Opasraportti

LuTK - Physics 2015 - 2016 (2015 - 2016)

Degree programme in physics

The degree programme in physics has been renewed at the University of Oulu. The Department of Physics consists of two sections: PHYSICS OF MATTER and ASTRONOMY, EARTH AND SPACE PHYSICS. The research groups at the department conduct world class research. Researching teachers train new students to become experts on different fields of physics.

In the degree programme, the student can gain information on e.g. how to study the changes in solar activity and their impact on the Earth with help from satellite data, model the ionosphere and northern lights, study the structure of matter in detail, study liquid crystals or lasers, develop accelerator-based light sources, search for groundwater, find financially significant concentrations of ore or even diamonds, find out how and why tectonic plates move, discover how neurons function, learn about superconductivity, research into galaxies and the universe, or learn how to teach and demonstrate physics. The student may also choose to participate in subject teacher education. The major subjects available are **biophysics, physics, geophysics, theoretical physics and astronomy.** These are exact sciences, which are characterized by the use of mathematical methods.

There are two sections at the department, but the studies in the Bachelor's Degree programme are very similar for all students. This guarantees a good knowledge of fundamental physics, makes it possible for the students to qualify for a diverse range of jobs and makes several specialization options available. In the Master's Degree programme, the students may choose from three orientation alternatives: astronomy, earth and space physics, physics of matter, or subject teacher education.

PHYSICS OF MATTER: courses are given and research is conducted in matter and its functioning. Matter is studied from its tiniest components all the way to the cellular level. The student can specialize in **atomic, molecular and material physics** (with physics as the major subject), **theoretical physics** or **biophysics.** If the student wishes to specialize in atomic, molecular and material physics, advanced courses in physics given by two spectroscopy groups are available: NMR (Nuclear Magnetic Resonance) research on molecules and materials, and Synchrotron Radiation (SR) research in electron structure and dynamics. The spectroscopy groups conduct both experimental and theoretical research and organize education on this research. The SR spectroscopy group also participates in instrumentation of international accelerator-based light sources and measuring stations. The aim of studies in **theoretical physics** is developing a scientific way of thinking, and an important feature is the mathematical modelling of natural phenomena. Research is conducted especially in quantum mechanical phenomena in the structure of matter: superconductivity and superfluids, quantum dots and nanoscale phenomena. The studies in **biophysics** include learning how to conduct exact research in biological systems, and during Master's degree studies the student can specialize in either the functioning of cells or medical technology. The research in biophysics is concentrated on the signalling of neurons.

ASTRONOMY, EARTH AND SPACE PHYSICS: Study fields include the physics of the Earth and near space along with astronomy. The student can specialize in **space physics** (with physics as the major subject), **geophysics** or **astronomy.** The studies and research in **space physics** are concentrated on the physics of the upper atmosphere, near space, solar wind, cosmic rays and the Sun. Geophysics studies the physical structure of the solid Earth, hydrosphere and atmosphere as well as their temporal and spatial changes. The University of Oulu focuses in Solid Earth Geophysics. The research subjects of **astronomy** include the entire universe and its phenomena in different scales.

COURSES GIVEN BY THE DEGREE PROGRAMME IN PHYSICS

The list of the study courses of the degree programme of the physics is found on the page 37.

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Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

765693S: Advanced astronomy studies at other universities, 0 op
763622S: Advanced course in quantum mechanics, 10 op
763698S: Advanced special course:, 6 - 8 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 and simulation of biosystems, 6 op
764664S: Analysis and simulation of biosystems, 6 op
763310A: Analytical mechanics, 6 op
761669S: Applications of NMR spectroscopy, 6 op
766650S: Applications of SR physics, 5 op
765336A: Astronomical observing techniques, 5 op
765107P: Astronomical world view, 5 op
Compulsory
765107P-01: Astronomical world view (part 1): Introduction to astronomy, 0 op
765107P-02: Astronomical world view (part 2): History of astronomy, 0 op
763655S: Astroparticle physics, 6 op
765669S: Astrophysics of interacting binary stars, 7 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
761385A: B.Sc. thesis and seminar, 10 op
764638S: Basic Neuroscience, 5 op
764338A: Basic Neuroscience, 5 op
761102P: Basic Thermodynamics, 2 op
764162P: Basic biophysics, 3 op
764163P: Basic biophysics, 5 op
761111P: Basic mechanics, 5 op
Compulsory
761111P-01: Basic mechanics, lectures and exam, 0 op
761111P-02: Basic mechanics, lab. exercises, 0 op
766355A: Basics of space physics, 5 op
764660S: Bioelectronics, 5 op
765306A: Celestial Mechanics II - Special topics, 7 op
765606S: Celestial Mechanics II - Special topics, 7 op
765304A: Celestial mechanics, 5 - 8 op
764622S: Cell membrane biophysics, 10 op
764322A: Cell membrane biophysics, 10 op
763629S: Classical field theory, 6 op
766645S: Cluster Physics, 5 op
761668S: Computational physics and chemistry, 6 op
765617S: Computer simulations, 5 op
763628S: Condensed matter physics, 10 op
766655S: Cosmic Rays, 8 op
765382A: Dark matter, 5 op
765682S: Dark matter, 5 op
766309A: Demonstrations in Physics and Chemistry, 2 op
761113P: Electricity and magnetism, 5 op
Compulsory
761113P-01: Electricity and magnetism, lectures and exam, 0 op

761113P-02: Electricity and magnetism, lab. exercises, 0 op
766632S: Electromagnetic waves, 6 op
766319A: Electromagnetism, 7 op
761673S: Electron and ion spectroscopy, 8 op
763696S: Electronic transport in mesoscopic systems, 6 op
764632S: Electrophysiological recordings, 6 op
764125P: Foundations of cellular biophysics, 5 op
765114P: Fundamentals of astronomy I, 5 op
765115P: Fundamentals of astronomy II, 5 op
761648S: Fundamentals of incoherent scatter radar, 8 op
762108P: GIS and spatial data 1, 5 op
765330A: Galaxies, 6 op
765630S: Galaxies, 6 op
763695S: General relativity, 6 op
762322A: Geomagnetism, 5 op
762305A: Geophysical research methods of rock and soil, 6 op
766656S: Heliospheric physics, 8 op
764621S: Hemodynamics, 5 op
765106P: History of astronomy, 3 op
763654S: Hydrodynamics, 6 op
762306A: Hydrology in geosciences, 6 op
764629S: Identification of linear systems, 5 op
764630S: Identification of nonlinear systems, 6 op
765658S: Introduction to Cosmology, 5 op
765358A: Introduction to Cosmology, 5 op
765354A: Introduction to Nonlinear Dynamics, 6 op
765654S: Introduction to Nonlinear Dynamics, 6 op
765103P: Introduction to astronomy, 2 op
764103P: Introduction to biophysics, 2 op
761645S: Introduction to experimental physical research, 6 op
762103P: Introduction to geophysics, 2 op
762107P: Introduction to global environmental geophysics, 5 op
762193P: Introduction to hydrology and hydrogeophysics, 4 op
763105P: Introduction to relativity 1, 2 op
763306A: Introduction to relativity 2, 2 op
762104P: Introduction to solid earth geophysics, 5 op
Compulsory
762104P-01: Introduction to solid earth geophysics (part 1): Introduction to geophysics, 0 op
762104P-02: Introduction to solid earth geophysics (part 2): Solid Earth geophysics, 0 op
761658S: Ionospheric physics, 8 op
766310A: Laboratory Course in Electron Spectroscopy, 2 op
761121P: Laboratory Exercises in Physics 1, 3 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
761657S: Magnetospheric physics, 8 op
766101P: Mathematics for physics, 5 op
761386A: Maturity test, 0 op
763685S: Maturity test, 0 op
761686S: Maturity test, 0 op
765657S: Maturity test, 0 op
764695S: Maturity test for MSc, 0 op
766323A: Mechanics, 6 op
764371A: Medical equipments, 5 op
764634S: Medical physics and imaging, 5 op
766677S: Modern characterization methods in material science, 6 op
764618S: Molecular biophysics, 5 op
766660S: Molecular properties, 6 op
761661S: Molecular quantum mechanics, 8 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
766669S: Nuclear magnetic relaxation, 6 op
766315A: Numerical modelling, 5 op
763616S: Numerical programming, 6 op
765667S: Observational Astrophysics and Data Analysis, 6 op
761665S: Optics, 6 op
761011Y: Orientation course for new students, 2 op
761644S: Physical measurements, 6 op
761112P: Physical world view, 3 op
766339A: Physics for teachers, 5 op
765659S: Physics of the Solar System I, 7 op
765359A: Physics of the Solar System I, 7 op
765679S: Physics of the Solar System II - Special topics, 7 op
765379A: Physics of the Solar System II - Special topics, 7 op
761653S: Plasma physics, 8 op
764637S: Practical training, 3 - 9 op
762352A: Practical training, 5 op
764337A: Practical training, 3 - 9 op
761337A: Practical training, 3 - 6 op
763650S: Practice, 3 - 5 op
761683S: Pro gradu thesis, 35 op
761684S: Pro gradu thesis, 20 op
764697S: Pro gradu thesis, 35 op
765621S: Pro gradu thesis, 20 op
763683S: Pro gradu thesis, 35 op
763682S: Pro gradu thesis, 20 op
765624S: Pro gradu thesis, 35 op
763312A: Quantum mechanics I, 10 op
763612S: Quantum mechanics I, 10 op
763613S: Quantum mechanics II, 10 op
763313A: Quantum mechanics II, 10 op
763693S: Quantum optics in electric circuits, 6 op
766116P: Radiation physics, biology and safety, 5 op
Compulsory
766116P-01: Radiation physics, biology and safety, exam, 0 op
766116P-02: Radiation physics, biology and safety, laboratory exercises, 0 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
761012Y: Senior tutoring, 1 op
765331A: Solar System Dynamics, 7 op
765631S: Solar System Dynamics, 7 op
766659S: Solar effects on climate, 6 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
765694S: Special course, 7 op
765394A: 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
761359A: Spectroscopic methods, 5 op
765666S: Statistical methods in astronomy, 5 op
765366A: Statistical methods in astronomy, 5 op
763620S: Statistical physics, 10 op
765673S: Stellar atmospheres, 7 op
765373A: Stellar atmospheres, 7 op
765608S: Stellar dynamics, 7 op
765343A: Stellar structure and evolution, 7 op
765643S: Stellar structure and evolution, 7 op
765661S: Structure and kinematics of galaxies, 6 op
766330A: Structure of matter, 6 op

Compulsory
766330A-01: Structure of matter, part 1: Solid state physics, 0 op
766330A-02: Structure of matter, part 2: Nuclear and particle physics, 0 op
765332A: Study project in astronomy 1, 5 op
Compulsory
765332A-01: Data processing in astronomy, 0 op
765332A-02: Study project, 0 op
763645S: Superconductivity, 6 op
766328A: Thermophysics, 6 op
765368A: Time Series Analysis in Astronomy, 6 op
765668S: Time Series Analysis in Astronomy, 6 op
765353A: Topics of modern astrophysics, 5 op
765653S: Topics of modern astrophysics, 5 op
761013Y: Tutoring, 2 op
764327A: Virtual measurement environments, 5 op
764627S: Virtual measurement environments, 5 op
761114P: Wave motion and optics, 5 op
Compulsory
761114P-01: Wave motion and optics, lectures and exam, 0 op
761114P-02: Wave motion and optics, lab. exercises, 0 op
766329A: Wave motion and optics, 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: Field 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:
Heikki Salo

763622S: Advanced course in quantum mechanics, 10 op

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

ECTS Credits:
10 credits
Language of instruction:
English
Timing:
3rd - 5th year
Learning outcomes:
The aim is that students know how to use the fundamental connection between the symmetry of the system and quantum mechanical operators. A special emphasis is in the coupling of angular momenta of several particles and rotational symmetry. In practical calculations it is important to be able to construct different dynamic pictures of quantum mechanics. Relativistic problems require a solution of the Dirac or Klein-Gordon equation.
Contents:
The study of the symmetry of a quantum mechanical system is an important part of the problem solving. The connections between the translational symmetry and momentum and the rotational symmetry and angular momentum are derived. Also the parity and time reversal symmetry are discussed. Specific issues derived in detail are coupling of angular momenta, spherical tensors, measurement of spin, hyperfine structure of hydrogen, Stark effect, 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 50 h, exercises 30 h, self-study 187 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Course 763313A Quantum mechanics II
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
G. Baym: Lectures on Quantum Mechanics (1969), J.J. Sakurai: Modern Quantum Mechanics (1985), J.J. Sakurai: Advanced Quantum Mechanics.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Erkki Thuneberg
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/763622s/etusivu

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

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
6 - 8 credits
6 credits without, 8 with practical assignment
Language of instruction:
English (if needed)
Timing:

Not lectured in 2015-16.
Learning outcomes:
The students know the basic principles of density functional theory (DFT) and the ways DFT can be applied to condensed matter physics problems. They are able to use existing DFT codes and introduce improvements in them. Moreover, the students will be able to critically assess the results obtained in the literature using DFT.
Contents:
The principles of density functional theory are presented and derived in detail. The main approximations used in density functional theory calculations are discussed. We also discuss the practical issues related with the calculations and the different computer codes available. The tight binding density functional formalism is discussed as a simplified example of large scale density functional based calculations. We also discuss theoretical methods for interpreting experimental data obtained with, e.g. low energy electron diffraction measurements.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 26 h, exercises 20 h, self-study 114 h.
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Quantum Mechanics I
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lecture material and articles distributed at the lectures and course web page.
Assessment methods and criteria:
Exam, 2 extra credits can be earned by doing a special assignment.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Matti Alatalo
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/763698s/etusivu

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

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

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:
Elena Kozlovskaya

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

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

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:
Elena Kozlovskaya

764364A: Analysis and simulation of biosystems, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764664S Analysis and simulation of biosystems 6.0 op

ECTS Credits:
6 credits
Language of instruction:
Finnish (or English)
Timing:
3th 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. Further, with those skills the student will be able to build simulations of relatively simple biosystems and analyze their properties.
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. Building on this simulation methods will be examined.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 36 h, calculation exercises 15 h, self-study 109 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Basic biophysics (764162P) is recommended before this course. Knowing Laplace transform is useful.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lecture handouts; M.C.K. Khoo: Physiological Control Systems, IEEE Press, New York, 2000; P. Doucet, P.B. Sloep: Mathematical modeling in the life sciences, Ellis Horwood limited, Chichester, 1992 (partly).
Course material availability can be checked here.
Assessment methods and criteria:
Exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Matti Weckström, Iikka Salmela
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/764364A/

764664S: Analysis and simulation of biosystems, 6 op

Voimassaolo: 01.01.2013 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

764364A Biosystems analysis 6.0 op

ECTS Credits:
6 credits
Language of instruction:
Finnish (or English)
Timing:
4th 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. Further, with those skills the student will be able to build simulations of relatively simple biosystems and analyze their properties.
Contents:
See 764364A Analysis and simulation of biosystems
Person responsible:
Matti Weckström, Iikka Salmela

763310A: Analytical mechanics, 6 op

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

ECTS Credits:
6 credits
Language of instruction:
Finnish
Timing:
2nd autumn
Learning outcomes:
To learn to apply Lagrange's method to problems of classical mechanics, to apply mathematical methods such as calculus of variations and small variations, to use Hamilton's method and to know about its application in statistical physics and in quantum mechanics.
Contents:
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. The topics covered are 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 26 h, 12 exercise sessions (36 h), self-study 98 h

Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
763101P Mathematics for physics and 766323A Mechanics
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
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).
Course material availability can be checked here.
Assessment methods and criteria:
Written examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Erkki Thuneberg and Matti Alatalo
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/763310a/etusivu

761669S: Applications of NMR spectroscopy, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
Not every year
Learning outcomes:
The student can explain the basic principles of the subject matter and can derive their consequences in the extent and level of the lectures. In addition, he/she can solve problems which require profound understanding of the essential contents of the course.
Contents:
The course deals with some topical subject matter in nuclear magnetic resonance spectroscopy (NMR spectroscopy), e.g., the spin density matrix theory or NMR in liquid crystals.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 35 h, exercises 20 h, self-study 105 h
Target group:
Primarily for the students of the degree programme in physics and chemistry. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
761663S NMR spectroscopy is helpful, but not necessary.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Material available from the lectures and/or web pages of the course.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:

Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Juhani Lounila
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761669S/

766650S: Applications of SR physics, 5 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
English
Timing:
Not lectured every year
Learning outcomes:
After the course the student is ready to start the MSc thesis 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24 h, exercises 10 h, self-study 73 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Marko Huttula
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/766650S/

765336A: Astronomical observing techniques, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
5 credits
Language of instruction:
English
Timing:
Not lectured every year
Learning outcomes:
After the finished course the student is expected to understand the role of observations in the formation of astronomical knowledge and to know the main observing techniques and instruments.
Contents:
The course gives an introduction to the modern ground- and space-based telescopes and detectors and observational methods. The primary detector in the visual wavelengths, the CCD camera, and basic image reduction techniques are introduced. Observational methods such as direct imaging, astrometry, photometry, spectroscopy, polarimetry and interferometry are described. Finally, the instruments and detectors of other electromagnetic wavelengths are also introduced.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 32 h, exercises 12 h, self-study 89 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Fundamentals of astronomy (recommended)
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Recommended reading:
Kitchin, C.R.: Astrophysical Techniques.
Romanishin, W.: An Introduction to Astronomical Photometry Using CCDs - http://observatory.ou.edu/wrccd22oct06.pdf
Birney, D. S., Gonzalez, G. & Oesper, D.: Observational Astronomy (2nd Edition - 2006)
Course material availability can be checked here
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Vitaly Neustroev
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/765336A/

765107P: Astronomical world view, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

765308A History of astronomy 5.0 op

ECTS Credits:
5 credits *(part 1, Introduction to astronomy 2 credits and part 2, History of astronomy 3 credits)*

Language of instruction:
English or Finnish
Timing:
First autumn
Learning outcomes:
Part 1, Introduction to astronomy: Student can describe by full sentences the role of astronomy in the formation of physical world view, can name the most central astronomical research subjects and can describe the proportions of the Universe.
Part 2, History of astronomy: 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:
Part 1, Introduction to astronomy: 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.
Part 2, History of astronomy: Historical background of present day astronomy, first astronomical observations, naming of stars and constellations, calendar, development of astronomical instruments, planetary motion, birth of astrophysics, the development of cosmological theories.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Part 1: Lectures 14 h, self-study 39 h
Part 2: Lectures 20 h, self-study 60 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Part 1: Course lectured in Finnish, course material available in English.
Part 2: Michael Hoskin (Ed.): The Cambridge Illustrated History of Astronomy, Cambridge University Press, 1997.
Assessment methods and criteria:
Both parts of the course have their own separate examinations. The final grade of the course is the weighted average of the grades of part 1 (2 cp) and part 2 (3 cp).
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Part 1: Heikki Salo
Part 2: Pertti Rautiainen
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/765107P/

Compulsory

765107P-01: Astronomical world view (part 1): Introduction to astronomy, 0 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Basic Studies
Laji: Partial credit
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

765103P	Introduction to astronomy	2.0 op
765106P	History of astronomy	3.0 op

Ei opintojaksokuvauksia.

