic Neuroscience, 5 op

Voimassaolo: 01.01.2009 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

764638S	Basic Neuroscience	5.0 op

ECTS Credits:
5 credits
Timing:
3. - 4. spring
Learning outcomes:
To provide basic understanding about the oganization and function of the nervous system.

Contents:
General organization and function of the peripheral and central nervous system are introduced based on a course book and a seminar on a specific topic, which students prepare in groups based on an additional material (book chapters and scientific articles). Learning during the course is constantly evaluated with multiple choice quizzes in beginning of the each lecture.
Person responsible:
Mikko Vähäsöyrinki

761102P: Basic Thermodynamics, 2 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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
Learning outcomes:
The student will learn to recognize and understand ordinary thermodynamic phenomena taking place around us as well as to take them into account and utilize them, for instance, in designing devices and buildings.
Contents:
We cover the basics of temperature, heat and thermal properties of matter both in macroscopic and microscopic levels. Topics in detail: Temperature, thermometers, heat, thermal properties of matter (e.g. thermal expansion, specific heat, phase changes), equations of state, the laws of thermodynamics, heat engines (e.g. internal-combustion engine), refrigerators, the 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.
http://physics.oulu.fi/fysiikka/oj/761102P
Person responsible:
Ville-Veikko Telkki

761322A: Basics of electronics, 5 op

Voimassaolo: - 31.07.2009

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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.
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 Physics

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.
Learning outcomes:
The basic objective of this course is to learn the basic physical principles and concepts related to the topics mentioned in Contents.
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 avaruussovellutuksiin. 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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766345A Basics of space physics 6.0 op

ECTS Credits:
5 credits
Timing:
Not lectured every year.
Learning outcomes:
The student has the basic knowledge on the effect of the Solar activity on the near space of the Earth; i.e. in solar wind, magnetosphere and ionosphere.
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. Two written intermediate examinations or one final examination.
Target group:
Can be chosen by physics students. Useful for most advanced level courses in space physics, especially Plasma Physics (761653S).
Recommended optional programme components:
Courses 766321A Electromagnetism I and 766322A Electromagnetism II.
Recommended or required reading:
Lecture material in Finnish, available on web pages.
Person responsible:
Tuomo Nygrén

764660S: Bioelectronics, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
4 credits
Timing:
4th spring
Learning outcomes:
Students have basic skills for understanding and analyzing of electronics and its applications to measurements of living organisms.
Contents:
The course introduces bioelectric recording techniques, electrodes, most commenly used amplifier types, basic signal processing of biosignals, but also concepts related to the origin of bio-potentials and currents and how they are distributed in biological volume conductors.
Learning activities and teaching methods:
Lectures 20 h, MatLab-based project work 10 h, calculation exercises 15 h, exam.
Target group:
Optional for biophysics M.Sc. students.
Recommended optional programme components:
Physics courses, programming skills.
Recommended or required reading:

Lectures and lecture notes. Books e.g. Semmlov J, Circuits signals and systems for bioenergetics, Elsevier Academic Press, 2005; Electronic Signal Processing, parts I-IV, The Open University Press, Milton Keynes 1984.
Person responsible:
Matti Weckström

764325A: Biophysical laboratory exercises, 5 op

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

764631S: Bioprocess dynamics, 4 op

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

Ei opintojaksokuvauksia.

765304A: Celestial mechanics, 5 - 8 op

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

ECTS Credits:
5 credits
Learning outcomes:
After the course the student should understand the basics of orbital dynamics, and also be able to solve simple perturbation problems via numerical integration methods.
Contents:
Orbital motion of planets: calculation of position from orbital elements, determination of elements from observations. Hyperbolic orbits. Applications of vectorial perturbation theory. General N-body problem.
Learning activities and teaching methods:
Lectures 32 h, exercises. One written examination.
Recommended or required reading:
A. E. Roy: Orbital motion, Adam Hilger, 1988.
Person responsible:
Heikki Salo

764623S: Cell membrane biophysics, 7 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764323A Cell membrane biophysics 7.0 op

ECTS Credits:
6 credits
Language of instruction:
Can be taught partly or completely in English.
Timing:
3rd or 4th autumn
Learning outcomes:
After finishing the course the student is able to describe the basics of cell membrane structure and function, to present the basic biophysical models describing the electrical function of the cell membrane, and to solve problems and calculations concerning these models. In addition, the student will be able to familiarize with the English literature of the field and present a short review of a given article.
Contents:
During the course the students will become acquainted with the central biophysical phenomena of the cell membrane, for example: the physical structure and properties of the cell membrane, lipids and proteins in the membrane, permeation and selectivity, ion channels and their kinetics. In addition they will get to know the basics about the theory of the intracellular or cell membrane recordings, the models describing the electrical function of the cell membrane and the analysis of these signals.
Learning activities and teaching methods:
30 h of lectures, 22 h of calculation exercises, 4-8 h seminars, seminar presentation, weekly assignments, home exam, final exam.
Target group:
Biophysics students: recommended in minor (LuK), compulsory in major (FM). Other students: recommended in biophysics minor (25 cu).
Recommended optional programme components:
Introduction to biophysics (764103P) and Foundations of cellular biophysics (764115P) are recommended to be done before this course. This course itself forms theoretical to Information processing in the nervous system (764680S).
Recommended or required reading:
Lecture handouts; J. Keener, J. Sneyd: Mathematical Physiology, Springer, Berlin, 1998 (partly).; D. Johnston, S. Wu: Foundations of Cellular Neurophysiology, MIT Press, Cambridge MA, 1995 (partly).
Person responsible:
Kyösti Heimonen, Marja Hyvönen

764323A: Cell membrane biophysics, 7 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764623S Cell membrane biophysics 7.0 op

ECTS Credits:
6 credits
Language of instruction:
Can be taught partly or completely in English.
Timing:
3rd or 4th autumn
Learning outcomes:
After finishing the course the student is able to describe the basics of cell membrane structure and function, to present the basic biophysical models describing the electrical function of the cell membrane, and to solve problems and calculations concerning these models. In addition, the student will be able to familiarize with the English literature of the field and present a short review of a given article.

Contents:
During the course the students will become acquainted with the central biophysical phenomena of the cell membrane, for example: the physical structure and properties of the cell membrane, lipids and proteins in the membrane, permeation and selectivity, ion channels and their kinetics. In addition they will get to know the basics about the theory of the intracellular or cell membrane recordings, the models describing the electrical function of the cell membrane and the analysis of these signals.
Learning activities and teaching methods:
Lectures 30 h, calculation exercises 22 h, seminars 4-8 h, seminar presentation, weekly assignments, home exam, final exam.
Target group:
Biophysics students: recommended in minor (LuK), compulsory in major (FM). Other students: recommended in biophysics minor (25 cu).
Recommended optional programme components:
Introduction to biophysics (764103P) and Foundations of cellular biophysics (764115P) are recommended to be done before this course. This course itself forms theoretical to Information processing in the nervous system (764680S).
Recommended or required reading:
Lecture handouts; J. Keener, J. Sneyd: Mathematical Physiology, Springer, Berlin, 1998 (partly).; D. Johnston, S. Wu: Foundations of Cellular Neurophysiology, MIT Press, Cambridge MA, 1995 (partly).
Person responsible:
Kyösti Heimonen, Marja Hyvönen
Other information:
https://wiki.oulu.fi/display/764323A/

763629S: Classical field theory, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Learning outcomes:
To understand the basics of classical field theory. Field is a central concept in physical theories. This is an introduction to general classical field theory starting from Lagrange mechanics and showing that the classical theory of electromagnetism can be derived from quite general principles.
Contents:
In the beginning the Lagrange formalism is generalized to apply to a continuous medium. Based on that the general classical field theory is formulated. The Lagrange formalism is also generalized to apply to 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 some subfields of electromagnetism, such as conservation laws, time-independent field, and the field generated by an accelerating charge.
Learning activities and teaching methods:
Lectures 26 h, 12 exercise sessions (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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
Not lectured every year.
Learning outcomes:
After successful completion, student has a basic knowledge of computer simulation methods of microscopic systems used in physics, chemistry, bio- and materials sciences. Student understands the application possibilities and restrictions of the methods and has versatile capabilities to use them in solving of various problems.
Contents:
The course builds a foundation for further studies of computational physics and the use of these methods in research. Subjects: Revision of basics of statistical mechanics, molecular dynamics, Monte Carlo -methods, stochastic simulation, quantum mechanical simulation, error estimation.
Learning activities and teaching methods:
Lectures 35 h, 4 practical works. One literary examination.
Target group:
Advanced undergraduate students in physics, chemistry and materials sciences and graduate students.
Recommended optional programme components:
Atomic physics and Thermophysics cum laude courses or comparable knowledge, basics of numerical analysis and some programming language.
Recommended or required reading:
M.P. Allen ja T.J. Tildesley: "Computer Simulation of Liquids".
W.H. Press, S.A. Teukolsky, W.T. Vetterling ja B.P. Flannery: " *Numerical Recipes: The Art of Scientific Computing*".
Person responsible:
Perttu Lantto

765617S: Computer simulations, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Learning outcomes:
After the course the student should be able to build simple simulation programs for astronomical applications, using basic N-body and Monte Carlo methods.
Contents:
N-body simulation methods, applied to dynamics of planetary rings and galaxies. Monte Carlo method, with astronomical applications to light scattering simulations.
Recommended or required reading:
Lecture material given during the course.

762620S: Computers in geophysics, 3 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
3 credits
Language of instruction:
Finnish
Timing:
4 th or 5 th autumn term
Learning outcomes:
After completion the student knows how to create in Fortran language a computer program that solves some numerical task.
Contents:
The solution of geophysical problems often requires writing own computer programs. The course teaches how to write programs in Fortran language and how to apply these skills to solve simple geophysical problems and tasks such as reading from file, formatted writing, numerical computations and data visualization. The course consists of practical computer exercises and compulsory tasks related to them.
Learning activities and teaching methods:
30 h exercises, approved tasks.
Target group:
Complusory in MSc studies of geophysics.
Recommended optional programme components:
Prior completion of courses 763114P ja 763315A is recommended.
Recommended or required reading:
Excercise material and Haataja J., Rahola J. & Ruokolainen J., 1998: Fortran 90/95 and Press W.H., Flannery B. P., Teukolsky S.A & Vetterling W.T., 1988: Numerical recipes in Fortran.
Person responsible:
Markku Pirttijärvi
Other information:
Course homepage: http://www.cc.oulu.fi/~mpi/MPopetus.html

763628S: Condensed matter physics, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763636S	Condensed matter physics	5.0 op

ECTS Credits:
10 credits
Timing:
4. year
Learning outcomes:
Deeper understanding of condensed matter. Modern technology is largely based on the understanding of condensed matter. Condensed matter has many interesting physical properties that are consequences of large number of particles and their interactions.
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, 12 exercise sessions (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 Physics

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.
Learning outcomes:
The basic objective of this course is to learn the basic physical principles and concepts related to the topics mentioned in Contents.
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 Physics

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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

780396A Demonstrations in Physics and Chemistry 2.0 op

ECTS Credits:
2 credits
Language of instruction:
This course will be given in Finnish.
Timing:
3 rd year in teachers education
Learning outcomes:
Every teacher in the upper secondary school should be able to make demonstrations in his/her physics or chemistry lessons. This course gives multiple hints to do them.
Contents:
The course Demonstrations in Physics and Chemistry 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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761108P Physical world view 5.0 op

ECTS Credits:
3 credits
Timing:

1. autumn
Learning outcomes:
After passing the course, the student can understand the importance of physics for the development of scientific world view and technology.
Contents:
Development of most important models and detection methods in physics in connection to the development of classical physics and modern physics. Importance of applications of physics for the development of the society.
Learning activities and teaching methods:
Lectures 21 h, one written examination.
Target group:
Compulsory.
Recommended optional programme components:
No prerequisite courses.
Recommended or required reading:
Feynman R., The charater of Physical Law, Penguin Books 1992.
See also http://research.microsoft.com/apps/tools/tuva/
Person responsible:
Helena Aksela

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

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
3 rd - 5 th year
Learning outcomes:
After passing the course the student understands the theoretical basics and use of electric methods based on the DC theory, knows their operation and measuring practice and is able to analyse and interpret measured data in near-surface geophysical surveys.
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 YGF-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 Physics

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
Learning outcomes:
The student masters the basic concepts of electricity and magnetism and is able to apply those when solving the problems related to electromagnetism.
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 brief: Coulomb's law. Electric field and potential. Gauss's law. Capacitors and dielectrics. Electric current, resistors, electromotive force and DC circuits. Magnetic field, motion of a charged particle in electric and magnetic fields, and applications. Ampère's law and 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: http://physics.oulu.fi/fysiikka/oj/761103P
Person responsible:
Anita Aikio

763626S: Electro-weak interactions, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
10 credits
Language of instruction:

English/Finnish
Timing:
Not lectured longer.
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 Physics

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.
Learning outcomes:
The basic objective of this course is to learn the basic physical principles and concepts related to the topics mentioned in Contents.
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/

766632S: Electromagnetic waves, 6 op

Voimassaolo: 01.08.2009 -

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

Ei opintojaksokuvauksia.

