Opasraportti

LuTK - Physics 2016 - 2017 (2016 - 2017)

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/biomedical physics, 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.

Tutkintorakenteet

Bachelor of Science, Physics (researcher)

Tutkintorakenteen tila: published

Lukuvuosi: 2016-17

Lukuvuoden alkamispäivämäärä: 01.08.2016

General studies, Language and Communication Studies (vähintään 9 op)

Optional studies may include other courses (e.g. language studies).

Compulsory studies

902002Y: English 1 (Reading for Academic Purposes), 2 op
902004Y: English 2 (Scientific Communication), 2 op
761011Y: Orientation course for new students, 2 op
901035Y: Second Official Language (Swedish), Oral Skills, 1 op
901034Y: Second Official Language (Swedish), Written Skills, 1 op
761012Y: Senior tutoring, 1 op

Optional studies

Physics, major subject (vähintään 82 op)

In the degree programme in physics the major subject in the Bachelor of Science degree is physics.

Basic studies in physics, intermediate courses in physics, B. Sc. thesis and maturity test listed below are compulsory (82 credits in total).

Choose B.Sc. thesis and maturity test according to the M.Sc. major subject.

Basic studies in physics (min 23 credits)

H325101: Physics, Basic studies, 23 - 34 op
- *Basic studies in physics*
  - 761112P: Physical world view, 3 op
  - 766101P: Mathematics for physics, 5 op
  - 763105P: Introduction to relativity 1, 2 op
  - 766106P: Laboratory exercises in physics 2, 4 op
  - 521141P: Elementary Programming, 5 op
  - 761121P: Laboratory Exercises in Physics 1, 3 op
    - *Compulsory*
      - 761121P-01: Laboratory exercises in physics 1, exam, 0 op
      - 761121P-02: Laboratory exercises in physics 1, lab. exercises, 0 op
  - 030005P: Information Skills, 1 op
- *At least one of the introduction courses in physics*
  - 764103P: Introduction to biophysics, 2 op
  - 765103P: Introduction to astronomy, 2 op
  - 762103P: Introduction to geophysics, 2 op
- *Compulsory for teacher students*

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

Intermediate studies in physics (min 59 credits)

H325102: Physics, Intermediate studies, 52 - 65 op
Intermediate studies in physics.
766343A: Mechanics, 7 op
Compulsory
766343A-01: Mechanics part 1, 0 op
766343A-02: Mechanics part 2, 0 op
766349A: Wave motion and optics, 7 op
766319A: Electromagnetism, 7 op
766326A: Atomic physics 1, 6 op
763343A: Solid state physics, 5 op
766344A: Nuclear and particle physics, 5 op
766348A: Thermophysics, 7 op
766384A: B.Sc. seminar, 4 op
766385A: B.Sc. thesis, 6 op
761386A: Maturity test, 0 op
Compulsory for physicist
766315A: Numerical modelling, 5 op
Compulsory intermediate courses for teacher
766339A: Physics for teachers, 5 op
766309A: Demonstrations in Physics and Chemistry, 2 op
766308A: Laboratory exercises in physics 3, 2 - 6 op

Minor subject study module

The selection of minor subjects for the B.Sc. degree already directs the student towards the area of specialization (astronomy, earth and space physics, physics of matter, or subject teacher) and the major subject (biophysics, geophysics, physics, theoretical physics, astronomy or electrical engineering) of the M.Sc. studies.

One of the minor subject study modules listed below must be chosen according to the major subject of one's M. Sc. studies.

It is advisable that courses of the future major subject are included in the schedule during the second and third year. The definitive selection of the major subject does not take place until the M.Sc. studies.

Minor subject study module Biophysics (25 credits)

H326004: Minor subject study module Biophysics, 25 - 30 op
Basic and intermediate studies in biophysics
764163P: Introduction to Biomedical Physics, 5 op
Compulsory
764163P-01: Introduction to Biomedical Physics (part 1), 0 op
764163P-02: Introduction to Biomedical Physics (part 2), 0 op
764125P: Foundations of cellular biophysics, 5 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
Courses in biophysics, either in B.Sc. or in M.Sc. degree
764322A: Cell membrane biophysics, 10 op
764338A: Basic Neuroscience, 5 op
Chemistry course can be included either chemistry nor biophysics
780120P: Basic Principles in Chemistry, 5 op
764327A: Virtual measurement environments, 5 op
761359A: Spectroscopic methods, 5 op
764364A: Analysis and simulation of biosystems, 6 op

Recommended courses in biophysics
521302A: Circuit Theory 1, 5 op

Minor subject study module Geophysics (32 credits)

H325504: Minor subject study module Geophysics, 32 - 35 op
Basic and intermediate studies in geophysics
762104P: Introduction to solid earth geophysics, 5 op
762306A: Hydrology in geosciences, 6 op
762305A: Geophysical research methods of rock and soil, 6 op
762107P: Introduction to global environmental geophysics, 5 op
Alternative
771113P: Introduction to Geology I, 5 op
771114P: Introduction to Geology II, 5 op
Recommended
762108P: GIS and spatial data 1, 5 op
762352A: Practical training, 5 op
762321A: Seismology and the structure of the earth, 5 op
762322A: Geomagnetism, 5 op

Minor subject study module Theoretical physics (28 credits)

H325304: Minor subject study module Theoretical physics, 28 op
Intermediate studies in theoretical physics
763310A: Analytical mechanics, 6 op
763312A: Quantum mechanics I, 10 op
763313A: Quantum mechanics II, 10 op
763306A: Introduction to relativity 2, 2 op
Recommended in theoretical physics
521286A: Computer Systems, 8 op
521287A: Introduction to Computer Systems, 5 op

Minor subject study module Astronomy (40 credits)

H325704: Minor subject study module Astronomy, 40 op
Basic and intermediate studies in astronomy
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
765114P: Fundamentals of astronomy I, 5 op
765115P: Fundamentals of astronomy II, 5 op
765332A: Study project in astronomy 1, 5 op
Compulsory
765332A-01: Data processing in astronomy, 0 op
765332A-02: Study project, 0 op
763306A: Introduction to relativity 2, 2 op
Recommended in astronomy
765336A: Astronomical observing techniques, 5 op
765331A: Solar System Dynamics, 7 op
765306A: Celestial Mechanics II - Special topics, 7 op
765330A: Galaxies, 6 op
765354A: Introduction to Nonlinear Dynamics, 6 op
765358A: Introduction to Cosmology, 5 op
765359A: Physics of the Solar System I, 7 op
765379A: Physics of the Solar System II - Special topics, 7 op
765367A: Observational Astrophysics and Data Analysis, 6 op
765343A: Stellar structure and evolution, 7 op
765304A: Celestial mechanics, 5 - 8 op
765373A: Stellar atmospheres, 7 op
765366A: Statistical methods in astronomy, 5 op
765368A: Time Series Analysis in Astronomy, 6 op
765353A: Topics of modern astrophysics, 5 op

Minor subject study module General physics (25 credits)

H325104: General Physics, 25 op
Basic and intermediate studies in general physics
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
766308A: Laboratory exercises in physics 3, 2 - 6 op
Compulsory
763306A: Introduction to relativity 2, 2 op
At least one of the courses listed below must be chosen
766355A: Basics of space physics, 5 op
761359A: Spectroscopic methods, 5 op
Recommended in general physics
761337A: Practical training, 3 - 6 op
521286A: Computer Systems, 8 op
521287A: Introduction to Computer Systems, 5 op
763312A: Quantum mechanics I, 10 op

Minor subject module Electrical engineering (43 credits)

H325135: Minor subject study module Electrical engineering (Degree programme in physics), 43 op
Intermediate studies in electrical engineering
521109A: Electrical Measurement Principles, 5 op
521301A: Digital Techniques 1, 8 op
521302A: Circuit Theory 1, 5 op
521431A: Principles of Electronics Design, 5 op
521337A: Digital Filters, 5 op
521330A: Telecommunication Engineering, 5 op
521384A: Basics in Radio Engineering, 5 op
521432A: Electronics Design I, 5 op

Minor subjects

The mathematics courses can be taken more focused either in science (a code beginning with 80) or in technique (a code beginning with 03).

Mathematics (min 40 credits)

H325136: Mathematics Minor (Degree programme in physics), 39 - 40 op
Studies in mathematics (Faculty of Science)
031076P: Differential Equations, 5 op
More compulsory courses: Select from the following list courses which are either beginning with 80 or beginning with 03.
802161P: Introduction to Real Functions, 5 op
031010P: Calculus I, 5 op
802120P: Introduction to Matrices, 5 op
031078P: Matrix Algebra, 5 op
802351A: Vector Calculus, 5 op
031075P: Calculus II, 5 op
From the following list, some are compulsory and some optional courses. Look in more details from the study guide.
802151P: Introduction to mathematical deduction, 5 op
031021P: Probability and Mathematical Statistics, 5 op
802162P: Continuity and Limit, 5 op
802320A: Linear Algebra, 5 op
802163P: Derivative, 5 op
031077P: Complex analysis, 5 op
031080A: Signal Analysis, 5 op
802334A: A Second Course in Differential Equations, 5 op
802338A: Complex Analysis II, 5 op

Other minor subjects

Optional courses

The B. Sc. degree must be at least 180 credits.

Bachelor of Science degree, Physics (teacher)

Tutkintorakenteen tila: published

Lukuvuosi: 2016-17

Lukuvuoden alkamispäivämäärä: 01.08.2016

General studies, Language and Communication Studies (vähintään 9 op)

Optional studies may include other courses (e.g. language studies).

Compulsory studies

902002Y: English 1 (Reading for Academic Purposes), 2 op
902004Y: English 2 (Scientific Communication), 2 op
761011Y: Orientation course for new students, 2 op
901035Y: Second Official Language (Swedish), Oral Skills, 1 op
901034Y: Second Official Language (Swedish), Written Skills, 1 op
761012Y: Senior tutoring, 1 op

Optional studies

Physics, major subject (vähintään 95 op)

In the degree programme in physics, the major subject in the Bachelor of Science degree is physics.

Basic studies in physics, intermediate studies in physics, B. Sc. thesis and maturity test below (88 credits in total) are compulsory.

It is recommended for teacher that B.Sc. thesis and maturity test are taken in physics.

Basic studies in physics (teacher) (min 30 credits)

H325101: Physics, Basic studies, 23 - 34 op
- *Basic studies in physics*
  - 761112P: Physical world view, 3 op
  - 766101P: Mathematics for physics, 5 op
  - 763105P: Introduction to relativity 1, 2 op
  - 766106P: Laboratory exercises in physics 2, 4 op
  - 521141P: Elementary Programming, 5 op
  - 761121P: Laboratory Exercises in Physics 1, 3 op
    - *Compulsory*
      - 761121P-01: Laboratory exercises in physics 1, exam, 0 op
      - 761121P-02: Laboratory exercises in physics 1, lab. exercises, 0 op
  - 030005P: Information Skills, 1 op
- *At least one of the introduction courses in physics*
  - 764103P: Introduction to biophysics, 2 op
  - 765103P: Introduction to astronomy, 2 op
  - 762103P: Introduction to geophysics, 2 op

Compulsory for teacher students
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

Intermediate studies in physics (teacher) (min 65 credits)

H325102: Physics, Intermediate studies, 52 - 65 op
Intermediate studies in physics.
766343A: Mechanics, 7 op
Compulsory
766343A-01: Mechanics part 1, 0 op
766343A-02: Mechanics part 2, 0 op
766349A: Wave motion and optics, 7 op
766319A: Electromagnetism, 7 op
766326A: Atomic physics 1, 6 op
763343A: Solid state physics, 5 op
766344A: Nuclear and particle physics, 5 op
766348A: Thermophysics, 7 op
766384A: B.Sc. seminar, 4 op
766385A: B.Sc. thesis, 6 op
761386A: Maturity test, 0 op
Compulsory for physicist
766315A: Numerical modelling, 5 op
Compulsory intermediate courses for teacher
766339A: Physics for teachers, 5 op
766309A: Demonstrations in Physics and Chemistry, 2 op
766308A: Laboratory exercises in physics 3, 2 - 6 op

Minor subjects

See the study guide

Pedagogic studies for teacher (min 30 credits)

Subsidiary entity for subject teacher (min 40 ECTS cr)

Optional courses

The B.Sc. degree is at least 180 credits.

Master of Science, Physics (researcher)

Tutkintorakenteen tila: published

Lukuvuosi: 2016-17

Lukuvuoden alkamispäivämäärä: 01.08.2016

Compulsory major studies in physics (vähintään 51 op)

Compulsory for all master's level students in physics

761686S: Maturity test, 0 op
761683S: Pro gradu thesis, 35 op
763612S: Quantum mechanics I, 10 op

766651S: Research project in physics, 6 op

Other advanced studies in physics (vähintään 29 op)

Fysiikan syventät opinnot koostuvat valitun syventymiskohteen pakollisista, syventymiskohteen suositeltavista ja ns. muista suositeltavista opinnoista.

Syventymiskohteen kurssilistaukseen ei ole listattu ns. muita suositeltavia opintoja. Ne tulee tarkistaa opinto-oppaasta.

Advanced studies in space physics

H325111: Advanced studies in physics (space physics), 29 - 69 op

Select at least two courses from the list below

761653S: Plasma physics, 8 op
761658S: Ionospheric physics, 8 op
761657S: Magnetospheric physics, 8 op
766656S: Heliospheric physics, 8 op

Select at least 13 credits from the list below or the remaining preceding courses.

761649S: Auroral physics, 6 op
761648S: Fundamentals of incoherent scatter radar, 8 op
766655S: Cosmic Rays, 8 op
766632S: Electromagnetic waves, 6 op
766654S: Solar physics, 8 op
763654S: Hydrodynamics, 6 op

Advanced studies in NANOMO (Atomic, Molecular and Material Physics,)

H325114: Advanced studies in physics (NANOMO), 29 - 69 op

Compulsory courses in NANOMO

761671S: Atomic physics 2, 8 op
761673S: Electron and ion spectroscopy, 8 op

Optional physics studies: Select at least 13 credits from the list below

766645S: Cluster Physics, 5 op
761644S: Physical measurements, 6 op
761675S: Laser and synchrotron radiation physics, 6 op
766677S: Modern characterization methods in material science, 6 op
766650S: Applications of SR physics, 5 op
521080S: X-ray Diffraction, 5 op

Other Recommended advanced studies

763628S: Condensed matter physics, 10 op
763622S: Advanced course in quantum mechanics, 10 op
763613S: Quantum mechanics II, 10 op
761668S: Computational physics and chemistry, 6 op
763694S: Methods in material physics, 6 op
766660S: Molecular properties, 6 op
763616S: Numerical programming, 6 op
766632S: Electromagnetic waves, 6 op
761645S: Introduction to experimental physical research, 6 op
800653S: Matrix Theory, 10 op
761661S: Molecular quantum mechanics, 8 op
521073S: Electroceramics and Intelligent Materials, 5 op
521074S: Microelectronics and Micromechanics, 5 op
521089S: Printed Electronics, 5 op
521088S: Optoelectronics, 5 op

Advanced studies in MRM (Atomic, Molecular and Material Physics)

H325112: Advanced studies in physics (NRM), 29 - 69 op

Compulsory two courses

761661S: Molecular quantum mechanics, 8 op
761663S: NMR spectroscopy, 8 op

Select at least 13 credits from the list below or other courses which are suitable for physics courses.
- 761670S: NMR spectroscopy in solids, 6 op
- 761668S: Computational physics and chemistry, 6 op
- 766660S: Molecular properties, 6 op
- 766661S: NMR Imaging, 8 op
- 761669S: Applications of NMR spectroscopy, 6 op
- 763616S: Numerical programming, 6 op
- 766669S: Nuclear magnetic relaxation, 6 op

Other Recommended advanced physics studies
- 763628S: Condensed matter physics, 10 op
- 763622S: Advanced course in quantum mechanics, 10 op
- 763613S: Quantum mechanics II, 10 op
- 761664S: Laser physics, 6 op
- 761665S: Optics, 6 op
- 766632S: Electromagnetic waves, 6 op
- 761645S: Introduction to experimental physical research, 6 op
- 800653S: Matrix Theory, 10 op

Minor subject

The minor subject can consists of general, basic, intermediate or advanced studies (at least 15 credits).

Optional courses

The M. Sc. degree must be at least 120 credits.

Master of Science, Astronomy (researcher)

Tutkintorakenteen tila: published

Lukuvuosi: 2016-17

Lukuvuoden alkamispäivämäärä: 01.08.2016

Compulsory major studies in astronomy (vähintään 35 op)

Compulsory for all master's level students in astronomy

765657S: Maturity test, 0 op
765624S: Pro gradu thesis, 35 op

Other advanced studies in astronomy (vähintään 45 op)

Select at least 45 credits listed below or other courses which can be accepted for the astronomy studies.

H325116: Advanced studies in physics (Astronomy), 45 - 999 op

Advanced Studies in Astronomy, at least 45 ECTS cr from the following
- 763655S: Astroparticle physics, 6 op
- 766654S: Solar physics, 8 op
- 765669S: Astrophysics of interacting binary stars, 7 op
- 765631S: Solar System Dynamics, 7 op
- 765606S: Celestial Mechanics II - Special topics, 7 op
- 765661S: Structure and kinematics of galaxies, 6 op
- 765630S: Galaxies, 6 op
- 765658S: Introduction to Cosmology, 5 op
- 765654S: Introduction to Nonlinear Dynamics, 6 op
- 765667S: Observational Astrophysics and Data Analysis, 6 op

765659S: Physics of the Solar System I, 7 op
765679S: Physics of the Solar System II - Special topics, 7 op
765673S: Stellar atmospheres, 7 op
765643S: Stellar structure and evolution, 7 op
765617S: Computer simulations, 5 op
765666S: Statistical methods in astronomy, 5 op
765668S: Time Series Analysis in Astronomy, 6 op
765653S: Topics of modern astrophysics, 5 op
765655S: Research project, 6 op
765608S: Stellar dynamics, 7 op
765692S: Special course given by a visiting lecturer, 4 - 6 op
765694S: Special course, 7 op

Other Recommended advanced studies

763695S: General relativity, 6 op
763616S: Numerical programming, 6 op
763310A: Analytical mechanics, 6 op
766632S: Electromagnetic waves, 6 op
761653S: Plasma physics, 8 op
766655S: Cosmic Rays, 8 op
763654S: Hydrodynamics, 6 op
763612S: Quantum mechanics I, 10 op
763613S: Quantum mechanics II, 10 op
761359A: Spectroscopic methods, 5 op
761661S: Molecular quantum mechanics, 8 op
802334A: A Second Course in Differential Equations, 5 op
031077P: Complex analysis, 5 op

Minor subject

The minor subject can consists of general, basic, intermediate or advanced studies (at least 15 credits).