765107P-02: Astronomical world view (part 2): History of astronomy, 0 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Basic Studies
Laji: Partial credit
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

765308A	History of astronomy	5.0 op
765103P	Introduction to astronomy	2.0 op
765106P	History of astronomy	3.0 op

Ei opintojaksokuvauksia.

763655S: Astroparticle physics, 6 op

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

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
Advanced studies, doctoral studies.
Learning outcomes:
The student knows basic phenomena of astroparticle physics such as 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.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24 h (8 x 3h), exercises 16 h, self-study 120 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
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.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Timo Enqvist

Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/763655S/

765669S: Astrophysics of interacting binary stars, 7 op

Voimassaolo: 01.03.2014 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

ECTS Credits:
7 credits
Language of instruction:
English
Timing:
Not lectured every year
Learning outcomes:
After the finished course the student is expected to understand the importance of binary stars and populations of binaries to modern astrophysics, to know the main concepts of the physics of accretion onto compact objects, accretion disk theory, and the evolution of interacting binary stars.
Contents:
Most stars are not alone, they orbit a companion in a binary star system. This course will address the evolution of such binary stars and their impact on the Universe. It will start by considering orbital dynamics and observations of binaries, followed by stellar interaction in the form of mass transfer by Roche-lobe overflow and wind mass transfer. The course will provide the necessary understanding of the physics of binary stars with black holes, neutron stars and white dwarfs, mass-transfer, chemistry and the importance of binary stars and populations of binaries to modern astrophysics. Theoretical considerations will be supplemented with the home exercises which constitute the important part of the course.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 32 h, exercise sessions 8 h, home exercises (30% of the final score), short essay and presentation (20%), self-study 130 h.
Target group:
Primarily for the students of the advanced level in the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Fundamentals of astronomy and Theoretical Astrophysics (recommended).
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously.
Recommended or required reading:
Accretion Power in Astrophysics (3rd edition, 2003) - J. Frank, A. King and D. Raine / Cambridge University Press. ISBN 0 521 62957 8. Interacting Binary Stars (1985) - Edited by J.E. Pringle and R.A. Wade / Cambridge University Press. ISBN 0 521 26608 4. Cataclysmic Variable Stars (2003) - Brian Warner / Cambridge University Press. ISBN 0 521 54209 X.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Vitaly Neustroev
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/765648S/etusivu

761105P: Atomic and Nuclear Physics, 3 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766326A Atomic physics 6.0 op

ECTS Credits:
3 credits
Language of instruction:
Finnish
Timing:
The course is not lectured any more. It can be completed in this form by a final examination.
Learning outcomes:
The student can explain the basic principles of atomic, nuclear and particle physics and can derive their consequences in the extent and level of the lectures (see Contents). In addition, he/she can solve problems which require profound understanding of the essential contents of the course.
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: Photons, electrons, and atoms. The wave nature of particles. Quantum mechanics. Atomic structure. Nuclear physics. Particle physics.
Mode of delivery:
Self-study or face-to-face teaching
Learning activities and teaching methods:
80 h independent work, or 23 h lectures, 12 h exercises and 45 h independent work in the course 766326A Atomic physics 1.
Target group:
No specific target qroup
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
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 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.
Course material availability can be checked here.
Assessment methods and criteria:
Written final examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Saana-Maija Huttula
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761105P/ and
https://wiki.oulu.fi/display/766326A/

766326A: Atomic physics 1, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field 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 can list differences between the classical and quantum mechanical concepts, and 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 can explain the physical conditions necessary when molecular bonds are created and can describe 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 46 h, exercises 24 h, self-study 90 h
Target group:
No specific target qroup
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
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.
Course material availability can be checked here.
Assessment methods and criteria:
Two written intermediate examinations or one final examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:

Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Saana-Maija Huttula
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/766326A/

761671S: Atomic physics 2, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Language of instruction:
English
Timing:
Not lectured every year.
Learning outcomes:
After the course the student is able to explain 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 44 h, exercises 20 h, self-study 149 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lecture notes, B.H. Bransden, C.J. Joachain: Physics of atoms and molecules
Course material availability can be checked here.
Assessment methods and criteria:
One oral (if agreed) examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Kari Jänkälä
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/761671s/etusivu

761649S: Auroral physics, 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field 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:
After the course, the student can describe the physical processes in the upper atmosphere as well as in the magnetosphere that lead to formation of aurora. The student is also able to solve mathematically problems associated with the processes. After the course, the student will able to communicate of the latest findings in auroral research.
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, known 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 36 h, exercises 12 h, self-study 112 h
Target group:
This course is useful especially for students who study space physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Recommended courses: 766355A Basics of space physics and 761658S Ionospheric physics
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
A. Aikio: Auroral Physics, available on the web-page of the course. Additional reading: M.H. Rees: Physics and chemistry of the upper atmosphere (Cambridge, 1989), 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).
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Anita Aikio
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761649S/

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

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

ECTS Credits:
10 credits
Language of instruction:
Finnish
Timing:
3rd autumn
Learning outcomes:
After passing the course, the student can carry out research work, search information and write scientific reports as well as give oral scientific presentations about the subject. By giving the seminar talk and writing the candidate thesis, the student learns important scientific communication skills necessary in scientific research in physics.
Contents:
Both written and oral reporting is essential part of the scientific research. In the course, the students participate in the seminars, act as an opponent, present a seminar talk, and write a candidate thesis. The candidate thesis is about 20 pages. Thesis is written about subject given by and under supervision of a senior researcher.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 10 h, seminar talk, act as an opponent (ca 20 h), candidate (B.Sc.) thesis, self-study 247 h
Target group:
Compulsory for Bachelor of Science in physics. In seminars 80% obligatory attendance.
Prerequisites and co-requisites:
Introduction to information retrieval (030005P).
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Material available from the web pages of the course.
Assessment methods and criteria:
Thesis 50 % and seminar 50 %.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail.
Person responsible:
Marko Huttula
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761385A/

764638S: Basic Neuroscience, 5 op

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

764338A	Basic Neuroscience	5.0 op

ECTS Credits:
5 credits

Language of instruction:
English
Timing:
3. - 4. spring
Learning outcomes:
Student will be able to explain basic oganization and functions of the nervous system.
Contents:
See 764338A Basic Neuroscience
Person responsible:
Roman Frolov, Matti Weckström, Kyösti Heimonen

764338A: Basic Neuroscience, 5 op

Voimassaolo: 01.01.2009 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764638S Basic Neuroscience 5.0 op

ECTS Credits:
5 credits
Language of instruction:
English
Timing:
3. - 4. spring
Learning outcomes:
Student will be able to explain basic oganization and functions 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 20 h, home work, seminar, self-study 113 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Dale Purves et al.: Neuroscience 4 ed., Sinauer Associates Inc., MA, USA, 2008 (parts).
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Roman Frolov, Matti Weckström, Kyösti Heimonen
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/764338A/

761102P: Basic Thermodynamics, 2 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field 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:
The course is not lectured any more. It can be completed in this form by a final examination.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 16 h, 4 exercises (8 h), self-study 29 h
Target group:
For the students of the University of Oulu
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Young and Freedman; University Physics, Addison Wesley (Edition 10, Chapters 15-18, or Editions 11-13, 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.
Course material availability can be checked here.
Assessment methods and criteria:
2 intermediate examinations (in autumn) or final examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Ville-Veikko Telkki
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761102P/

764162P: Basic biophysics, 3 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field 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	Basic biophysics (part 1): Introduction to biophysics	0.0 op

ECTS Credits:
3 credits
Language of instruction:
Finnish
Timing:
1st spring
Learning outcomes:
Student can describe and explain some basics and concepts of certain areas of biophysics and knows central targets of biophysical research.
Contents:
The content of the course is equivalent to the content of part 2 of the course 764163P Basic biophysics.
Person responsible:
Kyösti Heimonen, Marja Hyvönen, Matti Weckström

764163P: Basic biophysics, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764163P-01	Basic biophysics (part 1): Introduction to biophysics	0.0 op
764163P-02	Basic biophysics (part 2)	0.0 op
764103P	Introduction to biophysics	2.0 op
764162P	Introduction to biophysics	3.0 op

ECTS Credits:
5 credits *(part 1, Introduction to biophysics 2 credits and part 2, Basic biophysics 3 credits)*
Language of instruction:
Finnish
Timing:
Part 1: 1st autumn
Part 2: 1st spring
Learning outcomes:
Student can describe and explain some basics and concepts of certain areas of biophysics and knows central targets of biophysical research.
Contents:
The course introduces some basic biological processes from biophysics point of view, and describes so called systems thinking, biophysics and its methods, models and system analysis; for example basics of cellular and molecular biophysics, fluid flow phenomena, biomechanics and some other special issues.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Part 1: Lectures 14 h, self-study 39 h
Part 2: Lectures 20 h, final exam, 46 h of independent studies
Target group:
Mainly students in Physics B.Sc. program. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:

No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Part 1: Lectures and lecture notes
Part 2: Lectures, lecture notes.
Assessment methods and criteria:
Part 1: Exam
Part 2: Exam
Both parts of the course have their own separate examinations. The final grade of the course is the weighted average of the grades of part 1 (2 cp) and part 2 (3 cp).
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Kyösti Heimonen, Marja Hyvönen, Matti Weckström
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/764163P/

761111P: Basic mechanics, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761118P	Mechanics 1	5.0 op
761118P-02	Mechanics 1, lab. exercises	0.0 op
761118P-01	Mechanics 1, lectures and exam	0.0 op
ay761111P	Basic mechanics (OPEN UNI)	5.0 op
761101P	Basic Mechanics	4.0 op

ECTS Credits:
5 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 is able to describe the basic concepts of mechanics and 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, including 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 32 h, 8 exercises (16 h), 2 laboratory exercises (8 h), self-study 77 h
Target group:
For the students of the University of Oulu

Prerequisites and co-requisites:
Knowledge of vector calculus and basics of differential and integral calculus
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 13th edition, 2012, chapters 1-14. Also older editions can be used.
Lecture material: Finnish lecture material will be available on the web page of the course.
Course material availability can be checked here.
Assessment methods and criteria:
Three mini examinations and end examination or final examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Anita Aikio
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/761111P/etusivu

Compulsory

761111P-01: Basic mechanics, lectures and exam, 0 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Basic Studies
Laji: Partial credit
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

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

Ei opintojaksokuvauksia.

761111P-02: Basic mechanics, lab. exercises, 0 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Basic Studies
Laji: Partial credit
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

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

Ei opintojaksokuvauksia.

766355A: Basics of space physics, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766345A Basics of space physics 6.0 op

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
In most years
Learning outcomes:
The student identifies and is capable of naming the basic concepts and processes of solar activity, solar wind, magnetosphere and ionosphere. He can explain the reasons for different phenomena in space physics and apply the theory to simple problems.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 40 h, exercises 20 h, self-study 73 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
K. Mursula: Avaruusfysiikan perusteet (Basics of Space physics; in Finnish; distributed in the web page of the Department). Supporting material for instance: H. Koskinen: Johdatus plasmafysiikkaan ja sen avaruussovellutuksiin (Limes ry); A. Brekke: Physics of the upper polar atmosphere (Wiley & Sons).
Course material availability can be checked here.

Assessment methods and criteria:
Two written intermediate examinations or one final examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Kalevi Mursula
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/766355A
Passing the course helps in getting drafted in various project works of the space physics group.

764660S: Bioelectronics, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
English
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24 h, MatLab-based project work 10 h, calculation exercises 15 h, self-study 84 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Physics courses, programming skills.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
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. Course material availability can be checked here.
Assessment methods and criteria:
Final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Matti Weckström
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/764660S/

765306A: Celestial Mechanics II - Special topics, 7 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
7 credits
Language of instruction:
English
Timing:
Not lectured every year
Learning outcomes:

After completing the course the student can explain elements of perturbation theory, as they occur in problems of solar system dynamics, like tidal interactions, resonances, and spin orbit coupling.
Contents:
In extension of the course `Celestial Mechanics' this course addresses special topics like the gravitational field of non-spherical bodies, perturbation theory, resonances and planetary rotation.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
26 hours lecture, 26 hours exercises, 135 hours self-study
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
`Solar System Dynamics', C.D. Murray, S.F. Dermott (Cambridge University Press), `Physics of the Solar System', B. Bertotti, P. Farinella, D. Vokrouhlicky (Kluwer Academic Publishers)
Course material availability can be checked here.
Assessment methods and criteria:
One written examination and points from worked exercise problems
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Jürgen Schmidt
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/765306a/etusivu

765606S: Celestial Mechanics II - Special topics, 7 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
7 credits
Language of instruction:
English
Timing:
Not lectured every year
Learning outcomes:
After completing the course the student can explain elements of perturbation theory, as they occur in problems of solar system dynamics, like tidal interactions, resonances, and spin orbit coupling.
Contents:
See 765306A
Person responsible:
Jürgen Schmidt

765304A: Celestial mechanics, 5 - 8 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5-8 credits
Language of instruction:
English (or Finnish)
Timing:
Not lectured every year
Learning outcomes:
The student is able to describe the basic principles of orbital dynamics, and to apply them to solution of simple perturbation problems via numerical integration methods.
Contents:
The course deals with orbital motion of planets, containing several IDL-exercises. The topics include calculation of position from orbital elements, determination of elements from observations. Hyperbolic orbits. Applications of vectorial perturbation theory. General N-body problem.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 28 h, exercises and computer demonstrations 24 h, two independent home assessments, self-study 81 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
IDL manual + exercise material.
Fitzpatrick, R.: An Introduction to Celestial Mechanics.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Heikki Salo
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/765304A/

764622S: Cell membrane biophysics, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764322A	Cell membrane biophysics	10.0 op

ECTS Credits:
10 credits
Language of instruction:
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 make and present a short review and a talk about given scientific literature of this field.
Contents:
See 764322A
Person responsible:
Kyösti Heimonen

764322A: Cell membrane biophysics, 10 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

764622S	Molecular biophysics	10.0 op

ECTS Credits:
10 credits
Language of instruction:
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 make and present a short review and a talk about given scientific literature of this field.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 30 h, calculation exercises 22 h, seminars 4-8 h, seminar presentation, weekly assignments, self-study 210 h
Target group:
Biophysics students: recommended in minor (LuK), compulsory in major (FM). Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Introduction to biophysics (764103P) and Foundations of cellular biophysics (764115P) are recommended to be done before this course.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
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).
Course material availability can be checked here.
Assessment methods and criteria:
Home exam, final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:

Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Kyösti Heimonen
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/764322A/

763629S: Classical field theory, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
2nd - 5th year
Learning outcomes:
To apply the concept of field to classical electromagnetism and to recognize the derivation of the electromagnetic field theory based on general field theory and the principle of relativity.
Contents:
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. 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 26 h, 12 exercise sessions (24 h), self-study 110 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
763105P Introduction to relativity 1, 763306A Introduction to relativity 2 and 763310A Analytic mechanics.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
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).
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Jani Tuorila
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/763629S/

766645S: Cluster Physics, 5 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

ECTS Credits:
5 credits
Language of instruction:
English
Timing:
Lectures not given every year.
Learning outcomes:
After the course students can explain what is a cluster and are able to describe various formation mechanisms of clusters. Students can explain principles of spectroscopic methods studying the structure and properties of clusters, and are able to present information obtained from the specific details of the experimental spectra. Students are also able to provide examples of experimental methods on producing various type of clusters. Students will learn also to present principles of the data handling and information evaluation of the experiments.
Contents:
The course serves as an introduction to the materials research of nanostructures using electron spectroscopy. The scope of the course is in experimental methods of studying the properties of clusters. The course starts by short introductional part to clusters and then extents to the formation mechanisms of clusters. Few specific cluster sources will be reviewed. The course continues on focusing to the spectroscopy of clusters through example cases of present research. The studies of the development of metallicity and size dependent phase transformations in addition to methods resolving the surface and bulk structures of clusters will be overviewed. The course includes demonstrations where the students are familiarized with the spectroscopic equipment as well as the data handling of the measurements.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures, exercises, groupworks, self study
Target group:
Recommended for all students attending to the *SR master's degree programme.* The course is suitable for project works and provides a good base for the bachelor and master thesis at ELSP-lab.
Prerequisites and co-requisites:
Recommend course for background is 761673S Electron and Ion Spectroscopy.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Marko Huttula
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/766645S/

761668S: Computational physics and chemistry, 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field 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:
After successful completion, student has a basic knowledge of computer simulation methods to study the microscopic systems (atoms, molecules and solids) 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 chemistry and the use of these methods in research.
Subjects: electronic structure of finite systems, solid-state electronic structure, Monte Carlo and molecular dynamics simulations, quantum simulations, least-squares method, neural networks and genetic algorithms.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 35 h, 4 practical works, self-study 125 h
Target group:
Advanced undergraduate students in physics, chemistry and materials sciences and graduate students.
Prerequisites and co-requisites:
Atomic Physics 1 (766326A), Thermophysics (766328A), and Molecular Quantum Mechanics (761661S) courses or comparable knowledge. Basic programming and computer abilities.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lecture notes based on: Leach: Molecular Modelling: Principles and Applications, 2nd ed. (Prentice Hall, 2001). Jensen: Introduction to Computational Chemistry (Wiley, 1999). Allen and Tildesley: Computer Simulation of Liquids (Oxford, 1987) .Atkins and Friedman: Molecular Quantum Mechanics, 4th ed. (Oxford, 2005). Thijssen: Computational Physics (Cambridge, 1999). Giordano and Nakanishi: Computational Physics, 2nd ed. (Pearson, 2006). Pang: An Introduction to Computational Physics, 2nd ed. (Cambridge, 2006). Hill, Subramanian, and Maiti: Molecular Modeling Techniques in Material Sciences, (CRC, Taylor&Francis, 2005).
Course material availability can be checked here.
Assessment methods and criteria:
One written examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Perttu Lantto
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761668S/