766319A: Electromagnetism, 7 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

761119P	Electromagnetism 1	5.0 op
761312A	Electromagnetism 2	5.0 op
761119P-01	Electromagnetism 1, lectures and exam	0.0 op
761119P-02	Electromagnetism 1, lab. exercises	0.0 op
761113P	Electricity and magnetism	5.0 op
761113P-01	Electricity and magnetism, lectures and exam	0.0 op
761113P-02	Electricity and magnetism, lab. exercises	0.0 op
761103P	Electricity and Magnetism	4.0 op
766321A	Electromagnetism I	4.0 op
766322A	Electromagnetism II	4.0 op

ECTS Credits:
6 credits
Timing:
Second autumn term
Learning activities and teaching methods:
Lectures 46 h, 12 exercises (24 h), two written intermediate examinations or final examination.

766321A: Electromagnetism I, 4 op

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

766319A	Electromagnetism	7.0 op

ECTS Credits:
4 credits
Timing:
Not lectured longer.
Learning outcomes:
Understanding the mathematical formalism and experimental foundations of electrostatics and magnetostatics. Skills to apply the theory in simple problems.
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:
For students in the Faculty of Science. Useful in most courses in Space Physics.
Recommended optional programme components:
The course is continued by 766322A Electromagnetism II.
Recommended or required reading:
Lecture notes on web pages in Finnish. As additional material textbooks by I.S. Grant and W.R. Phillips (Electromagnetism, 2 nd ed., Wiley & Sons) and Lindell and Sihvola (Sähkömagneettinen kenttäteoria, 1. Staattiset kentät) can be used.
Person responsible:
Tuomo Nygrén

766322A: Electromagnetism II, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766319A Electromagnetism 7.0 op

ECTS Credits:
4 credits
Timing:
Second autumn
Learning outcomes:
The student understands the electromagnetic field theory and the theory of electric circuits and is able to apply them in simple problems.
Contents:
This course comprises the latter part of the theory of electromagnetism and it is continuation of the lecture course 766321A Electromagnetism 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:
For students in the Faculty of Science. Useful in most courses in Space Physics.
Recommended optional programme components:
This is the latter part of the two courses of electromagnetic theory, the first part is 766321A Electromagnetism I.
Recommended or required reading:

Lecture notes on web pages in Finnish. As additional material textbooks by I.S. Grant and W.R. Phillips (Electromagnetism, 2nd ed., Wiley & Sons) and Sihvola and Lindell (Sähkömagneettinen kenttäteoria, 2. Dynaamiset kentät) can be used.
Person responsible:
Tuomo Nygrén

761673S: Electron and ion spectroscopy, 8 op

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

ECTS Credits:
8 credits
Timing:
Not every year
Learning outcomes:
Students learn the practical side of electron spectroscopy.
Contents:
The course gives an introduction to the basics of electron and ion spectroscopy research at 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 basic ideas 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.
Recommended optional programme components:
Basic knowledges of atomic physics.
Recommended or required reading:
Lecture notes.
Person responsible:
Saana-Maija Huttula

763696S: Electronic transport in mesoscopic systems, 6 op

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

ECTS Credits:
6 credits
Learning outcomes:
To understand electronic transport on very small semiconductor or metallic structures.
Contents:
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, 12 exercise sessions (24 h), one oral examination.
Target group:
Especially for theoretical physicists.
Recommended optional programme components:

Quantum mechanics I (763312A), Thermophysics (766328A) and Structure of matter I and II (763333A and 766334A).
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

764632S: Electrophysiological methods, 6 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Learning outcomes:
After taking the course student can describe principles of the electrophysiological methods and understands their benefits and limitations. The acquired knowledge and skills enable student to start practising the skills independently.
Contents:
The course provides theoretical and hands-on practical introduction on the electrophysiological methods that enable recording electrical signals generated by the nervous system ranging from the populations of neurons to currents generated by single ion channels embedded on the cellular membranes (intra- and extracellular as well as patch-clamp recordings). Laboratory exercises are given on each technique to transfer theoretical knowledge into practical skills and to familiarize students with the typical instrumentation. The course also introduces basic data analysis methods that enable evaluating the recording quality and investigating function of the system under study.
Learning activities and teaching methods:
Lectures 12 h, laboratory demonstrations 6 h, practical lab-work 24 h, exam.
Target group:
Optional for biophysics M.Sc. students; post-graduate students.
Recommended optional programme components:
Membrane biophysics, Basic neuroscience, Neuronal information processing.
Recommended or required reading:
Lectures and lecture notes, book: The Axon Guide (http://www.moleculardevices.com/pages/instruments/axon_guide.html).
Person responsible:
Mikko Vähäsöyrinki

762684S: Excursion, 2 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opettajat: Korja, Toivo Johannes
Opintokohteen kielet: Finnish

ECTS Credits:
2 credits
Language of instruction:
Finnish
Timing:
Arranged on demand.

Learning outcomes:
After the excursion, student has become acquainted with a few employers in the field of geosciences, and with the work done there. Student has collected, prior to and during the excursion, information on duties and required skills of the professions in visited companies and organisations and is able to generalize this information into a job description of a geophysicists.
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).

766648S: Extension course in electron spectroscopy, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Timing:
Not every year
Learning outcomes:
Students get familiar with the research methods of electron spectroscopy.
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 Physics

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.cc.oulu.fi/~mpi/opetus/762644S_Sov.geof_maastokurssi.html

762645S: Field course in bedrock mapping and applied geophysics, 3 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
3 credits
Language of instruction:
Finnish
Timing:
4 th or 5 th year
Learning outcomes:
The course gives the students an opportunity to apply in practice what they have learned so far in their studies: to make field work and measurements, process and interpret data and to report the results.
Contents:
The course introduces the students of geophysics with geological bedrock mapping and gives the students of geology practical information about the methods of applied geophysics. The geophysical methods include magnetic, electrical, electromagnetic profiling. The course starts with four days of field work, after which the student groups process and interpret the collected geological and geophysical data themselves and report their results. The course is preferably arranged together with the course 772662S of the Department of Geosciences.
Learning activities and teaching methods:
32 h field work, 20 h processing and interpretation of measured data, approved written report.
Target group:
Complusory in MSc studies of geophysics. The course is arranged every two or three years.
Recommended optional programme components:
Prior completion of course 762102P.
Person responsible:
Markku Pirttijärvi
Other information:

Course homepage: http://www.cc.oulu.fi/~mpi/MPopetus.html

762646S: Field course in environmental geology and applied geophysics, 3 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
3 credits
Language of instruction:
Finnish
Timing:
4 th or 5 th year
Learning outcomes:
The course gives the students an opportunity to apply in practice what they have learned so far in their studies: to make field work and measurements, process and interpret data and to report the results.
Contents:
The course introduces the students of geophysics with various geological problems and gives the students of geology practical information about the methods of applied geophysics. The geological problems include peat bog, esker, hummocky moraine, clay layers and thick overburden. The geophysical methods include ground penetrating radar method and seismic, electrical and electromagnetic soundings. The course starts with four days of field work, after which the student groups process and interpret the collected geological and geophysical data themselves and report their results. The course is preferably arranged together with the course 773673S of the Department of Geosciences.
Learning activities and teaching methods:
32 h field work, 20 h processing and interpretation of measured data, approved written report.
Target group:
Complusory in MSc studies of geophysics. The course is arranged every two or three years.
Recommended optional programme components:
Prior completion of course 762102P.
Person responsible:
Markku Pirttijärvi
Other information:
Course homepage: http://www.cc.oulu.fi/~mpi/MPopetus.html

764115P: Foundations of cellular biophysics, 4 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764125P Foundations of cellular biophysics 5.0 op

ECTS Credits:
2 credits
Timing:
2nd autumn
Learning outcomes:
After finishing the course the student is able to describe the foundations or basics of cellular structure and function, to present the biophysical background for some of these, and to solve simple problems and calculations concerning cellular biophysics and -chemistry. In addition, the student can specify and categorize some of the central fields of cell biology and cellular biophysics.

Contents:
In this course cellular function is considered from the point of view of biophysics. The course concentrates on the subjects of energy metabolism, information transfer, and the cellular structures and features that are biophysically interesting. The course contains, for instance, the introduction to the physical chemistry of the cells, the structure of cell and cell membrane (some basic cell biology), cellular energy sources and metabolism, cellular trafficking, kinetics of enzyme reactions, basics of cell membrane function and transportation phenomena, some introduction into the electrical phenomena of the cell membrane and the basics of cellular information processing.
Learning activities and teaching methods:
Lectures 14 h, calculation exercises 6 h, weekly assignments, home exam, final exam.
Target group:
Compulsory in biophysics major (LuK) and 25 cu (approbatur) minor.
Recommended optional programme components:
Introduction to biophysics (764162P) is recommended to be done before this course. This course forms an introduction for the course Biophysics of cell membranes (764323A).
Recommended or required reading:
Lecture handouts; P.J. Antikainen, Biotieteiden fysikaalista kemiaa, WSOY, Helsinki 1981 (partly); J. Heino and M. Vuento, Solubiologia, WSOY, Porvoo 2002 (partly). Since the books are in Finnish, some corresponding literature can be discussed upon with the lecturer.
Person responsible:
Marja Hyvönen, Kyösti Heimonen

761666S: Fourier transform with applications, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
Not lectured every year.
Learning outcomes:
After successful pass of the course student is familiar with Fourier series and transformation and understands the importance and consequences of Fourier transform in experimental research.
Contents:
Mathematical background of Fourier series and transform as well as the properties of Fourier transform will be introduced. The principle of numerical Fourier transform, which a most important matter from the applications point of view, and its consequences will be represented. Furthermore, possibilities for mathematical manipulation of experimental data are discussed. Laplace transform and its special features are gone through and in the end of the course basics of spectroscopies, such as infrared, mass and NMR spectroscopy, which utilize Fourier transform, are introduced.
Learning activities and teaching methods:
Lectures 35 h, exercises 20 h. One written examination.
Target group:
Students in physics and chemistry directing at spectroscopic methods and students in natural and technical sciences being interested in signal treatment.
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

765104P: Fundamentals of astronomy, 8 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Learning outcomes:
Student understands the basic physical processes behind astronomical phenomena and reaches the level required in more advanced astronomy courses.
Contents:
A more detailed basic astronomy course that contains e.g. the fundamentals of electromagnetic radiation, celestial mechanics, stellar structure and evolution, the structure of the Milky Way and principles of cosmology.
Learning activities and teaching methods:
Lectures 32 h, exercises 20 h. One written examination.
Target group:
First or second year students in e.g. astronomy, physics, geophysics or geology.
Recommended or required reading:
H. Karttunen, K.-J. Donner, P. Kröger, H. Oja and M. Poutanen (eds.): Fundamental astronomy, Springer, 2007, Carroll, B.W., Ostlie, D.A., An Introduction to Modern Astrophysics, Pearson 2007.
Person responsible:
Pertti Rautiainen

761648S: Fundamentals of incoherent scatter radar, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Timing:
Not lectured every year.
Learning outcomes:
The student has sufficient mastering of signal theory. He understands the principle of classical scattering of electromagnetic waves in media, as well as the relation between the signal autocorrelation function and plasma autocorrelation function.
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:
Students interested in ionospheric research, especially those who want to participate in EISCAT measurements and data analysis.
Recommended optional programme components:

Useful basic information is given by Ionospheric physics (761658S).
Recommended or required reading:
Lecture material on web pages in English.
Person responsible:
Tuomo Nygrén

762106P: GIS and spatial data 1, 3 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
3 credits
Language of instruction:
Finnish
Timing:
2 nd or 3 rd autumn term
Learning outcomes:
After completion the student knows the basics of spatial data and GIS, especially GPS positioning and the map coordinate systems of Finland, and knows various ways to visualize spatial data.
Contents:
Geoscientific observations and measurements are always tied to spatial position of the data. The course provides basic information about the presentation and handling of spatially dependent geoscientific data and geographic information systems (GIS). The course considers the basics of spatial data, coordinate systems, map projections and map coordinates, satellite (GPS) positioning, geoscientific data and data visualization. Computer exercises demonstrate preparation and visualization of geoscientific data.
Learning activities and teaching methods:
Lectures 30 h and demonstrations, exam.
Target group:
Compulsory in BSc studies of geophysics, recommended to students of geosciences.
Recommended or required reading:
Lecture notes and Löytönen, M., Toivonen, T. & Kankaanrinta, I., (Eds.) 2003: Globus GIS.
Person responsible:
Markku Pirttijärvi
Other information:
Course homepage: http://www.cc.oulu.fi/~mpi/MPopetus.html

762606S: GIS and spatial data 2, 3 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Moisio, Kari Juhani

Opintokohteen kielet: Finnish

ECTS Credits:
3 credits
Timing:
3-5 th year
Learning outcomes:
After this course student will understand principles of spatial data in practice. Student can use different GIS-software, he can present and modify different kind of spatial data and adapt some analysis tools to it.