Optional courses

The M. Sc. degree must be at least 120 credits.

Master of Science degree, Biophysics (researcher)

Tutkintorakenteen tila: published

Lukuvuosi: 2016-17

Lukuvuoden alkamispäivämäärä: 01.08.2016

Compulsory major studies in biophysics (vähintään 80 op)

Compulsory for all master's level students in biophysics

H326003: Advanced studies in biophysics, 80 - 120 op

Compulsory advanced courses in biophysics

764697S: Pro gradu thesis, 35 op
764695S: Maturity test for MSc, 0 op
766651S: Research project in physics, 6 op
764680S: Neural information processing, 5 op

Select courses listed below or other advanced courses which can be accepted for the biophysics studies so that the advanced studies on biophysics are 80 credits in total.

764638S: Basic Neuroscience, 5 op
764622S: Cell membrane biophysics, 10 op
764618S: Molecular biophysics, 5 op

764625S: Laboratory projects of biophysics, 3 - 6 op
764664S: Analysis and simulation of biosystems, 6 op
764621S: Hemodynamics, 5 op
764629S: Identification of linear systems, 5 op
765654S: Introduction to Nonlinear Dynamics, 6 op
764632S: Electrophysiological recordings, 6 op
764634S: Medical physics and imaging, 5 op
764627S: Virtual measurement environments, 5 op
521124S: Sensors and Measuring Techniques, 5 op
761663S: NMR spectroscopy, 8 op
766661S: NMR Imaging, 8 op
766677S: Modern characterization methods in material science, 6 op
761673S: Electron and ion spectroscopy, 8 op
766675S: Laser and synchrotron radiation physics, 10 op
763616S: Numerical programming, 6 op
761644S: Physical measurements, 6 op
761645S: Introduction to experimental physical research, 6 op
766669S: Nuclear magnetic relaxation, 6 op
761665S: Optics, 6 op

Minor subject

The minor subject can consists of general, basic, intermediate or advanced studies (recommended at least 15 credits).

Recommended minor subjects for the students in biophysics are listed below or Physiology Minor or Biology studies.

The course can be included in one subject only.

If you do not need these subjects, leave those empty.

A300007 Medical Physics Minor

A300007: Medical Physics Minor, 15 - 25 op
Alternative studies, if they are not included already in other subjects.
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
764338A: Basic Neuroscience, 5 op
764634S: Medical physics and imaging, 5 op
764680S: Neural information processing, 5 op
761359A: Spectroscopic methods, 5 op
761663S: NMR spectroscopy, 8 op
080901A: Introduction to Technology in Clinical Medicine, 5 op
080915S: Tissue Biomechanics, 5 op
080916S: Biomechanics of Human Movement, 5 op
580402S: Biomedical Imaging Methods, 1 - 5 op
080914S: Biomedical Engineering and Medical Physics Seminar, 3 op
521467A: Digital Image Processing, 5 op
521337A: Digital Filters, 5 op
521273S: Biosignal Processing I, 5 op
521093S: Biomedical Instrumentation, 5 op

A300006 Medical Engineering Minor

A300006: Medical Engineering Minor, 15 - 25 op
Alternative studies, if they are not included already in other subjects.
761359A: Spectroscopic methods, 5 op
764371A: Medical equipments, 5 op
080901A: Introduction to Technology in Clinical Medicine, 5 op
041201A: Basics in eHealth, 5 op

080915S: Tissue Biomechanics, 5 op
080916S: Biomechanics of Human Movement, 5 op
580402S: Biomedical Imaging Methods, 1 - 5 op
080914S: Biomedical Engineering and Medical Physics Seminar, 3 op
580201A: Biomedical Engineering Programming Study, 5 op
580201S: Biomedical Engineering Programming Study, 5 op
521467A: Digital Image Processing, 5 op
521337A: Digital Filters, 5 op
521273S: Biosignal Processing I, 5 op
521093S: Biomedical Instrumentation, 5 op
521072S: Microsensors, 5 op
521300S: Electronics Design and Construction Exercise, 6 op
521405A: Electronic System Design, 5 op
521094S: Optoelectronic Measurements, 5 op

A450002 Signal Processing Minor

A450002: Signal Processing Minor, 17 op
Selected from at least 15 ECTS cr
031080A: Signal Analysis, 5 op
521337A: Digital Filters, 5 op
521467A: Digital Image Processing, 5 op
521259S: Digital Video Processing, 5 op
521279S: Signal Processing Systems, 5 op
521273S: Biosignal Processing I, 5 op
521288S: Multiprocessor Programming, 5 op

Other minor subject

Optional courses

The M. Sc. degree must be at least 120 credits.

Master of Science, Subject Teacher

Tutkintorakenteen tila: published

Lukuvuosi: 2016-17

Lukuvuoden alkamispäivämäärä: 01.08.2016

Compulsory major studies in physics (vähintään 32 op)

Compulsory for all subject teacher.
In Quantum Mechanics I, the first intermediate examination is enough to complete.

761686S: Maturity test, 0 op
761684S: Pro gradu thesis, 20 op
763612S: Quantum mechanics I, 10 op
766651S: Research project in physics, 6 op

Compulsory advanced studies in physics (vähintään 28 op)

Optional advanced studies in physics (in Space physics, SR spectroscopy or NMR spectroscopy).
Examples listed below.

761669S: Applications of NMR spectroscopy, 6 op

766650S: Applications of SR physics, 5 op
761671S: Atomic physics 2, 8 op
761649S: Auroral physics, 6 op
766645S: Cluster Physics, 5 op
761668S: Computational physics and chemistry, 6 op
766655S: Cosmic Rays, 8 op
761673S: Electron and ion spectroscopy, 8 op
766656S: Heliospheric physics, 8 op
761658S: Ionospheric physics, 8 op
761675S: Laser and synchrotron radiation physics, 6 op
761657S: Magnetospheric physics, 8 op
766677S: Modern characterization methods in material science, 6 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
766669S: Nuclear magnetic relaxation, 6 op
763616S: Numerical programming, 6 op
761644S: Physical measurements, 6 op
761653S: Plasma physics, 8 op
766654S: Solar physics, 8 op

Pedagogic studies for teacher (vähintään 30 op)

Pedagogic studies (second part).

Optional courses

Minor studies in the second teaching subject (60 credits in total).
Optional studies. The M. Sc. degree must be at least 120 credits.

Master of Science, Theoretical physics (researcher)

Tutkintorakenteen tila: published

Lukuvuosi: 2016-17

Lukuvuoden alkamispäivämäärä: 01.08.2016

Compulsory major studies in theoretical physics (vähintään 35 op)

Compulsory for all master's level students in theoretical physics

763685S: Maturity test, 0 op
763683S: Pro gradu thesis, 35 op

Other advanced studies in theoretical physics (vähintään 45 op)

Select at least 45 credits listed below or other courses which can be accepted for the theoretical physics studies.

H325115: Advanced studies in physics (Theoretical Physics), 45 - 999 op
Advanced Studies in Astronomy, at least 45 ECTS cr from the following
763620S: Statistical physics, 10 op
763622S: Advanced course in quantum mechanics, 10 op
763628S: Condensed matter physics, 10 op
763655S: Astroparticle physics, 6 op

763629S: Classical field theory, 6 op
763654S: Hydrodynamics, 6 op
763696S: Electronic transport in mesoscopic systems, 6 op
763645S: Superconductivity, 6 op
763695S: General relativity, 6 op
763616S: Numerical programming, 6 op
763693S: Quantum optics in electric circuits, 6 op
763698S: Advanced special course:, 6 - 8 op

Other Recommended advanced physics studies

766632S: Electromagnetic waves, 6 op
761653S: Plasma physics, 8 op
761671S: Atomic physics 2, 8 op
761668S: Computational physics and chemistry, 6 op
765608S: Stellar dynamics, 7 op
765643S: Stellar structure and evolution, 7 op
763650S: Practice, 3 - 5 op

Minor subject

The minor subject can consists of general, basic, intermediate or advanced studies (at least 15 credits).

Optional courses

The M. Sc. degree must be at least 120 credits.

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

765693S: Advanced astronomy studies at other universities, 0 op
762361A: An intermediate level course from another Finnish university, 0 op
762363A: An intermediate level course from another university abroad, 0 op
761105P: Atomic and Nuclear Physics, 3 op
761385A: B.Sc. thesis and seminar, 10 op
761102P: Basic Thermodynamics, 2 op
764162P: Basic biophysics, 3 op
761111P: Basic mechanics, 5 op
766345A: Basics of space physics, 6 op
764660S: Bioelectronics, 5 op
765682S: Dark matter, 5 op
765382A: Dark matter, 5 op
761113P: Electricity and magnetism, 5 op
765106P: History of astronomy, 3 op
764630S: Identification of nonlinear systems, 6 op
766693S: Industrial physics, 5 op
766310A: Laboratory Course in Electron Spectroscopy, 2 op
764337A: Practical training, 3 - 9 op
764637S: Practical training, 3 - 9 op
763682S: Pro gradu thesis, 20 op
765621S: Pro gradu thesis, 20 op
764651S: Research project in biophysics, 10 op
766659S: Solar effects on climate, 6 op
764606S: Special advanced course, 5 - 9 op
765394A: Special course, 7 op
765385A: Special course given by a visiting lecturer, 4 - 6 op
766359A: Spectroscopic methods, 7 op

766330A: Structure of matter, 6 op
761013Y: Tutoring, 2 op
761114P: Wave motion and optics, 5 op

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuuluvien opintokohteiden kuvaukset

902002Y: English 1 (Reading for Academic Purposes), 2 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Proficiency level:
B2/C1 on the Common European Framework of Reference scale.
Status:
This course is mandatory for students of the following degree programmes:
Faculty of Science
•Biology
•Chemistry
•Mathematical Sciences
•Physics
Oulu Mining School
•Geosciences degree programme
Faculty of Information Technology and Electrical Engineering
•Department of Information Processing Science

Students in the Department of Geography take English 3.

Engineering students in the following programmes take their English courses in the Faculty of Technology:
Oulu Mining School:
• Mining Technology and Mineral Processing degree programme

Faculty of Information Technology and Electrical Engineering
•Department of Electrical Engineering
•Department of Communications Engineering
•Department of Computer Science and Engineering

Please consult the Faculty Study Guide to establish the language requirements for your own degree program.
Required proficiency level:
English must have been the A1 or A2 language at school or equivalent English skills should have been acquired otherwise.
ECTS Credits:
2 ECTS credits (total work load 54 hours including classroom meetings.)
Language of instruction:
English
Timing:
Biology: 1st year spring term
Chemistry: 1st year autumn term

Geology: 1st year spring term
Information Processing Science: 1st year spring term
Mathematical Sciences (pedagogy): 1st year spring term
Mathematical Sciences: 2nd year autumn term
Physical Sciences: 1st year autumn term
Learning outcomes:
By the end of the course, you are expected to be able to

- have acquired effective vocabulary learning techniques
- be able to distinguish parts of words to infer meanings
- utilize your knowledge of text structure and cohesion markers to understand academic texts
- extract information and learn content from English readings in scientific and professional contexts

Contents:
The course will focus on reading strategies; these include recognizing how texts are organized, identifying key points in a text, and understanding words in context. Vocabulary work in the course will focus on a) academic vocabulary, as used in formal scientific writing, and b) using your knowledge of the meanings of parts of words (affixes) to infer meaning.
Mode of delivery:
Contact teaching
Learning activities and teaching methods:
The scope of the course is 2 op (54 hours student workload).
Target group:
1st year students of Biology, Chemistry, Geology, Information Processing Science, Physics, and Mathematics (pedagogy); 2nd year students of Mathematics
Prerequisites and co-requisites:
-
Recommended optional programme components:
Students are also required to take 902004Y Scientific Communication, which is taken AFTER completion of this course.
Recommended or required reading:
Photocopies will be provided by the teacher and/or required texts will be accessible online or from the university library.
Assessment methods and criteria:
Student work is monitored by continuous assessment. You are required to participate regularly and actively in all contact teaching provided, and successfully complete all required coursework. There will be three monthly tests on material covered so far.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/Fail
Person responsible:
Karen Niskanen
Working life cooperation:
-
Other information:
N.B. Students with grades *laudatur* or *eximia* in their A1 English school-leaving examination can be exempted from this course and will be granted the credits by the Faculty of Science.

902004Y: English 2 (Scientific Communication), 2 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Leikkaavuudet:

ay902004Y	English 2 (Scientific Communication) (OPEN UNI)	2.0 op

Proficiency level:
B2/C1 on the CEFR scales
Status:

This course is mandatory for all 2nd year students (except **geographers**) who will have English as their foreign language in their B.Sc. degree. This includes the students who were exempted from ‘Reading for Academic Purposes'(902002Y). Please consult the faculty study guide to establish the language requirements on your own degree programme.

Required proficiency level:

Students taking this course must have had English as the A1 or A2 language at school or the equivalent English skills should have been acquired otherwise. The course 'Reading for Academic Purposes' (902002Y) is a pre-requisite, unless exempted.

ECTS Credits:

The student workload is 53 hrs work/ 2 ECTS credits.

Language of instruction:

English

Timing:

Biology: 2nd year autumn term
Chemistry: 2nd year spring term
Geology: 2nd year spring term
Information Processing Science : 2nd year autumn term
Mathematics: 2nd year spring term
Physics: 2nd year autumn term

Learning outcomes:

By the end of the course, you are expected:

1. to have demonstrated your use of appropriate strategies and techniques for communicating effectively in English in an academic context.
2. to have demonstrated the ability to prepare and present scientific subjects to your classmates, using appropriate field-related vocabulary.

Contents:

Skills in listening, speaking, and presenting academic topics are practised in the classroom, where there is an emphasis on working in pairs and small groups. Homework tasks include online lecture listening and reading, preparation for classroom discussions and written work to support the classroom learning.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Contact teaching 28 hours, homework 28 hours

Target group:

2nd year students of Biology, Chemistry, Geology, Information Processing Science, Mathematics, Physics

Prerequisites and co-requisites:

-

Recommended optional programme components:

Also required: 902002Y Reading for Academic Purposes Englannin kieli 1

Recommended or required reading:

Course materials will be provided by the teacher.

Assessment methods and criteria:

Continuous assessment is based on regular attendance, active participation in all lessons and the successful completion of all homework tasks.

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

Grading:

Pass / fail.

Person responsible:

Karen Niskanen

Working life cooperation:

-

Other information:

-

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:
Elina Koskinen
Working life cooperation:
No work placement period

901035Y: Second Official Language (Swedish), Oral Skills, 1 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Opintokohteen kielet: Swedish

Leikkaavuudet:

901061Y Second Official Language (Swedish), Oral Skills 1.0 op
ay901035Y Second Official Language (Swedish), Oral Skills (OPEN UNI) 1.0 op
901004Y Swedish 2.0 op

901034Y: Second Official Language (Swedish), Written Skills, 1 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Opintokohteen kielet: Swedish

Leikkaavuudet:

901060Y Second Official Language (Swedish), Written Skills 1.0 op
ay901034Y Second Official Language (Swedish), Written Skills (OPEN UNI) 1.0 op
901004Y Swedish 2.0 op

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 degree programme in 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

H325101: Physics, Basic studies, 23 - 34 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Basic Studies

Laji: Study module
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Basic studies in physics

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. The student has inclusive knowledge of different teaching and study methods, which can be applied later on.

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:

Varied teaching methods

Learning activities and teaching methods:

Lectures, exercises and other teaching events 32 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:

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/
The person responsible of the course may refer also to other uselful material.
Course material availability can be checked here.

Assessment methods and criteria:

The exercises given during the course and a short written examination, or one extensive written examination.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Laura Timonen

Working life cooperation:

No work placement period

Other information:

Course website

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	Mathematics for physics	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 28 h, exercises 22 h, self-study 83 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

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

Working life cooperation:

No work placement period

Other information:

Course website

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/

521141P: Elementary Programming, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Rautiainen, Mika Oja

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521141P	Elementary Programming (OPEN UNI)	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5

Language of instruction:

Lectures and learning material are in Finnish. The course can be completed in English by self-studying from a book, completing assignments and exercises on the course learning environment, and delivering a final project.

Timing:

Fall, period 1. There is an option to extend the course to the 2nd period in cases where completing in one period doesn't fit the student's schedule.

Learning outcomes:

1. Is capable of solving problems in the computer's terms

2. Understands the basic concepts of programming

3. Knows the basics of the Python programming language

4. Is able to implement programs independently

5. Is able to use the internet to find information about programming

Contents:

Problem solving with programming, basic concepts of programming, writing Python code.

Mode of delivery:

Web-based teaching + face-to-face teaching

Learning activities and teaching methods:

30h of exercise groups, 105h self-studying in the web.

Target group:

1 st year students of computer science and engineering, electrical engineering, medical and wellness technology and industrial and engineering management, 2nd year students of physics, and other students of the University of Oulu

Prerequisites and co-requisites:

None.

Recommended optional programme components:

The course provides a basis for subsequent programming courses.

Recommended or required reading:

Web material in an online learning environment. Address will be announced at the beginning of the course.

Assessment methods and criteria:

The course is completed by passing all learning assignments, programming exercises and a final exercise project. Read more about assessment criteria at the University of Oulu webpage
Read more about assessment criteria at the University of Oulu webpage.

Grading:

pass/fail.

Person responsible:

Mika Oja

Working life cooperation:

-

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 10 h, exercises 20 h (5 x 4 h). Five different works will be made during the course in groups. Self-study 50 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

Compulsory

761121P-01: Laboratory exercises in physics 1, exam, 0 op

Opiskelumuoto: Basic Studies

Laji: Partial credit

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761115P-01	Laboratory Exercises in Physics 1, lecture and exam	0.0 op
761115P-02	Laboratory Exercises in Physics 1, laboratory exercises	0.0 op

Ei opintojaksokuvauksia.