765617S: Computer simulations, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits

Language of instruction:
English (or Finnish)
Timing:
Not lectured every year
Learning outcomes:
After the course the student IS able to build short simulation programs for simple astronomical applications, applying basic N-body and Monte Carlo methods introduced in course demonstrations.
Contents:
N-body simulation methods, applied to dynamics of planetary rings and galaxies. Monte Carlo method, with astronomical applications to light scattering simulations.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures and exercises 20 h, demonstrations 16 h, self-study 97 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Recommended: 765304A Celestial mechanics or 765608S Stellar dynamics
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lecture material given during the course
Assessment methods and criteria:
Home examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Heikki Salo
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/765617S/

763628S: Condensed matter physics, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763636S	Condensed matter physics	5.0 op

ECTS Credits:
10 credits
Language of instruction:
English
Timing:
3th -5th year
Learning outcomes:
To learn to apply quantum mechanics and statistical physics to solid state, in particular to crystal structure and scattering from it, electronic structure and transport properties in noninteracting electron model, interacting electron gas and lattice vibrations.
Contents:
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. 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 50 h, 12 exercise sessions (24 h), self-study 193 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
763333A Solid state physics, 763312A Quantum mechanics I, 766328A Thermophysics
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Michael P. Marder: Condensed Matter Physics. N.W. Ashcroft & N.D. Mermin: Solid state Physics.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Jani Tuorila
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/763628S/

766655S: Cosmic Rays, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Language of instruction:
English
Timing:
Roughly every third year.
Learning outcomes:
After passing the course the student is able to describe in physical terms the properties, origins, temporal variability, atmospheric effects and experimental methods of cosmic rays, and is able to apply physical theories describing the acceleration and modulation of cosmic rays to explain the properties of cosmic rays.
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 heliosphere 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 44 h, 10 exercises (20 h), self-study 149 h
Target group:

Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Recommended courses: 766355A Basics of space physics or 761353A Basics of plasma physics, or equivalent knowledge.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
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.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Kalevi Mursula
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/766655S/

765382A: Dark matter, 5 op

Voimassaolo: 01.09.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
5 credits
Language of instruction:
Lectures either in Finnish or in English depending on the students. The lecture notes are written in English.
Timing:
Basic, and advanced studies, doctoral studies (lectures are the same, for higher levels there are more exercises, exam problems, or other issues that for basic studies).
Learning outcomes:
After the course the student understands the existence of dark matter and its effect on the development of the universe and can explain the main candidates of dark matter. In addition, the student can explain both astronomical and particle physics experiments and methods for observing dark matter and to describe their problems like background radioactivity.
Contents:
The course covers current knowledge on the dark matter, in particle physics and astronomy point of view. The physics and observation in various methods of the dark matter will be discussed.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 16h (8 x 2 h). Exercises 4 - 6 times.
Target group:
Students interested in astronomy, nuclear or particle physics.
Prerequisites and co-requisites:
Basic skill on astronomy, nuclear and particle physics is an advantage but not required.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
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. Lectures, exercises, essay, exam.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Timo Enqvist
Working life cooperation:
No work placement period
Other information:
The first lecture on Wednesday September 30, 2015 at 14-16 o'clock (room TÄ219). No lecture on Wednesday October 21. The schedule of exercises will be fixed at the first lecture.

765682S: Dark matter, 5 op

Voimassaolo: 01.09.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

ECTS Credits:
5 credits
Language of instruction:
Lectures either in Finnish or in English depending on the students. The lecture notes are written in English.
Timing:
Basic, and advanced studies, doctoral studies (lectures are the same, for higher levels there are more exercises, exam problems, or other issues that for basic studies).
Learning outcomes:
After the course the student understands the existence of dark matter and its effect on the development of the universe and can explain the main candidates of dark matter. In addition, the student can explain both astronomical and particle physics experiments and methods for observing dark matter and to describe their problems like background radioactivity.
Contents:
See 765382A
Person responsible:
Timo Enqvist

766309A: Demonstrations in Physics and Chemistry, 2 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field 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:
Finnish
Timing:
3rd year in teacher's education
Learning outcomes:
Every teacher in the upper secondary school gets the courage and can make interesting demonstrations in his/her physics or chemistry lessons.
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 in Normaalikoulu, the training school of Educational faculty.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
33 h making and practicing demonstrations, self-study 20 h
Target group:
Compulsory for students becoming teachers.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Material distributed during demonstrations
Assessment methods and criteria:
Practical rehearsing of demonstrations
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grading scale pass/fail
Person responsible:
Saana-Maija Huttula
Working life cooperation:
No work placement period

761113P: Electricity and magnetism, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field 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
766319A	Electromagnetism	7.0 op
761103P	Electricity and Magnetism	4.0 op

ECTS Credits:
5 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 is able to describe the basic concepts of electricity and magnetism and 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.

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 32 h, 6 exercises (12 h), 2 laboratory exercises (8 h), self-study 81 h
Target group:
For the students of the University of Oulu.
Prerequisites and co-requisites:
Knowledge of vector calculus and basics of differential and integral calculus are needed.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 13th edition, 2012, chapters 21-31. Also older editions can be used.
Lecture material: Finnish lecture material will be available on the web page of the course.
Course material availability can be checked here.
Assessment methods and criteria:
Three mini examinations and end examination or final examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Anita Aikio
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761113P/

Compulsory

761113P-01: Electricity and magnetism, lectures and exam, 0 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Basic Studies
Laji: Partial credit
Vastuuyksikkö: Field 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
766319A	Electromagnetism	7.0 op
761103P	Electricity and Magnetism	4.0 op
761121P	Physical Measurements I	3.0 op

Ei opintojaksokuvauksia.

761113P-02: Electricity and magnetism, lab. exercises, 0 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Basic Studies
Laji: Partial credit
Vastuuyksikkö: Field 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
766319A Electromagnetism 7.0 op
761103P Electricity and Magnetism 4.0 op

Ei opintojaksokuvauksia.

766632S: Electromagnetic waves, 6 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field 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 can derive the basic results on electromagnetic waves starting from Maxwell's equations. He can analyse the various physical circumstances of wave propagation and is able to apply the theory to quantitative solution of problems either by hand or by means of a computer.
Contents:
Contents: This is an optional physics course at an advanced level on the properties, theory and applications of electromagnetic radiation.
Contents briefly: Maxwell's equations, electromagnetic waves, waveguides, generation of electromagnetic waves, electromagnetism and special relativity, scattering and absorption of electromagnetic waves.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 35 h, 10 exercises (20 h), self-study 105 h
Target group:
Primarily for the students of the degree programme in physics and chemistry. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
766319A Sähkömagnetismi or equivalent skills in basic theory of electromagnetism
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
I.S. Grant and W.R. Phillips, Electromagnetism, Second edition (Wiley & Sons); F.H. Read, Electromagnetic Radiation (Wiley & Sons).
Course material availability can be checked here.
Assessment methods and criteria:
One written examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Juha Vaara
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/766632S/

766319A: Electromagnetism, 7 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field 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:
7 credits
Language of instruction:
Finnish
Timing:
2nd autumn
Learning outcomes:
The student identifies the basic concepts of electromagnetic theory and is able to derive the individual results of electromagnetic field theory and electric circuits. He can apply field theory in simple problems and can solve both direct and alternating current circuits.
Contents:
Electromagnetism is a physical theory which was developed 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 into 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. 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, Laplace's and Poisson's equations magnetic field, Lorentz-force, the absence of magnetic monopoles Ampère's and Biot-Savart's laws, vector potential, magnetic moment, magnetic field vector, magnets, Faraday's law, inductance, magnetic energy, alternating currents, power in alternating current circuits, three-phase lines, linear circuits, Kirchhoff's laws, alternating current bridges, continuity equation, displacement current, Maxwell's equations.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 46 h, 12 exercises (24 h), self-study 117 h
Target group:
No specific target qroup
Prerequisites and co-requisites:
Courses in mathematics. 763101P Mathematics for physics.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
T. Nygrén: Sähkömagnetismi (in Finnish, available on web pages of the Department). English material are available on various textbooks like I.S. Grant ja W.R. Phillips: Electromagnetism (2nd edition, Wiley & Sons) or Cheng: Fundamentals of Engineering Electromagnetics (Addison-Wesley).
Assessment methods and criteria:
Two written intermediate examinations or final examination

Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Anita Aikio
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/766319A/

761673S: Electron and ion spectroscopy, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Language of instruction:
English
Timing:
Not every year
Learning outcomes:
After passing the course of Electron and Ion spectroscopy students are able to explain the basic concepts of electron spectroscopy. Students recognize the special characters of synchrotron radiation and can explain the basics of measuring the electron and ion spectra. The student can give an example of a calculational method, which she/he can use to interpret the experimental electron spectrum.
Contents:
The course gives an introduction to the basics of electron and ion spectroscopy research at the department of physics. 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 in details. The theoretical methods used in the interpretation of experimental spectra will be overviewed.
The course starts with a general overview to basics nature of electronic states and the transitions involved in spectroscopy. The conventional sources of ionization and the synchrotron radiation (SR) in spectroscopic research will be overviewed. Then the experimental apparatus for electron and ion spectroscopy will be presented and the handling of the data and experimental interpretation is covered. The course includes two laboratory exercises where the students familiarize to the experimental devices and learn to use datahandling software.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 40 h, exercises 16 h, laboratory exercises 8 h, self-study 149 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Basic knowledges of atomic physics.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Marko Huttula
Working life cooperation:

No work placement period
Other information:
https://wiki.oulu.fi/display/761673S/

763696S: Electronic transport in mesoscopic systems, 6 op

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

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
4th - 5th year
Learning outcomes:
To apply the quantum transmission formalism to calculate the conductance in mesoscopic structures, in particular quantum Hall effect, localization and double-barrier transmission.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 26 h, 12 exercise sessions (24 h), self-study 110 h
Target group:
Especially for theoretical physicists. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Quantum mechanics I (763312A), Thermophysics (766328A) and Solid state physics (763333A).
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
The course follows closely the book Supriyo Datta: Electronic transport in mesoscopic systems, no lecture notes available.
Course material availability can be checked here.
Assessment methods and criteria:
One oral examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Erkki Thuneberg
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/763696s/etusivu

764632S: Electrophysiological recordings, 6 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field 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:
After taking the course student can describe principles of the electrophysiological methods and their benefits and limitations. The student can also analyze some of the results produces by the recordings. In addition the student can and has done successfully all the central work phases belonging to the methods in question, and thus is independently able to continue to practice them further if necessary.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 12 h, laboratory demonstrations or practical lab-work 45 h, self-study 94 h
Target group:
Optional for biophysics M.Sc. students; post-graduate students. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
764323A/764623S Cell membrane biophysics, 764338A/764638S Basic neuroscience and 764680S Neural information processing
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lectures and lecture notes, book: The Axon Guide (http://www.moleculardevices.com/pages/instruments/axon_guide.html).
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Roman Frolov, Matti Weckström, Kyösti Heimonen
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/764632S/

764125P: Foundations of cellular biophysics, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764115P	Foundations of cellular biophysics	4.0 op

ECTS Credits:

5 credits
Language of instruction:
Finnish
Timing:
2nd spring
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24 h, calculation exercises 9 h, self-study 100 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Introduction to biophysics (764103P) is recommended to be done before this course.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
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. Course material availability can be checked here.
Assessment methods and criteria:
Home exam, final exam Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Marja Hyvönen, Kyösti Heimonen
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/764125P/

765114P: Fundamentals of astronomy I, 5 op

Voimassaolo: 01.03.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
1st - 2nd spring
Learning outcomes:
Student can describe the basic physical processes behind astronomical phenomena and can solve mathematical problems related to the course.

Contents:
A more detailed basic astronomy course (part one), that contains e.g. the fundamentals of electromagnetic radiation, astronomical instruments, celestial mechanics and the physical environment of the planets.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24 h, exercises 12 h, self-study 97 h
Target group:
First or second year students in e.g. astronomy, physics, geophysics or geology. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
H. Karttunen, K.-J. Donner, P. Kröger, H. Oja and M. Poutanen (eds.): Fundamental astronomy, Springer, 2007, chapters 1-7, Carroll, B.W., Ostlie, D.A., An Introduction to Modern Astrophysics, Pearson 2007.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Pertti Rautiainen
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/765114p/etusivu

765115P: Fundamentals of astronomy II, 5 op

Voimassaolo: 01.03.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
2nd - 3rd autumn
Learning outcomes:
Student can describe the basic physical processes behind astronomical phenomena and can solve mathematical problems related to the course.
Contents:
A more detailed basic astronomy course (part two), that contains e.g. stellar structure and evolution, the structure of the Milky Way and principles of cosmology.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24 h, exercises 12 h, self-study 97 h
Target group:
First or second year students in e.g. astronomy, physics, geophysics or geology. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:

No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
H. Karttunen, K.-J. Donner, P. Kröger, H. Oja and M. Poutanen (eds.): Fundamental astronomy, Springer, 2007, chapters 8-20, Carroll, B.W., Ostlie, D.A., An Introduction to Modern Astrophysics, Pearson 2007.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Pertti Rautiainen
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/765115p/etusivu

761648S: Fundamentals of incoherent scatter radar, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Language of instruction:
Finnish (also English if required)
Timing:
Not lectured every year.
Learning outcomes:
The student is able to identify and define the basic concepts of signal theory and classical scattering and to apply them to simple problems. He can connect together the concepts of signal autocorrelation function and plasma autocorrelation function and is able to explain the physical meaning of the signal spectrum. He is capable in relating the advantages of different modulation methods and in explaining their benefits in different measurement circumstances.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 44 h, exercises 20 h, self-study 149 h
Target group:
Students interested in ionospheric research, especially those who want to participate in EISCAT measurements and data analysis.
Prerequisites and co-requisites:
Useful basic information is given by Ionospheric physics (761658S).

Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lecture material on web pages in English.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Anita Aikio
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761648S/

762108P: GIS and spatial data 1, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opettajat: Moisio, Kari Juhani

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
2 nd or 3 rd autumn (continues to spring semester)
Learning outcomes:
After completion the student collects the basics of spatial data and geographical information systems (GIS) including especially the most important coordinate systems, map projections, Finnish map coordinates and satellite positioning, and knows how to visualise spatial data in various different ways.
Contents:
Geoscientific observations and measurements are always tied to spatial location 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 positioning, processing and visualisation of spatial data. Computer exercises demonstrate preparation and visualisation of geoscientific data in practice.
Mode of delivery:
Face to face
Learning activities and teaching methods:
Lectures and exercises totalling 40 h plus independent study.
Target group:
Students of Oulu Mining School, and the Faculties of Science and Technology. Obligatory to geosciences students in B.Sc. degree.
Prerequisites and co-requisites:
No specific prerequisites.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously.
Recommended or required reading:
Lecture notes and Löytönen, M., Toivonen, T. & Kankaanrinta, I., (Eds.) 2003: Globus GIS.
Assessment methods and criteria:
Examination and computer test.
Grading:
5-1/fail
Person responsible:
Kari Moisio

Working life cooperation:
No work practise.
Other information:
https://noppa.oulu.fi/noppa/kurssi/762108P/etusivu

765330A: Galaxies, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field 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
Language of instruction:
English
Timing:
2nd - 4th year
Learning outcomes:
Student recognizes the main components of galaxies and can apply them to classify galaxies. Student can describe the theories of formation of galactic structures. Student can describe in detail the contemporary view of large scale structure and cosmology. Student can solve mathematical problems related to the course and recognizes the terminology well enough to be able to read scientific publications.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 36 h, exercises, self-study 107 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Fundamentals of astronomy (recommended)
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Sparke, L., Gallagher, J.: Galaxies in the Universe, Cambridge, 2nd ed., 2007. Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Sébastien Comerón
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/763101p/etusivu

765630S: Galaxies, 6 op

Voimassaolo: 01.03.2014 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English
Leikkaavuudet:

765309A	Galaxies	5.0 op
765330A	Galaxies and cosmology	6.0 op

ECTS Credits:
5 credits
Language of instruction:
English
Timing:
2nd - 4th year
Learning outcomes:
Student recognizes the main components of galaxies and can apply them to classify galaxies. Student can describe the theories of formation of galactic structures. Student can describe in detail the contemporary view of large scale structure and cosmology. Student can solve mathematical problems related to the course and recognizes the terminology well enough to be able to read scientific publications.
Contents:
See 765330A
Person responsible:
Sébastien Comerón

763695S: General relativity, 6 op

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

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
2th - 5th year
Learning outcomes:
To recognize the basic assumptions of general relativity, to be able to repeat how this leads to Einstein field equations and their solution around a massive object, and to apply these in simple cases.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 26 h, 12 exercise sessions (24 h), self-study 110 h
Target group:

Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
763105P Introduction to relativity 1 and 763306A Introduction to relativity 2. The following courses are helpful: Analytical mechanics (763310A) and Classical field theory (763629S) and Hydrodynamics (763654S).
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
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.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Erkki Thuneberg
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/763695S/etusivu

762322A: Geomagnetism, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

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 the completion of the course, a student
- can describe how and where the Earth's magnetic field is generated
- can describe the reasons for the temporal and spatial variations of the geomagnetic field
- can describe how the geomagnetic field is described mathematically and physically
- can identify the instruments used in geomagnetic research on ground and in space
- can describe the magnetic field of other planets and the Sun and how the Sun interacts with the Earth's magnetic field
- can describe methods used to investigate Earth's electrical conductivity and magnetic susceptibility
- can define and discuss on the role of palaeomagnetism in the Earth sciences
- can list major phases and inventions in the history of geomagnetic research

Contents:
Introduction. History of geomagnetism. 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 the Sun and other planets in our solar system. Magnetic properties of Earth materials. Geomagnetic methods. Palaeomagnetism.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24 h, homework exercises 12 h, self-study 97 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:

No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Handouts. 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.
Course material availability can be checked here.
Assessment methods and criteria:
Examination (form to be selected during the course)
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Toivo Korja
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/762322A/