Contents:
In this course student familiarizes to GIS-software and the possibilities they offer in presenting and analyzing spatial data in practical exercises.
Learning activities and teaching methods:
Exercises 30 h, course is passed by returning exercise report.
Recommended optional programme components:
Course GIS and spatial data 1 is recommended before participation.
Recommended or required reading:
Exercise material.
Person responsible:
Kari Moisio

765330A: Galaxies, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

765309A	Galaxies	5.0 op
765630S	Galaxies	6.0 op

ECTS Credits:
5 credits
Learning outcomes:
Student knows the main components of galaxies and theoretical basis of their formation. Student knows the contemporary view of large scale structure and is familiar with the principles of cosmology.
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. The course also covers the exotic world of active galactic nuclei.
Learning activities and teaching methods:
Lectures 32 h, exercises. One written examination.
Target group:
Students of the second year or later.
Recommended optional programme components:
Fundamentals of astronomy (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 Physics

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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Learning outcomes:
To understand the basics of 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.
Contents:
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, 12 exercise sessions (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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits

Language of instruction:
Finnish (optionally English).
Timing:
4. - 5. year
Learning outcomes:
Upon completion of the course, student
- can describe how and where from the Earth's magnetic field is generated
- can describe reasons of temporal and spatial variations of the geomagnetic field
- knows how he geomagnetic field is described mathematically and physically
- knows the instruments used in geomagnetic research on ground and in space
- can describe the magnetic field of other planets and the Sun and how Sun interacts with the Earth's magnetic field
- can describe methods used to investigate Earth's electrical conductivity and magnetic susceptibility
- knows the role of palaeomagnetism in Earth sciences
- can list major phases and inventions in the history of geomagnetic research

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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
Finnish
Timing:
3 rd year
Learning outcomes:
After passing the course the student is able to classify, process and analyse geophysical data.
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 in the B.Sc. degree.
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 Physics
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.cc.oulu.fi/~mpi/opetus/762303A_Geofys_kentat.html

762603S: Geophysical field theory, 8 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Language of instruction:
Finnish
Timing:
4 th or 5 th spring term
Learning outcomes:
After completion the student knows better the mathematical background of geophysical field and how to solve simple field problems using symbolic mathematical software.
Contents:
Geophysical research methods of soil and bedrock are based on the measurements of the spatial and temporal variations of some physical fields. The course provides knowledge on the mathematical formulation of the physical fields behind the geophysical investigation methods and solution to the of simplified field problems related to these methods. The course considers electrostatic, static electric current, magnetostatic, electromagnetic and gravity fields and continuum mechanics. Course also considers the basics of vector analysis, relationship between the geophysical fields and physical material properties, equations of continuity, solutions to the equations of Laplace, Poisson, and Maxwell and the diffusion and wave equations. The computer exercises and practical work utilize symbolic mathematical software.

Learning activities and teaching methods:
Lectures 30 h and 30 h exercises and practical work, two interim exams or final exam and approved work report.
Target group:
Compulsory in MSc studies of geophysics.
Recommended or required reading:
Lecture notes and Eloranta, E., 2007: Geofysiikan kenttäteoria.
Person responsible:
Markku Pirttijärvi
Other information:
Course homepage: http://www.cc.oulu.fi/~mpi/MPopetus.html

762153P: Geophysical laboratory experiments, 2 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
2 credits
Language of instruction:
Finnish (optionally English).
Timing:
2./3. year
Learning outcomes:
Upon completion of the course, student
- understands the significance of observations in geophysical research
- is able to make systematic measurement, estimate the reliability of observations and provide confidence limits of obtained results
- can write a report on work and results in a given time
Contents:
Laboratory exercises associated with geophysical phenomena.
Learning activities and teaching methods:
Laboratory work 16 h (four exercises), home work 24 h, written reports of exercises.
Target group:
Compulsory for B.Sc. students in geophysics.
Recommended or required reading:
Handouts on geophysical laboratory exercises.
Person responsible:
Toivo Korja

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

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

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

Upon completion of the course, student
- knows major geophysical features of the lithosphere in Fennoscandia
-is able to compare these with data and models from other geoscience research (geology, geochemistry, geodesy)
- can list major current research programs and projects investigating the Fennoscandian lithosphere
can list major teams and organizations making lithospheric research in Fennoscandia

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 Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Elena Kozlovskaya

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits

Language of instruction:
Finnish

Timing:
4 th or 5 th year

Learning outcomes:
After completion the student knows the special characteristics of geophysical gravimetric and magnetic methods, anomalies, problem of non-uniqueness, and the basics of data processing and interpretation.

Contents:
Because the variations of density and magnetization create changes in Earth's gravity and magnetic field, the measurements of these fields can be used in geological bedrock mapping and mineral exploration. The course provides knowledge about the geophysical gravity and magnetic field measurements including physical and theoretical background, practical measurement arrangement, data processing and principles of interpretation. Modelling and interpretation software are used in computer exercises to study the generation of gravity and magnetic anomalies of various kinds.

Learning activities and teaching methods:
Lectures 20 h and 20 h demonstrations and practical work, exam and approved report.

Target group:
MSc students of geophysics.

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.cc.oulu.fi/~mpi/MPopetus.html

762616S: Ground Penetrating Radar Sounding, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Moisio, Kari Juhani

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
4 th or 5 th year
Learning outcomes:
After completion the student knows the special characteristics of GPR sounding and how to process and visually interpret GPR data.
Contents:
Ground penetrating radar (GPR) is a high frequency (20-2000 MHz) electromagnetic research instrument that is widely used in surficial and environmental geology and geotechnical and geophysical investigations. The course provides students with the basic knowledge and skills on GPR as a geophysical investigation method. The course deals with theoretical background, practical measurement arrangements, data processing, presentation and analysis. The course includes exercises, where basic mathematics and data processing are introduced, and a compulsory practical work, where the students process and interpret GPR data from their own measurements.
Learning activities and teaching methods:
Lectures 20 h and 20 h demonstrations and practical work, exam and approved report.
Target group:
MSc students of geophysics, students of surficial and environmental geology, and students of water resources and environmental engineering.
Recommended or required reading:
Lecture notes and Maatutkarengas r.y., 2000: Maatutkarengas RY:n 10-vuotisjuhlaseminaari 15.-16.2.2000 Kuopio.
Person responsible:
Markku Pirttijärvi
Other information:
Course homepage: http://www.cc.oulu.fi/~mpi/MPopetus.html

766656S: Heliospheric physics, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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.
Learning outcomes:
The basic objective of this course is to learn the basic physical principles and concepts related to the topics mentioned in Contents.
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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
4 credits
Timing:
4th or 5th autumn
Learning outcomes:
The students can ask relevant questions about the circulatory system, and develop and solve pertaining equations of pressure and flow releationships and energetics.
Contents:
The course covers most important physical and chemical properties of the blood, the electrical and mechanical function of the heart pump, pressure and flow relations in different parts of the circulatory system, laminar and turbulent, and also methods to measure the circulatory functions experimentally.
Learning activities and teaching methods:
Lectures 20 h, calculation exercises 15 h, written exam.
Target group:
Optional in biophysics M.Sc. studies; post-graduate students.
Recommended optional programme components:
Understanding differential equations and basic flow dynamics and basic mammalian anatomy is useful but not required.
Recommended or required reading:
Lectures and lecture notes. Westerhof, Sergiopulos, Noble: Snapshots of hemodynamics, Kluwer and Springer, 2005, 203 pp.
Person responsible:
Matti Weckström

765106P: History of astronomy, 3 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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
Learning outcomes:
After the course the student should have an overall understanding of the history of astronomy, and the development of physical world view in general.
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.
Recommended or required reading:
Michael Hoskin (Ed.): The Cambridge Illustrated History of Astronomy, Cambridge University Press, 1997.
Person responsible:
Heikki Salo

763654S: Hydrodynamics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Learning outcomes:
To understand the basics and some applications of hydrodynamics. The fluid state of matter is an important part of our daily life and its understanding is useful for all physicists, including bio-, geo-, space, astro- and theoretical physicists.
Contents:
Continuity assumption, velocity field, continuity equation, deformation tensor, stress tensor, hydrostatics, derivation of Navier-Stokes equation, solutions of Navier-Stokes equation, inviscid flow, sound waves, turbulence and surface waves on liquids.
Learning activities and teaching methods:
Lectures 26 h, 12 exercise sessions (24 h), one written examination.
Recommended optional programme components:
763101P, 766323A.
Recommended or required reading:
A. R. Paterson: A first course in fluid dynamics, E. Thuneberg, Hyrdodynamiikka (lecture notes). http://physics.oulu.fi/teoreettinen_fysiikka/oj/763654S
Person responsible:
Erkki Thuneberg

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

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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

ECTS Credits:
3 credits
Language of instruction:
English
Learning outcomes:
A successful learner from this course will be able to understand the unique properties of water ice and its significance in the modern world. This knowledge will enable students to formulate the main elements of glacier response to climate and the past evolution of large ice masses as climate has changed.
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 Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

764629S: Identification of linear systems, 5 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Timing:
4th-5th spring
Learning outcomes:
The students can use modern methods to identify linear biological systems.
Contents:
The course introduces the concept of system identification. Starting from Fourier analysis, computation of frequency response functions and coherence functions will be taught. With examples and using real data the meaning, interpretation and use of these functions are also treated. The course ends with independent analysing project.
Learning activities and teaching methods:
Lectures 10 h, project work 20 h.

Target group:
Obligatory for Biophysics M.Sc. students.
Recommended optional programme components:
Biosystem analysis (764364A), Differential equations, Basic programming skills with MatLab.
Recommended or required reading:
Lectures and lecture notes, System identification booklet (in English). Marmarelis V.Z.: Nonlinear dynamic modeling of physiological systems, IEEE Press, 2004. J. Bendat, Nonlinear system techniques and applications, Wiley, New York, 1998. (only parts of these books).
Grading:
Grading is based on project report.
Person responsible:
Matti Weckström

764630S: Identification of nonlinear systems, 6 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
4th-5th spring
Learning outcomes:
The students can use modern computational methods to identify nonlinear biological systems.
Contents:
The course introduces the concept s related to nonlinear systems and how they differ fundamentally from linear ones. Different methods to achieve nonlinear identification are dealt with and the errors in the estimates are also treated. With examples and using real data the meaning, interpretation and use of nonlinear functions are examined. The course ends with independent analysing project.
Learning activities and teaching methods:
Lectures 10 h, project work 20 h.
Target group:
Optional for Biophysics M.Sc. students.
Recommended optional programme components:
Identification of linear systems (764629S), Biosystem analysis (764364A), Differential equations, Basic programming skills with MatLab.
Recommended or required reading:
Lectures and lecture notes, System identification booklet (in English). Marmarelis V.Z.: Nonlinear dynamic modeling of physiological systems, IEEE Press, 2004. J. Bendat, Nonlinear system techniques and applications, Wiley, New York, 1998. (only parts of these books).
Grading:
Grading is based on project report.
Person responsible:
Matti Weckström

765660S: Impact craters, 4 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

4 credits
Timing:
The biennial or triennial nature of the advanced courses the student has to be aware by him/herself of the best time to take any particular course.
Learning outcomes:
The aim is that all students will master the course topics in theory and practice. The graded student achievement will show the level the student has reached this goal.
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.
Recommended optional programme components:
765303A
Recommended or required reading:
Comet/Asteroid Impacts and Human Society: An Interdisciplinary Approach by Peter T. Bobrowsky and Hans Rickman (Hardcover - Feb 21, 2007) Buy new: 150$
Catastrophic Events Caused by Cosmic Objects by Vitaly Adushkin and Ivan Nemchinov (Hardcover - Nov 20, 2007) Buy new: 139$
Latest books and review articles.
Person responsible:
Jouko Raitala

761662S: Infrared spectroscopy, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Timing:
Not lectured every year.
Learning outcomes:
Infrared spectroscopy is used to study molecular vibrations. In this course the principles of high resolution infrared spectroscopy to investigate the rotational fine structure observed in vibrational spectra is studied. The subject is considered from theoretical as well as from experimental point of view. The course is suitable for physicists who intend to work with optical spectroscopy or optics in general in the field of research or in industry.
Contents:
Theoretical part includes molecular energies, group theory, quantum mechanics, vibrational spectroscopy, rotational spectroscopy and high resolution rotation-vibration spectroscopy. In the experimental part the structure and working principles of optical spectrometers especially the Fourier Transform infrared spectrometer (FTIR) are considered.
Learning activities and teaching methods:
Lectures 44 h, exercises 20 h, one written examination.
Recommended optional programme components:
The principles of classical and quantum mechanics.
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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
Finnish
Timing:
4 th or 5 th year.
Learning outcomes:
After passing the course the student knows essential things of geophysical interpretation methods, understands geophysical tomography, the theoretical basics of non-linear optimization and inversion and is able to apply them in interpretation of geophysical data.
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 in the M.Sc. degree.
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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
3 credits
Language of instruction:
Can be taught also in English.
Timing:
4th or 5th spring
Learning outcomes:
After completing this course the student is able to describe the principles and methods of intracellular recording. In addition the student has once performed in practice all the working stages required by the intracellular recording method and is autonomously able to start to practice the working skills required by this kind of studies.
Contents:
This course familiarizes the students with the intracellular recording method and its modifications (e.g. the voltage clamp method) both in theory and in practice.
Learning activities and teaching methods:
ca. 10 h of lectures or demonstrations, ca. 20 h of laboratory works, exam.
Target group:
An optional course, which is organized according to individual agreement and need mainly for the 4th year or older biophysics students, who are specializing to the biophysics of cells and molecules. Can be organized also as a post-graduate course.
Recommended optional programme components:

The courses Cell membrane biophysics (764323A or 764623S) and Information processing in the nervous system (764680S) have to be passed before this course.
Recommended or required reading:
Lectures, group study materials etc. given material. Book: Microelectrode Techniques, ed. D. Ogden, Company of Biologists, Cambridge 1994 (or newer edition, partly).
Person responsible:
Matti Weckström, Kyösti Heimonen

765103P: Introduction to astronomy, 2 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

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
ay765103P	Introduction to astronomy (OPEN UNI)	3.0 op
765101P	Introduction to astronomy I	4.0 op

ECTS Credits:
3 credits
Language of instruction:
Course lectured in Finnish.
Timing:
Autumn
Learning outcomes:
Student understands the role of astronomy in the formation of physical world view, knows the most central astronomical research subjects and can outline the proportions of the Universe.
Contents:
Basic level introduction to astronomical topics: history of astronomy, astronomica methods, the Solar System, the Sun, stars and their evolution, interstellar matter, star clusters, the Milky Way and galaxies.
Learning activities and teaching methods:
Lectures 21 h. One written examination.
Target group:
Students from all faculties.
Recommended or required reading:
Course lectured in Finnish, possible English study material will be decided later.
Person responsible:
Pertti Rautiainen

765101P: Introduction to astronomy I, 4 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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.
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 Physics
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 mechanics, 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.
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

764103P: Introduction to biophysics, 2 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Department of Physics
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

ECTS Credits:
3 credits
Timing:
1st spring
Learning outcomes:
Acquiring basic knowledge of biophysics useful in more advanced courses.
Contents:

The course gives knowledge of basic biological processes from biophysics point of view. The focus is on cellular and molecular mechanisms but also includes introduction to the biophysics of movement and fluid flow phenomena and some other more specialized topics.
Learning activities and teaching methods:
Lectures 21 h, written examination.
Target group:
Students in Physics B.Sc. program (obligatory) and students aiming for Biophysics minor.
Recommended optional programme components:
None. This course is a good starting point for other studies in the field of Biophysics.
Recommended or required reading:
Lectures and lecture notes.
Person responsible:
Kyösti Heimonen, Marja Hyvönen and Matti Weckström

764162P: Introduction to biophysics, 3 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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

ECTS Credits:
5 credits
Timing:
1st spring
Learning outcomes:
Acquiring basic knowledge of biophysics useful in more advanced courses.
Contents:
The course gives knowledge of basic biological processes from biophysics point of view. The focus is on cellular and molecular mechanisms but also includes introduction to the biophysics of movement and fluid flow phenomena and some other more specialized topics.
Recommended optional programme components:
See 764103P Introduction to biophysics.

761645S: Introduction to experimental physical research, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Learning outcomes:
The student will have a basic knowledge of the problems and working paradigms of modern experimental physics.
Contents:
The course introduces the experimental working practices in a research group.
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

762103P: Introduction to geophysics, 2 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

762104P-01 Introduction to solid earth geophysics (part 1): Introduction to geophysics 0.0 op

ECTS Credits:
3 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, spring.
Learning outcomes:
Upon completion of the course, student
- understands the position and role of geophysics in the field of Earth system sciences
- can list major unsolved global research problems in Earth system sciences
- can describe the structure of the Earth and its neighbouring environment in space (spheres), their internal geophysical properties and the interactions between different spheres
- can describe large scale transfer (movement) of rock material inside the Earh and on its surface (convection, plate tectonics)
- can name major geophysical research methods
Contents:
An overview of geophysics: physics of geosphere, hydrosphere, atmosphere and atmosphere. Solid Earth geophysics and Earth Sciences.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, gravimetry, isostasy, tides. Deformation and rheology. Seismology: seismic waves and the internal structure of the Earth. Seismics: refraction and reflection. 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 and exercises 21 h. Examination.
Target group:
Recommended for all interested in the properties, structure and dynamics of the Earth. Compulsory for B.Sc. students in physics.
Recommended or required reading:
Handouts and lecture notes. Ahvenisto, U., Borén, E., Hjelt, S.-E., Karjalainen, T. ja Sirviö, J., 2004. Geofysiikka, Tunne maapallosi. WSOY. Recommended reading: Kakkuri, J., 1991. Planeetta maa. URSA and Lowrie, W., 1997. Fundamentals of geophysics. Cambridge University Press.
Person responsible:
Toivo Korja

762135P: Introduction to global environmental geophysics, 6 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
2 nd - 3 th year
Learning outcomes:
After passing the course the student understands the physical principles of global environmental issues and the use of geophysical methods in local environmental studies.
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 Physics

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:
2. year, spring.
Learning outcomes:
Upon completion of the course, student
- understands the concept of water cycle, can name the elements of the cycle, knows their physical basis and can estimate the magnitude of different components using the water balance equation
- can name methods and knows their principles used to observe evaporation, precipitation and runoff, and knows their spatial and temporal variation in Finland
- can describe the behaviour of water underground in vadoze zone and aquifers and knows how goundwater is formed and how it flows
- can name major geophysical methods used in goundwater research and exploration
Contents:
Introduction to hydrology and hydrogeophysics. 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. Selected parts from: Hooli, J. & Sallanko, J., 1996: Hydrologia luentomoniste.
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 Physics
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 Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Timing:
Not lectured longer.

763114P: Introduction to programming, 4 op

Voimassaolo: - 31.07.2014
Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

521141P Elementary Programming 5.0 op

ECTS Credits:
4 credits
Timing:
2. autumn
Learning outcomes:
The aim is to learn basic concepts of programming like construction choices and loops. The main effort is put into learning the use of functions in splitting the program into simpler subprograms.
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 physics students.
Recommended optional programme components:
Upper secondary school education.
Recommended or required reading:
http://www.raippa.fi/Ohjelmoinnin%20Alkeet
Person responsible:
Jouni Karjalainen

763102P: Introduction to relativity, 3 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763105P Introduction to relativity 1 2.0 op

ECTS Credits:
3 credits
Timing:
Not lectured longer.
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

763105P: Introduction to relativity 1, 2 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

763102P Introduction to relativity 3.0 op

ECTS Credits:
2 credits
Timing:
First spring
Learning outcomes:
To learn the basics of the special theory of relativity.
Contents:
The relativity of time and space, the Lorentz transformation of coordinates and momentum, time dilation and Lorentz contraction.
Learning activities and teaching methods:
Lectures 12 h, exercises 10 h, one written examination.
Target group:
Compulsory
Person responsible:
Erkki Thuneberg

763306A: Introduction to relativity 2, 2 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
2 credits
Timing:
1 st or 2 nd spring term
Learning outcomes:
To learn the basic mathematical tools of the special theory of relativity.
Contents:
Four-vectors, Minkowski diagram of space-time, the invariant space-time distance, the kinematics of scattering processes.
Learning activities and teaching methods:
Lectures 12 h, exercises 10 h, one written examination.
Person responsible:
Erkki Thuneberg

766115P: Introduction to the physical sciences, 1 op

Voimassaolo: - 31.07.2009
Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
1 credits
Language of instruction:
Finnish
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 9 h, 75 % present.
Target group:
Compulsory for student in physical sciences.
Recommended optional programme components:
Including to the course 761011Y Orientation course for new students 2 cu.
Recommended or required reading:
https://wiki.oulu.fi/display/761011Y/
Person responsible:
Marja Hyvönen

761658S: Ionospheric physics, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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
Learning outcomes:
The student understands after the course how the ionosphere is formed in the upper atmosphere and the most important physical processes taking place in the ionosphere. The student masters e.g. the theory of production and loss of ionization, the anisotropic conductivity and electric currents of the ionosphere, and the ambipolar diffusion.
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. This is 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 practical 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, exercises 20 h, 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. This is partly based on the textbook: A. Brekke, Physics of the Upper Atmosphere, John Wiley & Sons, 1997.
Person responsible:
Anita Aikio and Tuomo Nygrén

761121P: Laboratory Exercises in Physics 1, 3 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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
Language of instruction:
The lectures and the instruction material will be in Finnish. The laboratory experiments will be made in groups guided either in Finnish or in English.
Timing:
Autumn, spring.
Learning outcomes:
Main aim is to learn to make safe physical measurements, use different measurement tools, read different scales, handle the data, calculate the error estimations and make a sensible report of the measurements. After this course the student is able to make laboratory experiments and reports independently.
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 Laboratory exercises in physics 2 and 3.
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:
English material is given from laboratory.
http://physics.oulu.fi/fysiikka/oj/761121P/
Person responsible:
Kari Kaila

766107P: Laboratory exercises in physical sciences, 6 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Department of Physics
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 Laboratory exercises in physics 1.
Recommended or required reading:
761107P Fysiikan harjoitustyöt I, 1994. English material is given from laboratory.
http://physics.oulu.fi/fysiikka/oj/766107P/
Assessment methods and criteria:
Written reports of the experiments.
Person responsible:
Seppo Alanko, Toivo Korja (geophysics), Jari Kajava (astronomy)

761308A: Laboratory exercises in physics, 4 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physics
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

766106P: Laboratory exercises in physics 2, 4 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

761120P	Laboratory Exercises in Physics 2	5.0 op
761107P	Laboratory Exercises in Physics I	6.0 op
766107P	Laboratory exercises in physical sciences	6.0 op

ECTS Credits:
4 credits
Timing:
1. - 3. year
Target group:
Compulsory
Person responsible:
Seppo Alanko

766308A: Laboratory exercises in physics 3, 2 - 6 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

761615S	Laboratory exercises in physics 3	5.0 op
761315A	Laboratory Exercises in Physics 3	5.0 op
761308A	Laboratory exercises in physics II	4.0 op

Ei opintojaksokuvauksia.

764625S: Laboratory projects of biophysics, 3 - 6 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

761675S: Laser and synchrotron radiation physics, 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766675S Laser and synchrotron radiation physics 10.0 op

ECTS Credits:
6 credits
Timing:
Not lectured every year.
Learning outcomes:
The student understands the mechanisms of synchrotron radiation generation, and the properties of radiation in different beamlines. The student understands the special characteristics of laser radiation and the instrumentation and measurement designs needed. In addition the student will understand the basics of combined use of lasers and synchrotron radiation in spectroscopic research.
Contents:
The course consists of the basics of synchrotron radiation, its generation, characteristic features, and the interaction mechanisms between radiation and matter. The applications of synchrotron radiation are described, together with the design of the beamlines, instrumentation, and typical experimental targets and the interpretation of measurements. In addition the properties, instrumentation, and experimental designs of laser radiation are described. Especially the combined use of laser and synchrotron radiation physics is described.
Learning activities and teaching methods:
Lectures 35 h, exercises 20 h. One written examination.
Recommended or required reading:
Lecture notes and parts from the book: G. Margarindonto: Elements of Synchrotron Light, Oxford University Press (2002)
Person responsible:
Sami Heinäsmäki

761664S: Laser physics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
Not lectured every year.
Learning outcomes:
The structure and working principle of laser is reviewed in detail. The course is suitable for physicists who intend to work with optics or optical spectroscopy in the field of research or in industry.
Contents:
Introduction to laser physics, Fundamental wave an quantum properties of light, absorption and emission of radiation, laser resonators, pumping and amplification, characteristic properties and applications of laser light, different types of lasers, specific laser systems.
Learning activities and teaching methods:
Lectures 35 h, exercises 20 h, one written examination.
Recommended optional programme components:
766329A Wave motion and optics, 766321A Electromagnetism I and 766322A Electromagnetism II.
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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
35 credits
Timing:
5th year
Learning outcomes:
The student knows the background and methods for the research field of his/her thesis, and is able to perform relatively large research project as well as to handle reporting of the results.
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 in the M.Sc. degree.
Grading:
The departmental council grades the thesis approbatur - laudatur.
Person responsible:
Pertti Kaikkonen
Other information:

761657S: Magnetospheric physics, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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.
Learning outcomes:
The basic objective of this course is to learn the basic physical principles and concepts related to the topics mentioned in Contents.
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 avaruussovellutuksiin. 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 Physics