761121P-02: Laboratory exercises in physics 1, lab. exercises, 0 op

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

761115P-01	Laboratory Exercises in Physics 1, lecture and exam	0.0 op
761115P-02	Laboratory Exercises in Physics 1, laboratory exercises	0.0 op

Ei opintojaksokuvauksia.

030005P: Information Skills, 1 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Faculty of Technology
Arvostelu: 1 - 5, pass, fail
Opettajat: Sassali, Jani Henrik, Ursula Heinikoski
Opintokohteen kielet: Finnish
Leikkaavuudet:

030004P	Introduction to Information Retrieval	0.0 op

ECTS Credits:

1 ECTS credit

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

Students know the different phases of information retrieval process and basic techniques of scientific information retrieval. They will find the most important reference databases of their discipline and know how to evaluate information sources and retrieval results.

Contents:

Retrieval of scientific information, the retrieval process, key databases of the discipline, and evaluation of information retrieval and information sources.

Mode of delivery:

Blended teaching: classroom training, web-based learning material and exercises in Optima environment, a final assignment on a topic of the student’s own choice

Learning activities and teaching methods:

Training sessions 8h, group working 7h, self-study 12h

Target group:

Compulsory for all students of the Faculty of Technology, the Faculty of Information Technology and Electrical Engineering and the Faculty of Architecture. In the Faculty of Science compulsory for students of biology, physics, geosciences, chemistry and geography. Optional for students of biochemistry and mathematics.

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Web learning material https://wiki.oulu.fi/display/030005P.

Assessment methods and criteria:

Passing the course requires participation in the training sessions and successful completion of the course assignments.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

pass/fail

Person responsible:

Science and Technology Library Tellus, tellustieto (at) oulu.fi

Working life cooperation:

-

Other information:

-

At least one of the introduction courses in physics

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 Introduction to biomedical physics.

Person responsible:

Kyösti Heimonen

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

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

Compulsory for teacher students

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.

H325102: Physics, Intermediate studies, 52 - 65 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Study module
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Intermediate studies in physics.

766343A: Mechanics, 7 op

Voimassaolo: 01.08.2015 -
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
766323A Mechanics 6.0 op
761323A Mechanics 6.0 op

ECTS Credits:

7 credits

Language of instruction:

This course will be lectured in Finnish. Course book is in English. Most of the exercises are in English.

Timing:

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 57 h
Part 2: Lectures 22 h, exercises 10 h (5 x 2 h), self-study 61 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 766101P 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) and Perttu Lantto (part 2)

Working life cooperation:

No work placement period

Other information:

Course website and part 1 website

Compulsory

766343A-01: Mechanics part 1, 0 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Partial credit
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

766323A-02	Mechanics part 2	0.0 op
766323A-01	Mechanics part 1	0.0 op

Ei opintojaksokuvauksia.

766343A-02: Mechanics part 2, 0 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Partial credit
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

766323A-01	Mechanics part 1	0.0 op
766323A-02	Mechanics part 2	0.0 op

Ei opintojaksokuvauksia.

766349A: Wave motion and optics, 7 op

Voimassaolo: 01.12.2015 -
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
766329A	Wave motion and optics	6.0 op

ECTS Credits:
7 credits
Language of instruction:
Finnish. The course material and exercises are available in English.
Timing:
First 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 117 h

Target group:

No specific target qroup

Prerequisites and co-requisites:

766101P 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:

Course website

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/

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 40 h, exercises 20 h, self-study 100 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/

763343A: Solid state physics, 5 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766330A Structure of matter 6.0 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

763333A Structure of matter I 4.0 op

ECTS Credits:

5 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 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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, exercises 16 h, self-study 87 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/766348A).

Recommended optional programme components:

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

Recommended or required reading:

C. Kittel: Introduction to solid state physics.
Course material availability can be checked here.

Assessment methods and criteria:

Examination

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Erkki Thuneberg

Working life cooperation:

No work placement period

Other information:

Course website

766344A: Nuclear and particle physics, 5 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

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
766334A	Structure of matter II	2.0 op

ECTS Credits:

5 credits

Language of instruction:

Finnish

Timing:

2nd spring

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:

This course deals with the structure and properties of nuclei, nuclear forces, nuclear models, radioactivity, nuclear reactions, properties and interactions of fundamental particles, and unified theories of fundamental interactions.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, 8 exercises (16 h), self-study 87 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/766348A).

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), 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:

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:

Course website

766348A: Thermophysics, 7 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761314A	Thermophysics	5.0 op
761102P	Basic Thermodynamics	2.0 op
766328A	Thermophysics	6.0 op

ECTS Credits:

7 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 117 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, 2015.
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 766348A Thermophysics (7 cp), exceptionally only 6 cp (not 7 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.
Course website

766384A: B.Sc. seminar, 4 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761385A-01	B.Sc. thesis	0.0 op
761385A-02	Seminar	0.0 op

ECTS Credits:

4 credits

Language of instruction:

Finnish

Timing:

3rd autumn

Learning outcomes:

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 and present a seminar talk.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 10 h, seminar talk, act as an opponent (ca 20 h), self-study 77 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:

?

Grading:

Numerical grading scale 0 – 5, where 0 = fail.

Person responsible:

Marko Huttula

Working life cooperation:

No work placement period

Other information:

Course website ???

766385A: B.Sc. thesis, 6 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761385A-02	Seminar	0.0 op

761385A-01 B.Sc. thesis 0.0 op

ECTS Credits:

6 credits

Language of instruction:

Finnish or English

Timing:

3rd year

Learning outcomes:

The student can carry out research work, search information and write scientific reports about the subject.

Contents:

Both written and oral reporting is essential part of the scientific research. In the course, the students 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:

Self-study 160 h.

Target group:

Compulsory for Bachelor of Science in physics.

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:

B.Sc. thesis

Grading:

Numerical grading scale 0 – 5, where 0 = fail.

Person responsible:

Marko Huttula

Working life cooperation:

No work placement period

Other information:

Course website ???

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

Compulsory for physicist

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

Compulsory intermediate courses for teacher

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/

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

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/

H326004: Minor subject study module Biophysics, 25 - 30 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Basic Studies

Laji: Study module

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Basic and intermediate studies in biophysics

764163P: Introduction to Biomedical 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:

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

Working life cooperation:

No work placement period

Other information:

Course website

Compulsory

764163P-01: Introduction to Biomedical Physics (part 1), 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:

764163P	Basic biophysics	5.0 op
764103P	Introduction to biophysics	2.0 op
764162P	Introduction to biophysics	3.0 op

Ei opintojaksokuvauksia.

764163P-02: Introduction to Biomedical Physics (part 2), 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:

764163P	Basic biophysics	5.0 op
764103P	Introduction to biophysics	2.0 op
764162P	Introduction to biophysics	3.0 op

Ei opintojaksokuvauksia.

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:

Kyösti Heimonen

Working life cooperation:

No work placement period

Other information:

Course website

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.

Courses in biophysics, either in B.Sc. or in M.Sc. degree

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 (not necessarily organized every year)

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:

Course website

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 (organized only during odd-numbered years)

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, Kyösti Heimonen

Working life cooperation:

No work placement period

Other information:

Course website

Chemistry course can be included either chemistry nor biophysics

780120P: Basic Principles in Chemistry, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Chemistry

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

780117P	General and Inorganic Chemistry A	5.0 op
780109P	Basic Principles in Chemistry	4.0 op

ECTS Credits:

5 credits/134 hours of work

Language of instruction:

Finnish

Timing:

1st autumn

Learning outcomes:

Upon completion of the course, the student will be able to display an understanding of basic chemistry phenomenon; equilibrium of acids and bases, chemical equilibrium, redox reactions and stoichiometry.

Contents:

Introduction to chemistry, stoichiometry, redox reactions, chemical equilibrium, the equilibrium of acid and bases, buffer solutions, titration, thermodynamics.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

40 hours of lectures and 94 hours of self-study

Target group:

Biology, Geology, Process Engineering, Environmental Engineering compulsory. Geography, optional.

Prerequisites and co-requisites:

The compulsory course in upper secondary school chemistry (1st course)

Recommended optional programme components:

The course is not included in the 25 ECTS credits entity of chemistry!

Recommended or required reading:

Tro, N.J., Principles of Chemistry. A Molecular Approach, Pearson, 3. edition, 2016

Assessment methods and criteria:

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

Grading:

The course utilizes a numerical grading scale 0-5. In the numerical scale zero stands for a fail.

Person responsible:

Lecturer Minna Tiainen

Working life cooperation:

No

Other information:

No

764327A: Virtual measurement environments, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: Finnish

Leikkaavuudet:

764627S	Virtual measurement environments	5.0 op

ECTS Credits:

5 ECTS, 135 hours of work

Language of instruction:

English

Timing:

Bachelor studies, 2nd period

Learning outcomes:

The students will learn how to construct software 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 60 h, self-study 65 h

Target group:

Bachelor students of Medical Technology and Biophysics. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

Basic skills in programming.

Recommended or required reading:

Lecture and exercise notes, other given material

Assessment methods and criteria:

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

Grading:

The course utilizes a numerical grading scale 1-5 or fail. The grading is based on projects.

Person responsible:

Professor Timo Jämsä

Working life cooperation:

None

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/

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 - 4th autumn (organized only during even-numbered years or even more rarely)

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:

Iikka Salmela, Kyösti Heimonen

Working life cooperation:

No work placement period

Other information:

Kurssin sivu

Recommended courses in biophysics

521302A: Circuit Theory 1, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Rahkonen, Timo Erkki
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish. Exams can be arranged in English on demand.

Timing:

Spring, period 4

Learning outcomes:

After the course the student can

1. write and solve the equations describing the operation of a given electrical circuit

2. solve the sinusoidal steady-state solution using complex phasor arithmetics

3. solve time responses of electric circuits

4. simplify electrical circuits e.g. using equivalent circuits

5. simulate simple circuits and choose an appropriate circuit simulation method

Contents:

Equation of basic circuit elements, circuit laws and systematic building of network equations. Calculation of time and frequency responses. Use of complex phasor arithmetics. Basics of the use of circuit simulators.

Mode of delivery:

Classroom.

Learning activities and teaching methods:

30h lectures, 22h exercises, and a simulation exercise.

Target group:

Finnish BSc students.

Prerequisites and co-requisites:

Matrix algebra, complex arithmetics, differential equations.

Recommended optional programme components:

Background to all analog electronics cources.

Recommended or required reading:

Nilsson, Riedel: Electric Circuits (6th or 7th ed., Prentice-Hall 1996), Chapters 1-11.

Assessment methods and criteria:

Final exam. Also the simulation exercise must be passed.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

H325504: Minor subject study module Geophysics, 32 - 35 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Basic Studies
Laji: Study module
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Basic and intermediate studies in geophysics

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, Moisio, Kari Juhani
Opintokohteen kielet: Finnish

ECTS Credits:

5 credits

Language of instruction:

Finnish or English

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:

Elena Kozlovskaya, Kari Moisio

Working life cooperation:

No

Other information:

Course website

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:

Juha Pekka Lunkka, Kari Moisio

Working life cooperation:

No work practice

Other information:

Course website

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 and for geophysical students.

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, Elena Kozlovskaya

Working life cooperation:

No work practise.

Other information:

Course website

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, English

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, independent study

Learning activities and teaching methods:

Lectures and practicals

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:

Different modes of approvement

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Elena Kozlovskaya, Kari Moisio

Working life cooperation:

No work placement period

Other information:

Course website

Alternative

771113P: Introduction to Geology I, 5 op

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

ay771113P	Introduction to Geology I (OPEN UNI)	5.0 op

ECTS Credits:

5 credits

Language of instruction:

Finnish

Timing:

1st year autumn

Learning outcomes:

Stdents have an understanding of the basic concepts of the Earth, from its composition and internal *structure* to the geological *processes* that has led to its evolution the present Earth as part of the solar system. They can tell how endogenic processes in the mantle and crust produce magmas and how magmas produce different igneous rock type upon emplacement below and on the Earth’s surface. Students are able to recognise and classify common igneous rocks based on their mineral composition and are familiar with common metamorphic rocks and know the metamorphic facies concepts. They can relate deformation and metamorphism of the rocks to plate tectonic processes.

Contents:

Evolution of the Earth as part of the solar system, structure and composition of the Earth. Classification of igneous rocks, magmatism, origin and crystallisation of magmas, volcanism, metamorphism and formation of metamorphic rocks, plate tectonics and deformation structures.

Mode of delivery:

Face to face

Learning activities and teaching methods:

36 h lectures, 6 h exercises

Target group:

1st year geoscience students. The course is a good minor subject course for others.

Prerequisites and co-requisites:

Basic course in mineralogy (771102P) is parallel to this course.

Recommended optional programme components:

This course is intended as an introduction to the scope and methods of igneous and metamorphic petrology.

Recommended or required reading:

Martti Lehtinen, Pekka Nurminen and Tapani Rämö (1998) Suomen kallioperä – 3000 vuosimiljoonaa. Suomen Geologinen Seura, Gummerus Jyväskylä, ISBN 952-90-9260-1, Chapters 2-3. John Grotzinger & Thomas H. Jordan (2010 or 2014) Understanding Earth, 6 th or 7 th edition, Chapters 1-4, 6-7, 9-10, 12.

Assessment methods and criteria:

Written examination and identification test of rock types.

Grading:

5-1/fail

Person responsible:

Eero Hanski

Working life cooperation:

No

771114P: Introduction to Geology II, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opettajat: Eero Hanski

Opintokohteen kielet: Finnish

ECTS Credits:

5 credits

Language of instruction:

Finnish

Timing:

1st year autumn

Learning outcomes:

Upon completion of the course, students should have acquired basic knowledge on the concepts and processes of surficial geology. Students should also be able to identify basic sediment types and soils.

Contents:

Basic concepts of surficial physical geology, weathering, erosion, sedimentation, and sediment types, soils and geological processes forming sedimentary deposits.

Mode of delivery:

Face to face

Learning activities and teaching methods:

16 h lectures, 8 h exercises

Target group:

1st year Geoscience students. The course ia s good minor subject course for others.

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Handouts and John Grotzinger & Thomas H. Jordan (2010 or 2014) Understanding Earth, 6 th or 7 th edition, Chapters 5, 8, 15-21.

Assessment methods and criteria:

Obligatory exercises and written examination.

Grading:

5-1/fail

Person responsible:

Juha Pekka Lunkka and Tiina Eskola

Working life cooperation:

No

Recommended

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:

Course website

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:

Kari Moisio

Working life cooperation:

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

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:

Kari Moisio

Working life cooperation:

No work placement period

Other information:

Course website

H325304: Minor subject study module Theoretical physics, 28 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Basic Studies
Laji: Study module
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Intermediate studies in theoretical physics

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

Working life cooperation:

No work placement period

Other information:

Course website

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:

Matti Alatalo

Working life cooperation:

No work placement period

Other information:

Course website

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:

Matti Alatalo

Working life cooperation:

No work placement period

Other information:

Course website

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

Working life cooperation:

No work placement period

Other information:

Course website

Recommended in theoretical physics

521286A: Computer Systems, 8 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Teemu Leppänen
Opintokohteen kielet: Finnish
Leikkaavuudet:

521142A	Embedded Systems Programming	5.0 op

ECTS Credits:

8

Language of instruction:

Lecturing in Finnish, course and exercise material available in English.

Timing:

Autumn, periods 1-2.

Learning outcomes:

1. Student understands the basic computer architecture and organization.

2. Student understands CPU operation and datapath in general.

3. Student knows different number systems and data representations in computers.

4. Student is familiar of I/O operation with peripheral devices in general.

5. Student is able to implement small programs with the C programming language for general-purpose computers for embedded systems.

6. Student recognizes how embedded systems programming is different from programming general-purpose computers.

Contents:

Yleinen tietokoneen organisaatio ja arkkitehtuuri, keskusyksikkö, muistihierarkia ja muistinhallinta, tietotyypit, laiterekisterit ja I/O, yleinen tietokoneen ohjelmointi ja laiteläheisen ohjelmointi, C-kielen perusteet.

Mode of delivery:

Web-based and face-to-face teaching.

Learning activities and teaching methods:

Lectures (40h), course exercises (20h), laboratory exercise (3h) and course projects in groups.

Target group:

2nd year students of computer science and engineering and 3rd year students of electrical engineering.

Prerequisites and co-requisites:

Elementary programming 521141P.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Course material will be announced at the beginning of the course.

Assessment methods and criteria:

Students complete the course exercises after lectures, participate to the laboratory exercise and complete the course projects in groups. Assessment is based on the exercises and the course projects. More detailed information on assessment will be announced at the beginning of the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Teemu Leppänen, Mika Rautiainen.

Working life cooperation:

No.

521287A: Introduction to Computer Systems, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Leppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521287A	Introduction to Computer Systems (OPEN UNI)	5.0 op

521142A Embedded Systems Programming 5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Lecturing in Finnish, course and exercise material available in English.

Timing:

Autumn, periods 1-2.

Learning outcomes:

Upon completing the course, the student understands the basics of computer architecture and CPU operation.Student knows number systems and data representations in computer.
Student is familiar of I/O operation with peripheral devices in general.
Student is able to implement small programs with the C programming language for general-purpose computers and for embedded systems.
Student recognizes how embedded systems programming is different from programming general-purpose computers.

Contents:

Overview of computer architecture and CPU, data types and memory management, interrupts, registers and I/O, general computer and embedded systems programming, basics of the C programming language.

Mode of delivery:

Web-based teaching + face-to-face teaching.

Learning activities and teaching methods:

Lectures (20h), course exercises (10-20h), laboratory exercise (3h) and course project in a group.

Target group:

Students of the University of Oulu

Prerequisites and co-requisites:

Elementary programming 521141P

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Lecture notes. Other material will be announced at the course start.

Assessment methods and criteria:

Students complete the course exercises after lectures, participate to the laboratory exercise and complete the course project in a group. Assessment is based on the exercises and the course project. More detailed information on assessment can be found from the course Web pages in Noppa Portal.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Teemu Leppänen, Mika Rautiainen.