762305A: Geophysical research methods of rock and soil, 6 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
Finnish
Timing:
2nd spring
Learning outcomes:
After passing the course the student can explain on which the use of geophysical methods in studying rock and soil is based. The student can describe theoretical basics and the measuring techniques of the methods and is able to apply the methods in various important economical and civil tasks.
Contents:
The aim of the course is to learn the principles of applying different geophysical methods for various economical and civil tasks. Geophysical subjects in sediments and bedrock and basics for their exploration. Basics of petrophysical properties. Gravity methods, magnetic methods, resistivity methods, IP method, electromagnetic methods, radiometric methods and seismic methods: the physical principles, devices and the most important ways of using them in practice. Aerogeophysical methods. Borehole measurements. Geothermal research.
Mode of delivery:
Face to face
Learning activities and teaching methods:
Lectures 40 h, practical exercises 20 h, field exercises 20 h plus independent study.
Target group:
Students of Oulu Mining School, and the Faculties of Science and Technology. Obligatory to geosciences stdents in B.Sc. degree.
Prerequisites and co-requisites:
No particular pre-requisites.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously.
Recommended or required reading:
Material given during lectures and Peltoniemi, M. (1988) Maa- ja kallioperän geofysikaaliset tutkimusmenetelmät and applicable parts of the following textbooks: Milsom, J. (1989) Field Geophysics; Telford, W.M., Geldart, T.M. & Sheriff, R.E. (1990) Applied Geophysics; Kearey; P., Brooks, M. & Hill, I. (2002) An Introduction to Geophysical

Exploration (3 rd edition); Parasnis, D.S. (1997) Principles of Applied Geophysics (5 th edition); Reynolds, J.M. (2011) An Introduction to Applied and Environmental Geophysics (2nd edition); Sharma, P.V.,(1997) Environmental and Engineering Geophysics.
Assessment methods and criteria:
Examination
Grading:
5-1/fail
Person responsible:
Kari Moisio, Toivo Korja, Elena Kozlovskaya
Working life cooperation:
No work practise.
Other information:
https://noppa.oulu.fi/noppa/kurssi/762305A/etusivu

766656S: Heliospheric physics, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Language of instruction:
English
Timing:
Roughly every third year.
Learning outcomes:
After passing the course the student is able to describe in physical terms the structure of solar corona, the origin, properties and temporal variability of solar wind and heliospheric magnetic field, and the global structure of the heliosphere. The student is able to apply physical theories describing the acceleration of solar wind and the structure of the heliospheric magnetic field to explain heliospheric phenomena.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 44 h, 10 exercises (20 h), self-study 149 h
Target group:
Recommended especially for students of space physics, astronomy and theoretical physics.
Prerequisites and co-requisites:
Recommended courses: 766355A Basics of space physics or 761353A Basics of plasma physics, or equivalent knowledge.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
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.
Course material availability can be checked here
Assessment methods and criteria:

One final examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Kalevi Mursula
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/766656S/

764621S: Hemodynamics, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish, English

ECTS Credits:
5 credits
Language of instruction:
English
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 20 h, calculation exercises 15 h, self-study 98 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Understanding differential equations and basic flow dynamics and basic mammalian anatomy is useful but not required.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lectures and lecture notes. Westerhof, Sergiopulos, Noble: Snapshots of hemodynamics, Kluwer and Springer, 2005, 203 pp.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Matti Weckström
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/764621S/

765106P: History of astronomy, 3 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Field 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
Language of instruction:
English or Finnish
Timing:
Autumn
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:
The content of the course is equivalent to the content of part 2 of the course 765107P Astronomical world view.
Person responsible:
Pertti Rautiainen

763654S: Hydrodynamics, 6 op

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

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
2nd - 5th year
Learning outcomes:
To recognize the basics of hydrodynamic phenomena and to apply these quantitatively to simple flow problems.
Contents:
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. Continuum 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 26 h, 12 exercise sessions (24 h), self-study 110 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
763101P Mathematics for physics, 766323A Mechanics
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously

Recommended or required reading:
A. R. Paterson: A first course in fluid dynamics, E. Thuneberg, Hyrdodynamiikka (lecture notes).
Course material availability can be checked here
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Erkki Thuneberg
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/763654S/

762306A: Hydrology in geosciences, 6 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Pekka Lunkka

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:
2nd or 3rd spring term; given every year.
Learning outcomes:
Upon the completion of the course, a student
- can define the concept of a water cycle, can name the elements of the cycle, can identify their physical basis and can estimate the magnitude of different components using the water balance equation
- can name and distinguish the principles of the methods used to observe evaporation, precipitation and runoff, and summarize their spatial and temporal variation in Finland
- can describe the behaviour of underground water in vadoze zone and aquifers and can define how the groundwater is formed and how it flows
- can identify different types of aquifers and can describe their relationship with structures of soil and bedrock
- owns basics of hydrogeology (groundwater geology)
- can name major geological and geophysical methods used in groundwater research and exploration
Contents:
Introduction to hydrology and hydrological processes in geosciences. Properties and behaviour of water in hydrosphere including hydrological cycle, its different components (evaporation, precipitation and runoff) and their relationship, observations and spatial and temporal variation of each hydrological component in Finland. The second part of the course introduces properties and behaviour of water underground including geohydrological and hydrogeophysical aspects of water and hydrogeology. This part of the course concentrates on the behaviour and properties of water in soil, superficial deposits and bedrock, particularly in Finland. Themes such as groundwater flow, aquifers, groundwater quality, geological and geophysical research methods in hydrogeology will also be introduced.
Mode of delivery:
Face to face
Learning activities and teaching methods:
40 h lectures, 20 h exercises, 100 h independent study.
Target group:
Course is compulsory for geoscience students (geophysics, geology). Also offers to the other students of the University of Oulu.
Prerequisites and co-requisites:
The following courses are required: Introduction to Solid Earth Geophysics (762104P); Physical Sedimentology (773317A); Introduction to Glacial Geology (773303A).

Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously.
Recommended or required reading:
Handouts and lecture notes. Selected parts from: Hooli, J. & Sallanko, J., (1996) Hydrologian luentomoniste; Grundvatten, Teori & Tillämpning. Knutsson, G. & Morfeldt, C-O. (1993) Svensk Byggtjänst, 304 p. Maanalaiset vedet - pohjavesigeologian perusteet; Korkka-Niemi, K. & Salonen, V-P. (1996) Täydennyskoulutuskeskus. Turun yliopisto, 181 p. Mälkki, E. (1999) Pohjavesi ja pohjaveden ympäristö. Tammi, 304 p.
Assessment methods and criteria:
Examination
Grading:
5-1/fail
Person responsible:
Toivo Korja and Juha Pekka Lunkka
Working life cooperation:
No work practice
Other information:
https://wiki.oulu.fi/display/762306A/

764629S: Identification of linear systems, 5 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
English
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 10 h, project work 30 h, self-study 105 h
Target group:
Compulsory for M.Sc. students in biophysics
Prerequisites and co-requisites:
Biosystem analysis (764364A), Differential equations, Basic programming skills with MatLab.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
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).
Course material availability can be checked here.
Assessment methods and criteria:
Grading is based on project report
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:

Matti Weckström
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/764629S/

764630S: Identification of nonlinear systems, 6 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
English
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 10 h, project work 30 h, self-study 120 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Identification of linear systems (764629S), Analysis and simulation of biosystems(764364A), Differential equations, Basic programming skills with MatLab.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
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).
Course material availability can be checked here.
Assessment methods and criteria:
Grading is based on project report.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Matti Weckström
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/764630S/

765658S: Introduction to Cosmology, 5 op

Voimassaolo: 29.10.2013 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Leikkaavuudet:

765358A Introduction to Cosmology 5.0 op

ECTS Credits:
5 ECTS credits
Language of instruction:
English
Timing:
2nd, 3rd, or 4th year of study (intermediate course), master (advanced course).
Learning outcomes:
The student will learn to derive the basic properties of an isotropic and homogeneous Universe from the Friedmann equations. The consequences of these equations will be compared to the observed Universe in order to study the properties of the different components of the Universe (baryonic matter, non-baryonic dark matter, dark energy...)
Contents:
See 765358A
Person responsible:
Sébastien Comerón

765358A: Introduction to Cosmology, 5 op

Voimassaolo: 29.10.2013 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Leikkaavuudet:

765658S Introduction to Cosmology 5.0 op

ECTS Credits:
5 ECTS credits
Language of instruction:
English
Timing:
2nd, 3rd, or 4th year of study (intermediate course), master (advanced course).
Learning outcomes:
The student will learn to derive the basic properties of an isotropic and homogeneous Universe from the Friedmann equations. The consequences of these equations will be compared to the observed Universe in order to study the properties of the different components of the Universe (baryonic matter, non-baryonic dark matter, dark energy...)
Contents:
The course will introduce the Friedmann-Lemaître-Robertson-Metric and the Friedmann equations and will introduce some predictions. Then, observed properties of the Universe will be presented. Fitting the parameters of the theoretical model with observed data leads to the Standard Model which is the present-day paradigm to explain the Universe.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
32 hours of lectures and exercises, 101 hours of self-study.
Target group:
Astronomy and physics students
Prerequisites and co-requisites:

Basic knowledge in physics and mathematics
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously.
Recommended or required reading:
Introduction to Cosmology by Barbara Ryden. Addusson-Wesley, 1st edition, 2002. The lecturer will provide some notes with essential points.
Course material availability can be checked here.
Assessment methods and criteria:
Final examination (intermediate and advanced). For the advanced course students, 20% of the mark will come from an extra assignment.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grades from 0 to 5, where 0=fail
Person responsible:
Sébastien Comerón
Working life cooperation:
No work placement period

765354A: Introduction to Nonlinear Dynamics, 6 op

Voimassaolo: 01.01.2013 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Leikkaavuudet:

765654S Introduction to Nonlinear Dynamics 6.0 op

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
Not lectured every year
Learning outcomes:
After the course the student is able to apply basic concepts and methods of Nonlinear Dynamics to modeling approaches in physics, astronomy, biology, and chemistry.
Contents:
The course introduces the methods of the Nonlinear Dynamics approach to the analysis of dynamical systems, such as the concepts of fixed points, stability, bifurcations, as well as synchronization and chaos. Applications to various scientific problems are outlined as worked out examples and in the exercises.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24 h and exercises (10-12 times), self-study 128 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
`Nonlinear Dynamics And Chaos' by Steven Strogatz
Assessment methods and criteria:
One written examination and points from worked exercise problems
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail

Person responsible:
Jürgen Schmidt
Working life cooperation:
No work placement period

765654S: Introduction to Nonlinear Dynamics, 6 op

Voimassaolo: 01.01.2013 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English
Leikkaavuudet:

765354A Introduction to Nonlinear Dynamics 6.0 op

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
Not lectured every year
Learning outcomes:
After the course the student is able to apply basic concepts and methods of Nonlinear Dynamics to modeling approaches in physics, astronomy, biology, and chemistry.
Contents:
See 765354A Introduction to Nonlinear Dynamics
Person responsible:
Jürgen Schmidt

765103P: Introduction to astronomy, 2 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Field 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:
2 credits
Language of instruction:
Finnish or English
Timing:
First autumn
Learning outcomes:
Student can describe by full sentences the role of astronomy in the formation of physical world view, can name the most central astronomical research subjects and can describe the proportions of the Universe.
Contents:
The content of the course is equivalent to the content of part 1 of the course 765107P Astronomical world view.
Person responsible:

Heikki Salo

764103P: Introduction to biophysics, 2 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Field 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 Basic biophysics (part 1): Introduction to biophysics 0.0 op

ECTS Credits:
2 credits
Language of instruction:
Finnish
Timing:
1st autumn
Learning outcomes:
Student knows some basics and concepts of certain areas of biophysics and central targets of biophysical research.
Contents:
The content of the course is equivalent to the content of part 1 of the course 764163P Basic biophysics.
Person responsible:
Kyösti Heimonen, Marja Hyvönen

761645S: Introduction to experimental physical research, 6 op

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

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
4th - 5th year
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Exercises 120 h. Working in a research group. Written report about research.
Target group:
Students in line: Astronomy, earth and space physics or in line: Physics of matter
Prerequisites and co-requisites:
Advanced physics course related to the field of research to be carried out.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously

Recommended or required reading:
Course material and journals
Assessment methods and criteria:
Written report about research in a research group.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Professors
Working life cooperation:
No work placement period

762103P: Introduction to geophysics, 2 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

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:
2 credits
Language of instruction:
Finnish (It is possible to accomplish the course in English, although all the lectures will be given in Finnish).
Timing:
1. year, autumn fall
Learning outcomes:
Upon the completion of the course, a student
- 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 transport (movement) of rock material inside the Earth and on its surface (convection, plate tectonics) and give physical and geological reasons for transport
- can describe the position and role of geophysics in the field of the Earth system sciences
- can list major unsolved global research problems in the Earth system sciences
- can name major geophysical research methods
Contents:
See 762104P
Person responsible:
Toivo Korja

762107P: Introduction to global environmental geophysics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:

2nd or 3rd spring
Learning outcomes:
After the course the student can define and explain 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures and practicals totalling 40 h plus independent study 93 h.
Target group:
The course is suitable for students of the Oulu Mining School, Faculty of Science and the Faculty of Technology Obligatory for students of geophysics in the B.Sc. degree.
Prerequisites and co-requisites:
No particular pre-requisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously.
Recommended or required reading:
Lecture notes and Kakkuri, J. & Hjelt, S.-E., 2000: Ympäristö ja geofysiikka and applicable parts of the following: Houghton, J., 2004: Global warming: The complete briefing (3rd ed.).
Assessment methods and criteria:
Examination and approved practicals
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Kari Moisio
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/762107p/etusivu

762193P: Introduction to hydrology and hydrogeophysics, 4 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
4 credits
Language of instruction:
Finnish (It is possible to accomplish the course in English, although all the lectures and exercises will be given in Finnish).
Timing:
The course is not lectured any more.
Learning outcomes:
Upon the completion of the course, a student
- can define the concept of a water cycle, can name the elements of the cycle, can identify their physical basis and can estimate the magnitude of different components using the water balance equation
- can name and distinguish the principles of the methods used to observe evaporation, precipitation and runoff, and summarize their spatial and temporal variation in Finland
- can describe the behaviour of underground water in vadoze zone and aquifers and can define how the groundwater is formed and how it flows
- can name major geophysical methods used in groundwater research and exploration
Contents:
See 762306A

Person responsible:
Toivo Korja

763105P: Introduction to relativity 1, 2 op

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

763102P Introduction to relativity 3.0 op

ECTS Credits:
2 credits
Language of instruction:
Finnish
Timing:
First spring
Learning outcomes:
To learn why relativity is needed, to apply Lorentz transformation, to clarify paradoxical situations using space-time diagrams, to explain why signals faster than light do not exist, to solve particle motion in constant field, and to explain the equivalence of mass and energy.
Contents:
The relativity of time and space, the Lorentz transformation of coordinates, time dilation and Lorentz contraction, Minkowski diagrams, formulation of Newtons laws for relativistic particles, equivalence of energy and mass.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 12 h, 5 exercise sets (10 h), self-study 31 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Mathematics for physics and Mechanics
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lecture notes.
Assessment methods and criteria:
One written examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Erkki Thuneberg and Matti Alatalo
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/763105p/etusivu

763306A: Introduction to relativity 2, 2 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Physics

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

ECTS Credits:
2 credits
Language of instruction:
Finnish
Timing:
1st or 2nd spring term
Learning outcomes:
To learn to interpret time and space as a four-dimensional space, where quantities are described by four-vectors, to apply four-vectors to particle processes and to explain global positioning system.
Contents:
Four-vectors, the invariant space-time distance, the kinematics of scattering processes.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 10 h, exercises 8 h, self-study 35 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Course 763105P Introduction to relativity 1
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
One written examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Erkki Thuneberg and Matti Alatalo
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/763306a/etusivu

762104P: Introduction to solid earth geophysics, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Oulu Mining School
Arvostelu: 1 - 5, pass, fail
Opettajat: Elena Kozlovskaya
Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
1st year autumn, every year.
Learning outcomes:
Upon the completion of the course, a student
- can describe the position and role of geophysics in the field of the Earth system sciences
- can list major unsolved global research problems in the 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 Earth and on its surface (convection, plate tectonics)
- can name major geophysical research methods.

Contents:
An overview of geophysics: physics of geosphere, hydrosphere, atmosphere and magnetosphere. 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 profiling. 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.

Mode of delivery:
Face to face

Learning activities and teaching methods:
30 h lectures, 10 h exercises, 93 h independent study.

Target group:
Course is compulsory for geoscience students (geophysics, geology). Also for the other students of the University of Oulu.

Prerequisites and co-requisites:
No specific prerequisites. The course substitutes previous courses 762103P Introduction to Geophysics (2 cr) and 762192P Solid Earth Geophysics (3 cr).

Recommended optional programme components:
Parallel courses Introduction to geology I (771113P), Introduction to geology II (771114P).

Recommended or required reading:
Material given during the lectures and U., Borén, E., Hjelt, S.-E., Karjalainen, T. and Sirviö, J. (2004) Geofysiikka, Tunne maapallosi. WSOY, 191 p. Additional recommended reading: Musset, A.E. and Aftab Khan, M. (2000) Looking into the Earth: An Introduction to Geological Geophysics. Cambridge University Press, 470 p. and Lowrie, W. (1997) Fundamentals of Geophysics. Cambridge University Press, 354 p.

Assessment methods and criteria:
Examination.
B.Sc. students in physics can complete the course 762103P Johdatus geofysiikkaan/Introduction to Geophysics (2 cr) in their curriculum by this course without exercises.

Grading:
5-1/fail

Person responsible:
Toivo Korja

Working life cooperation:
No

Other information:
https://wiki.oulu.fi/display/762104P/

Compulsory

762104P-01: Introduction to solid earth geophysics (part 1): Introduction to geophysics, 0 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Basic Studies
Laji: Partial credit
Vastuuyksikkö: Oulu Mining School
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

762103P Introduction to geophysics 2.0 op

Ei opintojaksokuvauksia.