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
Learning outcomes:
Upon completion of the course, student
- understands bases of magnetotelluric methods
- is able to plan and carry out magnetotelluric survey
- is able to use numerical tools for time series processing, analysis of magnetotelluric impedance tensor and modelling and inversion
- understands how geophysical, petrophysical and geological data are incorporated into the tectono-geological interpretation of conductivity models
- knows major targets of applications of magnetotelluric method

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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
4 credits
Timing:
The biennial or triennial nature of the advanced courses the student has to be aware by him/herself of the best time to take any particular course.
Learning outcomes:
The aim is that all students will master the course topics in theory and practice. The graded student achievement will show the level the student has reached this goal.
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.
Recommended optional programme components:
Planetology I.
Recommended or required reading:
Planetary Mapping (Cambridge Planetary Science Old) by Ronald Greeley and Raymond M. Batson (Paperback - Feb 26, 2007); Price 58$
McFadden, P. Weissman, T. Johnson (2006): Encyclopedia of the Solar System, 2nd Edition, Academic Press (soveltuvin osin).
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

763311A: Mathematical methods, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
3 rd year (fall), especially useful for theoretical physics students, not compulsory.
Learning outcomes:
The course provides mathematical tools needed in advanced courses in theoretical physics. Emphasis is on problem solving.
Contents:
The course is divided into three parts. First we (re-)introduce complex variables, functions, differentiation and integration. We move swiftly to properties of analytic functions, Taylor and Laurent series and classification of singularities. The main goal is to become proficient at complex integration and residue calculation. The second part covers solution of certain ordinary and partial differential equations using power series and Fourier expansions. Frobenius method, orthogonal functions, wave equation, heat equation. Finally we briefly (to the extent time permits) touch upon more concepts relevant to theoretical physics, Fourier and Laplace transforms, distributions, Green's functions, group theory.
Learning activities and teaching methods:

Lectures 26 h, exercises sessions 24 h, one examination.
Recommended optional programme components:
As a prerequisite course Complex Analysis I is recommended, but not required. There is overlap with Complex Analysis I and II and Differential Equations II, but from a more hands-on application perspective.
Recommended or required reading:
Schaum's Outline Series: Theory and problems of complex variables, Mikko Saarela: Lecture notes, E. Kreyszig: Advanced Engineering Mathematics (Wiley, any edition). More references on request. http://physics.oulu.fi/teoreettinen_fysiikka/oj/763311A

763101P: Mathematics for physics, 6 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766101P Mathematics for physics 5.0 op

ECTS Credits:
6 credits
Timing:
First autumn
Learning outcomes:
The course quickly provides the student the basic mathematical knowledge and skills required in physical sciences. The objective is to learn the basics of differential and integral calculus, methods for solving the most typical first and second order differential equations and the basics of vector differential calculus. After the course the student understands the basic mathematical methods needed in physics and is able to apply them to problems arising in the different physics courses. Another objective is also to understand the geometrical meaning of different mathematical concepts and their connection to physical phenomena.
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. http://physics.oulu.fi/teoreettinen_fysiikka/oj/763101P/
Person responsible:
Timo Asikainen

761386A: Maturity test, 0 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
0 credits
Timing:
3. spring
Learning outcomes:
The student knows the vocabulary of the research field of his/her thesis and can independently produce text related to the thesis.

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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
0 credits
Timing:
5. year
Learning outcomes:
The student can independently produce text from the research field of his/her thesis using the language of the thesis.
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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
0 credits
Timing:
5. year
Learning outcomes:
The student can independently produce text from the research field of his/her thesis using the language of the thesis.
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 Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
0 credits
Timing:
5. year
Learning outcomes:
The student can independently produce text from the research field of his/her thesis using the language of the thesis.
Grading:
Pass.
Person responsible:
Juri Poutanen

762679S: Maturity test, 0 op

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

ECTS Credits:
0 credits
Timing:
5 th year
Learning outcomes:
The student can independently produce text from the research field of his/her thesis using the language of the thesis.
Contents:
Written test about a subject of the pro gradu (M.Sc.) thesis. 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 Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
0 credits
Learning outcomes:

The student knows the vocabulary of the research field of his/her thesis and can independently produce text related to the thesis.
Grading:
Pass.
Person responsible:
Juri Poutanen

763385A: Maturity test, 0 op

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

ECTS Credits:
0 credits
Timing:
3rd spring
Learning outcomes:
The student knows the vocabulary of the research field of his/her thesis and can independently produce text related to the thesis.
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 Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
0 credits
Timing:
3rd year
Learning outcomes:
The student knows the vocabulary of the research field of his/her thesis and can independently produce text related to the thesis.
Contents:
The length of the text is recommended to be one exam paper.
Target group:
Compulsory for students of geophysics.
Person responsible:
Pertti Kaikkonen

764395A: Maturity test for BSc, 0 op

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

ECTS Credits:
0 credits
Timing:
3rd spring
Learning outcomes:
The student knows the vocabulary of the research field of his/her thesis and can independently produce text related to the thesis.
Contents:
The student writes a sample essay, which shows that he/she is well acquainted with the field of the thesis.
Learning activities and teaching methods:
The test event.
Target group:
Compulsory for Bachelor of Science in Biophysics.
Person responsible:
Matti Weckström

764695S: Maturity test for MSc, 0 op

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

ECTS Credits:
0 credits
Timing:
5. year
Learning outcomes:
The student can independently produce text from the research field of his/her thesis using the language of the thesis.
Contents:
The student writes a sample essay, which shows that he/she is well acquainted with the field of the thesis.
Learning activities and teaching methods:
The test event.
Target group:
Compulsory for Master of Science in Biophysics.
Person responsible:
Matti Weckström

766323A: Mechanics, 6 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physics
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:
6 - 7 credits
Language of instruction:
This course will be lectured in Finnish. Course book is in English. Most of the exercises are in English.
Timing:
Autumn continuing to spring
Learning outcomes:
Classical mechanics helps to see and understand phenomena in our everyday life.
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 46 h, exercises 24 h (12 x 2 h). Two written intermediate examinations or one final examination.
Target group:
Compulsory.
Recommended optional programme components:
Needs a course 763101P Mathematics for physics, 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
Other information:
https://wiki.oulu.fi/display/766323A/

764369A: Medical Equipments, 3 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

764633S: Medical Physics, 4 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
4 credits
Timing:
4th-5th Autumn
Learning outcomes:
The students are familiar with most common devices and technologies used in the hospitals.

Contents:
The course gives an introduction to the basic physics related to biomedical equipment used in hospitals (e.g. imaging and therapeutic devices). Covered topics include e.g. x ray imaging, computed tomography, magnetic resonance imaging, isotope techniques, radiation therapy and biomedical signal processing. The course contents may vary depending on the lecturers.
Learning activities and teaching methods:
Lectures 30 h, calculus assignments 15 h, exam.
Target group:
Physics MSc students with biophysics major or/and medical physics minor, biomedical engineering students.
Recommended optional programme components:
Recommended: physics basic courses and Radiation physics, biology and safety (764317A).
Recommended or required reading:
Dowsett, Kenny, Johnston. The Physics of Diagnostic Imaging, 2nd ed., Hodder Arnold, 2006
Additional literature depending on the lecturers.
Person responsible:
Iikka Salmela
Other information:
https://wiki.oulu.fi/display/764633S/

765677S: Meteorites, 4 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
4 credits
Timing:
The biennial or triennial nature of the advanced courses the student has to be aware by him/herself of the best time to take any particular course.
Learning outcomes:
The aim is that all students will master the course topics in theory and practice. The graded student achievement will show the level the student has reached this goal.
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.
Recommended optional programme components:
Basics in Planetology I, planetological ang geological studies.
Recommended or required reading:
Field Guide to Meteors and Meteorites (Patrick Moore's Practical Astronomy Series) by O. Richard Norton and Lawrence A. Chitwood (Paperback - Jun 6, 2008); Price 39.95$
Meteorites: A Petrologic, Chemical and Isotopic Synthesis (Cambridge Planetary Science) by Robert Hutchison (Paperback - Jan 29, 2007); Price 95$
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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
Autumn
Learning outcomes:
The aim is to learn theoretical many-particle methods to simulated strongly correlated quantum systems.
Contents:
Advanced methods for theoretical investigations of strongly correlated quantum systems are presented. 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.
Person responsible:
Mikko Saarela

762630S: Modelling of electromagnetic fields, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
4 th or 5 th year
Learning outcomes:
After passing the course the student knows how to find out theoretical electromagnetic responses of the earth model either by electromagnetic scale modelling or by analytical solution or by numerical modelling. The student understands the basics of different numerical methods and is able to apply them in solving electromagnetic field equations.
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 30 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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
4 credits
Timing:
4nd - 5th year
Learning outcomes:
The student gets acquainted with the properties of essential biomolecules and the methodology for the research of biomolecular systems.
Contents:
The biophysical properties of biomolecules and their interactions with the environment of water and ions. The principles of experimental methodology are considered together with the introduction to the simulation methods at the atomic and molecular level.
Learning activities and teaching methods:
Lectures 16 h, exercises, and small projects, final exam.
Target group:
Voluntary.
Recommended optional programme components:
Biophysics of cell membranes (764323A) and Spectroscopic methods (761359A).
Recommended or required reading:
Lecture material; Tom A. Waigh: Applied Biophysics, A Molecular Approach for Physical Scientists, John Wiley & Sons Ltd., Chichester 2007 (partly).
Person responsible:
Marja Hyvönen

761661S: Molecular quantum mechanics, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
Not lectured every year.
Learning outcomes:
After passing the course, the students can routinely apply the formalism of quantum mechanics and group theory to molecular problems, understand the basic features of the electronic structure of atoms and molecules, and know about the methods of electronic structure calculation.
Contents:
The course will provide the necessary background for students interested in molecular spectroscopy and/or the electronic structure calculations of molecules, materials and nanostructures. Subject matters: the basics of quantum mechanics, group theory, perturbation theory, variation theory, the structure and spectra of atoms, molecular electronic structure, computation of molecular electronic structure (quantum chemistry).
Learning activities and teaching methods:
Lectures 35 h, demonstrations 20 h, final examination.
Target group:
Advanced undergraduate and beginning graduate students of physics, chemistry and materials sciences.

Recommended optional programme components:
Necessary background: Intermediate courses in atomic and thermal physics, or the corresponding knowledge. The course constitutes the basis for the graduate course Molecular properties, which treats Chapters 10-13 of the textbook.
Recommended or required reading:
P.W. Atkins and R.S. Friedman, "Molecular Quantum Mechanics", 4th edition, Chapters 1 - 9, Oxford University Press, 2005.
https://wiki.oulu.fi/display/761661S/
Person responsible:
Juha Vaara

763624S: Monte Carlo and simulation methods, 6 op

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

ECTS Credits:
6 credits
Timing:
Not lectured longer.
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 Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
Not lectured every year.
Learning outcomes:

The course gives students an understanding of the principles of the imaging methods based on nuclear magnetic resonance (NMR) and explains how NMR imaging can be used to characterize physical properties of various materials.

Contents:
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:
Physics and chemistry students directing at materials research.

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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits

Timing:
Not lectured every year.

Learning outcomes:
After a successful pass of the course, student understands the physical basis of NMR phenomenon and realizes the potential of NMR spectroscopy in studies of molecular and materials properties.

Contents:
NMR (Nuclear Magnetic Resonance) spectroscopy is a most applicable tool to study the physical properties of all states of matter. It makes feasible, for example, the determination of molecular structures, even those of biological macromolecules, other molecular properties and the study of their dynamics. The most well-known application of NMR phenomenon is magnetic resonance imaging (MRI).
During the course, students get familiar with the basics of NMR spectroscopy, parameters affecting the structure of NMR spectra and spectral simulations. NMR allows the manipulation of nuclear spins applying pulse sequences. Various pulse sequences related to spectral editing and polarization transfer will be treated as well as basics of multidimensional NMR, and structure of NMR spectrometer.

Learning activities and teaching methods:
Lectures 44 h, exercises 20 h. One written examination.

Target group:
Students in physics and chemistry.

Recommended optional programme components:
Basic knowledge on quantum mechanics and atomic physics helps but is not compulsory.