Working life cooperation:

-

Other information:

521287A Introduction to Computer Systems replaces course 521142A Embedded systems programming for electrical engineering students.

H325704: Minor subject study module Astronomy, 40 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Basic Studies
Laji: Study module
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Basic and intermediate studies in astronomy

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 24 h, self-study 56 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.

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 26 h, exercises 12 h, self-study 95 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. (4. edition or newer.)
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

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.

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

Working life cooperation:

No work placement period

Other information:

Course website

Recommended in astronomy

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/

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/

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

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:

6 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 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.

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

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

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

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

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

765367A: Observational Astrophysics and Data Analysis, 6 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

765667S	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/765367A/etusivu

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

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/

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/

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/

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/

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

H325104: General Physics, 25 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Basic Studies

Laji: Study module

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Basic and intermediate studies in general physics

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.

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/

Compulsory

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

Working life cooperation:

No work placement period

Other information:

Course website

At least one of the courses listed below must be chosen

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.

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/

Recommended in general physics

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:

Seppo Alanko

Working life cooperation:

Work placement period

521286A: Computer Systems, 8 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Leppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521142A	Embedded Systems Programming	5.0 op

ECTS Credits:

8

Language of instruction:

Lecturing in Finnish, course and exercise material available in English.

Timing:

Autumn, periods 1-2.

Learning outcomes:

1. Student understands the basic computer architecture and organization.

2. Student understands CPU operation and datapath in general.

3. Student knows different number systems and data representations in computers.

4. Student is familiar of I/O operation with peripheral devices in general.

5. Student is able to implement small programs with the C programming language for general-purpose computers for embedded systems.

6. Student recognizes how embedded systems programming is different from programming general-purpose computers.

Contents:

Yleinen tietokoneen organisaatio ja arkkitehtuuri, keskusyksikkö, muistihierarkia ja muistinhallinta, tietotyypit, laiterekisterit ja I/O, yleinen tietokoneen ohjelmointi ja laiteläheisen ohjelmointi, C-kielen perusteet.

Mode of delivery:

Web-based and face-to-face teaching.

Learning activities and teaching methods:

Lectures (40h), course exercises (20h), laboratory exercise (3h) and course projects in groups.

Target group:

2nd year students of computer science and engineering and 3rd year students of electrical engineering.

Prerequisites and co-requisites:

Elementary programming 521141P.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Course material will be announced at the beginning of the course.

Assessment methods and criteria:

Students complete the course exercises after lectures, participate to the laboratory exercise and complete the course projects in groups. Assessment is based on the exercises and the course projects. More detailed information on assessment will be announced at the beginning of the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Teemu Leppänen, Mika Rautiainen.

Working life cooperation:

No.

521287A: Introduction to Computer Systems, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Leppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521287A	Introduction to Computer Systems (OPEN UNI)	5.0 op
521142A	Embedded Systems Programming	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Lecturing in Finnish, course and exercise material available in English.

Timing:

Autumn, periods 1-2.

Learning outcomes:

Upon completing the course, the student understands the basics of computer architecture and CPU operation.Student knows number systems and data representations in computer.
Student is familiar of I/O operation with peripheral devices in general.
Student is able to implement small programs with the C programming language for general-purpose computers and for embedded systems.
Student recognizes how embedded systems programming is different from programming general-purpose computers.

Contents:

Overview of computer architecture and CPU, data types and memory management, interrupts, registers and I/O, general computer and embedded systems programming, basics of the C programming language.

Mode of delivery:

Web-based teaching + face-to-face teaching.

Learning activities and teaching methods:

Lectures (20h), course exercises (10-20h), laboratory exercise (3h) and course project in a group.

Target group:

Students of the University of Oulu

Prerequisites and co-requisites:

Elementary programming 521141P

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Lecture notes. Other material will be announced at the course start.

Assessment methods and criteria:

Students complete the course exercises after lectures, participate to the laboratory exercise and complete the course project in a group. Assessment is based on the exercises and the course project. More detailed information on assessment can be found from the course Web pages in Noppa Portal.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Teemu Leppänen, Mika Rautiainen.

Working life cooperation:

-

Other information:

521287A Introduction to Computer Systems replaces course 521142A Embedded systems programming for electrical engineering students.

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:

Matti Alatalo

Working life cooperation:

No work placement period

Other information:

Course website

H325135: Minor subject study module Electrical engineering (Degree programme in physics), 43 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Other Entity
Laji: Study module
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Intermediate studies in electrical engineering

521109A: Electrical Measurement Principles, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Saarela
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 136h

Language of instruction:

Course is lectured in Finnish. Lecture notes are available in English. Laboratory exercises and the exam can be done in English.

Timing:

Periods 1-2.

Learning outcomes:

1. is able to measure basic measurements with a multimeter,

2. is able to measure basic measurements with an oscilloscope,

3. is able to operate signal and function generators.

4. is able to estimate the validity of their measurements.

Contents:

Units of measures, standards of measures, analysis of errors, most commonly used analog and digital measuring methods, equipment and electrical safety regulations.

Mode of delivery:

Pure face-to-face teaching.

Learning activities and teaching methods:

Lectures 20h, laboratory exercises 16 h and self-study 100h.

Target group:

Course is compulsory for electrical engineering, information engineering and wellness technology students. Course is open for all students in University of Oulu.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

None.

Recommended or required reading:

Course material is in English and Finnish and can be found in Optima.

Assessment methods and criteria:

Exam and passed lab exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Grade is based on exam and grade is on numerical scale 1-5.

Person responsible:

Juha Saarela

Working life cooperation:

None.

521301A: Digital Techniques 1, 8 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Antti Mäntyniemi

Opintokohteen kielet: Finnish

Leikkaavuudet:

521412A-02	Digital Techniques 1, Exercise Work	0.0 op
521412A	Digital Techniques 1	6.0 op
521412A-01	Digital Techniques, Exam	0.0 op

ECTS Credits:

8

Language of instruction:

Finnish

Timing:

Periods 3-4

Learning outcomes:

1. After the course, students are able to ably binary number system and Boolean algebra in the form of switching algebra to the design and functional analyze of simple digital circuits.
2. In addition, they are also able to use in their designs graphical symbols specified in the dependency notation standard (SFS4612 ja IEEE/ANSI Std.91-1991) and different descriptions of function and structure of state machines.
3. Based on this knowledge, students are able to implement and analyze digital devices consisting of ordinary simple digital components.
4. After having assimilated the basic knowledge of digital technique, students are able to understand also the function and structure of micro controllers and micro processors.

Contents:

The principles of digital devices, Boolean algebra, numeral systems, operating principle, analysis and synthesis of combinational logic, flip-flops, operating principle, analysis and synthesis of sequential logic (state machines), physical characteristics of CMOS technology, registers and register transfers, computer memory, instruction set architecture, computer design basics, interfaces and data transmission.

Mode of delivery:

Classroom

Learning activities and teaching methods:

Lessons 40 h, guidance of the project work 20 h.

Target group:

Primarily 1st year electrical engineering and computer science and engineering BSc students. The course can be taken by the students of the university of Oulu.

Prerequisites and co-requisites:

-

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Text books, MIT OpenCourseWare and execise literature.

Assessment methods and criteria:

Project work, home assignment and exam. Partial exams are recommended.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Project work pass/fail. Numerical grading 1-5 for exam. Final grading is based on exam.

Person responsible:

Antti Mäntyniemi

Working life cooperation:

-

521302A: Circuit Theory 1, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Rahkonen, Timo Erkki
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish. Exams can be arranged in English on demand.

Timing:

Spring, period 4

Learning outcomes:

After the course the student can

1. write and solve the equations describing the operation of a given electrical circuit

2. solve the sinusoidal steady-state solution using complex phasor arithmetics

3. solve time responses of electric circuits

4. simplify electrical circuits e.g. using equivalent circuits

5. simulate simple circuits and choose an appropriate circuit simulation method

Contents:

Equation of basic circuit elements, circuit laws and systematic building of network equations. Calculation of time and frequency responses. Use of complex phasor arithmetics. Basics of the use of circuit simulators.

Mode of delivery:

Classroom.

Learning activities and teaching methods:

30h lectures, 22h exercises, and a simulation exercise.

Target group:

Finnish BSc students.

Prerequisites and co-requisites:

Matrix algebra, complex arithmetics, differential equations.

Recommended optional programme components:

Background to all analog electronics cources.

Recommended or required reading:

Nilsson, Riedel: Electric Circuits (6th or 7th ed., Prentice-Hall 1996), Chapters 1-11.

Assessment methods and criteria:

Final exam. Also the simulation exercise must be passed.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

521431A: Principles of Electronics Design, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Häkkinen

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Spring, period 4

Learning outcomes:

1. should be able to analyze and design such electronic building blocks as rectifiers, clamping circuits, amplifiers and CMOS logic elements using diodes, operational amplifiers and MOS and bipolar junction transistors.

Contents:

Analogue and digital circuits, basic amplifier related concepts, operational amplifier, diodes and diode circuits, single stage bipolar and MOS transistor amplifiers, small signal modeling and analyzing ac properties of amplifiers, internal structures of digital circuits (mainly CMOS), MOS/CMOS switch.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h and exercises 20 h.

Target group:

Students of Electrical engineering. Other students of the University of Oulu may also participate.

Prerequisites and co-requisites:

Circuit Theory I

Recommended optional programme components:

Recommended course Principles of Semiconductor Devices.

Recommended or required reading:

Lecture notes, Razavi: Fundamentals of Microelectronics (John Wiley & Sons 2008), chapters 1-8 and 15 partially or Sedra & Smith : Microelectronic Circuits (6th ed.), chapters 1-5 and 14.

Assessment methods and criteria:

Final or 2 mid-term exams.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Juha Häkkinen

Working life cooperation:

-

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Esa Rahtu

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521337A	Digital Filters (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish, English study material available

Timing:

Spring, period 3.

Learning outcomes:

1. Student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods.

2. Student is able to solve for the impulse and frequency responses of FIR and IIR filters given as difference equations, transfer functions, or realization diagrams, and can present analyses of the aliasing and imaging effects based on the responses of the f

3. Student is able to explain the impacts of finite word length in filter design.

4. Student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

Contents:

1. Sampling theorem, aliasing and imaging, 2. Discrete Fourier transform, 3. Z-transform and frequency response, 4. Correlation and convolution, 5. Digital filter design, 6. FIR filter design and realizations, 7. IIR filter design and realizations, 8. Finite word length effects and analysis, 9. Multi-rate signal processing.

Mode of delivery:

Face-to-face teaching (Lectures), independent work, group work

Learning activities and teaching methods:

Lectures and exercises 50 h. The design exercises familiarize the students with the methods of digital signal processing using the Matlab software package. The rest as independent work.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

031077P Complex Analysis, 031080A Signal Analysis

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Lecture notes and exercise materials. Material is in Finnish and in English. Course book: Ifeachor, E., Jervis, B.: Digital Signal Processing, A Practical Approach, Second Edition, Prentice Hall, 2002.

Assessment methods and criteria:

The course can be passed either with week exams or a final exam. In addition, the exercises need to be returned and accepted.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Esa Rahtu

Working life cooperation:

None.

521330A: Telecommunication Engineering, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Heikki Antero Kärkkäinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521357A	Basics of Analog Communications	3.0 op
521361A	Telecommunication Engineering II	3.0 op

ECTS Credits:

5

Language of instruction:

Finnish. The course can be completed in other languages e.g. in English as a book examination.

Timing:

The course is held in the spring semester, during period IV. It is recommended to complete the course at the 2nd spring semester.

Learning outcomes:

1. can tell and explain the essential blocks and their operation in time & frequency domains for frequently used analog and digital carrier and pulse modulation methods.
2. understands essential differences both between linear and non-linear modulations, and between coherenr and non-coherent modulations.
3. understands in which system applications each analog or digital modulation is typically used.
4. can tell limitations on system performance caused by noise interference and various transmission channels, and can propose methods to suppress interference both in analog and digital transmission.
5. can perform system analysis, and can calculate performances of analog and digital modulations based on simple assumptions regarding channel models.
6. can compare modulations from the standpoints of resource use (transmitted power and bandwidth needed) and implementation complexity.

7. understands the meanings of various equalizing, diversity and coding methods from the standpoint of improvement for digital transmission reliability.
8. understands various standards and specifications of new digital transmission systems.
9. can apply gained knowledge in working life to design of systems and their sub-system units, and can also perform computer simulations.
10. understands the principles of information theory, source coding and error-control coding, and masters various most commonly used coding methods.

Contents:

Essential and optional blocks of coherent and non-coherent analog and digital transmission systems and their operation principles. Linear (amplitudemodulation) and non-linear (anglemodulation) modulation principles, and differences in their performance and operation. Carrier and pulse modulation principles and their differences. The most important analog (DSB, AM, SSB, VSB, PM, FM, PAM,PWM, PPM) and digital (ASK/MASK, PSK/MPSK, FSK/MFSK, DPSK, QPSK/OQPSK, MSK/GMSK, QAM, MCM/OFDM, TCM, DM, PCM) carrier and pulse modulation methods and their performance analysis (SNR, BEP) and comparison based on the AWGN channel model. Influence of single-tone carrier radiofrequency interference (RFI) in the case of analog modulations. The threshold effect in the case of non-linear modulations and non-linear detectors. Mixing-principle and superheterodyne receiver. Phase-lock loop techniques, and FDM, TDM and QM-multiplexing methods. Matcher filter and correlation receiver principles. Characteristics and modelling of radio channels. Influence of band-limiting and multi-path propagation (inter-symbol interference ISI & fading) on system performance. Diversity, channel equalizing and MCM/OFDM methods for reducing channel interference. Spread-spectrum technique, and benefits & limitations & applications of that principle. Cellular system idea. Basics of information theory, source coding and error-control coding methods.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Face-to-face teaching 52 h. No separate times for class-ecercises. Exercises are integrated as part of face-to-face teaching event. Self-study 73 h. Total 125 h.

Target group:

Second year B.Sc.(Tech.) students in electrical engineering and computer engineering degree programmes.

Prerequisites and co-requisites:

031080A Signal analysis course.

Recommended optional programme components:

No connections to other courses.

Recommended or required reading:

Lecture slides in Finnsih are stored into the TTK-OPTIMA environment. The course and lecture slides are based on the book: R.E. Ziemer & W.H. Tranter: Principles of Communications: Systems, Modulation and Noise, 7th edition, 2015, John Wiley & Sons, Partially chapters: Ch 1 (ss. 1-16), Ch 3 (112-151), Ch 4 (ss. 156-184, 194-209), Ch 5 (ss. 215-216, 225-239), Ch 8 (ss. 349-361, 370-380, 384-390), Ch 9 (ss. 396-468), Ch 10 (ss. 477-516, 528-532, 540-546, 553-557), Ch 12 (ss. 615-647, 657-664, 668-670, 679-683).

Assessment methods and criteria:

Course can be passed either with several mini-exams during course, or with final exam.

Grading:

Course can be passed either with several mini-exams during course, or with final exam.
Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Kari Kärkkäinen

Working life cooperation:

No

Other information:

This course replaces the following candidate level courses: 521357A Telecommunication Engineering I (3 ECTS) and 521361A Telecommunication Engineering II (3 ECTS).

521384A: Basics in Radio Engineering, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Erkki Salonen
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn, 1st period

Learning outcomes:

1. can define what radio engineering is and list its separate areas.

2. understands the meaning of Maxwell's equations and can solve the propagation of radio waves in a homogeneous medium

3. can solve EM-fields at an interface of two lossless media.

4. knows main properties of most common transmission line types and can solve EM-fields for coaxial lines and rectangular waveguides.

5. can utilize the methods based on the Smith chart for the impedance matching of microwave circuits and antennas.

6. understands the meaning of Y-, Z-, and S-matrix and can use S-parameters for solving charasteristics of microwave circuits.

7. can describe the operation of passive transmission line devices, resonators, filters and circuits based on the semiconductor devices.

8. knows the terms to describe antenna charasteristics and can define radiation patterns of simple antennas and antenna arrays.

9. knows different propagation phenomena and can evaluate, which phenomena are relevant in different radio systems in different frequency bands.

10. can describe the structure of a typical radio system and can calculate the S/N-ratio linkbudget for a radio system on a free-space radio link.

Contents:

Introduction to radio waves and radio engineering. Fundamentals of electromagnetic fields. Transmission lines and waveguides. Impedance matching. Microwave circuit theory. Passive transmission line and waveguide devices. Resonators and filters. Circuits based on semiconductor devices. Antennas. Propagation of radio waves. Radio system. Applications of radio engineering. Biological effects and safety standards.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 26 h and exercises 16 h including graded exercise problems.

Target group:

3 rd year bachelor’s degree students.

Prerequisites and co-requisites:

Elementary knowledge of the electromagnetic theory.

Recommended optional programme components:

-

Recommended or required reading:

In Finnish: Antti Räisänen & Arto Lehto: Radiotekniikan perusteet. Otatieto, 2011; also older versions of the book can be used as a course book. In English: Antti V. Räisänen & Arto Lehto: Radio Engineering for Wireless Communication and Sensor Applications, Artech House, 2003. Additional reading in Finnish: Jyrki Louhi & Arto Lehto: Radiotekniikan harjoituksia. Otatieto, 1995.

Assessment methods and criteria:

The course is passed with a final examination.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5.

Person responsible:

Erkki Salonen

Working life cooperation:

-

521432A: Electronics Design I, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Häkkinen

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Autumn, period 1

Learning outcomes:

1. should be able to recount the principles covering the design of multistage amplifiers

2. should be able to analyze and set the frequency response of a transistor amplifier

3. should be able to make use of feedback to improve the properties of an amplifier in the desired manner

4. should be able to analyze the stability of a given degree of feedback amplification and to dimension an amplifier correctly to ensure stability

5. should be able to describe the principles governing the design of power amplifiers

6. should be able to make widespread use of operational amplifiers for realizing electronic circuits and to take account of the limitations imposed by the non-idealities inherent in operational amplifiers

7. should be able to design low-frequency oscillators, to explain the operating principles of radio frequency oscillators and tuned amplifiers

8. should be able to recount the basic principles governing the functions and properties of emitter-coupled logic

Contents:

Frequency response of a transistor amplifier, differential amplifier, feedback, stability and nonidealities of a feedback amplifier, comparator, output stages and power amplifiers, applications of operational amplifier, oscillators, tuned amplifiers and ECL logic.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 40 h and exercises 20 h.