762104P-02: Introduction to solid earth geophysics (part 2): Solid Earth geophysics, 0 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies
Laji: Partial credit
Vastuuyksikkö: Oulu Mining School
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

761658S: Ionospheric physics, 8 op

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

ECTS Credits:
8 credits
Language of instruction:
English
Timing:
Not every year
Learning outcomes:
After the course, the student can describe how the ionosphere is formed in the upper atmosphere and solve problems associated with the most important physical processes, e.g. the production and loss of ionization, electric currents, and 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 EUV 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, some selected phenomena of the ionosphere (e.g. electrojets in the equatorial and auroral regions, sporadic-E layers and polar wind).
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 40 h, exercises 20 h, self-study 153 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No prequisities are required, but useful basics are given in course 766355A Basics of space physics.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
A. Aikio and T. Nygrén: Ionospheric Physics, available on the web-page of the course. This is in some parts based on the textbook: A. Brekke, Physics of the Upper Atmosphere, John Wiley & Sons, 1997.
Course material availability can be checked here
Assessment methods and criteria:
End examination, possibly also project work that will be graded.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail

Person responsible:
Anita Aikio
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761658S/

766310A: Laboratory Course in Electron Spectroscopy, 2 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
2 credits
Language of instruction:
English
Timing:
First year of MSc programme
Learning outcomes:
After the course students can explain basic methods of performing and data handling of experiments in Electron Spectroscopy Research Group. Students learn a manner to formal results reporting and are able to describe physical basis of the measurements.
Contents:
The course is a substitute of the Laboratory exercises in physics 3 tailored to the students in *SR Masters Programme*. The course includes a common introductional part and three laboratory exercises at the Electron Spectroscopy research group. The focus is on the methods and special requirements on experimental research on the field of atomic- and molecular physics. Through the laboratory work and results reporting students will be familiarized to the experimental devices and principles of ion- and electron spectroscopy. The demonstration cover also introduction to the generation and maintaining a vacuum environment necessary for experiments.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Laboratory work in small groups
Target group:
Recommended for all students attending to the *SR Masters Programme*. No credits given for students successfully passed the course 766308A.
Prerequisites and co-requisites:
No specific prerequisities
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Preliminary work instructions
Assessment methods and criteria:
Accepted reports
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Marko Huttula
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/766310A/

761121P: Laboratory Exercises in Physics 1, 3 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Field 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:
Spring
Learning outcomes:
The student can safely make physical measurements, use different measurement tools, read different scales, handle the data, calculate the error estimations and make a sensible report of his laboratopy measurements.
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. Measurements are made with different instruments. As a result the most probable value is determined as well as its error. The skills obtained during this course can be applied in the other laboratory courses Laboratory exercises in physics 2 and 3.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 12 h, exercises 20 h (5 x 4 h). Five different works will be made during the course in groups. Self-study 48 h.
Target group:
No specific target qroup
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
A booklet: Fysiikan laboratoriotyöt I, laboratoriotöiden työohje. Course material is in Finnish. A few English material is available in teaching laboratory.
Assessment methods and criteria:
Written reports of the experiments and one written examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Seppo Alanko
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761121P/
Registration for the course and exams will be found by using the code 761121P-01

766106P: Laboratory exercises in physics 2, 4 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Field 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
Language of instruction:
Finnish
Timing:
1. spring - 3. autumn
Learning outcomes:
After completing the course, the student can rather independently work with the most important measuring instruments used in physics and has experience in planning and conducting different measurements. The student is also able to critically assess her/his own results and report them to a group of peers.
Contents:
The laboratory exercises (1/3 – 1/2 ECTS per exercise) train the student in applying measurements to research into different physical phenomena. The exercises include practising how to plan the measurements, learning how to use the measuring instruments, processing and assessing the results, and drawing up scientific reports. Some of the exercises can be chosen according to the student's own interest. Half (2 ECTS) of the exercises take place in the teaching laboratory and the other half (2 ECTS) in the research laboratories of the department's research groups. Minor subject and physics teacher students may substitute some or all of the research laboratory exercises by teaching laboratory exercises.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Per one exercise, 4 h of measurements in the laboratory and 5 – 9 h of preparation and drawing up a report independently.
Target group:
No specific target qroup
Prerequisites and co-requisites:
Recommended: 761121P Laboratory exercises in physics 1.
Recommended optional programme components:
Each exercise is closely related to a basic or intermediate course in physics, because the phenomena connected to the measurements and their theory are discussed in the lectures for the courses.
Recommended or required reading:
The exercise work instructions and guidelines for the work report, which can be found on the website of the course.
Assessment methods and criteria:
Adequate familiarization with the phenomenon under scrutiny and the measurements before the exercise (oral or written questions), successfully completing the guided measurements, reporting on the exercise (the work report will be graded).
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Seppo Alanko
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/766106P/

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

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field 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

ECTS Credits:
6 credits
Language of instruction:
Finnish
Timing:
2. spring - 3. spring
Learning outcomes:
After the course students are capable for planning, performing, data handling and results reporting on physical measurements. Students are able to evaluate the validity of observations and to estimate the errorlimits and the possible sources of errors.
Contents:
The course is a follow up for the Laboratory exercises in physics 1 and 2 courses where the methods learned will be used to familiarize oneself with the wide range of physics phenomena in laboratory circumstances.
The laboratory exercises may be chosen from a variety of works from at the physics exercise laboratory or from the works given at the research group laboratories (1/2 op / exercise). Exercises already included in the course "Laboratory exercises in physics 2" may not be selected.
Possibility is also to choose special research related exercises (1op / exercise, max. 1 exercise/research group) where students are included in the daily topics of research supervised by the researchers at research groups of the department. Research related exercises are to be agreed with a supervising researcher and the correspondent of the course.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Laboratory exercises in small groups
Target group:
No specific target qroup
Prerequisites and co-requisites:
Courses 761121P Laboratory exercises in physics 1 and 766106P Laboratory exercises in physics 2
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Laboratory exercise instructions
Assessment methods and criteria:
Written reports of exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Marko Huttula
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/766308A/

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

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5-9 credits
Language of instruction:
Written work instructions mostly in Finnish, teaching can be given also in English.
Timing:
4th spring (can be started during the 3rd spring)
Learning outcomes:
After finishing this course the student is able to plan and execute laboratory setups with the support of the supervisor for certain basic biophysical measurements and recordings, analyze their results and compile a report of the work done according to the basic principles of scientific writing.
Contents:
The meaning of these laboratory projects is to familiarize the student with some central issues and problems of biophysics and their solutions, and during the making of the work reports to practice the skills of scientific writing. These projects are more demanding than previous physics or biophysics laboratory works, and they require more spontaneous and independent working.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
4-8 laboratory projects, ca. 30-65 h, evaluated work reports, self-study 77-175 h
Target group:
Students in biophysics master program
Prerequisites and co-requisites:
It is strongly recommended that all the laboratory works of bachelor's (LuK) degree in physics are done before starting this course.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Written work instructions and other literature given during the course.
Assessment methods and criteria:
Work reports are evaluated.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Kyösti Heimonen and in each separate project also other biophysics teachers.
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/764625S/

761675S: Laser and synchrotron radiation physics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766675S Laser and synchrotron radiation physics 10.0 op

ECTS Credits:
6 credits
Language of instruction:
English

Timing:
Not lectured every year.
Learning outcomes:
The student can explain the mechanisms of synchrotron radiation generation, and the properties of radiation in different beamlines. The student can name the special characteristics of laser radiation and the instrumentation and measurement designs needed. In addition the student can give examples of 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 35 h, exercises 20 h, self-study 105 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
766326A Atomic physics 1
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lecture notes and parts from the book D. Attwood: Soft X-Rays and Extreme Ultraviolet Radiation: Principles and Applications.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Marko Huttula
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761675S/

761664S: Laser physics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
Finnish (in English as book exam)
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 and 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.
Mode of delivery:

Face-to-face teaching
Learning activities and teaching methods:
Lectures 35 h, exercises 20 h, self-study 105 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
766329A Wave motion and optics, 766319A Electromagnetism
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
W.T. Silfvast: Laser fundamentals, O. Svelto: Principles of lasers.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Seppo Alanko
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761664S/

761657S: Magnetospheric physics, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Language of instruction:
English
Timing:
Roughly every third year.
Learning outcomes:
After passing the course the student is able to describe the formation of the magnetosphere as an interaction between solar wind and planetary magnetic field, to explain in physical terms the essential factors and phenomena of magnetospheric structre and dynamics, to compare different magnetospheres, and to apply basic methods of space plasmas to describe magnetospheric phenomena.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 44 h, 10 exercises (20 h), self-study 149 h
Target group:
Recommended especially for students of space physics, astronomy and theoretical physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:

Recommended courses: 766355A Basics of space physics or 761353A Basics of plasma physics, or equivalent knowledge.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
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.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Kalevi Mursula
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761657S/

766101P: Mathematics for physics, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay766101P	Mathematics for physics (OPEN UNI)	5.0 op
763101P	Vector and tensor analysis	6.0 op

ECTS Credits:
5 credits
Language of instruction:
Finnish
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
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 30 h, exercises 24 h, self-study 79 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously

Recommended or required reading:
Lecture notes.
Assessment methods and criteria:
Four written intermediate examinations or final examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Seppo Alanko
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/766101P/etusivu

761386A: Maturity test, 0 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
0 credits
Language of instruction:
English
Timing:
3rd autumn or 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Independent work
Target group:
Compulsory in B.Sc. degree for student of physics.
Prerequisites and co-requisites:
B.Sc. thesis
Recommended optional programme components:
No alternative course units
Recommended or required reading:
No reading
Assessment methods and criteria:
The test event
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Scale pass/fail
Person responsible:
Professors
Working life cooperation:
No work placement period

763685S: Maturity test, 0 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
0 credits
Language of instruction:
Englanti
Timing:
5th year
Learning outcomes:
The student can write a lucid abstract of his/her M.Sc. Thesis.
Contents:
The student describes and analyses the material, research methods, and results of his/her M.Sc. Thesis. The abstract must fit on a single page.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Independent work
Target group:
A compulsory part the degree, students of theoretical physics.
Prerequisites and co-requisites:
After completed master thesis.
Recommended optional programme components:
No alternative course units
Recommended or required reading:
No reading
Assessment methods and criteria:
The test event
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Scale pass/fail
Person responsible:
Erkki Thuneberg
Working life cooperation:
No

761686S: Maturity test, 0 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
0 credits
Language of instruction:
English
Timing:
5. year
Learning outcomes:
The student can write a lucid abstract of his/her M.Sc. Thesis.
Contents:
The student describes and analyses the material, research methods, and results of his/her M.Sc. Thesis. The abstract must fit on a single page.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:

Independent work
Target group:
Compulsory for Master of Science in physics.
Prerequisites and co-requisites:
Written after the completion of the pro gradu thesis
Recommended optional programme components:
No alternative course units
Recommended or required reading:
No reading
Assessment methods and criteria:
The test event
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Scale pass/fail
Person responsible:
Professors
Working life cooperation:
No

765657S: Maturity test, 0 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
0 credits
Language of instruction:
English
Timing:
5. year
Learning outcomes:
The student can write a lucid abstract of his/her M.Sc. Thesis.
Contents:
The student describes and analyses the material, research methods, and results of his/her M.Sc. Thesis. The abstract must fit on a single page.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Independent work
Target group:
Compulsory for Master of Science in astronomy
Prerequisites and co-requisites:
Written after the completion of the pro gradu thesis
Recommended optional programme components:
No alternative course units
Recommended or required reading:
No reading
Assessment methods and criteria:
The test event
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Scale pass/fail
Person responsible:
Heikki Salo
Working life cooperation:
No

764695S: Maturity test for MSc, 0 op

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

ECTS Credits:
0 credits
Language of instruction:
Finnish or English
Timing:
5th study year
Learning outcomes:
The student can independently produce text from the research field of his/her thesis using the language of the thesis (762681S).
Contents:
If a student has written a maturity test for his/her Bachelor degree, showing a good command of Finnish or Swedish, the maturity test for the M.Sc. degree is an abstract of his/her Master's thesis, written as regulated by the faculty.
Mode of delivery:
Face to face
Learning activities and teaching methods:
Independent work
Target group:
Compulsory for Master of Science in biophysics.
Prerequisites and co-requisites:
Written after the completion of the Master's thesis.
Recommended optional programme components:
No alternative course units.
Recommended or required reading:
No reading
Assessment methods and criteria:
The test event
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/fail
Working life cooperation:
No work practise.

766323A: Mechanics, 6 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field 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 credits
Language of instruction:
This course will be lectured in Finnish. Course book is in English. Most of the exercises are in English.

Timing:
1st year
Learning outcomes:
The student learns to recognise mechanics-related phenomena in his/her surrounding and nature. He/she is able to describe concepts of mechanics and to apply those in different problems.
Contents:
The development in physics started from mechanics. This is due to the mechanical phenomena such as motion that has fundamental significance in our environment. The research of mechanics has led to invariant laws, which are essential in all physics research.
Part 1 **:** Motion and dynamics of motion, motion in three dimension, fields and energy.
Part 2: Many-body interactions, gravitation, rigid-body dynamics, relative motion, mechanics of fluids.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Part 1: Lectures 24 h, exercises 12 h (6 x 2 h), self-study 44 h
Part 2: Lectures 22 h, exercises 10 h (5 x 2 h), self-study 48 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu
Prerequisites and co-requisites:
Needs a course 763101P Mathematics for physics, especially vectors, differential and integral calculus. This course includes the basic mechanics.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
H.D. Young and R.A. Freedman, University Physics, as well as other material as needed.
Course material availability can be checked here.
Assessment methods and criteria:
Part 1: One end exam.
Part 2: One end exam.
Both parts must be passed.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Juha Vaara (part 1) ja Perttu Lantto (part 2)
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/766323A/

764371A: Medical equipments, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
2nd - 4th year
Learning outcomes:
The student can recognize and describe most of the equipment and the technology behind them as used in hospitals.
Contents:
The course covers most of the technology behind the equipments used for diagnosis and treatment in hospitals. This knowledge forms one of the basis for students interested in Biomedical engineering. Examples of

phenomena or environments for which technology is included: bio-electricity, blood pressure and flow, pulmonary function, operative environment, physical treatment, hospital laboratory tests.
Mode of delivery:
Face-to-face teaching or guided approach to course literature
Learning activities and teaching methods:
Written material, handouts from several sources covering the required topics, for self-study or independent reading (133 h)
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Matti Weckström ja Timo Jämsä
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/764371A/

764634S: Medical physics and imaging, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
4th-5th Autumn
Learning outcomes:
The student is able to define the physical principles on which various medical diagnostic and therapeutic devices are based upon.
Contents:
The course acquaints the students to the basic physics related to imaging modalities and therapeutic systems used in hospitals. Covered topics include e.g. x-ray imaging, computed tomography, magnetic resonance imaging, nuclear medicine, radiation therapy and methods of clinical neurophysiology.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 32 h, calculus assignments 4 h, demonstrations 6 h, reporting 25 h, self-study 112 h
Target group:
Physics MSc students with biophysics major or/and medical physics minor, biomedical engineering students. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Recommended: physics basic courses and Radiation physics, biology and safety (766116P, 761116P, 764117P or 764317A).
Recommended optional programme components:

No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Dowsett, Kenny, Johnston: The Physics of Diagnostic Imaging, 2nd ed., Hodder Arnold, 2006.
Webster: Medical instrumentation: application and design, 4th ed, John Wiley & Sons, 2010.
Podgorsak: Radiation Oncology Physics – A handbook for teachers and students, IAEA, 2005 (http://www-pub.iaea.org/mtcd/publications/pdf/pub1196_web.pdf).

Additional literature depending on the lecturers.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Miika Nieminen
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/764634S/

766677S: Modern characterization methods in material science, 6 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field 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 course is aiming to give an overview of the advances in the material characterization techniques **.** After passing the course the students can explain basic principles of different techniques, spanning from the determinations of the morphology of the electric structures of bulk materials, nano-films as well as the free and deposited clusters.
Contents:
The course will focus on the methods and special requirements on experimental research on the field of material science. The lessons and demonstration cover the basic principles related to the conventional characterization methods, microscopic detections, and the latest synchrotron-radiation-based techniques. The students will also be trained to practice laboratory works on the PVD sample growth system, morphological, and the electric structure measurements through SEM and the XPS. The course will also cover introduction to the inorganic material growth methods and the requirements to select different techniques.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24 h, exercises 10 h, 2 laboratory exercises, self-study 118 h
Target group:
Primarily for the students of the international master program degree in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:

Material Characterization techniques, by Sam Zhang, Lin Li, and Ashok Kumar, CRC press (2009); X-ray characterization of materials edited by Eric Lifshin, Wiley-VCH, (1999).
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Wei Cao
Working life cooperation:
No work placement period

764618S: Molecular biophysics, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish, English

ECTS Credits:
5 credits
Language of instruction:
English (or Finnish, depending of attenders)
Timing:
4th - 5th autumn (not necessarily every 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 16 h, exercises 16 h, small projects, home exam, self-study 101 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Cell membrane biophysics (764323A) and Spectroscopic methods (761359A)
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lecture material; Tom A. Waigh: Applied Biophysics, A Molecular Approach for Physical Scientists, John Wiley & Sons Ltd., Chichester 2007 (partly).
Course material availability can be checked here.
Assessment methods and criteria:
Home exam and final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Marja Hyvönen
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/764618S/

766660S: Molecular properties, 6 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field 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:
After passing the course, the students understand the basic quantum-mechanical principles behind both experimental spectroscopic and computational (electronic-structure) means of investigating the structure and properties of molecules in the gas phase, in solution and in the solid state.
Contents:
Molecular rotations and vibrations, electronic transitions, electric, optical, and magnetic properties of molecules.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 35 h, demonstrations 16 h, two computer-based homework exercises, self-study 109 h
Target group:
Advanced undergraduate and beginning graduate students of physics, chemistry and materials sciences. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Necessary background: Intermediate courses in atomic and thermal physics, 761661S Molecular quantum mechanics or the corresponding knowledge.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
P.W. Atkins and R.S. Friedman, "Molecular Quantum Mechanics", 5th edition, Chapters 10 - 13, Oxford University Press, 2011. Lecture notes.
Course material availability can be checked here.
Assessment methods and criteria:
Final examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Juha Vaara
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/766660S/

761661S: Molecular quantum mechanics, 8 op

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

ECTS Credits:
8 credits

Language of instruction:
English
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).
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 44 h, demonstrations 20 h, self-study 149 h
Target group:
Advanced undergraduate and beginning graduate students of physics, chemistry and materials sciences. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Necessary background: Intermediate courses in atomic and thermal physics, or the corresponding knowledge.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
P.W. Atkins and R.S. Friedman, "Molecular Quantum Mechanics", 5th edition, Chapters 1 - 9, Oxford University Press, 2011.
Course material availability can be checked here.
Assessment methods and criteria:
Final examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Juha Vaara
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761661S/

766661S: NMR Imaging, 8 op

Voimassaolo: 01.01.2010 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Language of instruction:
English
Timing:
Every second year (odd year), autumn
Learning outcomes:
After completion, student understands the principles of the imaging methods based on nuclear magnetic resonance (NMR) and how NMR imaging can be used to characterize physical properties of various materials.
Contents:

Topics include one-dimensional Fourier imaging, *k* space, gradient echoes, multidimensional Fourier imaging, continuous and discrete Fourier transform, sampling, folding, filtering, resolution, and contrast.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 44 h, exercises 20 h, self-study 149 h
Target group:
Primarily for the students of the degree programme in physics and chemistry. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
761663S NMR spectroscopy is helpful, but not necessary.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
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).
Course material availability can be checked here.
Assessment methods and criteria:
One written examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Juhani Lounila and Ville-Veikko Telkki
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/766661S/