Recommended or required reading:
Material will be distributed during the course. Suitable literature are, for example, M.H. Levitt, Spin dynamics. Basics of Nuclear Magnetic Resonance (John Wiley & Sons, Chichester, 2001). 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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

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

764680S: Neural information processing, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Can be taught also in English.
Timing:
4 th autumn
Learning outcomes:
After passing this course the student can describe and explain the basic principles in the information processing of neurons. The student is also able to solve, analyze and calculate problems and exercises concerning this field. In addition the student is able to start deeper studies on the literature of this scientific field.
Contents:
The course introduces the basics of the cellular functions concerning neural information processing, for example: nerve cell membrane phenomena, synaptic functions, neural signals, neuronal information. In addition some special issues of neuronal information processing are dealt with.
Learning activities and teaching methods:
Lectures ca. 30 h, calculation exercises 15 h, exam, home exam.
Target group:
This is an optional course for the students in the biophysics master program (major) and in biophysics minor.
Recommended optional programme components:
Cell membrane biophysics (764323A or 764623S) is recommended to be done before this course.
Recommended or required reading:
Lectures and other material given during the course.
Person responsible:
Matti Weckström, Kyösti Heimonen

766334A: Nuclear and particle physics, 2 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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
Learning outcomes:
The course gives an overview of the fundamentals of nuclear and particle physics.
Contents:
The course 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.
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 and R. Resnick: Quantum physics of atoms, molecules, solids, nuclei, and particles, John Wiley & Sons (in part).
Person responsible:
Juhani Lounila

763315A: Numerical modelling, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
4 credits
Timing:
Second spring
Learning outcomes:
The aim is to learn symbolic and numerical modeling with modern programming tools. In addition an introduction to latex-based processing of mathematical text is presented.
Contents:
The course introduces basic symbolic and numerical modeling of physical phenomena using Mathematica-program. 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 Introduction to C-programming (recommended).
Recommended or required reading:
Mathematica notebook.
Person responsible:
Mikko Saarela

763616S: Numerical programming, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
4. autumn
Learning outcomes:
The aim of the course is to learn numerical methods and algorithms derived from them. Special emphasis is in the use of program libraries and graphical presentation.
Contents:
Numerical algorithms are derived for differentiation, integration and interpolation. Ordinary differential equations and differential equations with eigenvalues are solved. Algorithms for linear equations and matrix equations with eigenvalues are given. The fast Fourier transform is derived. The programming language is C or Fortran. The reports are written in latex and the graphics is drawn with gnuplot.
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 Introduction to C-programming.
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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761685S Optics 5.0 op

ECTS Credits:
8 credits
Timing:
Not lectured every year.
Learning outcomes:
Chosen fields of optics are studied in great detail. The course is suitable for physicists who intend to work with optics or optical spectroscopy in the field of research or in industry.
Contents:
Classical optics (electromagnetic waves, dispersion, propagation of light, geometrical optics, aberrations, polarization, interference, diffraction, coherence) and chosen fields in modern optics (for example Fourier optics, non-linear optics, light modulation, T-optics, light quides, beam tracing, numerical methods, etc...) .
Learning activities and teaching methods:
Lectures 44 h, exercises 20 h, one written examination.
Recommended optional programme components:
761329A, 761321A and 766322A.
Recommended or required reading:

F. L. Pedrotti, L.S. Pedrotti: Introduction to optics, E. Hecht: Optics.
http://physics.oulu.fi/fysiikka/oj/761665S/
Person responsible:
Seppo Alanko

761011Y: Orientation course for new students, 2 op

Opiskelumuoto: General Studies
Laji: Course
Vastuuyksikkö: Department of Physics
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:
This course will be given in Finnish.
Timing:
1 st autumn
Learning outcomes:
The course aims to familiarize the new students in the university and in teaching and research at the Department of Physics.
Contents:
The aim of the course is to introduce new students to the university, academic studies and the studies of physics. This course will also introduce the research areas of the Department of physics. The research is made in physics: space physics, electron, infrared and NMR spectroscopy as well as in biophysics, theoretical physics, astronomy and geophysics. One hour 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:
Group work 10 - 15 h. Lectures 10 h, 75 % present.
Target group:
Compulsory for students of the physics.
Person responsible:
Anja Pulkkinen and Marja Hyvönen

762085Y: Orientation course for new students, 2 op

Voimassaolo: - 31.07.2009
Opiskelumuoto: General Studies
Laji: Course
Vastuuyksikkö: Department of Physics
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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
3 credits
Learning outcomes:
Mastering the theory and practice of patch-clamping living cells.
Contents:
Theory of using glass capillaries in patch-clamp configuration, errors and caveats in recordings, basic analysing techniques of whole-cell and isolated patch data; practical exercise.
Learning activities and teaching methods:
Lectures 10 h, laboratory practice 20 h, exam.
Target group:
Optional for biophysics M.Sc. students; post-graduate students.
Recommended optional programme components:
Optional in biophysics M.Sc. studies. The courses "Cell membrane biophysics" and "Neuronal information processing" are necessary (not required formally).
Recommended or required reading:
Lectures. Books: The Axon guide, Axon coroporation (available free via the internet), others: Microelectrode Techniques, ed. by D. Ogden, Company of Biologists, Cambridge 1994 (or newer); Sakmann and Neher, Single-channel recording, Plenum, New York, 1995 (or newer).
Person responsible:
Matti Weckström

762327A: Physical Properties of Rocks, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
Not lectured every year.
Learning outcomes:
After passing the course the students will understand basic principles of generating and maintaining vacuum atmosphere using different kinds of vacuum pump systems and pressure gauges. During the course the students will form a basic understanding to the experimental research of atomic- and molecular physics.
Contents:
The course will focus on the methods and special requirements on experimental research on the field of atomic- and molecular physics. The lessons and demonstration cover the basic principles related to generation and maintaining a vacuum environment necessary for experiments. The students will be introduced to the designing of a vacuum system and learn the vacuum diagnostics as well as the working principles of most common vacuum pumps and pressure gauges. The course will also cover introduction to charge particle and radiation detection and analysis.
Learning activities and teaching methods:
Lectures 30 h, exercises 30 h. One written examination.
Target group:
Optional
Recommended or required reading:
Lecture notes.
Person responsible:
Marko Huttula

762607S: Physical properties of rocks, 6 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 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:
4. or 5. year for students in geophysics.

Learning outcomes:
Upon completion of the course, student
- understands the position, role and significance of petrophysics (rock property analysis) in geophysical and geological research
- can explain physical properties of major rocks and rock forming minerals and their mutual dependence
- knows how temperature and pressure affect physical properties of rocks
- knows how the structure of rocks affect their physical properties
- can use petrophysical data in geological interpretation of geophysical models
- is able to measure major petrophysical properties of rock samples

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 M.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

766338A: Physics for teachers, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761316A Being a teacher in mathematical subjects 5.0 op

ECTS Credits:
4 credits

Language of instruction:
This course will be given in Finnish.

Timing:
2. - 3. spring

Learning outcomes:
The aim of the course is to orient the teacher students by giving them preliminary skills before their educational studies.

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

764116P	Radiation physics, biology and safety	3.0 op

ECTS Credits:
3 credits
Recommended or required reading:
http://physics.oulu.fi/biofysiikka/oj/764117P/
Person responsible:
Seppo Alanko and Kyösti Heimonen

765303A: Planetology I, 7 op

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

ECTS Credits:
5 credits
Learning outcomes:
The aim is that all students will master the course topics in theory and practice. The graded student achievement will show the level the student has reached this goal.
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.
Recommended or required reading:
Planetary Systems and the Origins of Life Edited by Ralph Pudritz, Paul Higgs, Jonathon Stone. Published December 2007 | Hardback | ISBN-13:9780521875486 |
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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Learning outcomes:
The aim is that all students will master the course topics in theory and practice. The graded student achievement will show the level the student has reached this goal.
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.
Recommended or required reading:
Jupiter Odyssey: The Story of NASA's Galileo Mission By David M. Harland. Published by Springer, 2000; ISBN 1852333014, 9781852333010, 448 pages
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 Physics

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.
Learning outcomes:
The basic objective of this course is to learn the basic physical principles and concepts related to the topics mentioned in Contents.
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 Physics

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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
3 - 9 credits
Learning outcomes:
After practical training the student understands better the actual needs of employment.
Contents:

Have you found a job, e.g. a summer job, which supports your studies in biophysics, and could be accepted as a practical training? One month of employment corresponds 1.5 study points. Maximum of 3 study points from practical training can be included to Bachelor or Master of Science studies in biophysics. The rest are counted as extra study points.
Target group:
Voluntary.
Person responsible:
Matti Weckström

761337A: Practical training, 3 - 6 op

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
3 - 6 credits
Learning outcomes:
After practical training the student understands better the actual needs of employment.
Contents:
Have you found a job, e.g. a summer job, which supports your studies in physics, and could be accepted as a practical training? One month of employment corresponds 1.5 study points. Maximum of 6 study points from practical training can be included in Bachelor and/or Master of Science studies in physics.
Learning activities and teaching methods:
Training and a written report.
Target group:
Optional for physics students.
Person responsible:
Anja Pulkkinen

762352A: Practical training, 5 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Learning outcomes:
In practical training, student is introduced to working life in geophysics, and thereby supported and advanced student's studies. In addition, training gives an overview of technical and economic organisation, administration and supervision of the work in the company or equivalent organisation in question.
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 (minimum 2 months) and a written report.
Target group:
Recommended for M.Sc. students in geophysics.
Person responsible:
Toivo Korja

763684J: Practical training for PhD studies, 2 - 8 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Post-graduate Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
2-8 credits
Contents:
The main duties of PhD students in the Physics Training program are gaining expertise on his/her field of specialty, carry out research in this field and pass successfully exams of the courses agreed in the post-graduate study plan. Apart from these, he/she should be able to paraphrase novice students, colleagues and ordinary citizens about physical phenomena and his/her own research field. This training is aimed at introducing post-graduate students to clear and natural performance in various teaching events and in later tasks outside university.
Training is documented in the post-graduate study plan. It gives 8 cu at the maximum. Each teaching period of 80 hours during an academic year results in 2 cu. The loading factors agreed in the department are taken into account when counting the teaching hours.

762684J: Practical training for PhD studies, 2 - 8 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Post-graduate Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
2-8 credits
Contents:
The main duties of PhD students in the Physics Training program are gaining expertise on his/her field of specialty, carry out research in this field and pass successfully exams of the courses agreed in the post-graduate study plan. Apart from these, he/she should be able to paraphrase novice students, colleagues and ordinary citizens about physical phenomena and his/her own research field. This training is aimed at introducing post-graduate students to clear and natural performance in various teaching events and in later tasks outside university.
Training is documented in the post-graduate study plan. It gives 8 cu at the maximum. Each teaching period of 80 hours during an academic year results in 2 cu. The loading factors agreed in the department are taken into account when counting the teaching hours.

765684J: Practical training for PhD studies, 2 - 8 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Post-graduate Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
2-6 credits
Contents:

The main duties of PhD students in the Physics Training program are gaining expertise on his/her field of specialty, carry out research in this field and pass successfully exams of the courses agreed in the post-graduate study plan. Apart from these, he/she should be able to paraphrase novice students, colleagues and ordinary citizens about physical phenomena and his/her own research field. This training is aimed at introducing post-graduate students to clear and natural performance in various teaching events and in later tasks outside university.
Training is documented in the post-graduate study plan. It gives 8 cu at the maximum. Each teaching period of 80 hours during an academic year results in 2 cu. The loading factors agreed in the department are taken into account when counting the teaching hours.

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

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
3 credits
Timing:
2 nd - 4 th year
Learning outcomes:
To see working in practice.
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 Physics

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

Opintokohteen kielet: Finnish

ECTS Credits:
20 credits
Language of instruction:
Finnish, English
Timing:
4. - 5. year
Learning outcomes:
The student knows the background and methods for the research field of his/her thesis, and is able to perform relatively large research project as well as to handle reporting of the results.
Contents:
A written M.Sc. thesis of approximately 50 pages.
Target group:
Compulsory for subject teacher line
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.