Target group:

Students of Electrical engineering. Other students of the University of Oulu may also participate.

Prerequisites and co-requisites:

Principles of electronic design

Recommended optional programme components:

This course is required when participating in Laboratory Exercises on Analogue Electronics.

Recommended or required reading:

Lecture notes, Razavi: Fundamentals of Microelectronics (John Wiley & Sons 2008), chapters 10-13-8 and 14, partially or Sedra & Smith : Microelectronic Circuits (6th ed.), chapters 7,8,9,13 and partially 11 and 12.

Assessment methods and criteria:

Final or 2 mid-term exams.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Juha Häkkinen

Working life cooperation:

-

H325136: Mathematics Minor (Degree programme in physics), 39 - 40 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Basic Studies

Laji: Study module

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Studies in mathematics (Faculty of Science)

031076P: Differential Equations, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031076P	Differential Equations (OPEN UNI)	5.0 op
800320A	Differential equations	5.0 op
031017P	Differential Equations	4.0 op

Ei opintojaksokuvauksia.

More compulsory courses: Select from the following list courses which are either beginning with 80 or beginning with 03.

802161P: Introduction to Real Functions, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802154P	Elementary functions	3.0 op
800147P	Basic Methods in Mathematics I / appl.	8.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

1st year, 1st period

Learning outcomes:

After completing the course the student is able to
- operate with elementary functions
- calculate derivatives and apply them
- use different integration techniques
- apply calculus in problem solving

Contents:

The course concerns real-valued functions of one variable and their calculus. In addition to calculation techniques, effort is made to understand the underlying concepts so that they can be applied in problem solving. The aim of the course is to develop calculation routine as well as deductive skills.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28h lectures, 14h exercises, 91h study a part of which may be guided

Target group:

Mathematics major and minor students

Prerequisites and co-requisites:

No

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

No

Other information:

-

031010P: Calculus I, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Lusikka

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031010P	Calculus I (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn semester, periods 1-3.

Learning outcomes:

After completing the course the student identifies concepts of vector algebra and can use vector algebra for solving problems of analytic geometry. The student can also explain basic characteristics of elementary functions and is able to analyse the limit and the continuity of real valued functions of one variable. Furthermore, the student can solve problems associated with differential and integral calculus of real valued functions of one variable.

Contents:

Vector algebra and analytic geometry. Limit, continuity, differential and integral calculus and applications of real valued functions of one variable. Complex numbers.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 55 h / Group work 22 h.

Target group:

-

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Grossmann, S.I.: Calculus of One Variable; Grossmann, S.I.: Multivariable Calculus, Linear Algebra and Differential Equations (partly); Adams, R.A.: A Complete Course Calculus (partly).

Assessment methods and criteria:

Intermediate exams or a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Ilkka Lusikka

Working life cooperation:

-

Other information:

-

802120P: Introduction to Matrices, 5 op

Voimassaolo: 01.06.2015 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

802118P	Linear Algebra I	4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

1. year, autumn

Learning outcomes:

After completing the course the student is able to
- apply arithmetic operations of matrices
- solve system of linear equations by matrix methods and can apply matrix factorizations to find the solution of the system of linear equations.
- recognize the vector space and understands the concepts of basis and dimension of a vector space
- analyse matrices by the parameters, vectors and vector spaces of matrices
- diagonalize matrices and apply diagonalization to the simple problems

Contents:

Vectors and matrices, Systems of linear equations, determinant of a matrix, matrix factorizations, vector spaces, base, dimension, rank of matrice, eigenvalues and eigenvectors of a matrix, diagonalization.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, Exercises and group work 14 h, independent work

Target group:

Major and minor studies

Prerequisites and co-requisites:

802151P Introduction to Mathematical Deduction

Recommended or required reading:

Lecture notes
Grossman, S.I. : Elementary Linear Algebra, David C. Lay: Linear Algebra and Its Applications.

Assessment methods and criteria:

Exercise points and/or exams

Grading:

Fail, 1-5

Person responsible:

Tero Vedenjuoksu

Working life cooperation:

-

Other information:

Homepage in Noppa-portal.

031078P: Matrix Algebra, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Matti Peltola

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031078P	Matrix Algebra (OPEN UNI)	5.0 op
031019P	Matrix Algebra	3.5 op

Ei opintojaksokuvauksia.

802351A: Vector Calculus, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

800328A	Calculus of several variables	5.0 op
800322A	Analysis II	8.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

1st or 2nd year, 3rd period

Learning outcomes:

After completing the course the student is able to - operate functions of several variables - apply derivates of functions of several variables - calculate multiple integrals

Contents:

The course concerns calculus of severable variables. The central concepts of the course are partial derivative, gradient, divergence, curl and multiple integral. Integral theorems related to functions of several variables are also presented. The course offers basic tools for further courses in analysis as well as for applications.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28h lectures, 14h exercises, 91h study a part of which may be guided

Target group:

Mathematics major and minor students

Prerequisites and co-requisites:

802161P Introduction to Real Functions
802120P Introduction to Matrices

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Mahmoud Filali

Working life cooperation:

No

Other information:

-

031075P: Calculus II, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Lusikka

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031075P	Calculus II (OPEN UNI)	5.0 op
031011P	Calculus II	6.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Spring, period 3

Learning outcomes:

The course gives the basics of theory of series and differential and integral calculus of real and vector valued functions of several variables. After completing the course the student is able to examine the convergence of series and power series of real terms. Furthermore, the student can explain the use of power series e.g. in calculating limits and is able to solve problems related to differential and integral calculus of real and vector valued functions of several variables.

Contents:

Sequences, series, power series and Fourier series of real terms. Differential and integral calculus of real and vector valued functions of several variables.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 28 h.

Target group:

-

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the course Calculus I.

Recommended optional programme components:

-

Recommended or required reading:

Kreyszig, E.: Advanced Engineering Mathematics; Grossmann, S.I.: Multivariable Calculus, Linear Algebra and Differential Equations.

Assessment methods and criteria:

Intermediate exams or a final exam.

Grading:

Numerical grading scale 1-5.

Person responsible:

Ilkka Lusikka

Working life cooperation:

-

Other information:

-

From the following list, some are compulsory and some optional courses. Look in more details from the study guide.

802151P: Introduction to mathematical deduction, 5 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay802151P	Introduction to mathematical deduction (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS

Language of instruction:

Finnish

Timing:

First period at the first semester.

Learning outcomes:

After completing the course, student

- is able to use different methods proving techniques
- is able to use basic set theoretic concepts and definitions
- is able to define and apply basic definitions related to functions

Contents:

The course in an introduction to mathematical deduction and introduces different types of proof techniques. The course covers the concepts familiar from upper secondary school studies more profound way. Main concepts in this course are basic set theory and functions.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30h, exercises 18h

Target group:

Major and minor students

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

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

Grading:

Pass/Fail

Person responsible:

Maarit Järvenpää

Working life cooperation:

-

Other information:

Course homepage: https://noppa.oulu.fi/noppa/kurssi/802151p/etusivu

031021P: Probability and Mathematical Statistics, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kemppainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031021P	Probability and Mathematical Statistics (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Spring semester, periods 4-6

Learning outcomes:

After completing the course the student knows the key concepts of probability and the most important random variables and is able to use them in calculating probabilities and parameters of probability distributions. In addition, the student is able to analyze statistical data by calculating interval and point estimates for the parameters. The student is also able to formulate statistical hypotheses and test them.

Contents:

The key concepts of probability, random variable, parameters of probability distributions, estimation of parameters, hypothesis testing.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 44 h/Exercises 22 h/Self-study 68 h.

Target group:

-

Prerequisites and co-requisites:

The recommended prerequisites are the course 031010P Calculus I and some parts of the course 031011P Calculus II.

Recommended optional programme components:

-

Recommended or required reading:

Milton, J.S., Arnold, J.C. (1992): Introduction to Probability and Statistics.

Assessment methods and criteria:

Intermediate exams or a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Jukka Kemppainen

Working life cooperation:

-

Other information:

-

802162P: Continuity and Limit, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

800119P	Functions and limit	5.0 op
802155P	Continuity and limit	4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

1. year, 2. period

Learning outcomes:

After completing the course, student is able to derive and proof main results of the course use different types of proof techniques define the limit of function and the continuity of function derive and proof the limit using different proof techniques deduce the continuity of functions using different proof techniques.

Contents:

The main concept of the course are the limit of a real-valued function and the continuity of real-valued function. Interrelations between these concepts are also studied.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28h lectures, 14h exercises

Target group:

Main and minor students

Prerequisites and co-requisites:

802151P Introduction to mathematical deduction

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

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

Grading:

Failed, 1-5

Person responsible:

Esa Järvenpää

Working life cooperation:

-

Other information:

-

802320A: Linear Algebra, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802119P	Linear Algebra II	5.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year, 1st period

Learning outcomes:

On successful completion of this course, the student will be able to
- apply the definition of linear space and concepts associated with linear spaces such as basis
- work with linear mappings and their matrix representations
- apply the definition of inner product space and concepts associated with inner product spaces such as orthogonality
- prove results related to linear spaces

Contents:

The aim of the course is to provide the student with the knowledge needed in almost all later courses in mathematics: abstract vector spaces and subspaces, linear independence and bases, inner product spaces, linear mappings and concepts associated with linear mappings such as kernel, eigenvalues and eigenvectors.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28h lectures, 14h exercises, 91h independent study

Target group:

Mathematics majors and minors students

Prerequisites and co-requisites:

802120P Introduction to Matrices

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

No

Other information:

-

802163P: Derivative, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

800317A	Continuity and derivative	5.0 op
802156P	Derivative	4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

1. year, 3. period

Learning outcomes:

After completing the course, student is able to
- derive and proof main results of the course
- use different types of proof techniques
- use and apply the concept of derivative in different types of problems

Contents:

The course considers the concept of derivative of real-valued function and applies this concept to different types oif situations.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28h lectures, 14 h exercises

Target group:

Pää- ja sivuaineopiskelijat

Prerequisites and co-requisites:

802151P Introduction to mathematical deduction
802155P Limits and continuity

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Esa Järvenpää

Working life cooperation:

No

Other information:

-

031077P: Complex analysis, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Jukka Kemppainen
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay031077P	Complex analysis (OPEN UNI)	5.0 op
031018P	Complex Analysis	4.0 op

Ei opintojaksokuvauksia.

031080A: Signal Analysis, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Kotila, Vesa Iisakki
Opintokohteen kielet: Finnish
Leikkaavuudet:

031050A	Signal Analysis	4.0 op

Ei opintojaksokuvauksia.

802334A: A Second Course in Differential Equations, 5 op

Voimassaolo: 01.06.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

800346A	Differential Equations II	4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year or later, 2nd period

Learning outcomes:

On successful completion of this course, the student will be able to - apply method of Frobenius to solve second order linear differential equations - derive and prove the basic properties of Bessel functions, Legendre polynomials and Hermite polynomials - apply integral transformations to solve some integral equations and ordinary differential equations with constant coefficients - recognize heat and wave equations and choose the proper method to solve them.

Contents:

The course is devoted to second order ordinary differential equations that are important in applications and classical partial differential equations such as heat and wave equations. Method of Frobenius is introduced to solve second order ordinary differential equations. Some special functions (Gamma function and Bessel functions etc.) and also orthogonal polynomials (Legendre and Hermite polynomials) are considered. Basic facts about Fourier series and Fourier transform are given. Laplace transform is discussed at more advanced level than in earlier studies. Separation of variables is introduced as a method to solve certain boundary value problems for heat and wave equations.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28h, exercises 14h

Target group:

Students majoring in mathematics or applied mathematics, physics or engineering students

Prerequisites and co-requisites:

Differential equations, Complex analysis

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes. Additional reading: Colton D, Partial differential equations, Dover, 1988 Lebedev N N, Special Functions and their applications, Dover, 1972 Nagle R K, Fundamentals of differential equations and boundary value problems, Addison-Wesley, 1996 Zill D G and Cullen M R, Differential equations with boundary-value problems, Brooks/Cole, 2001

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Markus Harju

Working life cooperation:

No

Other information:

-

802338A: Complex Analysis II, 5 op

Voimassaolo: 01.06.2016 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

Ei opintojaksokuvauksia.

902002Y: English 1 (Reading for Academic Purposes), 2 op

Voimassaolo: 01.08.1995 -
Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

Proficiency level:
B2/C1 on the Common European Framework of Reference scale.
Status:
This course is mandatory for students of the following degree programmes:
Faculty of Science
•Biology
•Chemistry
•Mathematical Sciences
•Physics
Oulu Mining School
•Geosciences degree programme
Faculty of Information Technology and Electrical Engineering
•Department of Information Processing Science

Students in the Department of Geography take English 3.

Engineering students in the following programmes take their English courses in the Faculty of Technology:
Oulu Mining School:
• Mining Technology and Mineral Processing degree programme

Faculty of Information Technology and Electrical Engineering
•Department of Electrical Engineering
•Department of Communications Engineering
•Department of Computer Science and Engineering

Please consult the Faculty Study Guide to establish the language requirements for your own degree program.
Required proficiency level:
English must have been the A1 or A2 language at school or equivalent English skills should have been acquired otherwise.
ECTS Credits:
2 ECTS credits (total work load 54 hours including classroom meetings.)
Language of instruction:
English
Timing:
Biology: 1st year spring term
Chemistry: 1st year autumn term
Geology: 1st year spring term
Information Processing Science: 1st year spring term
Mathematical Sciences (pedagogy): 1st year spring term

Mathematical Sciences: 2nd year autumn term
Physical Sciences: 1st year autumn term
Learning outcomes:
By the end of the course, you are expected to be able to

- have acquired effective vocabulary learning techniques
- be able to distinguish parts of words to infer meanings
- utilize your knowledge of text structure and cohesion markers to understand academic texts
- extract information and learn content from English readings in scientific and professional contexts

Contents:
The course will focus on reading strategies; these include recognizing how texts are organized, identifying key points in a text, and understanding words in context. Vocabulary work in the course will focus on a) academic vocabulary, as used in formal scientific writing, and b) using your knowledge of the meanings of parts of words (affixes) to infer meaning.
Mode of delivery:
Contact teaching
Learning activities and teaching methods:
The scope of the course is 2 op (54 hours student workload).
Target group:
1st year students of Biology, Chemistry, Geology, Information Processing Science, Physics, and Mathematics (pedagogy); 2nd year students of Mathematics
Prerequisites and co-requisites:
-
Recommended optional programme components:
Students are also required to take 902004Y Scientific Communication, which is taken AFTER completion of this course.
Recommended or required reading:
Photocopies will be provided by the teacher and/or required texts will be accessible online or from the university library.
Assessment methods and criteria:
Student work is monitored by continuous assessment. You are required to participate regularly and actively in all contact teaching provided, and successfully complete all required coursework. There will be three monthly tests on material covered so far.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/Fail
Person responsible:
Karen Niskanen
Working life cooperation:
-
Other information:
N.B. Students with grades *laudatur* or *eximia* in their A1 English school-leaving examination can be exempted from this course and will be granted the credits by the Faculty of Science.

902004Y: English 2 (Scientific Communication), 2 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Leikkaavuudet:

ay902004Y	English 2 (Scientific Communication) (OPEN UNI)	2.0 op

Proficiency level:
B2/C1 on the CEFR scales
Status:
This course is mandatory for all 2nd year students (except **geographers**) who will have English as their foreign language in their B.Sc. degree. This includes the students who were exempted from ‘Reading for Academic Purposes'(902002Y). Please consult the faculty study guide to establish the language requirements on your own degree programme.

Required proficiency level:
Students taking this course must have had English as the A1 or A2 language at school or the equivalent English skills should have been acquired otherwise. The course 'Reading for Academic Purposes' (902002Y) is a pre-requisite, unless exempted.
ECTS Credits:
The student workload is 53 hrs work/ 2 ECTS credits.
Language of instruction:
English
Timing:
Biology: 2nd year autumn term
Chemistry: 2nd year spring term
Geology: 2nd year spring term
Information Processing Science : 2nd year autumn term
Mathematics: 2nd year spring term
Physics: 2nd year autumn term
Learning outcomes:
By the end of the course, you are expected:

1. to have demonstrated your use of appropriate strategies and techniques for communicating effectively in English in an academic context.
2. to have demonstrated the ability to prepare and present scientific subjects to your classmates, using appropriate field-related vocabulary.

Contents:
Skills in listening, speaking, and presenting academic topics are practised in the classroom, where there is an emphasis on working in pairs and small groups. Homework tasks include online lecture listening and reading, preparation for classroom discussions and written work to support the classroom learning.
Mode of delivery:
Contact teaching
Learning activities and teaching methods:
Contact teaching 28 hours, homework 28 hours
Target group:
2nd year students of Biology, Chemistry, Geology, Information Processing Science, Mathematics, Physics
Prerequisites and co-requisites:
-
Recommended optional programme components:
Also required: 902002Y Reading for Academic Purposes Englannin kieli 1
Recommended or required reading:
Course materials will be provided by the teacher.
Assessment methods and criteria:
Continuous assessment is based on regular attendance, active participation in all lessons and the successful completion of all homework tasks.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass / fail.
Person responsible:
Karen Niskanen
Working life cooperation:
-
Other information:
-

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:
Elina Koskinen
Working life cooperation:
No work placement period

901035Y: Second Official Language (Swedish), Oral Skills, 1 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Opintokohteen kielet: Swedish

Leikkaavuudet:

901061Y	Second Official Language (Swedish), Oral Skills	1.0 op
ay901035Y	Second Official Language (Swedish), Oral Skills (OPEN UNI)	1.0 op
901004Y	Swedish	2.0 op

901034Y: Second Official Language (Swedish), Written Skills, 1 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Opintokohteen kielet: Swedish

Leikkaavuudet:

901060Y Second Official Language (Swedish), Written Skills 1.0 op
ay901034Y Second Official Language (Swedish), Written Skills (OPEN UNI) 1.0 op
901004Y Swedish 2.0 op

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 degree programme in 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

H325101: Physics, Basic studies, 23 - 34 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Basic Studies

Laji: Study module

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Basic studies in physics

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. The student has inclusive knowledge of different teaching and study methods, which can be applied later on.