761663S: NMR spectroscopy, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Language of instruction:
English
Timing:
Every second year (even year), autumn
Learning outcomes:
After completion, student understands the physical basis of NMR phenomenon and realizes the potential of NMR spectroscopy in the studies of molecular and materials properties.
Contents:
NMR (Nuclear Magnetic Resonance) spectroscopy is a versatile tool for studying the physical properties of all states of matter. It makes possible, 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, the interactions affecting the structure of NMR spectra and the principles of a spectrometer. Modern NMR allows the manipulation of nuclear spins applying various pulse sequences, and pulse sequences related to, *e.g.*, polarization transfer will be treated as well as the basics of multidimensional NMR.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 44 h, exercises 20 h, self-study 149 h
Target group:

Primarily for the students of the degree programme in physics and chemistry. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Basic knowledge on quantum mechanics and atomic physics helps but is not compulsory.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Material will be distributed during the course. The course is mainly based on the following book: J. Keeler, Understanding NMR Spectroscopy (John Wiley & Sons, Chichester, 2010).
Course material availability can be checked here.
Assessment methods and criteria:
One written examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Ville-Veikko Telkki
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761663S/

761670S: NMR spectroscopy in solids, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field 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 can explain the basic principles of nuclear magnetic resonance spectroscopy (NMR spectroscopy) in the solid state and can derive their consequences in the extent and level of the lectures (see Contents). In addition, he/she can solve problems which require profound understanding of the essential contents of the course.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 35 h, 10 exercises (20 h), self-study 105 h
Target group:
Primarily for the students of the degree programme in physics and chemistry. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
761663S NMR spectroscopy is helpful, but not necessary.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Material available from the lectures and/or web pages of the course.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:

Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Juhani Lounila
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761670S/

764680S: Neural information processing, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
English
Timing:
4th autumn
Learning outcomes:
After finishing the course the student is able to describe and explain the basic principles, model and functions in the information processing of neurons, for example: membrane functions of neurons, synaptic functions, neural signals, neural information. These models and functions enable the student to solve, analyze and calculate problems and exercises concerning this field. In addition the student is able to describe certain special issues of neural information processing, to illustrate biophysical models made of them and solve calculations concerning them.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures ca. 30 h, calculation exercises 15 h, home exam, self-study 88 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Cell membrane biophysics (764323A or 764623S) is recommended to be done before this course.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lectures and other material given during the course.
Assessment methods and criteria:
Final examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Matti Weckström, Kyösti Heimonen, Roman Frolov
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/764680S/

766334A: Nuclear and particle physics, 2 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field 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
Language of instruction:
Finnish
Timing:
Second spring term
Learning outcomes:
The student can explain the basic principles of nuclear and particle physics and can derive their consequences in the extent and level of the lectures (see Contents). In addition, he/she can solve problems which require profound understanding of the essential contents of the course.
Contents:
The content of the course is equivalent to the content of part 2 of the course 766330A Structure of Matter.
Person responsible:
Juhani Lounila

766669S: Nuclear magnetic relaxation, 6 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field 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 can explain the basic principles of the theory of nuclear magnetic relaxation and can derive their consequences to the experimentally observable relaxation phenomena in the extent and level of the lectures (see Contents). In addition, he/she can solve problems which require profound understanding of the essential contents of the course.
Contents:
The course dissects the behavior of nuclear spins of a material, especially liquid, in a magnetic field when the system is approaching equilibrium after an applied perturbation, consisting of e.g., a radiofrequency pulse sequence. This process, nuclear magnetic relaxation, is important in various applications of nuclear magnetic resonance (NMR), e.g., in NMR spectroscopy. It has effects on how NMR experiments are carried out. Moreover, experimental relaxation parameters contain valuable information on the properties of the material, e.g., on the geometry and dynamics of its molecules. The main goal of this course is to pin down how the relaxation phenomena observed in NMR experiments can be derived from the fundamental properties of a nuclear spin system. Our method of choice is the Redfield theory, which describes the nuclear spin system by a quantum mechanical density operator, but the surroundings of the spins are treated classically.
Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:
Lectures 35 h, 10 exercises (20 h), self-study 105 h
Target group:
Primarily for the students of the degree programme in physics and chemistry. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
761663S NMR spectroscopy is helpful, but not necessary.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Material available from the lectures and/or web pages of the course.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Juhani Lounila
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/766669S/

766315A: Numerical modelling, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
Finnish
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
14 exercises, 4 homework projects, self-study 91 h
Target group:
Primarily for the students of the degree programme in physics.
Prerequisites and co-requisites:
521141P Elementary programming (recommended)
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Mathematica notebook
Assessment methods and criteria:
One written examination and 3 exercise works
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0-5, where 0 = fail

Person responsible:
Heikki Vanhamäki
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/766315A/etusivu

763616S: Numerical programming, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
4th autumn
Learning outcomes:
The student can apply commonly used methods in function interpolation and approximation, numerical integration and solving sets of linear equations. For differential equations the student can explain the differences between the initial value- and boundary value -problems and can choose the appropriate methods for solving them. The student can write computer programs to solve numerical problems and can utilize the common mathematical program libraries such as Lapack and GSL when writing programs.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 26 h, 11 exercises, 4 homework projects, self-study 134 h
Target group:
Primarily for the students of the degree programme in physics
Prerequisites and co-requisites:
Basic knowledge of programming, 763114P Introduction to programming
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lecture notes, W. H. Press, B. P. Flannery, S. A. Teukolsky and W. T. Vetterling: Numerical Recipes. The Art of Scientific Computing.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Kari Jänkälä
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/763616s/etusivu

765667S: Observational Astrophysics and Data Analysis, 6 op

Voimassaolo: 01.01.2011 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

765367A Observational Astrophysics and Data Analysis 6.0 op

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
Not lectured every year
Learning outcomes:
After the finished course the student is expected to understand the role of observations in the formation of astronomical knowledge and to know the instruments and detectors used in astronomy, the observational methods with the modern space- and ground-based telescopes, as well as data reduction and data analysis methods.
Contents:
This course broadly covers the theory and practice of obtaining meaningful astronomical data. Topics covered include different detector/telescope configurations, the atmosphere and its effects on observations, observational experiments, calibrations and data reductions, both on a theoretical level and experimentally with the real data. There is an introduction to observational methods including direct imaging, astrometric, photometric, polarimetric, spectroscopic, and interferometric measurements of astronomical sources across the electromagnetic spectrum. It also introduces some analysis tools and statistical techniques (signal detection, signal-to-noise estimates, model fitting, and goodness-of-fit estimation, etc.) that are commonly used in astronomical research.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 32 h, exercises 12 h, self-study 116 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Fundamentals of astronomy (recommended), Statistical methods in astronomy (765366A/765666S).
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Recommended reading:
Kitchin, C.R.: Astrophysical Techniques (5th Edition - 2008)
ISSI Scientific Report Volume 9 (SR-009): Observing Photons in Space (2010)
Romanishin, W.: An Introduction to Astronomical Photometry Using CCDs - http://observatory.ou.edu/wrccd22oct06.pdf
Birney, D. S., Gonzalez, G. & Oesper, D.: Observational Astronomy (2nd Edition - 2006)
Course material availability can be checked here.
Assessment methods and criteria:
One written examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Vitaly Neustroev
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/765667S/etusivu

761665S: Optics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761685S Optics 5.0 op

ECTS Credits:
6 credits
Language of instruction:
Finnish (in English as book exam)
Timing:
Not lectured every year.
Learning outcomes:
Chosen fields of optics are studied in great detail. The course is suitable for physicist who will apply her/his knowledge to research and industry in the field of optics.
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...) .
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 35 h, exercises 20 h, self-study 105 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
766329A Wave motion and optics, 766319A Electromagnetism
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
F. L. Pedrotti, L.S. Pedrotti: Introduction to optics, E. Hecht: Optics.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Seppo Alanko
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761665S/

761011Y: Orientation course for new students, 2 op

Opiskelumuoto: General Studies

Laji: Course

Vastuuyksikkö: Field 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:
Finnish
Timing:
1st autumn
Learning outcomes:
After the course student recognizes research targets in his/her own field and can ask questions of teaching and studying at right places and right people.
Contents:
During the course, older students introduce the new students to the studying environment and university organization, provide information on the subject matters, aims and prospects related to the field of study, and help with the practical issues connected to the beginning of the studies.
This course will also introduce the research areas of the Department of physics: physics; space physics, electron and NMR spectroscopy as well as biophysics, theoretical physics, astronomy and geophysics. One hour period is reserved for each field and also to present possibilities for educational studies and the employment of the physicists are looked through.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Group work 10-15 h, lectures 9-10 h, 75 % present, self-study 34 h
Target group:
Compulsory for students in physics.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Handouts
Assessment methods and criteria:
Group work min 10 h, lectures 75 % present
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Scale pass/fail
Person responsible:
Anja Pulkkinen and Marja Hyvönen
Working life cooperation:
No work placement period

761644S: Physical measurements, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field 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:
After passing the course the students can explain basic principles of generating and maintaining vacuum atmosphere using different kinds of vacuum pump systems and pressure gauges, can give examples on methods of the experimental research of atomic and molecular physics and are able to name special properties of them.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 30 h, exercises 10 h, laboratory exercise 6 h, self-study 116 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Fontell, Maula, Nieminen..., Insinööritieto OY: "Tyhjiötekniikka"
Material distributed at lessons
Optional/Additional: Moore, Davis & Coplan, Building Scientific Apparatus, Cambridge Press (chapters 3, 5, 7)
Hablanian; High Vacuum Technology, A Practical guide, Marcel Dekker Inc (1997)
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Marko Huttula
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761644S/

761112P: Physical world view, 3 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761108P	Physical world view	5.0 op

ECTS Credits:
3 credits
Language of instruction:
Finnish
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 20 h, self-study 60 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites

Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Feynman R., The Character of Physical Law, Penguin Books 1992.
See also http://research.microsoft.com/apps/tools/tuva/
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Matti Weckström and Juha Vaara
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761112P/

766339A: Physics for teachers, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761316A Being a teacher in mathematical subjects 5.0 op

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
3. autumn
Learning outcomes:
The students learn the teaching 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. High school physics books beside the university course books 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 other students during their physics courses. All this lowers the step to move into the teachers training.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
80% present, teaching training, report, self-study 107 h
Target group:
Compulsory for physics students becoming teachers.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
High school and university level physics books
Assessment methods and criteria:
Lecture trainings, learning diary.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grading scale pass/fail

Person responsible:
Saana-Maija Huttula
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/766339A/

765659S: Physics of the Solar System I, 7 op

Voimassaolo: 01.08.2013 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English
Leikkaavuudet:

765684S	Physics of the Solar System I	5.0 op
765384A	Physics of the solar system I	5.0 op
765359A	Physics of the Solar System I	7.0 op

ECTS Credits:
7 credits
Language of instruction:
English
Timing:
Not lectured every year
Learning outcomes:
The student learns basic concepts and methods of solar system science and their application to current problems in the field.
Contents:
See 765359A
Person responsible:
Jürgen Schmidt

765359A: Physics of the Solar System I, 7 op

Voimassaolo: 01.08.2013 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English
Leikkaavuudet:

765684S	Physics of the Solar System I	5.0 op
765384A	Physics of the solar system I	5.0 op
765659S	Physics of the Solar System I	7.0 op

ECTS Credits:
7 credits
Language of instruction:
English
Timing:
Not lectured every year
Learning outcomes:
The student learns basic concepts and methods of solar system science and their application to current problems in the field.

Contents:
The course describes and discusses observations of planets and their satellite systems, asteroids and meteoroids, comets and dwarf planets. Fundamental modern research methods and their application to up to date problems and pheomena in the solar system are introduced. Topics of planetary formation as well as extrasolar planets will be briefly discussed.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
26 hours lecture, 26 hours exercises, 135 hours self-study
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
`Planetary Sciences', I. de Pater, J.J. Lissauer (Cambridge University Press),
`Physics of the Solar System', B. Bertotti, P. Farinella, D. Vokrouhlicky (Kluwer Academic Publishers).
Course material availability can be checked here.
Assessment methods and criteria:
One written examination and points from worked exercise problems
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Jürgen Schmidt
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/765359a/etusivu

765679S: Physics of the Solar System II - Special topics, 7 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
7 credits
Language of instruction:
English
Timing:
Not lectured every year
Learning outcomes:
The student learns concepts and methods of solar system science and their application to current problems in the field.
Contents:
See 765379A
Person responsible:
Jürgen Schmidt

765379A: Physics of the Solar System II - Special topics, 7 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
7 credits
Language of instruction:
English
Timing:
Not lectured every year
Learning outcomes:
The student learns concepts and methods of solar system science and their application to current problems in the field.
Contents:
In extension of Physics of the Solar System I, this course addresses in greater depth special topics like planetary magnetospheres, tidal interaction, planetary interiors, and the origin and evolution of the Solar System.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
26 hours lecture, 26 hours exercises, 135 hours self-study
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
`Planetary Sciences', I. de Pater, J.J. Lissauer (Cambridge University Press),
`Physics of the Solar System', B. Bertotti, P. Farinella, D. Vokrouhlicky (Kluwer Academic Publishers),
`Solar System Dynamics', C.D. Murray, S.F. Dermott (Cambridge University Press)
Course material availability can be checked here.
Assessment methods and criteria:
One written examination and points from worked exercise problems
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Jürgen Schmidt
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/765379a/etusivu

761653S: Plasma physics, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Language of instruction:
English
Timing:
Roughly every third year.
Learning outcomes:

The course begins with the introduction of the basic plasma theories: the kinetic theory and magnetohydrodynamics. After passing the course the student is able to explain the physical content of these theories, and is able to apply the theories to basic plasma problems. The student is also able to linearize partial differential equations related to these theories, transforming complicated differential equations into a solvable form. The student is able to apply these methods to study basic plasma wave modes and the most important plasma instabilities.

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, linearization of differential equations, MHD waves, waves in cold plasma, kinetic theory of plasma waves, Landau damping, instabilities.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 44 h, 10 exercises (20 h), self-study 149 h

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.

Prerequisites and co-requisites:

Recommended course 761353A Basics of plasma physics, or equivalent knowledge.

Recommended optional programme components:

No alternative course units or course units that should be completed simultaneously

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.

Course material availability can be checked here.

Assessment methods and criteria:

One written examination

Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Timo Asikainen

Working life cooperation:

No work placement period

Other information:

https://wiki.oulu.fi/display/761653S/

764637S: Practical training, 3 - 9 op

Voimassaolo: 01.08.2013 -

Opiskelumuoto: Advanced Studies

Laji: Practical training

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

3-9 credits

Language of instruction:

English or Finnish

Timing:

2nd - 5th year

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 4 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.
Mode of delivery:
A summer job, for example
Learning activities and teaching methods:
Practical training and report
Target group:
Students in biophysics
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
No specific material
Assessment methods and criteria:
Report
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Scale pass/fail
Person responsible:
Matti Weckström
Working life cooperation:
Work placement period

762352A: Practical training, 5 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
English or Finnish
Timing:
M.Sc. studies
Learning outcomes:
In practical training, a student is introduced to working life in geophysics. After training, the student can recognize the skills and demands of the job and can define need for the selection of the content of 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.
Mode of delivery:
Training (minimum 2 months)
Learning activities and teaching methods:
A written report
Target group:
Recommended for M.Sc. students in geophysics
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:

No specific material
Assessment methods and criteria:
Report
Grading:
Scale pass/fail
Person responsible:
Toivo Korja
Working life cooperation:
Work placement period

764337A: Practical training, 3 - 9 op

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
3 - 9 credits
Language of instruction:
English or Finnish
Timing:
2nd - 5th year
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 4 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.
Mode of delivery:
A summer job, for example
Learning activities and teaching methods:
Practical training and report
Target group:
Students in biophysics
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
No specific material
Assessment methods and criteria:
Report
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Scale pass/fail
Person responsible:
Matti Weckström
Working life cooperation:
Work placement period

761337A: Practical training, 3 - 6 op

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
3 - 6 credits
Language of instruction:
English or Finnish
Timing:
2nd - 5th year
Learning outcomes:
After the practical training, the student is able to participate in scientific research in his/her own field.
Contents:
A job, e.g. a summer job, which supports studies in physics, and could be accepted as a practical training. One month of employment corresponds 1.5 study points. Maximum of 6 credits from practical training can be included in Bachelor and/or Master of Science studies in physics.
Mode of delivery:
A summer job, for example
Learning activities and teaching methods:
Training and a written report
Target group:
Students in physics
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
No specific material
Assessment methods and criteria:
Report
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Scale pass/fail
Person responsible:
Anja Pulkkinen
Working life cooperation:
Work placement period

763650S: Practice, 3 - 5 op

Opiskelumuoto: Advanced Studies

Laji: Practical training

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
3 - 5 credits
Language of instruction:
English or Finnish
Timing:
2nd - 4th year
Learning outcomes:
To see working in practice.
Contents:
Training that is not directly related to other study accomplishments.
Mode of delivery:
A summer job, for example
Learning activities and teaching methods:
An essay of the work is written.
Target group:
Students in theoretical physics
Prerequisites and co-requisites:

No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
No specific material
Assessment methods and criteria:
Work report
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Scale pass/fail
Person responsible:
Erkki Thuneberg
Working life cooperation:
Work placement period

761683S: Pro gradu thesis, 35 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
35 credits
Language of instruction:
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
A written M.Sc. thesis of approximately 50 pages, self-study 933 h
Target group:
Compulsory for space physics and atom, molecule and material physics student (M.Sc. degree)
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
No reading
Assessment methods and criteria:
The thesis
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Professors
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761683S/

761684S: Pro gradu thesis, 20 op

Opiskelumuoto: Advanced Studies
Laji: Diploma thesis
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
20 credits
Language of instruction:
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
The student gets independently acquainted to certain field of physics and prepares a thesis, based on own research. Self-study 533 h.
Target group:
Compulsory for subject teacher line
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
No reading
Assessment methods and criteria:
The thesis
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Professors
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761684S/

764697S: Pro gradu thesis, 35 op

Opiskelumuoto: Advanced Studies
Laji: Diploma thesis
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:
35 credits
Language of instruction:
English
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.
Mode of delivery:
Face-to-face teaching
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. Self-study 933 h.
Target group:
Compulsory for Master of Science in Biophysics
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
Ei vaihtoehtoisia tai samanaikaisesti suoritettavia opintojaksoja
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
No reading
Assessment methods and criteria:
The thesis
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Matti Weckström
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/764697S/