764697S: Pro gradu thesis, 35 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
35 credits
Timing:
Usually 5th year.
Learning outcomes:
The student knows the background and methods for the research field of his/her thesis, and is able to perform relatively large research project as well as to handle reporting of the results.
Contents:
Final thesis of the major studies for Master of Science in Biophysics. Thesis is based mostly to student's own research, which is, however, strictly supervised.
Learning activities and teaching methods:
The student gets independently acquainted to certain field of biophysics and prepares, based on own research, a thesis of approximately 50 pages.
Target group:
Compulsory for Master of Science in Biophysics.
Grading:
The dean of the faculty orders the examiners for the thesis according to the suggestion of the professor of biophysics. The thesis is accepted and graded by the board of the department. The grade is between approbatur and laudatur.
Person responsible:
Matti Weckström

763682S: Pro gradu thesis, 20 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Department of Physics

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

Opintokohteen kielet: Finnish

ECTS Credits:
20 credits
Timing:
4. - 5. year
Learning outcomes:
To learn how to make an independent research project.
Contents:
For subject teacher line based mainly on literature search. Length approximately 50 pages. Includes a seminar talk.
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 Physics

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

Opintokohteen kielet: Finnish

ECTS Credits:
35 credits
Timing:
4. - 5. year
Learning outcomes:
The student knows the background and methods for the research field of his/her thesis, and is able to perform relatively large research project as well as to handle reporting of the results.
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 approbatur - 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 Physics

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

Opintokohteen kielet: Finnish

ECTS Credits:
35 credits
Language of instruction:
Finnish, English
Timing:
5. year
Learning outcomes:

The student knows the background and methods for the research field of his/her thesis, and is able to perform relatively large research project as well as to handle reporting of the results.
Contents:
Final thesis of the major studies for Master of Science in Physics. Thesis is based mostly to student's own research, which is, however, strictly supervised.
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 Physics

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

Opintokohteen kielet: Finnish

ECTS Credits:
20 credits
Timing:
5th year
Learning outcomes:
The student knows the background and methods for the research field of his/her thesis, and is able to perform relatively large research project as well as to handle reporting of the results.
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 approbatur - 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 Physics

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

Opintokohteen kielet: Finnish

ECTS Credits:
35 credits
Timing:
4. - 5. year
Learning outcomes:
To learn how to make a large independent research project.
Contents:

Written study about some special topic within theoretical physics, based on own research work and literature search. Length more than 50 pages. Includes a seminar talk.
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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
3. spring
Learning outcomes:
The aim is to learn to find out hierarchical structures in physical systems and to model them using object oriented programming tools.
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 Introduction to C-programming.
Recommended or required reading:
Strourstrup: The C ++ Programming language.
Person responsible:
Pekka Pietiläinen

766647S: Quantum Information, 6 op

Voimassaolo: 01.01.2009 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
6 credits
Language of instruction:
English
Learning outcomes:
The course introduces into the main concepts and promises of quantum computations; it starts from a short account on classical computations, outlines the basic mathematics and models of quantum computations, and discusses various topics from quantum communication, quantum algorithms, entanglement as well as quantum measures.
Contents:
Quantum information is a rather young and multidisciplinary field of modern physics in which many questions, that have been raised during the last decade, have not been answered yet until now. This makes this field a very

interesting topic and attracts many students and researchers from different areas, including mathematicians, physicists, computer scientists, quantum opticians and others. Quantum information shows in particular that the laws of physics and information processing are closely linked to each other. In this lecture, we present the foundations of quantum information science and discuss also the relationship between physics and information.
Learning activities and teaching methods:
Lectures 35 h, exercises 20 h, one examination.
Target group:
This lecture is appropriate for 3rd year under-graduate and higher.
Recommended or required reading:
M.A. Nielsen and I.L. Chang; Quantum Computation and Quantum Information (Cambridge University Press, 2000 and later). Lecture notes.
Person responsible:
Stephan Fritzsche
Other information:
https://wiki.oulu.fi/display/766647S/

763625S: Quantum field theory, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
10 credits
Language of instruction:
English/Finnish
Timing:
Not lectured longer.
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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763612S Quantum mechanics I 10.0 op

ECTS Credits:
10 credits
Timing:
3. autumn
Learning outcomes:
Applications of modern nanotechnology based on quantum mechanics belong to our every day life. Particles in this microworld are in quantum states classified with quantum numbers and corresponding wave functions. Quantum states are solutions of the Schrödinger equation and their eigenvalues are the measurable quantities. The aim of the course is the learn to solve the Schrödinger equation in one- and three-dimensional problems, which have important applications in condensed matter theory as well as in atomic, nuclear and molecular physics. One of the basic principles of quantum mechanics is the Heisenberg uncertainty principle, which states that the position and the velocity of a particle can not be measured exactly at the same time. The aim of the course is to understand what uncertainty principle means in practice.
Contents:
The course begins with basic principles and postulates of quantum mechanics, which lead to derivation of the Schrödinger equation. As examples several one-dimensional problems for scattering and bound states are solved. Special emphasis is put on the symmetry of the system. In three-dimensional problems the symmetry is connected with the angular momentum. The corresponding operators and quantum numbers are derived. As examples the hydrogen atom and harmonic oscillator are solved. The Heisenberg uncertainty relation is presented. The time independent perturbation theory with some examples is introduced.
Learning activities and teaching methods:
Lectures 50 h, 13 exercises. Two written intermediate examinations or one final examination.
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).
http://physics.oulu.fi/teoreettinen_fysiikka/oj/763312A
Person responsible:
Mikko Saarela

763612S: Quantum mechanics I, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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.
Recommended or required reading:
http://physics.oulu.fi/teoreettinen_fysiikka/oj/763312A
Person responsible:
Mikko Saarela

763313A: Quantum mechanics II, 10 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763613S Quantum mechanics II 10.0 op

ECTS Credits:
10 credits
Timing:
3. spring
Learning outcomes:
Heisenberg developed representation of quantum mechanics, which is based on matrices and the theory of Hilbert space. Measurable quantities are described by Hermitian operators and their eigenvalues are results of measurements. A quantum state is a linear combination of the eigenstates of the Hermitian matrix and the corresponding coefficients determine the probability of the measured result. The representation the system can by transformed by unitary transformations without changing the measurable quantities. The aim of the course is the understand these basic principles of quantum mechanics.
Contents:
An important example of the basic ideas in quantum mechanics 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 ionic Hydrogen molecule and He-atom 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 or one final examination.
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 Physics

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.
Learning outcomes:

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.

Contents:
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, one written examination.

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 Physics

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 term

Learning outcomes:
Radioactive materials and ionizing radiation are inevitable elements in modern environment. Radioactivity is widely used in medicine, industry, and power production. In this course the physical principles of radiation and its uses as well as the regulations for radiation safety in Finland are reviewed. The objective is to obtain basic facts for general discussion in society, for example.

Contents:
Basics on nuclear physics and radioactivity, interaction of radiation and matter, radiation detectors, applications of radiation, radiation in the environment, 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:
Part of the core studies for Bachelor of Sciences. First part of the course 764117P Säteilyfysiikka, biologia ja turvallisuus.

Recommended optional programme components:
None.

Recommended or required reading:
Säteilyfysiikka ed.by Seppo Alanko (2007), STUK (Radiation and Nuclear Safety Authority in Finland) regulatory guides and lecture notes. http://physics.oulu.fi/fysiikka/oj/761117P/

Person responsible:
Seppo Alanko

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

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

764116P: Radiation physics, biology and safety, 3 op

Voimassaolo: 01.08.2009 - 02.12.2010
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

761117P	Radiation physics	2.0 op
764117P	Physics, Biology and Safety Radiation	3.0 op

ECTS Credits:
3 credits
Timing:
2nd or 3rd spring
Learning outcomes:
After finishing the course the student is able to describe the basic principles of radiation physics and explain the essential effects of ionising radiation function on biological organisms. In addition, the student remembers the essential features of radiation safety and laws and regulations (in Finland) concerning this. The course introduces the knowledge necessary to pass the so called "responsible manager for radiation safety" exam (in Finland).
Contents:
The course introduces the basic information necessary for radiation safety in industry and research where ionising radiation is used. During the course the properties of ionising electromagnetic radiation (for example X-radiation), particle radiation and radioactive substances are introduced and described in addition with their biological effects and law and regulation (in Finland) concerning the radiation safety.
Learning activities and teaching methods:
Lectures 26 h, calculation exercises 8 h, home exam, final exam.
Target group:
Biophysics students (compulsory in minor, LuK) and those other physics students, who are required to do this course, and students in biomedical engineering program.
Recommended optional programme components:
Not necessary.
Recommended or required reading:
Lecture notes and handouts, required law texts (in Finnish).
Person responsible:
Seppo Alanko and Kyösti Heimonen

765676S: Radiative Processes in Astrophysics, 8 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physics
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 Physics

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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Timing:
The course is lectured every second or third year and the student has to be aware by him/herself of the best time to take this particular course.
Learning outcomes:

The aim is that all students will master the course topics in theory and practice. The graded student achievement will show how the student has reached this goal.
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 (6th edition; John Wiley & Sons 2008) ISBN 978-0-470-05245-7
Introduction to Remote Sensing, Fourth Edition by James B. Campbell (Guilford Press, 2008) ISBN-10: 1-59385-319-X / ISBN-13: 978-1-59385-310-8
Aerial Photography and Image Interpretation, 2 nd Edition by David P. Paine, James D. Kiser, 648 pages (Wiley 2003) ISBN: 978-0-471-20489-3
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 Physics

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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
10 credits
Timing:
4nd - 5th year
Learning outcomes:
The student understands the character of research work and knows the principles of presenting the research results.
Contents:

Research or development in a real working environment. When agreed, the project can be combined with summer job or practical training.
Learning activities and teaching methods:
Objective-oriented project with final report of the work.
Target group:
Compulsory for Master of Science in Biophysics.
Recommended or required reading:
Depending of the project.
Person responsible:
Matti Weckström

766651S: Research project in physics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Learning outcomes:
The student has increased experience after participating in a science project and has thereby a better understanding of scientific work in that selected area of physics.
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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Timing:
3 rd-5 th year
Learning outcomes:
After this course student will understand the importance of seismology and related theoretical background in investigation of the Earth's deep structure. Student can explain the seismic wave phenomena, wave propagation, and the difference and significance of different seismic waves. Student can define basic theory and terminology behind seismic observations, analysis and interpretation. Student also realizes the relationship between seismology and plate tectonics and can define Earth's large scale seismic structure.
Contents:
This course focuses in the fundamentals of the most important methods for investigating the Earth's deep structure, i.e., seismological and seismic method. Course starts with some history of seismology, theory of wave

motion, seismic waves, their propagation and properties. Seismic ray, raytracing and travel time inversion. Seismic registrations and the Earth's deep structure. Location and magnitudes of earthquakes and fault plane solution. The structure of crust, mantle and core in the light of seismic research. The relationship between seismology and plate tectonics and 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: Stein, S. and Wysession, M., 2003: An introduction to seismology, earthquakes, and earth structure. Shearer, P.M., 1999: Introduction to seismology. Bolt, B.A., 1999: Inside the Earth. Evidence from earthquakes; Bullen, K.E. & Bolt, B.A., 1985: An introduction to the theory of seismology.
Person responsible:
Kari Moisio

765609S: Selenology, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
The biennial or triennial nature of the advanced courses the student has to be aware by him/herself of the best time to take any particular course.
Learning outcomes:
The aim is that all students will master the course topics in theory and practice. The graded student achievement will show the level the student has reached this goal.
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.
Recommended or required reading:
Observing the Moon: The Modern Astronomer's Guide by Gerald North (Hardcover - Jul 30, 2007); Price 47$
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 Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Moisio, Kari Juhani

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
4 th or 5 th year
Learning outcomes:
After this course student will understand how seismic refraction and reflection soundings are used to investigate the structure of soil and bedrock. Student will understand theoretical background, limitations and error sources of both methods. Student can solve basic equations of refraction and reflection methods, interpretate and analyse measured data. Student can also use seismic equipment in the field and produce seismic data.
Contents:
This course gives basic knowledge required for seismic refraction and reflection soundings and their interpretation. Contents of this course; Physical principles and theory of seismic refraction and reflection soundings and measurement in practice. Interpretation and correction of seismic soundings. Case histories. Independent work includes refraction or reflection 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: Burger, H.R., 2006: Introduction to Applied Geophysics: Exploring the Shallow Subsurface; 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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Timing:
4-5th year
Learning outcomes:
The student is able to use different modelling and simulation techniques in the analysis of such biosystems and control circuits that can be described with either linear or nonlinear differential equations.
Contents:
The principles of the levels of simulations are described in lectures. Furthermore, the principles are utilized in practicals, from which students write reports.
Learning activities and teaching methods:
Lectures 8 h, practicals 4 h, 4 simulation reports.
Target group:
Compulsory in MSc in biophysics.
Recommended optional programme components:
Basics of control and systems technique are useful. Additionally, Virtual measurement environments (764327A) is recommended before this course. Knowing Matlab and SIMULINK software is also useful.
Recommended or required reading:
Lecture handouts; M.C.K. Khoo: Physiological Control Systems, IEEE Press, New York, 2000.
Assessment methods and criteria:
Based to simulation reports.
Person responsible:
Matti Weckström

766654S: Solar physics, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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.
Learning outcomes:
The basic objective of this course is to learn the basic physical principles and concepts related to the topics mentioned in Contents.
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 Physics

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 Physics

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
Learning outcomes:
To understand the basics of solid state physics. The rapid development of technology is largely based on understanding the properties of the solid state. There are many interesting phenomena in solid state physics, which are consequences of very large number of particles and their interactions.
Contents:
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 for students in physics .
Recommended optional programme components:
Atomic physics (766326A), Electromagnetism (766321A, 766322A). An important supporting course is Thermophysics (766322A).
A more extensive course on solid state physics is Condensed matter physics (763628S).
Recommended or required reading:
H.M. Rosenberg: The Solid State, C. Kittel: Introduction to solid state physics.
Person responsible:
Erkki Thuneberg

764606S: Special advanced course, 5 - 9 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
3 - 9 credits
Timing:
2nd - 4th year
Learning outcomes:
After the special course the student has essentially deeper understanding of the chosen field of biophysics or of the chosen methodology.
Contents:
The topical questions and methods of biophysics evolve rapidly. Therefore, this course can be utilized to keep the studies of biophysics up to date in subjects that are not included to other courses.
Learning activities and teaching methods:
For instance lectures, exercises, and small projects depending of the subject.
Target group:
Voluntary.
Person responsible:
Matti Weckström

765394A: Special course, 7 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physics
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 Physics
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 Physics
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 Physics

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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
Variable 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.