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:

Varied teaching methods

Learning activities and teaching methods:

Lectures, exercises and other teaching events 32 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:

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/
The person responsible of the course may refer also to other uselful material.
Course material availability can be checked here.

Assessment methods and criteria:

The exercises given during the course and a short written examination, or one extensive written examination.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Laura Timonen

Working life cooperation:

No work placement period

Other information:

Course website

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	Mathematics for physics	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 28 h, exercises 22 h, self-study 83 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

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

Working life cooperation:

No work placement period

Other information:

Course website

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/

521141P: Elementary Programming, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Rautiainen, Mika Oja

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521141P	Elementary Programming (OPEN UNI)	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5

Language of instruction:

Lectures and learning material are in Finnish. The course can be completed in English by self-studying from a book, completing assignments and exercises on the course learning environment, and delivering a final project.

Timing:

Fall, period 1. There is an option to extend the course to the 2nd period in cases where completing in one period doesn't fit the student's schedule.

Learning outcomes:

1. Is capable of solving problems in the computer's terms

2. Understands the basic concepts of programming

3. Knows the basics of the Python programming language

4. Is able to implement programs independently

5. Is able to use the internet to find information about programming

Contents:

Problem solving with programming, basic concepts of programming, writing Python code.

Mode of delivery:

Web-based teaching + face-to-face teaching

Learning activities and teaching methods:

30h of exercise groups, 105h self-studying in the web.

Target group:

1 st year students of computer science and engineering, electrical engineering, medical and wellness technology and industrial and engineering management, 2nd year students of physics, and other students of the University of Oulu

Prerequisites and co-requisites:

None.

Recommended optional programme components:

The course provides a basis for subsequent programming courses.

Recommended or required reading:

Web material in an online learning environment. Address will be announced at the beginning of the course.

Assessment methods and criteria:

The course is completed by passing all learning assignments, programming exercises and a final exercise project. Read more about assessment criteria at the University of Oulu webpage
Read more about assessment criteria at the University of Oulu webpage.

Grading:

pass/fail.

Person responsible:

Mika Oja

Working life cooperation:

-

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 10 h, exercises 20 h (5 x 4 h). Five different works will be made during the course in groups. Self-study 50 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

Compulsory

761121P-01: Laboratory exercises in physics 1, exam, 0 op

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

761115P-01	Laboratory Exercises in Physics 1, lecture and exam	0.0 op
761115P-02	Laboratory Exercises in Physics 1, laboratory exercises	0.0 op

Ei opintojaksokuvauksia.

761121P-02: Laboratory exercises in physics 1, lab. exercises, 0 op

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

Leikkaavuudet:

761115P-01	Laboratory Exercises in Physics 1, lecture and exam	0.0 op
761115P-02	Laboratory Exercises in Physics 1, laboratory exercises	0.0 op

Ei opintojaksokuvauksia.

030005P: Information Skills, 1 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Faculty of Technology
Arvostelu: 1 - 5, pass, fail
Opettajat: Sassali, Jani Henrik, Ursula Heinikoski
Opintokohteen kielet: Finnish
Leikkaavuudet:

030004P	Introduction to Information Retrieval	0.0 op

ECTS Credits:

1 ECTS credit

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

Students know the different phases of information retrieval process and basic techniques of scientific information retrieval. They will find the most important reference databases of their discipline and know how to evaluate information sources and retrieval results.

Contents:

Retrieval of scientific information, the retrieval process, key databases of the discipline, and evaluation of information retrieval and information sources.

Mode of delivery:

Blended teaching: classroom training, web-based learning material and exercises in Optima environment, a final assignment on a topic of the student’s own choice

Learning activities and teaching methods:

Training sessions 8h, group working 7h, self-study 12h

Target group:

Compulsory for all students of the Faculty of Technology, the Faculty of Information Technology and Electrical Engineering and the Faculty of Architecture. In the Faculty of Science compulsory for students of biology, physics, geosciences, chemistry and geography. Optional for students of biochemistry and mathematics.

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Web learning material https://wiki.oulu.fi/display/030005P.

Assessment methods and criteria:

Passing the course requires participation in the training sessions and successful completion of the course assignments.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

pass/fail

Person responsible:

Science and Technology Library Tellus, tellustieto (at) oulu.fi

Working life cooperation:

-

Other information:

-

At least one of the introduction courses in physics

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 Introduction to biomedical physics.

Person responsible:

Kyösti Heimonen

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

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

Compulsory for teacher students

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.

H325102: Physics, Intermediate studies, 52 - 65 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Study module
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Intermediate studies in physics.

766343A: Mechanics, 7 op

Voimassaolo: 01.08.2015 -
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
766323A Mechanics 6.0 op

761323A Mechanics 6.0 op

ECTS Credits:

7 credits

Language of instruction:

This course will be lectured in Finnish. Course book is in English. Most of the exercises are in English.

Timing:

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 57 h
Part 2: Lectures 22 h, exercises 10 h (5 x 2 h), self-study 61 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 766101P 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) and Perttu Lantto (part 2)

Working life cooperation:

No work placement period

Other information:

Course website and part 1 website

Compulsory

766343A-01: Mechanics part 1, 0 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766323A-02	Mechanics part 2	0.0 op
766323A-01	Mechanics part 1	0.0 op

Ei opintojaksokuvauksia.

766343A-02: Mechanics part 2, 0 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766323A-01	Mechanics part 1	0.0 op
766323A-02	Mechanics part 2	0.0 op

Ei opintojaksokuvauksia.

766349A: Wave motion and optics, 7 op

Voimassaolo: 01.12.2015 -

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
766329A	Wave motion and optics	6.0 op

ECTS Credits:

7 credits

Language of instruction:

Finnish. The course material and exercises are available in English.

Timing:

First 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 117 h

Target group:

No specific target qroup

Prerequisites and co-requisites:

766101P 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:

Course website

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/

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 40 h, exercises 20 h, self-study 100 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/

763343A: Solid state physics, 5 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766330A	Structure of matter	6.0 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
763333A	Structure of matter I	4.0 op

ECTS Credits:

5 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 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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, exercises 16 h, self-study 87 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/766348A).

Recommended optional programme components:

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

Recommended or required reading:

C. Kittel: Introduction to solid state physics.
Course material availability can be checked here.

Assessment methods and criteria:

Examination

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Erkki Thuneberg

Working life cooperation:

No work placement period

Other information:

Course website

766344A: Nuclear and particle physics, 5 op

Voimassaolo: 01.12.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

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
766334A	Structure of matter II	2.0 op

ECTS Credits:

5 credits

Language of instruction:

Finnish

Timing:

2nd spring

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:

This course deals with the structure and properties of nuclei, nuclear forces, nuclear models, radioactivity, nuclear reactions, properties and interactions of fundamental particles, and unified theories of fundamental interactions.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, 8 exercises (16 h), self-study 87 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/766348A).

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), 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:

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:

Course website

766348A: Thermophysics, 7 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761314A	Thermophysics	5.0 op
761102P	Basic Thermodynamics	2.0 op
766328A	Thermophysics	6.0 op

ECTS Credits:

7 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 117 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, 2015.
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 766348A Thermophysics (7 cp), exceptionally only 6 cp (not 7 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.
Course website

766384A: B.Sc. seminar, 4 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761385A-01	B.Sc. thesis	0.0 op
761385A-02	Seminar	0.0 op

ECTS Credits:

4 credits

Language of instruction:

Finnish

Timing:

3rd autumn

Learning outcomes:

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 and present a seminar talk.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 10 h, seminar talk, act as an opponent (ca 20 h), self-study 77 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:

?

Grading:

Numerical grading scale 0 – 5, where 0 = fail.

Person responsible:

Marko Huttula

Working life cooperation:

No work placement period

Other information:

Course website ???

766385A: B.Sc. thesis, 6 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761385A-02	Seminar	0.0 op
761385A-01	B.Sc. thesis	0.0 op

ECTS Credits:

6 credits

Language of instruction:

Finnish or English

Timing:

3rd year

Learning outcomes:

The student can carry out research work, search information and write scientific reports about the subject.

Contents:

Both written and oral reporting is essential part of the scientific research. In the course, the students 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:

Self-study 160 h.

Target group:

Compulsory for Bachelor of Science in physics.

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:

B.Sc. thesis

Grading:

Numerical grading scale 0 – 5, where 0 = fail.

Person responsible:

Marko Huttula

Working life cooperation:

No work placement period

Other information:

Course website ???

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

Compulsory for physicist

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

Compulsory intermediate courses for teacher

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/

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

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/

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

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/

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:
Matti Alatalo
Other information:
Course website

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

H325111: Advanced studies in physics (space physics), 29 - 69 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Study module
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Select at least two courses from the list below

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/

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/

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/

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/

Select at least 13 credits from the list below or the remaining preceding courses.

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/

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/

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:

Ilya Usoskin

Working life cooperation:

No work placement period

Other information:

https://wiki.oulu.fi/display/766655S/

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/

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/

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:

Course website

H325114: Advanced studies in physics (NANOMO), 29 - 69 op

Voimassaolo: 01.08.2016 -
Opiskelumuoto: Advanced Studies
Laji: Study module
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory courses in NANOMO

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 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 deep understanding of the structure of many-electron atoms and their electron-electron interactions and electron dynamics. The quantum mechanical formalisms are applied to the description of quantum states and transitions in a many-electron atoms. 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:

766326A Atomic physics 1 and 763312A Quantum mechanics I

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:

Course website

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/

Optional physics studies: Select at least 13 credits from the list below

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:

Kurssin sivu

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/

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/

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:

This course is aiming to give an overview of advances in materials characterization methods**.** Through the course, students are expect to master basic characterization methods, and correlate observed phenomena to materials properties. Techniques are dedicated to determinations of morphologies and electronic structures of bulk, nano-films as well as free and deposited clusters.

Contents:

The course will be focused on methods and special requirements on experimental researches in the field of materials science. The lessons and demonstration include principles related to conventional characterization methods, microscopic detections, and the latest synchrotron-radiation-based techniques. Students will be guided to practice laboratory works of the vapor deposit sample growth system, morphological, and electronic structure measurements through SEM and the XPS. The course will also cover introduction to inorganic material growth methods, requirements to select different techniques, and physical insights within materials functionalities.

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 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

Other information:

Course website

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/

521080S: X-ray Diffraction, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Hagberg
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 132,5 hours of work

Language of instruction:

Finnish, English if needed

Timing:

Autumn semester period 1. Lectured every other year.

Learning outcomes:

1. explain the general principles of interaction between X-rays and solid matter and the physics underlying behind these phenomena

2. explain how the crystal structure, phase ratio, grain size and stress state in a solid material with X-ray diffraction (XRD) method can be experimentally determined

Contents:

Generation, detection and properties of x-rays. X-ray scattering and diffraction methods. Determination of crystal structure and phase composition. Analysis of grain size, texture and stresses. Electron and neutron diffraction.

Mode of delivery:

Lectures, exercises and laboratory work.

Learning activities and teaching methods:

Lectures and exercises altogether 32 h / laboratory work 18 h / self-access writing of work report 30 h / self-access learning 52,5 h.

Target group:

Primarily for students in electrical engineering.

Prerequisites and co-requisites:

Basic physics and mathematics.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Lecture notes. For reference, parts from books B.E. Warren: X-ray diffraction, Addison-Wesley, 1969., B.D. Cullity and S.R. Stock: Elements of X-Ray Diffraction, 3rd Edition, 2001, Prentice Hall and some other books informed by lecturer.

Assessment methods and criteria:

Final grade of the course will be a weighted average of theoretical examination (2/3) and laboratory exercises (1/3). Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Juha Hagberg

Working life cooperation:

No

Other information:

The course is held next on autumn 2017.

Other Recommended advanced studies

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:

Matti Alatalo

Working life cooperation:

No work placement period

Other information:

Course website

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

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:

Matti Alatalo

Other information:

Course website

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/

763694S: Methods in material physics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

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/

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 numerical methods in function interpolation, integration, derivation and solving sets of linear equations. The student knows how to solve the eigenvalues and eigenvectors of a symmetric matrix. 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 for differentiation, special functions, integration, derivation, interpolation and Fourier transform. Ordinary differential equations and differential equations with eigenvalues are solved. Algorithms for linear equations and matrix equations with eigenvalues are given. The programming language can be chosen freely. Examples are given in Fortran and Mathematica languages.

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:

Course website

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/

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:

Can contain work placement period

800653S: Matrix Theory, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

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/

521073S: Electroceramics and Intelligent Materials, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Antti Uusimäki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521103S	Electroceramics and Intelligent Materials	4.0 op

ECTS Credits:

5 ECTS credits / 132.5 hours of work

Language of instruction:

Finnish and English

Timing:

The course is held in the period 2 biannually. The course is held next on autumn 2017.

Learning outcomes:

1. Student is able to estimate the properties and usability of functional ceramics in different electronics components applications and perform calculatory structural dimensioning for them.

2. Student is able to compare and choose applicable processing methods for the fabrication of functional structures.

3. Student is able to interpret new research results of the field and recognize their application areas.

Contents:

Microstructures and special features of ceramic materials. Dielectric, polarization and electrical conductivity properties and influence of lattice defects on them. Fabrication and processing of ceramics. Ceramic conductors and insulators, piezoelectric and ferroelectric ceramics, pyroelectric and electro-optic ceramics, magnetic ceramics.

Mode of delivery:

The course will be implemented as face to face teaching.

Learning activities and teaching methods:

The implementation methods of the course vary. The course will be arranged utilizing activating teaching methods agreed on together with the students. There will be 30 hours of guided teaching events and 102.5 hours of teaching without guidance either privately or in a group.

Target group:

Master's level students.

Prerequisites and co-requisites:

The recommended prerequisite is to familiarize with the course 521104P Introduction to Materials Physics

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes. Text book A.J. Moulson and J.M. Herbert: Electroceramics, Wiley, 2003.

Assessment methods and criteria:

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

Grading:

The final exam utilizes a numerical grading scale 1-5.

Person responsible:

Antti Uusimäki

Working life cooperation:

No

521074S: Microelectronics and Micromechanics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Krisztian Kordas

Opintokohteen kielet: English

Leikkaavuudet:

521224S	Microelectronics and Micromechanics	6.0 op
521224S-01	Microelectronics and Micromechanaics, exam	0.0 op
521224S-02	Microelectronics and Micromechanics, exercise	0.0 op

ECTS Credits:

5

Language of instruction:

English

Timing:

3rd period

Learning outcomes:

Objective: The course provides advanced knowledge on the semiconductor techniques of VLSI and on special topics of micromechanics and hybrid fabrication. Especially recent progress on the field is introduced in application point of view.
Learning outcomes: After completing the course the student can give account on correlations between basic physics/chemistry and materials processing/technology in microelectronics, micromechanics and nanotechnology. The student can describe design aspects and operation principles of micro and nano-devices. The students get acquainted with working in laboratory environment similar to those in academic and industrial research labs. Laboratory work practice on either (i) thin film fabrication in clean room, (ii) inkjet printing and electrical characterization of thin film devices with nanopartciles or (iii) synthesis of carbon nanotubes and characterization by electron microscopy techniques will provide a good opportunity also to learn how to design and run experiments safely and manage laboratory reports.

Contents:

Theory and practice of VLSI semiconductor fabrication technologies to support and deepen the understanding of general fabrication and operation principles introduced during previous courses. The state-of-the-art semiconductor devices and circuits: pushing the limits of dimensions and speed. Implementation of VLSI technologies in fabrication of components for micromechanics. Sensors (flow, pressure) and actuators (valves, pumps, motors, switches and components for micro-optics) using MEMSs. Devices on the nanoscale and integration of nanomaterials in microsystems: new concepts of design, fabrication and operation.

Mode of delivery:

Lectures, laboratory exercise with supervision and guidance.

Learning activities and teaching methods:

Though the course is primarily based on lectures, the communication channel is open in both directions enabling continuous comments, questions and feedback from the students. Critical explanations and think alouds are also applied to motivate thinking and active learning.

Target group:

Students of the University of Oulu.

Prerequisites and co-requisites:

Passing the basic course “521070A Introduction to microfabrication techniques” before the advanced course is recommended.

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes and references therein.

Assessment methods and criteria:

Examination and completion of both laboratory exercise and report.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading 1-5.

Person responsible:

Krisztian Kordas

Working life cooperation:

-

521089S: Printed Electronics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Fabritius

Opintokohteen kielet: Finnish

Leikkaavuudet:

521217S	Printed Electronics	4.0 op
521095S	Advanced Course of Printed Electronics	3.0 op

ECTS Credits:

5

Language of instruction:

Finnish. English if more than two international students in the course.

Timing:

Period 2.

Learning outcomes:

1. Knows the most typical materials and printing methods suitable for their processing
2. Can explain the principles of materials and printing methods
3. Can utilize the material and manufacturing process knowledge to design fabrication processes for electrical components
4. Can analyse how the selected materials and printing methods influence on the performance of electrical components

Contents:

Materials (conductive and semi-conductive polymers, photoactive polymers, dielectrics, particle based inks) and processing methods (screen printing, gravure printing, flexo printing, inkjet) utilized in printed electronics, surface wetting and film formation, printed electrical components (passive components, solar cells, light emitting diodes, transistors) and their fabrication. Possibilities and challenges of printing based processing methods and how to take them into account in the printed electronics fabrication.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Combined lectures and exercises 30 h and self-study 100 h

Target group:

Primarily for the students of electrical engineering

Prerequisites and co-requisites:

None.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time

Recommended or required reading:

D.R. Gamota, P. Brazis, K. Kalyanasundaram and J. Zhang, "Printed organic and molecular electronics", handout

Assessment methods and criteria:

Course is completed by final examination.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Tapio Fabritius

Working life cooperation:

Not included.