765621S: Pro gradu thesis, 20 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
20 credits
Language of instruction:
English
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
The student gets independently acquainted to certain field of astronomy and prepares, based on own research, a thesis of approximately 50 pages. Self-study 533 h.
Target group:
For subject teacher (M.Sc. degree).
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
No reading

Assessment methods and criteria:
The thesis
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Heikki Salo
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/765621S/

763683S: Pro gradu thesis, 35 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
35 credits
Language of instruction:
English
Timing:
4th - 5th year
Learning outcomes:
To be able to make a scientific research under guidance and to write a scientific report.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
The student gets independently acquainted to certain field of theoretical physics and prepares a thesis, based on own research. Self-study 933 h.
Target group:
Compulsory for theoretical physics students (for subject teacher line course 763682S).
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
No reading
Assessment methods and criteria:
The thesis
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Erkki Thuneberg
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/763683S/

763682S: Pro gradu thesis, 20 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
20 credits
Language of instruction:
English
Timing:
4. - 5. year
Learning outcomes:
To learn to collect results from literature and to write a report.
Contents:
For subject teacher line based mainly on literature search. Includes a seminar talk.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
The student gets independently acquainted to certain field of theoretical physics and prepares, based on own research, a thesis of approximately 50 pages. Self-study 533 h.
Target group:
Subject teachers in theoretical physics (M.Sc. degree).
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
No reading
Assessment methods and criteria:
The thesis
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Erkki Thuneberg
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/763682S/

765624S: Pro gradu thesis, 35 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
35 credits
Language of instruction:
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:
Guided research in the field of astronomy, writing of the thesis, and seminar presentation.
Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:
The student gets independently acquainted to certain field of astronomy and prepares, based on own research, a thesis of approximately 50 pages. Self-study 933 h.
Target group:
Compulsory for Master of Science in Astronomy
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
No reading
Assessment methods and criteria:
The thesis
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Heikki Salo
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/765624S/

763312A: Quantum mechanics I, 10 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763612S Quantum mechanics I 10.0 op

ECTS Credits:
10 credits
Language of instruction:
English (or Finnish, depending on the participants)
Timing:
3rd autumn
Learning outcomes:
The most important goal of the course is the development of a quantum mechanical frame-of-mind. After the course, the student knows the postulates of quantum mechanics and can solve the Schrödinger equation in such one- and three-dimensional problems that have important applications in condensed matter physics and in atomic, nuclear and molecular physics. The student will also learn to derive the uncertainty principle and use it to interpret what happens in a quantum mechanical measurement.
Contents:
Quantum mechanics, together with the general theory of relativity, lays the foundation for the modern scientific understanding of the nature. Recent developments in nanotechnology has also brought quantum-based applications into our everyday lives. However, the greatest influence quantum mechanics brings is on how we understand and interpret the behavior of the basic building blocks of nature. One of the interesting results of quantum mechanics is the uncertainty principle which means, for example, that a particle does not possess well defined position and velocity at a given time. This has far-reaching consequences in our understanding of the structure of matter, and even of the present amount and distribution of galaxies in the known universe. The inherent indeterminacy in the particles' classical state implies that the microscopic particles have to be described with the so-called wave function, which determines the probability density of finding the particle at an arbitrary location. The course begins with the introduction of the basic principles and postulates of quantum mechanics. As an example, several one-dimensional problems for the time-evolution of the wave function are solved. The uncertainty principle is derived in its general form, and applied to the simultaneous measurement of position and velocity. In three-dimensional problems, spherical symmetry is connected with the angular momentum. The corresponding operators and quantum numbers are derived. As an example, the quantized energy states of hydrogen atom are solved. An introduction to the periodic table of elements is presented.

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 50 h, 12 exercises (á 3 h), self-study and examination 184 h
Target group:
Compulsory for theoretical physicists and physicists. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Atomic physics (766326A) and knowledge of linear algebra and differential equations.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
J. Tuorila: Kvanttimekaniikka I (2013, in Finnish). D. Griffiths: Introduction to Quantum Mechanics (2005).
Course material availability can be checked here.
Assessment methods and criteria:
Two written intermediate examinations or one final examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Jani Tuorila
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/763312A/etusivu

763612S: Quantum mechanics I, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763312A	Quantum mechanics I	10.0 op

ECTS Credits:
10 credits
Language of instruction:
English (or Finnish, depending on the participants)
Timing:
3rd autumn or later
Learning outcomes:
The most important goal of the course is the development of a quantum mechanical frame-of-mind. After the course, the student knows the postulates of quantum mechanics and can solve the Schrödinger equation in such one- and three-dimensional problems that have important applications in condensed matter physics and in atomic, nuclear and molecular physics. The student will also learn to derive the uncertainty principle and use it to interpret what happens in a quantum mechanical measurements.
Contents:
See 763312A Quantum mechanics I.
Target group:
Compulsory for physicists.
Person responsible:
Jani Tuorila
Other information:
https://noppa.oulu.fi/noppa/kurssi/763312A/etusivu

763613S: Quantum mechanics II, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763313A Quantum mechanics II 10.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
10 credits
Language of instruction:
English (or Finnish, depending on the participants)
Timing:
Spring
Learning outcomes:
Course continues the development of the quantum mechanical frame-of-mind. After the course, the student can solve different physical eigenvalue problems by using matrices, can calculate the quantum numbers of the system, and can estimate the effect of a perturbation. The student can also solve problems that arise in low-energy scattering.
Contents:
See 763313A
Target group:
Advanced course for students in physics.
Person responsible:
Jani Tuorila
Other information:
https://noppa.oulu.fi/noppa/kurssi/763313A/etusivu

763313A: Quantum mechanics II, 10 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763613S Quantum mechanics II 10.0 op

ECTS Credits:
10 credits
Language of instruction:
English (or Finnish, depending on the participants)
Timing:
3rd spring
Learning outcomes:
Course continues the development of the quantum mechanical frame-of-mind. After the course, the student can solve different physical eigenvalue problems by using matrices, can calculate the quantum numbers of the system, and can estimate the effect of a perturbation. The student can also solve problems that arise in low-energy scattering.
Contents:
The general formulation of quantum mechanics in terms of abstract Hilbert space and its linear transformations is presented, and shown to be equivalent with the wave function formalism used in Quantum Mechanics I. The properties of the general theory are illustrated in terms of the two quantum paradigms: the two-level system and the harmonic oscillator. 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. Effects of weak perturbations are studied in terms of time-independent and time-dependent perturbation theory. As an example, we calculate fine-structure corrections to hydrogen atom, Zeeman effect, and the bound states of ionic Hydrogen molecule and He-atom. We derive the Fermi golden rule to calculate radiation induced transition rates 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 50 h, 12 exercises, self-study and examination 184 h
Target group:
For all interested in modern, quantum phenomena, compulsory for theoretical physicists. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Quantum Mechanics I (763312A).
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
J. Tuorila: Kvanttimekaniikka II (2014, in Finnish). D. Griffiths: Introduction to Quantum Mechanics (2005). Course material availability can be checked here.
Assessment methods and criteria:
Two written intermediate examinations or one final examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Jani Tuorila
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/763313A/etusivu

763693S: Quantum optics in electric circuits, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763634S	Quantum devices	5.0 op

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
3rd - 5th year
Learning outcomes:
To solve time-dependent quantum mechanical problems in harmonic oscillator, two-state system and free electrons that involve damping and noise.
Contents:
With present nanofabrication methods it is possible to make such small electric circuits that quantum effects become essential. The circuits behave like artificial atoms and the methods to deal with them resemble those used in quantum optics and NMR rather than traditionally used by electrical engineers. 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 26 h, 11 exercise sessions, self-study 112 h

Target group:
For all interested in time-dependent quantum phenomena.
Prerequisites and co-requisites:
Recommended prerequisites Quantum mechanics I and II and Analytical mechanics.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
E. Thuneberg, Quantum optics in electric circuits. Exercises.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Erkki Thuneberg
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/763693S/etusivu

766116P: Radiation physics, biology and safety, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761116P	Radiation physics, biology and safety	3.0 op

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
2nd or 3rd spring
Learning outcomes:
After finishing the course the student is able to describe the physical mechanisms giving rise to different kinds of radiation 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.
Contents:
The topics of the course include the origin of ionizing radiation e.g. as a result of radioactive decay and in nuclear reactions, the interaction between radiation and matter, the detection and measurements of radiation, physical quantities and measuring units related to radiation, radiation in the environment, and examples of utilizing radiation. The biologic effects of radiation and the legislation on radiation safety are also discussed.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 26 h, exercises 8 h, laboratory exercises 8 h, self-study 91 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lecture notes, required law texts (in Finnish)
Assessment methods and criteria:

One written exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Seppo Alanko
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/766116p/etusivu

Compulsory

766116P-01: Radiation physics, biology and safety, exam, 0 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Basic Studies
Laji: Partial credit
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

761116P Radiation physics, biology and safety 3.0 op

Ei opintojaksokuvauksia.

766116P-02: Radiation physics, biology and safety, laboratory exercises, 0 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Basic Studies
Laji: Partial credit
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opettajat: Seppo Alanko
Opintokohteen kielet: Finnish
Leikkaavuudet:

761116P Radiation physics, biology and safety 3.0 op

Ei opintojaksokuvauksia.

765655S: Research project, 6 op

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

ECTS Credits:
6 credits
Language of instruction:
English or Finnish
Timing:
3th - 5th year
Learning outcomes:
Student is introduced to astronomical research in practice.
Contents:

Astronomical research under guidance, self-study 160 h
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
A study report
Target group:
Students in astronomy
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Recently published books and review articles
Assessment methods and criteria:
Written report
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Scale pass/fail
Person responsible:
Heikki Salo
Working life cooperation:
May include work placement period.

764651S: Research project in biophysics, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
10 credits
Language of instruction:
English
Timing:
4th - 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Objective-oriented project with final report of the work. Self-study 267 h.
Target group:
Compulsory for Master of Science in Biophysics.
Prerequisites and co-requisites:
BSc level biophysics
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Depending on the project.
Assessment methods and criteria:
Report and seminar based on that
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:

Matti Weckström
Working life cooperation:
No work placement period

766651S: Research project in physics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
4. – 5. year
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 a topic of one advanced course.
Mode of delivery:
Self-study 160 h
Learning activities and teaching methods:
Measurements and/or processing of results of measurements in a field of the underlying advanced course in physics, and a written report of the project.
Target group:
Compulsory for Master of Science in Physics.
Prerequisites and co-requisites:
The completion of the underlying advanced course in physics is recommended.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously.
Recommended or required reading:
No reading
Assessment methods and criteria:
The written report of the project
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
The lecturer of the underlying advanced course
Working life cooperation:
No work placement period

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

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
English

Timing:
3rd -5th year
Learning outcomes:
After this course student can explain the seismic wave phenomena, the wave propagation, and the difference and significance of different seismic waves related to the investigation of the Earth's structure. Student can define and explain basic theory and terminology behind seismic wave observations, analysis and interpretation. Student can analyze earthquake fault plane solutions and seismograms. Student can describe seismic methods used for investigating the Earth. He can define Earth's seismic structure, analyze results of seismic investigations and distinguish between different plate tectonic areas from seismic viewpoint.
Contents:
This course focuses in the fundamentals of the most important methods for investigating the Earth's deep structure, seismological and seismic methods. 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 the Finland and the Europe.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 30 h, exercises 15 h, self-study 88 h
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.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
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.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Elena Kozlovskaya
Working life cooperation:
No work placement period

761012Y: Senior tutoring, 1 op

Voimassaolo: 01.05.2010 -

Opiskelumuoto: General Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
1 credits
Language of instruction:
Finnish
Timing:
First autumn and spring terms
Learning outcomes:
After the course, the students have a clear picture of what successful studying of physics requires. The students identify the characteristics of their own methods of studying and of using time.
Contents:

Every new student is assigned a personal senior tutor who is an experienced member of the teaching personnel of the Department of Physics. The tutor keeps watch on the progress of the studying and aims to promote it by helping, advising, and supporting the student in all the matters related to the studies.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
The tutoring takes place mainly at monthly personal meetings, but the tutor can be contacted at any time.
Target group:
The course is compulsory for all physics students.
Prerequisites and co-requisites:
No prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
No reading
Assessment methods and criteria:
Active attendance at the tutoring program
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grading scale pass/fail
Person responsible:
Juhani Lounila
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761012Y/

765331A: Solar System Dynamics, 7 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
7 credits
Language of instruction:
English (or Finnish)
Timing:
Not lectured every year
Learning outcomes:
After the course the student can explain the basic mechanisms affecting the dynamics of Solar System particles, and is able to compare the different theories for the planetary formation.
Contents:
Basics of Solar system dynamics: orbital motions of planets, satellites, asteroids, and comets. Solar system formation and stability. The course includes several computer exercises which cover numerical integration, restricted three-body problem, resonances, and chaos.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 28 h, guided computer exercises 24 hours, one independent home assignment, self-study 135 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:

Lecture and exercise material given during the course.
Murray, C.D and Dermott, S.F.: Solar System Dynamics (part of)
Imke de Pater, Lissauer J.J. Planetary Sciences (part of)
Course material availability can be checked here.
Assessment methods and criteria:
One written examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Heikki Salo
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/765331A/

765631S: Solar System Dynamics, 7 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
7 credits
Language of instruction:
English (or Finnish)
Timing:
Not lectured every year
Learning outcomes:
After the course the student can explain the basic mechanisms affecting the dynamics of Solar System particles, and is able to compare the different theories for the planetary formation.
Contents:
Basics of Solar system dynamics: orbital motions of planets, satellites, asteroids, and comets. Solar system formation and stability. The course includes several computer exercises which cover numerical integration, restricted three-body problem, resonances, and chaos.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 28 h, guided computer exercises 24 hours, one independent home assignment, self-study 135 h
Compared to 765331A, includes another home assignment on more advanced level.
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lecture and exercise material given during the course.
Murray, C.D and Dermott, S.F.: Solar System Dynamics (part of)
Imke de Pater, Lissauer J.J. Planetary Sciences (part of)
Course material availability can be checked here.
Assessment methods and criteria:
One written examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:

Heikki Salo
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/765631S/

766659S: Solar effects on climate, 6 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

ECTS Credits:
6 credits
Language of instruction:
English or Finnish
Timing:
Roughly every second year
Learning outcomes:
After passing the course the student is able to describe the basic patterns and modes of climate and climate variability, general circulation, ocean-atmosphere coupling, and telecommunication, as well as the major influences of the Sun by the different mechanisms to the climate modes and patterns.
Contents:
This is an optional physics course at an advanced level on the solar effects on the Earth's atmosphere and climate. Climate change is well known to everyone and its importance to mankind overall can hardly be overestimated. On the other hand, while the Sun is the ultimate source of climate, the solar effects on climate change are still poorly understood. Moreover, in addition to the electromagnetic radiation (total and spectral irradiance), new solar effects have recently been found that are related to solar wind.
Topics: Major modes of climate variability, stratosphere-troposphere coupling, telecommunication between various modes, volcanic influences, greenhouse gas warming, NAO/NAM, ENSO, QBO, ozone depletion, total and spectral solar irradiance, top-down and bottom-up mechanisms of solar influence, solar wind effects
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 30 h, 4 exercises (8 h), seminar, essay writing, self-study
Target group:
Primarily for the students of the degree programme in physics, especially space physics. Also for other students of the University of Oulu.
Prerequisites and co-requisites:
Recommended background information: Basics of Space physics -course or equivalent information.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Course material will be informed during the course.
Assessment methods and criteria:
Seminar, essay and one final examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Kalevi Mursula
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/766659S

766654S: Solar physics, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8 credits
Language of instruction:
English
Timing:
Roughly every third year.
Learning outcomes:
After passing the course the student is able to describe in physical terms the structure, history and energy production of the Sun, the solar oscillations and the generation and activity of solar magnetic fields, and is able to apply physical theories and mathematical methods describing the Sun to explain the basic phenomena in the Sun.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 44 h, 10 exercises (20 h), self-study 149 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
M. Stix, The Sun. An Introduction, 2. edition, Springer, 2004. Lecture notes: K. Mursula: Solar Physics.
Course material availability can be checked here.
Assessment methods and criteria:
Final examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Kalevi Mursula
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/766654S/

762192P: Solid Earth Geophysics, 3 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

3 credits
Language of instruction:
Finnish (It is possible to accomplish the course in English, although all the lectures and exercises will be given in Finnish).
Timing:
1. year, autumn term
Learning outcomes:
Upon the completion of the course, a student
- can name major geophysical research methods, describe their physical basis and name the research targets both in global and applied geophysics
- can describe Earth's large scale internal structure and a detailed local structure of the Fennoscandian lithosphere (crust, upper mantle)
Contents:
See 762104P
Person responsible:
Toivo Korja

763333A: Solid state physics, 4 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field 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
Language of instruction:
Finnish
Timing:
2nd spring
Learning outcomes:
To learn to explain the basics of solid state physics such as lattice structure, binding interactions, lattice vibrations, band structure and its effect on conductivity, conductivity of semiconductors, the interaction between light and matter, magnetism and superconductivity, and to apply these to different materials.
Contents:
The content of the course is equivalent to the content of part 1 of the course 766330A Structure of Matter.
Person responsible:
Erkki Thuneberg and Matti Alatalo

764606S: Special advanced course, 5 - 9 op

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

ECTS Credits:
5 - 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
For instance lectures, exercises, and small projects depending of the subject.
Target group:
Students in biophysics, 2nd - 4th year
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Course lecture notes
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Matti Weckström
Working life cooperation:
No work placement period

765694S: Special course, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field 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:
Heikki Salo

765394A: Special course, 7 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
4 - 6 credits
Contents:
With changing topic.
Person responsible:
Heikki Salo

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

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field 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:
Heikki Salo

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

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field 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:
Heikki Salo

761359A: Spectroscopic methods, 5 op

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

766359A Spectroscopic methods 7.0 op

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
Every second year (odd year), spring term
Learning outcomes:
After completion, 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 X-ray analytics are introduced
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 46 h, exercises 24 h, self-study 63 h
Target group:
Compulsory for students in biophysics. Recommended for students directing at some of the lines in atomic, molecular and materials physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Partly distributed through net, and partly as paper copies during the course.
Assessment methods and criteria:
Two written examinations or one final examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Ville-Veikko Telkki
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761359A/