761359A: Spectroscopic methods, 5 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766359A Spectroscopic methods 7.0 op

ECTS Credits:
5 credits
Timing:
Not every year.
Learning outcomes:
After a successful pass of the course, student knows the principles of various spectroscopic methods and what kind of physical/biophysical phenomena can be studied and what kind of information can be obtained with these methods.
Contents:
Basic principles of infrared, mass and NMR spectroscopy and röntgen analytics are introduced.
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 for students directing at some of the lines in atomic, molecular and materials physics.
Recommended optional programme components:
None.
Recommended or required reading:
Partly distributed through net, and partly as paper copies during the course.
Person responsible:
Jukka Jokisaari

764359A: Spectroscopic methods, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Timing:
Not lectured every year.
Learning outcomes:
After a successful pass of the course, student knows the principles of various spectroscopic methods and what kind of physical/biophysical phenomena can be studied and what kind of information can be obtained with these methods.
Contents:
Basic principles of infrared, mass and NMR spectroscopy and röntgen analytics are introduced.
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 for students directing at some of the lines in atomic, molecular and materials physics.
Recommended optional programme components:
None.
Recommended or required reading:
Partly distributed through net, and partly as paper copies during the course.
Person responsible:

Jukka Jokisaari

765666S: Statistical methods in astronomy, 5 op

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

ECTS Credits:
5 credits
Contents:
See Statistical methods in astronomy (765366A).
Compared to 765366A, includes extra homework assignments on more advanced level.
Person responsible:
Heikki Salo

765366A: Statistical methods in astronomy, 5 op

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

ECTS Credits:
5 credits
Learning outcomes:
After the course the student should master the basic statistical methods and their use in commonly encountered astronomical problems.
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.
Recommended or required reading:
Wall, J. V. and Jenkins, C. R.: Practical Statistics for Astronomers; Bevington P. R. and Robinson D. K.: Data Reduction and Erros Analysis for the Physical Sciences.
Person responsible:
Heikki Salo

763620S: Statistical physics, 10 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physics
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:
Erkki Thuneberg

765608S: Stellar dynamics, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
7 credits
Learning outcomes:
After the course the student should have basic knowledge of galactic dynamics on the level that makes possible to study research articles on the field.
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 or required reading:
J. Binney, S. Tremaine: Galactic dynamics, Princeton University Press, 2008 (part of the book).
Person responsible:
Heikki Salo

765343A: Stellar structure and evolution, 7 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

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

Stellar equilibrium. Theory of polytropes. Radiation transport. Convection. Nuclear reaction. Stellar evolution. Stellar pulsations. White dwarfs, degenerate gas. Supernovae. Neutron stars and black holes. The course can be also incorporated into advanced studies with some supplementary work.
Learning activities and teaching methods:
Lectures 32 h, exercises.
Recommended or required reading:
D. Prialnik: An introduction to the theory of stellar structure and evolution; R. Bowers, T. Deeming: Astrophysics I. Stars; R. Kippenhahn, A. Weigert: Stellar structure and evolution.
Person responsible:
Juri Poutanen

765643S: Stellar structure and evolution, 7 op

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

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

766649S: Strong- and short-pulse atomic physics, 6 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

Language of instruction:
English
Timing:
Not lectured every year.
Learning outcomes:
Student learns the basic knowledge of strong and short pulse atomic physics that enables one to follow up the on-going advances in the strong-field community.
Contents:
Attosecond physics is a new field in science that combines optical and collisions physics by using strong and (ultra-) short light pulses. Such strong electro-magnetic fields may accelerate the electrons up to relativistic energies and, thus, wavelength below of 1 Å, which enables one to observe the dynamics of phenomena at the femto- and attosecond scale. The course introduces into this recently emerging field with emphasis on the light-atom interaction and simple models for describing the electron dynamics in strong fields. It also discusses some of the main techniques for producing short and intense pulses, such as free-electron lasers or high harmonics, together with some recent experiments in this field.
Learning activities and teaching methods:
Lectures 35 h, exercises 16 h, one oral examination.
Recommended or required reading:
Controlling the Quantum World: The Science of Atoms, Molecules and Photons (The National Academy Press, Washington, 2007). Lecture notes and scientific articles.
Person responsible:
Stephan Fritzsche
Other information:

https://wiki.oulu.fi/display/766649S/

765661S: Structure and kinematics of galaxies, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Learning outcomes:
Student understands how the structure of the Milky Way is studied and how our own stellar system compares with other galaxies.
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:
Fundamentals of astronomy, Galaxies and cosmology (recommended).
Recommended or required reading:
J. Binney, M. Merrifield: Galactic Astronomy, Princeton University Press, 1998.
Person responsible:
Pertti Rautiainen
Other information:
https://wiki.oulu.fi/display/765661S/

765333A: Study project in astronomy 1, 7 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
7 credits
Learning outcomes:
Student is able to use computer in processing and visualizing astronomical data.
Contents:
Basics of Linux operating system, data processing and visualization (IDL), a small study project.
Learning activities and teaching methods:
Lectures 6 h and study project.

763645S: Superconductivity, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

6 credits
Timing:
3. or 4. autumn
Learning outcomes:
To understand superconductivity as a phenomenom and the theory behind. 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.
Contents:
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, 12 exercise sessions (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

766684J: Teaching tasks, 2 - 8 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Post-graduate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
2-8 credits
Contents:
The main duties of PhD students in the Physics Training program are gaining expertise on his/her field of specialty, carry out research in this field and pass successfully exams of the courses agreed in the post-graduate study plan. Apart from these, he/she should be able to paraphrase novice students, colleagues and ordinary citizens about physical phenomena and his/her own research field. This training is aimed at introducing post-graduate students to clear and natural performance in various teaching events and in later tasks outside university.
Training is documented in the post-graduate study plan. It gives 8 cu at the maximum. Each teaching period of 80 hours during an academic year results in 2 cu. The loading factors agreed in the department are taken into account when counting the teaching hours.

764684J: Teaching tasks, 2 - 8 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Post-graduate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
2-8 credits

Contents:
The main duties of PhD students in the Physics Training program are gaining expertise on his/her field of specialty, carry out research in this field and pass successfully exams of the courses agreed in the post-graduate study plan. Apart from these, he/she should be able to paraphrase novice students, colleagues and ordinary citizens about physical phenomena and his/her own research field. This training is aimed at introducing post-graduate students to clear and natural performance in various teaching events and in later tasks outside university.
Training is documented in the post-graduate study plan. It gives 8 cu at the maximum. Each teaching period of 80 hours during an academic year results in 2 cu. The loading factors agreed in the department are taken into account when counting the teaching hours.

765673S: Theoretical astrophysics, 7 op

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

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

765373A: Theoretical astrophysics, 7 op

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

ECTS Credits:
5 credits
Language of instruction:
Finnish or English
Timing:
4 th or 5 th year
Learning outcomes:
After completion the student knows the characteristics of various geophysical electromagnetic methods, anomalies and theoretical principles.
Contents:
Electromagnetic (EM) measurements are used to provide information about the subsurface variations of electrical conductivity that can be used in geological mapping of soil and bedrock, environmental studies and mineral exploration. The course provides knowledge on the theory and applications of the geophysical EM methods including electromagnetic induction, quasi-static approximation, attenuation of the fields, time and frequency domain measurements, electric and magnetic dipole source in free-space, conductive whole space, above layered earth, and near two- and three-dimensional targets. In addition the various electromagnetic systems for near-surface investigations, their responses and anomalies and the effect of conductive host medium and overburden layer and data interpretation are studied. Modelling and interpretation software are used in computer exercises to emphasize the lectures.
Learning activities and teaching methods:
Lectures 20 h and 20 h demonstrations and practical work, exam and approved report.
Target group:
MSc students of geophysics.
Recommended or required reading:
Lecture notes and 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.cc.oulu.fi/~mpi/MPopetus.html

762628S: Thermal processes of the earth, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Moisio, Kari Juhani

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Timing:
4 th or 5 th year
Learning outcomes:
After this course student will have understanding of the thermal phenomena present in the Earth's surface and below. Student will understand the theory related to thermal processes and the birth and consequences of the different mechanisms. Student realizes the most important factors affecting heat transport and heat generation in the Earth. Student can derive and calculate thermal distribution in the crust and mantle. He can describe fundamentals of heat flow determination, related error sources and global heat flow distribution.
Contents:
This course focuses in the fundamentals of the thermal phenomena in the Earth, thermal processes in the crust and the mantle and their consequences. 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; Ranalli, G., 1995: Rheology of the Earth; Cermak, V. & Rybach, L., (eds.), Terrestial heat flow and the lithosphere structure.
Person responsible:
Kari Moisio

766328A: Thermophysics, 6 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physics
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
Learning outcomes:
This course is intended to give students a physically clear understanding of the basic principles of thermophysics, emphasizing the methods of statistical physics.
Contents:
The goal of the course is to explain how the macroscopic thermophysical 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, 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, two written intermediate examinations or one final examination.
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, 2008. http://physics.oulu.fi/fysiikka/oj/766328A
Person responsible:
Juhani Lounila

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

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

ECTS Credits:
3 credits
Language of instruction:
Finnish or English
Timing:
4 th or 5 th year
Learning outcomes:

After completion the student knows special characteristics of TEM methods, anomalies and how to interpret data with layered earth model.

Contents:
The course gives detailed information on time-domain electromagnetic 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 and data interpretation is included.

Learning activities and teaching methods:
30 h lectures and demonstrations, exam.

Target group:
MSc students of geophysics.

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.cc.oulu.fi/~mpi/MPopetus.html

762086Y: Tutoring, 2 op

Voimassaolo: - 31.07.2009

Opiskelumuoto: General Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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)

761013Y: Tutoring, 2 op

Opiskelumuoto: General Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
2 credits

Timing:
2 nd – 5 th autumn

Learning outcomes:
The student has work experience as a group leader and as a tutor for new students.
Contents:
The advanced student guides 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

762617S: VLF-method, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
4 th or 5 th year
Learning outcomes:
After passing the course the student understands thoroughly the theoretical basics of the VLF-method, its operation and measuring practice and is able to analyse and interpret VLF data in near-surface geophysical research.
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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits

Timing:
The biennial or triennial nature of the advanced courses the student has to be aware by him/herself of the best time to take any particular course.
Learning outcomes:
The aim is that all students will master the course topics in theory and practice. The graded student achievement will show the level the student has reached this goal.
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.
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 Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764627S Virtual measurement environments 5.0 op

ECTS Credits:
5 credits
Timing:
3rd autumn
Learning outcomes:
The students will learn how to construct sofware environments for measurements and data analysis.
Contents:
The course gives basic skills to use MATLAB and LabView programming environments to construct their own (custom) programs, with which they can both measure and analyze data with the computer.
Learning activities and teaching methods:
Lectures 10 h, project work about 60 h. Project reports.
Target group:
Students in Physics B.Sc. program (obligatory) and students aiming for Biophysics minor.
Recommended optional programme components:
None, but basics of programming principles are useful. The skills acquired in this course can be used in various courses and laboratory projects.
Person responsible:
Matti Weckström, Jouni Takalo

761104P: Wave Motion, 3 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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
Learning outcomes:
The student can classify different types of wave motions and knows the characterizing quantities (wavelength, period, wave speed), can apply geometrical optics to simple mirror and lens systems, knows the meaning of interference and diffraction and can apply these in simple cases.
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.
Person responsible:
Sami Heinäsmäki
Other information:
https://wiki.oulu.fi/display/761104P/

766329A: Wave motion and optics, 6 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Physics
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:
Firts spring
Learning outcomes:
In natural sciences different types of waves (ripples on a pond, musical sounds, seismic waves from earth quake, light, radio waves and so on) play important role. The objective of this course is to study the theory of wave motion. Important part is given to the wave nature of light and principles of optics.
Contents:
General principles of wave motion, sound, light, electromagnetic waves, production and measurement of light, gepmetric optics, optical instruments, wave equation, superposition of waves , 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:
Compulsory.
Recommended or required reading:
Pedrotti, F.L., Pedrotti, L. S.: Introduction to optics, Englewood Cliffs, Prentice-Hall and others. http://physics.oulu.fi/fysiikka/oj/766329A/
Person responsible:
Seppo Alanko

761672S: X-ray physics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Timing:
Not lectured every year.
Learning outcomes:
Student knows the origin of characteristic X-ray and braking radiation and the principles of X-ray absorption, reflection, and scattering. Student is able to describe the applications of X-radiation in materials science and understands the physical basis of the research methods.
Contents:
The course introduces the physical origin of X-radiation, interaction processes between x-ray and material, and some important applications in materials science. The X-ray sources like X-ray tube and synchrotron radiation ring are examined in details. The main contents of the course are the interaction processes like absorption, reflection and scattering of X-ray in materials. Some research methods like X-ray diffraction from chrystalline matter and X-ray fluorescence. The course does not require preceding studies on quantum mechanics.
Learning activities and teaching methods:
Lectures 35 h, exercises 20 h. One written examination.
Recommended or required reading:
Lecture notes
Person responsible:
Helena Aksela and Leena Partanen