521088S: Optoelectronics, 5 op

Voimassaolo: 01.01.2014 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Kostamovaara

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Spring, period 3

Learning outcomes:

1. is able to explain the principles of operation of optical fibres and wavequides

2. is able to explain the principles of operation of semiconductor light sources and photo detectors, and knows the factors affecting their performance

3. is able to outline the circuit-level structures for optical transmitter circuits and photo detector preamplifiers

4. is able to compare their performance in terms of the main performance parameters

Contents:

Wave/particle dualism of optical radiation, optical waveguides and their properties, sources of radiation (LED- and laser structures), photo detectors (PIN- and AP-diodes,SPAD), light source modulation, preamplifiers and their bandwidth/stability/noise analysis.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h and exercises 20 h, may include a seminar.

Target group:

This course is targeted mainly for the students of electrical engineering degree program, but available for other students as well.

Prerequisites and co-requisites:

Principles of semiconductor devices.

Recommended optional programme components:

This course is targeted mainly for the students of electrical engineering degree program, but available for other students as well.

Recommended or required reading:

Lecture notes, S. Kasap: Optoelectronics and Photonics, Principles and Practices, Prentice Hall 2013, 2nd Ed.

Assessment methods and criteria:

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

Grading:

Numerical grading scale 1-5.

Person responsible:

Juha Kostamovaara

Working life cooperation:

Does not apply.

H325112: Advanced studies in physics (NRM), 29 - 69 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Study module
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory two courses

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/

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/

Select at least 13 credits from the list below or other courses which are suitable for physics courses.

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 programmes 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:

Course website

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/

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/

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 programmes 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:

Course website

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 programmes 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:

Course website

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 numerical methods in function interpolation, integration, derivation and solving sets of linear equations. The student knows how to solve the eigenvalues and eigenvectors of a symmetric matrix. 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 for differentiation, special functions, integration, derivation, interpolation and Fourier transform. Ordinary differential equations and differential equations with eigenvalues are solved. Algorithms for linear equations and matrix equations with eigenvalues are given. The programming language can be chosen freely. Examples are given in Fortran and Mathematica languages.

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:

Course website

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 programmes 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:

Course website

Other Recommended advanced physics studies

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:

Matti Alatalo

Working life cooperation:

No work placement period

Other information:

Course website

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

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:

Matti Alatalo

Other information:

Course website

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/

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/

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/

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:

Can contain work placement period

800653S: Matrix Theory, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

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

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/

H325116: Advanced studies in physics (Astronomy), 45 - 999 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Study module

Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Advanced Studies in Astronomy, at least 45 ECTS cr from the following

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/

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/

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

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/

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

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/

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:

6 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 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

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

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

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:

See 765367A

Person responsible:

Vitaly Neustroev

Other information:

https://noppa.oulu.fi/noppa/kurssi/765367A/etusivu

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

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

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/

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

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/

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

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

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

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.

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/

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

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

Other Recommended advanced studies

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:

Course website

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 numerical methods in function interpolation, integration, derivation and solving sets of linear equations. The student knows how to solve the eigenvalues and eigenvectors of a symmetric matrix. 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 for differentiation, special functions, integration, derivation, interpolation and Fourier transform. Ordinary differential equations and differential equations with eigenvalues are solved. Algorithms for linear equations and matrix equations with eigenvalues are given. The programming language can be chosen freely. Examples are given in Fortran and Mathematica languages.

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:

Course website

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

Working life cooperation:

No work placement period

Other information:

Course website

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/

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/

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:

Ilya Usoskin

Working life cooperation:

No work placement period

Other information:

https://wiki.oulu.fi/display/766655S/

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:

Course website

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:

Matti Alatalo

Other information:

Course website

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:

Matti Alatalo

Other information:

Course website

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/

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/

802334A: A Second Course in Differential Equations, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

800346A	Differential Equations II	4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year or later, 2nd period

Learning outcomes:

On successful completion of this course, the student will be able to - apply method of Frobenius to solve second order linear differential equations - derive and prove the basic properties of Bessel functions, Legendre polynomials and Hermite polynomials - apply integral transformations to solve some integral equations and ordinary differential equations with constant coefficients - recognize heat and wave equations and choose the proper method to solve them.

Contents:

The course is devoted to second order ordinary differential equations that are important in applications and classical partial differential equations such as heat and wave equations. Method of Frobenius is introduced to solve second order ordinary differential equations. Some special functions (Gamma function and Bessel functions etc.) and also orthogonal polynomials (Legendre and Hermite polynomials) are considered. Basic facts about Fourier series and Fourier transform are given. Laplace transform is discussed at more advanced level than in earlier studies. Separation of variables is introduced as a method to solve certain boundary value problems for heat and wave equations.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28h, exercises 14h

Target group:

Students majoring in mathematics or applied mathematics, physics or engineering students

Prerequisites and co-requisites:

Differential equations, Complex analysis

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes. Additional reading: Colton D, Partial differential equations, Dover, 1988 Lebedev N N, Special Functions and their applications, Dover, 1972 Nagle R K, Fundamentals of differential equations and boundary value problems, Addison-Wesley, 1996 Zill D G and Cullen M R, Differential equations with boundary-value problems, Brooks/Cole, 2001

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Markus Harju

Working life cooperation:

No

Other information:

-

031077P: Complex analysis, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Jukka Kemppainen
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay031077P	Complex analysis (OPEN UNI)	5.0 op
031018P	Complex Analysis	4.0 op

Ei opintojaksokuvauksia.

H326003: Advanced studies in biophysics, 80 - 120 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Study module
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory advanced courses in biophysics

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:

Kyösti Heimonen

Working life cooperation:

No work placement period

Other information:

Course website

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

Person responsible:

Kyösti Heimonen

Working life cooperation:

No work practise.

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

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:

Kyösti Heimonen, Roman Frolov

Working life cooperation:

No work placement period

Other information:

Course website

Select courses listed below or other advanced courses which can be accepted for the biophysics studies so that the advanced studies on biophysics are 80 credits in total.

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 (organized only during odd-numbered years)

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, Kyösti Heimonen

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 (not necessarily organized every year)

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

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 spring (organized only during even-numbered years or even more rarely)

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:

Sampo Mattila

Working life cooperation:

No work placement period

Other information:

Course website

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, not necessarily organized every year)

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:

Course website

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	Analysis and simulation of biosystems	6.0 op

ECTS Credits:

6 credits

Language of instruction:

Finnish (or English)

Timing:

3th or 4th autumn (organized only during even-numbered years or even more rarely)

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:

Iikka Salmela, Kyösti Heimonen

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 spring (organized only during odd-numbered years or even more rarely)

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:

Kyösti Heimonen

Working life cooperation:

No work placement period

Other information:

Course website

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 (organized only during even-numbered years or even more rarely)

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:

Iikka Salmela, Kyösti Heimonen

Working life cooperation:

No work placement period

Other information:

Course website

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

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:

4th-5th year (organized only during odd-numbered years or even more rarely)

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, Kyösti Heimonen

Working life cooperation:

No work placement period

Other information:

Course website

764634S: Medical physics and imaging, 5 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Health Sciences
Arvostelu: 1 - 5, pass, fail
Opettajat: Miika Nieminen
Opintokohteen kielet: Finnish

ECTS Credits:

6 credits

Language of instruction:

English

Timing:

4th-5th Autumn (organized only during odd-numbered years or even more rarely)

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, Kyösti Heimonen

Working life cooperation:

No work placement period

Other information:

Course website
The course will be organized using other code.

764627S: Virtual measurement environments, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: Finnish

Leikkaavuudet:

764327A	Virtual measurement environments	5.0 op

ECTS Credits:

5 credits

Language of instruction:

Finnish

Timing:

Not lectured any more using this code.

Learning outcomes:

The students will learn how to construct software 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.

Person responsible:

Timo Jämsä

521124S: Sensors and Measuring Techniques, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Igor Meglinski

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English.

Timing:

Period 1.

Learning outcomes:

After the course the student is capable to explain the operating principles of different sensors and can select a right sensor for each measuring target. He/she is able to quantify the requirements that affect sensor selection as well as recognize and evaluate the uncertainty of a measurement. In addition the student is able to plan and design sensor signal conditioning circuits.

Contents:

Methods for measuring displacement, velocity, acceleration, torque, liquid level, pressure, flow, humidity, sound and temperature. Ultrasound, optical and nuclear measurement techniques and applications, material analyses such as pH measurement and gas concentration, pulp and paper measurements and smart sensors.

Mode of delivery:

Pure face-to-face teaching.

Learning activities and teaching methods:

Lectures 26h, exercises 12h and self-study 100h.

Target group:

4 year students.

Prerequisites and co-requisites:

No.

Recommended optional programme components:

No.

Recommended or required reading:

H. N. Norton: Handbook of Transducers, Prentice Hall P T R, 1989 or 2002; lecture and exercise notes.

Assessment methods and criteria:

The course is passed by a final exam and passed exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Igor Meglinski

Working life cooperation:

No.

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/

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 programmes 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:

Course website

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:

This course is aiming to give an overview of advances in materials characterization methods**.** Through the course, students are expect to master basic characterization methods, and correlate observed phenomena to materials properties. Techniques are dedicated to determinations of morphologies and electronic structures of bulk, nano-films as well as free and deposited clusters.

Contents:

The course will be focused on methods and special requirements on experimental researches in the field of materials science. The lessons and demonstration include principles related to conventional characterization methods, microscopic detections, and the latest synchrotron-radiation-based techniques. Students will be guided to practice laboratory works of the vapor deposit sample growth system, morphological, and electronic structure measurements through SEM and the XPS. The course will also cover introduction to inorganic material growth methods, requirements to select different techniques, and physical insights within materials functionalities.

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 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

Other information:

Course website

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/

766675S: Laser and synchrotron radiation physics, 10 op

Voimassaolo: 01.01.2016 -

Opiskelumuoto: Advanced Studies

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

761675S	Synchrotron radiation research	6.0 op

ECTS Credits:

10 ECTS gredits

Language of instruction:

English / Finnish

Timing:

During masters degree studies. Not lectured every year.

Learning outcomes:

- Student will be able to apply the basic physical principles of electromagnetism, special relativity and quantum mechanics to analyse lasers and synchrotron radiation light sources.
- Student will know all the fundamental components included in lasers and synchrotron radiation light sources.
- Student will be able to explain the special characteristics of laser and synchrotron radiation, their differences and similarities and how they can be altered at will.
- Student will be able to name and describe example application areas of lasers and synchrotron radiation light sources.

Contents:

The course consists of two broad subjects: laser physics and synchrotron radiation physics. In the first part, theory for laser action is developed from classical electromagnetic field theory and quantum mechanics. Requirements for materials and operation of lasers as well as properties of laser radiation are described in detail. Main laser types with low and high density gain media are introduced. Some real life applications of lasers are introduced via visits to different laboratories hosting laser equipment within University of Oulu. The second part of the course starts with a revision of special relativity and introduction to particle accelerators. Generation and properties of radiation by relativistic charged particles, synchrotron radiation, is described quantitatively using relativistic electromagnetic field theory. The course ends with a qualitative treatment of free-electron lasers which represent the most recent generation of light sources combining elements from laser and particle accelerator based light sources.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

50 h of lectures, 24 h of exercises, 193 h of self-study

Target group:

Primarily for physics degree students. Also for other students with solid physics background.

Prerequisites and co-requisites:

All intermediate level compulsory physics courses (*e.g.* atomic physics 1, electromagnetism, structure of matter, wave motion and optics, introduction to relativity) including quantum mechanics I.

Recommended optional programme components:

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

Recommended or required reading:

L. Hautala: Laser and synchrotron radiation physics (2016) lecture notes which are based on the books: Laser fundamentals by William T. Silfvast (Cambridge University Press, 2nd edition) and Particle Accelerator Physics by Helmut Wiedemann (Springer, 3rd edition).

Assessment methods and criteria:

Two written intermediate examinations or one final examination.

Grading:

Numerical grading scale 0 - 5, where 0 = fail.

Person responsible:

Lauri Hautala

Working life cooperation:

No work placement period.

Other information:

Course wiki page

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 numerical methods in function interpolation, integration, derivation and solving sets of linear equations. The student knows how to solve the eigenvalues and eigenvectors of a symmetric matrix. 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 for differentiation, special functions, integration, derivation, interpolation and Fourier transform. Ordinary differential equations and differential equations with eigenvalues are solved. Algorithms for linear equations and matrix equations with eigenvalues are given. The programming language can be chosen freely. Examples are given in Fortran and Mathematica languages.

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:

Course website

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/

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:

Can contain work placement period

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 programmes 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:

Course website

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/

A300007: Medical Physics Minor, 15 - 25 op

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

Ei opintojaksokuvauksia.

Alternative studies, if they are not included already in other subjects.

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.

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 (organized only during odd-numbered years)

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, Kyösti Heimonen

Working life cooperation:

No work placement period

Other information:

Course website

764634S: Medical physics and imaging, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course
Vastuuyksikkö: Health Sciences
Arvostelu: 1 - 5, pass, fail
Opettajat: Miika Nieminen
Opintokohteen kielet: Finnish

ECTS Credits:

6 credits

Language of instruction:

English

Timing:

4th-5th Autumn (organized only during odd-numbered years or even more rarely)

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, Kyösti Heimonen

Working life cooperation:

No work placement period

Other information:

Course website
The course will be organized using other code.

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:

Kyösti Heimonen, Roman Frolov

Working life cooperation:

No work placement period

Other information:

Course website

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/

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/

080901A: Introduction to Technology in Clinical Medicine, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course
Vastuuyksikkö: Health Sciences
Arvostelu: 1 - 5, pass, fail
Opettajat: Jämsä, Timo Jaakko
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credit points / 135 hours of work

Language of instruction:

Finnish

Timing:

1st and 2nd periods

Learning outcomes:

The student can identify technologies in different fields of medical technology, can describe the principles behind these technologies and evaluate the advantages and limitations of the technologies.

Contents:

Course introduction lectures. Specialists from different clinical areas give lectures and demonstrations, in which main themes and terms of the field are introduced and technical equipment and methods are presented. Expert lecturers on other current topics related to the course.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Initial exam. Lectures 35 h / Demonstrations 10 h / Course assignment and self-study 90 h. Final exam which is based on lectures and all given materials.

Target group:

Bachelor students interested in Biomedical Engineering (medical technology, information technology, electrical engineering, physics, other related degree programs).

Recommended or required reading:

T.Sora, P. Antikainen, M. Laisalmi, S. Vierula: Sairaanhoidon teknologia, WSOY 2002[MH1] .
P. Pölönen, T. Ala-Kokko et al.: Akuuttihoidon laitteet, Duodecim 2013.
Available as an e-print: http://www.terveysportti.fi/dtk/aho/koti
The material addressed during the lectures.

Assessment methods and criteria:

Initial exam with multiple-choice questions (literature for the initial exam: T. Sora, P. Antikainen, M. Laisalmi, S. Vierula: Sairaanhoidon teknologia, WSOY 2002). Taking part in the lectures and demos. Learning assignment. Final exam with essay-type questions. In order to participate in the final exam the student must have passed initial exam and learning assignment.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1-5 or fail. Grading is based on the grade of the final exam.

Person responsible:

Professor Timo Jämsä

Working life cooperation:

The course will be mainly organized in the hospital, and lectures are given by clinical specialists.

080915S: Tissue Biomechanics, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credit points /135 hours of work.

Language of instruction:

English

Timing:

Master studies, 1st period

Learning outcomes:

The student can describe the main biomechanical characteristics of different tissues as well as their failure mechanisms. The student can perform practical biomechanical experiments, analyze measurement data, interpret results, and report them using good scientific reporting practice. The student understand how numerical modeling can be used to solve problems in tissue biomechanics.

Contents:

Introduction to tissue biomechanics. Most important biomechanical parameters and material models. Experimental measurements of biomechanical properties of tissues. Structure, composition and mechanical properties of different tissues. Biomechanical modeling of tissues.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 15h / Exercises 8h / Assignment 8h / Self-study 104h. Final exam.

Target group:

Students of Medical Technology (medical and wellness technology, biomedical engineers, biophysics, other degree programs) and all other who are interested

Prerequisites and co-requisites:

Basic knowledge on cell biology, anatomy and physiology, mechanics differential equations and matrix algebra.

Recommended or required reading:

Material given during lectures.

Assessment methods and criteria:

Accepted exercises, written exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Associate Professor Simo Saarakkala

Working life cooperation:

No

Other information:

080916S: Biomechanics of Human Movement, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credit points / 135 hours of work.

Language of instruction:

English

Timing:

Master studies, 3rd period

Learning outcomes:

The student can describe the main challenges of movement biomechanics and principles for motion analysis. The student knows basics of biomechanical measurement and modeling of movement. The student can perform practical biomechanical experiments, analyze measurement data, interpret results, and report them using good scientific reporting practice.

Contents:

Musculoskeletal biomechanics. Motion sensors and motion analysis. Biomechanical modeling ofmovement. Balance measurement. Fall biomechanics. Measurement of physical activity.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 14 h / Assignment 54 h / Self-study 67 h. Final exam.

Target group:

Students of Medical Technology (medical and wellness technology, biomedical engineers, biophysics, other degree programs) and all other who are interested

Prerequisites and co-requisites:

It is recommended to have basic knowledge on anatomy and physiology, sensors and measurement techniques and signal processing.

Recommended or required reading:

Material given during lectures.

Assessment methods and criteria:

Accepted home exercises and assignments, written exam. The exam includes definition and explanation assignments and problems.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor Timo Jämsä

Other information:

This course is a part of the specialization of Health Technology.

580402S: Biomedical Imaging Methods, 1 - 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Simo Saarakkala

Opintokohteen kielet: English

ECTS Credits:

1-5 ECTS credit points / 27-135 hours of work.

Language of instruction:

English

Timing:

Master studies, 4th period. The course is not organized every year.

Learning outcomes:

The student understands and can describe the basic principles and main applications of imaging methods used in biomedical research.

Contents:

Differences between in vivo, ex vivo and in vitro imaging. Light and electron microscopy. Optical projection and coherence tomography. Optical in vivo imaging. Magnetic resonance imaging. Fourier transform infrared imaging spectroscopy. Raman imaging spectroscopy. Micro-computed tomography. Ultrasound imaging. Basics of image analysis and interpretation.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Differences between in vivo, ex vivo and in vitro imaging. Light and electron microscopy. Optical projection and coherence tomography. Optical in vivo imaging. Magnetic resonance imaging. Fourier transform infrared imaging spectroscopy. Raman imaging spectroscopy. Micro-computed tomography. Ultrasound imaging. Basics of image analysis and interpretation.