765666S: Statistical methods in astronomy, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
English (or Finnish)
Timing:
Not lectured every year
Learning outcomes:
After the course the student is able to apply basic statistical methods in commonly encountered simple astronomical problems.
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: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Language of instruction:
English (or Finnish)
Timing:
Not lectured every year
Learning outcomes:
After the course the student is able to apply basic statistical methods in commonly encountered simple astronomical problems.
Contents:
Use of statistical inference in astronomy. Probability distributions, hypothesis testing, correlation analysis, data modeling.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures and exercises 22 h, computer demonstrations 18 h, self-study 93 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Wall, J. V. ja Jenkins, C. R.: Practical Statistics for Astronomers, 2nd edition, Bevington P. R. ja Robinson D. K.: Data Reduction and Error Analysis for the Physical Sciences.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Heikki Salo
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/765366A/

763620S: Statistical physics, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
10 credits
Language of instruction:
English
Timing:
3rd - 5th year
Learning outcomes:
To recognize the basics of statistical physics and to apply them to thermodynamics, noninteracting classical-, Bose- and Fermi gases, to perturbation theory of interacting systems and to phase transitions.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 50 h, exercises 30 h, self-study 187 h
Target group:
Theoretical physics students and students interested in the microscopical foundations of the properties of matter. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Quantum mechanics II (763313A) and Thermodynamics (766328A), also recommended is Advanced quantum mechanics (763622S).
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
J. Arponen: Statistinen fysiikka (in Finnish)
L.E. Reichl: A Modern Course in Statistical Physics
Lecture notes
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Jani Tuorila
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/763620S/

765673S: Stellar atmospheres, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
7 credits
Language of instruction:
English
Timing:
Not lectured every year
Learning outcomes:
The student should understand in the end of the course basics of radiation transport, physics of formation of stellar spectra, know the main opacity sources in various types of stars, understand theory of line formation and be able to determine chemical composition from stellar spectra.
Contents:
See Stellar atmospheres (765373A). Compared to 765373A, includes extra homework assignments on more advanced level.
Person responsible:
Vitaly Neustroev
Other information:
https://wiki.oulu.fi/display/765373A/

765373A: Stellar atmospheres, 7 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
7 credits
Language of instruction:
English
Timing:
Not lectured every year
Learning outcomes:
The student should understand in the end of the course basics of radiation transport, physics of formation of stellar spectra, know the main opacity sources in various types of stars, understand theory of line formation and be able to determine chemical composition from stellar spectra.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 32 h and exercises, self-study 155 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Fundamentals of astronomy (recommended)
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
E. Böhm-Vitense: Stellar astrophysics, vol. 2, Cambridge Univ. Press, 1989.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Vitaly Neustroev
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/765373A/

765608S: Stellar dynamics, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
7 credits
Language of instruction:
English (or Finnish)
Timing:
Not lectured every year
Learning outcomes:

After the course the student can discuss the basic principles of galactic dynamics on a level that makes possible to start independent study of research articles published on the field.
Contents:
Introduction to stellar dynamics. Galactic dynamics and spiral structure, globular clusters
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 32 h, exercises, demonstrations 20 h, self-study 135 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:
Recommended: 766323A Mechanics or 765304A Celestial mechanics
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
J. Binney, S. Tremaine: Galactic dynamics, Princeton University Press, 2008 (part of the book).
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Heikki Salo
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/765608S/

765343A: Stellar structure and evolution, 7 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
7 credits
Language of instruction:
English
Timing:
Lectured every 2nd year
Learning outcomes:
Students understand basic equations that describe the physics of stellar structure and evolution and know how to use them in practice.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 40 h, exercises, self-study 147 h
Target group:
Primarily for the students of the degree programme in physics
Prerequisites and co-requisites:
Fundamentals of astronomy (recommended)
Recommended optional programme components:

No alternative course units or course units that should be completed simultaneously
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.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Sébastien Comerón
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/765343A/

765643S: Stellar structure and evolution, 7 op

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

ECTS Credits:
7 credits
Language of instruction:
English
Timing:
Lectured every 2nd year
Learning outcomes:
Students understand basic equations that describe the physics of stellar structure and evolution and know how to use them in practice.
Contents:
See 765343A Stellar structure and evolution. Compared to 765343A, includes extra homework assignments on more advanced level.
Person responsible:
Sébastien Comerón
Other information:
https://wiki.oulu.fi/display/765643S/

765661S: Structure and kinematics of galaxies, 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field 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:

Student can describe how the structure and kinematics of the Milky Way is studied and can solve small study problems. Student can critically evaluate scientific articles on the course subject by using physical arguments.
Contents:
Locations, movements and distances of stars, the structure and kinematics of star cluster, interstellar matter, dynamics of the Milky Way.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 32 h, exercises, self-study 128 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Fundamentals of astronomy, Galaxies and cosmology (recommended)
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
J. Binney, M. Merrifield: Galactic Astronomy, Princeton University Press, 1998.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Heikki Salo
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/765661S/

766330A: Structure of matter, 6 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763343A	Solid state physics	5.0 op
763333A	Structure of matter I	4.0 op
766334A	Structure of matter II	2.0 op

ECTS Credits:
6 credits *(Part 1, Solid state physics 4 credits and part 2, Nuclear and particle physics 2 credits)*
Language of instruction:
Finnish
Timing:
2nd spring
Learning outcomes:
Part 1, Solid state physics: To learn to explain the basics of solid state physics such as lattice structure, binding interactions, lattice vibrations, band structure and its effect on conductivity, conductivity of semiconductors, the interaction between light and matter, magnetism and superconductivity, and to apply these to different materials.
Part 2, Nuclear and particle physics: The student can explain the basic principles of nuclear and particle physics and can derive their consequences in the extent and level of the lectures (see Contents). In addition, he/she can solve problems which require profound understanding of the essential contents of the course.
Contents:
Part 1, 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. 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.
Part 2, Nuclear and particle physics: This part 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Part 1: Lectures 30 h, exercises 16 h, self-study 61 h
Part 2: Lectures 20 h, exercises 10 h, self-study 23 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Atomic physics 1 (766326A), Electromagnetism (766319A). An important supporting course is Thermophysics (766322A).
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Part 1: C. Kittel: Introduction to solid state physics.
Part 2: Textbooks: H. D. Young and R. A. Freedman: University Physics, 13th edition, Pearson Addison-Wesley, 2012, or earlier editions (in part), R. Eisberg and R. Resnick: Quantum physics of atoms, molecules, solids, nuclei, and particles, John Wiley & Sons (in part). Additioanl material available from the web pages of the course. Course material availability can be checked here.
Assessment methods and criteria:
Both parts of the course have their own separate examinations. The final grade of the course is the weighted average of the grades of part 1 (4 cp) and part 2 (2 cp).
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Part 1: Erkki Thuneberg and Matti Alatalo
Part 2: Juhani Lounila
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/766330A/etusivu

Compulsory

766330A-01: Structure of matter, part 1: Solid state physics, 0 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Partial credit
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

766344A	Nuclear and particle physics	5.0 op
763343A	Solid state physics	5.0 op
763333A	Structure of matter I	4.0 op
766334A	Structure of matter II	2.0 op

Ei opintojaksokuvauksia.

766330A-02: Structure of matter, part 2: Nuclear and particle physics, 0 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Partial credit
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

763343A	Solid state physics	5.0 op
766344A	Nuclear and particle physics	5.0 op
766334A	Structure of matter II	2.0 op
763333A	Structure of matter I	4.0 op

Ei opintojaksokuvauksia.

765332A: Study project in astronomy 1, 5 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field 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-02	Research Project of Astronomy I: Study project	0.0 op
765307A	Research Project of Astronomy I	5.0 op
765135P	Data processing in astronomy	2.0 op

ECTS Credits:
5 credits *(part 1, Data processing in astronomy 2 credits and part 2, Research project 3 credits)*
Language of instruction:
English or Finnish
Timing:
1st - 3th year
Learning outcomes:
Student is able to use computer in processing and visualizing astronomical data, student is able to appy basic tools in the Linux-environment.
Contents:
Part 1, 765332A-01, Data processing in astronomy. Basics of Linux operating system, writing reports (Emacs, Latex), data processing and visualization (IDL)
Part 2, 765332A-02, Research project.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Part 1: Lectures 6 h, computer exercises 18 h, self-study 29 h
Part 2: Study project, self-study 80 h
Target group:
Students in astronomy, all students of the degree programme in physics
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Separately given research material
Assessment methods and criteria:

Part 1: Participation to lectures and exercises, homework assignment.
Part 2: Written report of the study project
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Teachers
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/765332A/

Compulsory

765332A-01: Data processing in astronomy, 0 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Partial credit
Vastuuyksikkö: Field 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-02	Research Project of Astronomy I: Study project	0.0 op
765307A	Research Project of Astronomy I	5.0 op
765135P	Data processing in astronomy	2.0 op

Ei opintojaksokuvauksia.

765332A-02: Study project, 0 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Partial credit
Vastuuyksikkö: Field 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-02	Research Project of Astronomy I: Study project	0.0 op
765307A	Research Project of Astronomy I	5.0 op

Ei opintojaksokuvauksia.

763645S: Superconductivity, 6 op

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

ECTS Credits:
6 credits

Language of instruction:
English
Timing:
3rd - 5th year
Learning outcomes:
To recognize how superconducting phenomena can be explained starting from BCS theory and from Ginzburg-Landau and London theories based on it, and to apply them to simple examples.
Contents:
Superconductivity is a phenomenon where quantum mechanics becomes visible on a macroscopic scale. The BCS theory of superconductivity is known as one of the most successful theories of condensed matter. The course begins with experimental observations and a reminder about statistical physics. The thermodynamics of superconductivity is studied under magnetic field. The main content of the course is the Bardeen-Cooper-Schrieffer (BCS) theory, which explains the occurrence of superconductivity, and the Ginzburg-Landau theory, which can explain many of the observed phenomena. The course finishes with a short discussion of superconductivity of the second kind and Josephson effects.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 26 h, 12 exercise sessions (24 h), self-study 110 h
Target group:
Course designed especially for theoretical physicists. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
763312 A Quantum mechanics I and 763313A Quantum mechanics II
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
M. Tinkham, Introduction to Superconductivity, McGraw-Hill (1975, 1996); E. Thuneberg: Suprajohtavuus (lecture notes).
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Erkki Thuneberg
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/763645s/etusivu

766328A: Thermophysics, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field 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
Language of instruction:
Finnish
Timing:
Third autumn semester
Learning outcomes:

The student can explain the basic principles of thermophysics and can derive their consequences in the extent and level of the lectures (see Contents). In addition, he/she can solve problems which require profound understanding of the essential contents of the course.
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). For this purpose, the students are given a physically clear understanding of the basic principles of thermophysics, recognizing the fundamental role of its statistical nature. Topics will include: Basic concepts, The first law, Thermal expansion, heat transfer, and diffusion, 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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 46 h, 12 exercises (24 h), self-study 90 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Textbooks: H. D. Young and R. A. Freedman: University Physics, 13th edition, Pearson Addison-Wesley, 2012, or earlier editions (in part), F. Mandl: Statistical Physics, second edition, John Wiley & Sons Ltd., 1988 (in part).
Lecture notes: Juhani Lounila: 766328A Termofysiikka, Oulun yliopisto, 2014.
Course material availability can be checked here.
Assessment methods and criteria:
Two written intermediate examinations or one final examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0-5, where 0 = fail
Person responsible:
Juhani Lounila
Working life cooperation:
No work placement period
Other information:
Due to the partial overlap of the subject matters of the courses 761102P Basic Thermodynamics (2 cp) and 766328A Thermophysics (6 cp), exceptionally only 5 cp (not 6 cp) are given for the latter course in the special case that the student has previously completed the course Basic Thermodynamics and has got 2 cp for that.
https://wiki.oulu.fi/display/766328A/

765368A: Time Series Analysis in Astronomy, 6 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

767301A	Time Series Analysis in Astronomy	5.0 op
767601S	Time Series Analysis in Astronomy	5.0 op
765668S	Time Series Analysis in Astronomy	6.0 op

ECTS Credits:
6 credits
Language of instruction:
English
Timing:

Not lectured every year
Learning outcomes:
After taking the course the student is expected to understand basic time series concepts and terminology, to be able to select time series methods appropriate to goals and summarize results of time series analysis in writing. The main objective of this course is to develop the skills needed to do empirical research in fields operating with time series data sets.
Contents:
This is an introductory course, with particular emphasis on practical aspects of the typical time series encountered in astronomy and in related field of sciences: search for periodicities hidden in noise. Topics include detrending, filtering, autoregressive modeling, spectral analysis, regression, and wavelet analysis. Methods that can be applied to evenly and unevenly spaced time series are considered.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24 h, exercises 24 h. The theoretical part of lectures concentrates on both parametric and nonparametric time series analysis methods. The practical part involves programming, application and interpretation of the results. Self-study 85 h.
Target group:
Student of the intermediate and advanced level.
Prerequisites and co-requisites:
No pre-knowledge is required in the time series analysis field. A rough knowledge of Fourier transforms and related functions as well as some basic knowledge in Statistics would be an advantage.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Numerical Recipes, papers.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Vitaly Neustroev
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/765368A/

765668S: Time Series Analysis in Astronomy, 6 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

767301A	Time Series Analysis in Astronomy	5.0 op
767601S	Time Series Analysis in Astronomy	5.0 op
765368A	Time Series Analysis in Astronomy	6.0 op

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
Not lectured every year
Learning outcomes:
After taking the course the student is expected to understand basic time series concepts and terminology, to be able to select time series methods appropriate to goals and summarize results of time series analysis in writing.

The main objective of this course is to develop the skills needed to do empirical research in fields operating with time series data sets.
Contents:
See 765368A Time Series Analysis in Astronomy
Person responsible:
Vitaly Neustroev

765353A: Topics of modern astrophysics, 5 op

Voimassaolo: 01.01.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
5 credits
Language of instruction:
English
Timing:
Not lectured every year
Learning outcomes:
Student learns to use scientific literature, and to prepare and give oral presentations.
Contents:
Current research topics in astronomy that are typically not covered by textbooks.
Mode of delivery:
Presentations given by students, comments on other students' presentations.
Learning activities and teaching methods:
Introductory lecture, oral presentations by the students
Target group:
Primarily for the students of astronomy degree program.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Will be given by the lecturer.
Assessment methods and criteria:
Three oral presentations and active participation in discussion on other students' presentations.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Heikki Salo
Working life cooperation:
No work placement period

765653S: Topics of modern astrophysics, 5 op

Voimassaolo: 01.01.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5 credits
Language of instruction:
English
Timing:
Not lectured every year
Learning outcomes:
Student learns to use scientific literature, and to prepare and give oral presentations.
Contents:
See 765353A Topics of modern astrophysics
Person responsible:
Heikki Salo

761013Y: Tutoring, 2 op

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

ECTS Credits:
2 credits
Language of instruction:
Finnish
Timing:
2nd – 5th autumn
Learning outcomes:
The student can guide study groups in matters of studying and the organization of university.
Contents:
A student who has been at the university for a few years, is actively involved and has an interest in new students may serve as a tutor for the course 761011Y Orientation course for new students.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Tutoring 10 – 15 h
Target group:
Optional for the students in physics
Prerequisites and co-requisites:
First year studies
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Handouts
Assessment methods and criteria:
Tutoring 10-15 h
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Scale pass/fail
Person responsible:
Anja Pulkkinen
Working life cooperation:
No work placement period

764327A: Virtual measurement environments, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764627S Virtual measurement environments 5.0 op

ECTS Credits:
5 credits
Language of instruction:
Finnish
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 10 h, project work about 60 h, self-study 63 h
Target group:
Students in biophysics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
None, but basics of programming principles are useful.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lecture and exercises notes
Assessment methods and criteria:
Project reports
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Matti Weckström
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/764327A/

764627S: Virtual measurement environments, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764327A Virtual measurement environments 5.0 op

ECTS Credits:
5 credits
Language of instruction:
Finnish
Timing:
Autumn
Learning outcomes:
The students will learn how to construct sofware environments for measurements and data analysis.
Contents:
See 764327A Virtual measurement environments

Person responsible:
Matti Weckström

761114P: Wave motion and optics, 5 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Field 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
761104P	Wave Motion	3.0 op

ECTS Credits:
5 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 can name the characterizing quantities (wavelength, period, wave speed), can apply geometrical optics to simple mirror and lens systems, can explain the meaning of interference and diffraction and their applications, like using interference to determine wavelength of radiation.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 32 h, exercises 10 h, 2 laboratory exercises (8 h), self-study 83 h
Target group:
The students of the University of Oulu
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 13th edition, 2008. Also earlier editions can be used.
Course material availability can be checked here.
Assessment methods and criteria:
Three mini examinations and one end examination or a final examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Ville-Veikko Telkki
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/761114p/etusivu

Compulsory

761114P-01: Wave motion and optics, lectures and exam, 0 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Basic Studies
Laji: Partial credit
Vastuuyksikkö: Field 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
761104P Wave Motion 3.0 op
761121P Physical Measurements I 3.0 op

Ei opintojaksokuvauksia.

761114P-02: Wave motion and optics, lab. exercises, 0 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Basic Studies
Laji: Partial credit
Vastuuyksikkö: Field 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

Ei opintojaksokuvauksia.

766329A: Wave motion and optics, 6 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field 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
Language of instruction:
Finnish. The course material and exercises are available in English.
Timing:
Firts spring
Learning outcomes:

The student is able to treat different types of waves by methods of general theory of wave motion. The student is also able to solve problems related to basic optics and apply her/his knowledge to teaching and research in physics.

Contents:

General principles of wave motion, sound, electromagnetic waves, production and measurement of light, propagation of light, image formation in mirrors and lenses, matrix method in ray tracing, aberrations, optical instruments, interference, interferometry, polarization, Fraunhofer diffraction, diffraction grating, laser principles.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 46 h, exercises 24 h, self-study 90 h

Target group:

No specific target qroup

Prerequisites and co-requisites:

763101P Mathematics for physics

Recommended optional programme components:

No alternative course units or course units that should be completed simultaneously

Recommended or required reading:

H. D. Young and R. A. Freedman, University Physics, Addison-Wesley, 2000 ja 2004, F. L. Pedrotti ja L. S. Pedrotti, Introduction to optics, Prentice-Hall, 2. ed., 1993 ja E. Hecht, Optics, (3rd ed.), Addison Wesley Longman, 1998.

Course material availability can be checked here.

Assessment methods and criteria:

Three written intermediate examinations or one final examination

Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

Other information:

https://noppa.oulu.fi/noppa/kurssi/766329a/etusivu