Target group:

Master Students of Medical and Wellness technology and Biomedical Engineering and all other who are interested in methods of biomedical imaging

Recommended or required reading:

Required literature is given in the lectures.

Assessment methods and criteria:

Participation in the lectures and demonstrations, study diary. Exercises. Written exam. The course can be taken as 1, 2, 3 or 5 ECTS.

1 ECTS # participation in the lectures
2 ECTS # participation in the lectures and demonstrations
3 ECTS # participation in the lectures and demonstrations + practical assignment
5 ECTS # participation in the lectures and demonstrations + practical assignment and final exam

Grading:

The 1, 2 or 3 ECTS courses utilize verbal grading: pass or fail. The 5 ECTS course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Associate Professor Simo Saarakkala

Working life cooperation:

No

080914S: Biomedical Engineering and Medical Physics Seminar, 3 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: Finnish

ECTS Credits:

3 ECTS credit points / 81 hours of work

Language of instruction:

English or Finnish

Timing:

Master studies, 1st period

Learning outcomes:

The student can identify the essential features of scientific publications. The student can present the central content of a scientific article to others. The student can present critical questions related to a scientific presentation, and give and receive feedback on the presentations.

Contents:

Seminars and scientific literature. Publication forums in the field and characteristics of scientific articles.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Introduction lectures, presentations and discussion of the latest scientific publications on the basis. Each student will give two presentations and opponed two (peer-assessment).
Lectures and seminars 20 h / Self-study 61 h.

Target group:

Students of Medical Technology (medical and wellness technology, biomedical engineering, biophysics, other degree programs)

Recommended optional programme components:

Selected scientific articles and material indicated by lecturer

Recommended or required reading:

Selected scientific articles and material indicated by lecturer

Assessment methods and criteria:

Attending seminars, making presentations and acting as an opponent. The assessment criteria are based on the learning outcomes of the course. The more detailed assessment criteria is found on Optima.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor Timo Jämsä

Other information:

Also for doctoral studies

521467A: Digital Image Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521467A	Digital Image Processing (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Lectures in Finnish and exercises in English. Course can be passed in Finnish and English.

Timing:

Autumn, period 1.

Learning outcomes:

1. understands the basic theory of digital image processing and knows its main applications.
2. is able to apply spatial and frequency domain and wavelet based methods in image enhancement, restoration, compression, segmentation and recognition.

Contents:

This course provides an introduction to digital image processing and machine vision. Topics: 1.Introduction, 2.Image enhancement, 3.Image restoration, 4. Color image processing, 5. Wavelets, 6. Image compression,7. Morphological image processing, 8. Image segmentation, 9. Representations and descriptions, 10. Pattern recognition.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 24 h, exercises 14 h and Matlab design exercises 30 h. The rest as independent work.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

In order to obtain deep understanding of the content, it is a benefit if the student has completed the first year mathematic courses in the computer science and engineering BSc program or otherwise has equivalent knowledge.

Recommended or required reading:

Gonzalez, R.C., Woods, R.E.: Digital Image Processing, Second Edition, Addison-Wesley, 2002 (see course website: http://www.ee.oulu.fi/research/imag/courses/dkk/). Lecture notes and exercise material.

Assessment methods and criteria:

The course is passed by a final exam and programming exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Janne Heikkilä

Working life cooperation:

None.

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Esa Rahtu

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521337A	Digital Filters (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish, English study material available

Timing:

Spring, period 3.

Learning outcomes:

1. Student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods.

2. Student is able to solve for the impulse and frequency responses of FIR and IIR filters given as difference equations, transfer functions, or realization diagrams, and can present analyses of the aliasing and imaging effects based on the responses of the f

3. Student is able to explain the impacts of finite word length in filter design.

4. Student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

Contents:

1. Sampling theorem, aliasing and imaging, 2. Discrete Fourier transform, 3. Z-transform and frequency response, 4. Correlation and convolution, 5. Digital filter design, 6. FIR filter design and realizations, 7. IIR filter design and realizations, 8. Finite word length effects and analysis, 9. Multi-rate signal processing.

Mode of delivery:

Face-to-face teaching (Lectures), independent work, group work

Learning activities and teaching methods:

Lectures and exercises 50 h. The design exercises familiarize the students with the methods of digital signal processing using the Matlab software package. The rest as independent work.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

031077P Complex Analysis, 031080A Signal Analysis

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Lecture notes and exercise materials. Material is in Finnish and in English. Course book: Ifeachor, E., Jervis, B.: Digital Signal Processing, A Practical Approach, Second Edition, Prentice Hall, 2002.

Assessment methods and criteria:

The course can be passed either with week exams or a final exam. In addition, the exercises need to be returned and accepted.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Esa Rahtu

Working life cooperation:

None.

521273S: Biosignal Processing I, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English. Examination can be taken in English or Finnish.

Timing:

The course unit is held in the autumn semester, during period II. It is recommended to complete the course at the end of studies.

Learning outcomes:

1. knows special characteristics of the biosignals and typical signal processing methods

2. can solve small-scale problems related to biosignal analysis

3. implement small-scale software for signal processing algorithms

Contents:

Biomedical signals. Digital filtering. Analysis in time-domain and frequency domain. Nonstationarity. Event detection. Signal characterization.

Mode of delivery:

Face-to-face teaching and guided laboratory work.

Learning activities and teaching methods:

Lectures 10h, Laboratory work 20h, Self-study 20h, written examination.

Target group:

Students interested in biomedical engineering, at their master's level studies.
Students of the University of Oulu.

Prerequisites and co-requisites:

The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Programming skills, especially basics of the Matlab. Basic knowledge of digital signal processing.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

The course is based on selected chapters of the book "Biomedical Signal Analysis", R.M Rangayyan, 2nd edition (2015). + Lecture slides + Task assignment specific material.

Assessment methods and criteria:

Laboratory work is supervised by assistants who also check that the task assignments are completed properly. The course ends with a written exam. Read more about assessment criteria at the University of Oulu webpage.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Tapio Seppänen

Working life cooperation:

No.

521093S: Biomedical Instrumentation, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Igor Meglinski

Opintokohteen kielet: Finnish

Leikkaavuudet:

521107S	Biomedical Instrumentation	6.0 op

ECTS Credits:

5

Language of instruction:

English.

Timing:

Period 3.

Learning outcomes:

After the course the student is capable to explain principles, applications and design of medical instruments most commonly used in hospitals. He/she can describe the electrical safety aspects of medical instruments and can present the physiological effects of electric current on humans. In addition the student is able to explain medical instrumentation development process and the factors affecting it. He/she also recognizes typical measurands and measuring spans and is able to plan and design a biosignal amplifier.

Contents:

Diagnostic instruments (common theories for medical devices, measurement quantities, sensors, amplifiers and registering instruments). Bioelectrical measurements (EKG, EEG, EMG, EOG, ERG), blood pressure and flow meters, respiration studies, measurements in a clinical laboratory, introduction to medical imaging methods and instruments, ear measurements, heart pacing and defibrillators, physical therapy devices, intensive care and operating room devices and electrical safety aspects.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures/exercises 42 h and self-study 100 h.

Target group:

Students interested in biomedical measurements.

Prerequisites and co-requisites:

None

Recommended optional programme components:

Course replaces earlier courses Biomedical measurements and Biomedical instrumentation.

Recommended or required reading:

R. S. Khandpur: Biomedical Instrumentation, Technology and Applications, McGraw-Hill, 2005 and J. G. Webster: Medical Instrumentation, Application and Design, 4th edition, John Wiley & Sons, 2010.

Assessment methods and criteria:

The course is passed by the final exam or optionally with the assignments/test agreed at the first lecture. Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5.

Person responsible:

Igor Meglinski

Working life cooperation:

No.

A300006: Medical Engineering Minor, 15 - 25 op

Opiskelumuoto: Intermediate Studies

Laji: Study module
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.

Alternative studies, if they are not included already in other subjects.

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/

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:

Usually only an exam on the basis of given material.

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.

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 Jämsä

Other information:

The course will be organized using other code.

080901A: Introduction to Technology in Clinical Medicine, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Health Sciences
Arvostelu: 1 - 5, pass, fail
Opettajat: Jämsä, Timo Jaakko
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credit points / 135 hours of work

Language of instruction:

Finnish

Timing:

1st and 2nd periods

Learning outcomes:

The student can identify technologies in different fields of medical technology, can describe the principles behind these technologies and evaluate the advantages and limitations of the technologies.

Contents:

Course introduction lectures. Specialists from different clinical areas give lectures and demonstrations, in which main themes and terms of the field are introduced and technical equipment and methods are presented. Expert lecturers on other current topics related to the course.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Initial exam. Lectures 35 h / Demonstrations 10 h / Course assignment and self-study 90 h. Final exam which is based on lectures and all given materials.

Target group:

Bachelor students interested in Biomedical Engineering (medical technology, information technology, electrical engineering, physics, other related degree programs).

Recommended or required reading:

T.Sora, P. Antikainen, M. Laisalmi, S. Vierula: Sairaanhoidon teknologia, WSOY 2002[MH1] .
P. Pölönen, T. Ala-Kokko et al.: Akuuttihoidon laitteet, Duodecim 2013.
Available as an e-print: http://www.terveysportti.fi/dtk/aho/koti
The material addressed during the lectures.

Assessment methods and criteria:

Initial exam with multiple-choice questions (literature for the initial exam: T. Sora, P. Antikainen, M. Laisalmi, S. Vierula: Sairaanhoidon teknologia, WSOY 2002). Taking part in the lectures and demos. Learning assignment. Final exam with essay-type questions. In order to participate in the final exam the student must have passed initial exam and learning assignment.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1-5 or fail. Grading is based on the grade of the final exam.

Person responsible:

Professor Timo Jämsä

Working life cooperation:

The course will be mainly organized in the hospital, and lectures are given by clinical specialists.

041201A: Basics in eHealth, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Medicine

Arvostelu: 1 - 5, pass, fail

Opettajat: Jarmo Reponen

Opintokohteen kielet: English

Leikkaavuudet:

ay041201A	Basics in eHealth (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credit points / 135 hours of work

Language of instruction:

English

Timing:

2nd period

Learning outcomes:

The student can define central information and communication technological terms and solutions in healthcare, and can list respective applications in healthcare services and training.
The student can evaluate the societal and economic significance of information and communication technology in healthcare

Contents:

- terms and concepts
- societal dimensions
- delivery of health services
- electronic patient records
- data transfer within the health care system
- data transfer between the health care professionals and the patients
- citizens providing their own health data, mHealth-solutions
- national healthcare information exchange in Finland- remote consultations, radiologypsychiatry, teleradiology, telepsychiatry
- economical and functional assessment
- remote education
- future visions of health care information systems

Mode of delivery:

Web-based teaching

Learning activities and teaching methods:

Interactivity takes place in virtual learning environment Optima. The course consists of video-taped lectures, power point-presentations and links to other material available in the web. Performance of duties includes an essay, exam, participating in discussions on the grounds of the lectures.
Web lectures 15h / Web exam 40h / Written essay 40h / Self-study and participation to web discussion 40h

Target group:

Students of Medical Technology (medical and wellness technology, biomedical engineering, biophysics, other degree programs), Students of Health Sciences and information technology and everyone who is interested

Recommended or required reading:

All recommended or required reading are offered in Optima virtual learning environment

Assessment methods and criteria:

Web tasks, an essay and final exam

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor Jarmo Reponen

Working life cooperation:

No

Other information:

Recommended literature:
Graig J Wootton R, Patterson V (Eds): An introduction to
Telemedicine,RSM Press 2006
Hämäläinen P, Reponen J, Winblad I, Kärki J, Laaksonen M, Hyppönen H, Kangas M (2013) eHealth and eWelfare of Finland, Check point 2011. THL Report 5/ 2013.
(https://www.julkari.fi/bitstream/handle/10024/104368/URN_ISBN_978-952-245-835-3.pdf?sequence=1)
Saranto K, Korpela M (toim) Tietotekniikka ja tiedonhallinta sosiaali-
ja terveydenhuollossa, WSOY, Porvoo-Helsinki-Juva 1999
Reponen J, Kangas M. Hämäläinen P, Keränen N (2015) Tieto- ja viestintäteknologian käyttö terveydenhuollossa vuonna 2014. Tilanne ja kehityksen suunta. [English summary] THL Raportteja 12 /2015.

(http://www.julkari.fi/bitstream/handle/10024/126470/URN_ISBN_978-952-302-486-1.pdf?sequence=1)

Journals:
Journal of Telemedicine and Telecare
Telemedicine and e-Health
In addition: eLibrary in the Optima comprising updating of the topics of the lectures and some selected essays (by permission of the author)

080915S: Tissue Biomechanics, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credit points /135 hours of work.

Language of instruction:

English

Timing:

Master studies, 1st period

Learning outcomes:

The student can describe the main biomechanical characteristics of different tissues as well as their failure mechanisms. The student can perform practical biomechanical experiments, analyze measurement data, interpret results, and report them using good scientific reporting practice. The student understand how numerical modeling can be used to solve problems in tissue biomechanics.

Contents:

Introduction to tissue biomechanics. Most important biomechanical parameters and material models. Experimental measurements of biomechanical properties of tissues. Structure, composition and mechanical properties of different tissues. Biomechanical modeling of tissues.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 15h / Exercises 8h / Assignment 8h / Self-study 104h. Final exam.

Target group:

Students of Medical Technology (medical and wellness technology, biomedical engineers, biophysics, other degree programs) and all other who are interested

Prerequisites and co-requisites:

Basic knowledge on cell biology, anatomy and physiology, mechanics differential equations and matrix algebra.

Recommended or required reading:

Material given during lectures.

Assessment methods and criteria:

Accepted exercises, written exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Associate Professor Simo Saarakkala

Working life cooperation:

No

Other information:

080916S: Biomechanics of Human Movement, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Health Sciences
Arvostelu: 1 - 5, pass, fail
Opettajat: Jämsä, Timo Jaakko
Opintokohteen kielet: English

ECTS Credits:

5 ECTS credit points / 135 hours of work.

Language of instruction:

English

Timing:

Master studies, 3rd period

Learning outcomes:

The student can describe the main challenges of movement biomechanics and principles for motion analysis. The student knows basics of biomechanical measurement and modeling of movement. The student can perform practical biomechanical experiments, analyze measurement data, interpret results, and report them using good scientific reporting practice.

Contents:

Musculoskeletal biomechanics. Motion sensors and motion analysis. Biomechanical modeling ofmovement. Balance measurement. Fall biomechanics. Measurement of physical activity.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 14 h / Assignment 54 h / Self-study 67 h. Final exam.

Target group:

Students of Medical Technology (medical and wellness technology, biomedical engineers, biophysics, other degree programs) and all other who are interested

Prerequisites and co-requisites:

It is recommended to have basic knowledge on anatomy and physiology, sensors and measurement techniques and signal processing.

Recommended or required reading:

Material given during lectures.

Assessment methods and criteria:

Accepted home exercises and assignments, written exam. The exam includes definition and explanation assignments and problems.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor Timo Jämsä

Other information:

This course is a part of the specialization of Health Technology.

580402S: Biomedical Imaging Methods, 1 - 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Health Sciences
Arvostelu: 1 - 5, pass, fail
Opettajat: Simo Saarakkala
Opintokohteen kielet: English

ECTS Credits:

1-5 ECTS credit points / 27-135 hours of work.

Language of instruction:

English

Timing:

Master studies, 4^{th} period. The course is not organized every year.

Learning outcomes:

The student understands and can describe the basic principles and main applications of imaging methods used in biomedical research.

Contents:

Differences between in vivo, ex vivo and in vitro imaging. Light and electron microscopy. Optical projection and coherence tomography. Optical in vivo imaging. Magnetic resonance imaging. Fourier transform infrared imaging spectroscopy. Raman imaging spectroscopy. Micro-computed tomography. Ultrasound imaging. Basics of image analysis and interpretation.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Differences between in vivo, ex vivo and in vitro imaging. Light and electron microscopy. Optical projection and coherence tomography. Optical in vivo imaging. Magnetic resonance imaging. Fourier transform infrared imaging spectroscopy. Raman imaging spectroscopy. Micro-computed tomography. Ultrasound imaging. Basics of image analysis and interpretation.

Target group:

Master Students of Medical and Wellness technology and Biomedical Engineering and all other who are interested in methods of biomedical imaging

Recommended or required reading:

Required literature is given in the lectures.

Assessment methods and criteria:

Participation in the lectures and demonstrations, study diary. Exercises. Written exam. The course can be taken as 1, 2, 3 or 5 ECTS.

1 ECTS # participation in the lectures
2 ECTS # participation in the lectures and demonstrations
3 ECTS # participation in the lectures and demonstrations + practical assignment
5 ECTS # participation in the lectures and demonstrations + practical assignment and final exam

Grading:

The 1, 2 or 3 ECTS courses utilize verbal grading: pass or fail. The 5 ECTS course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Associate Professor Simo Saarakkala

Working life cooperation:

No

080914S: Biomedical Engineering and Medical Physics Seminar, 3 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: Finnish

ECTS Credits:

3 ECTS credit points / 81 hours of work

Language of instruction:

English or Finnish

Timing:

Master studies, 1st period

Learning outcomes:

The student can identify the essential features of scientific publications. The student can present the central content of a scientific article to others. The student can present critical questions related to a scientific presentation, and give and receive feedback on the presentations.

Contents:

Seminars and scientific literature. Publication forums in the field and characteristics of scientific articles.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Introduction lectures, presentations and discussion of the latest scientific publications on the basis. Each student will give two presentations and opponed two (peer-assessment).
Lectures and seminars 20 h / Self-study 61 h.

Target group:

Students of Medical Technology (medical and wellness technology, biomedical engineering, biophysics, other degree programs)

Recommended optional programme components:

Selected scientific articles and material indicated by lecturer

Recommended or required reading:

Selected scientific articles and material indicated by lecturer

Assessment methods and criteria:

Attending seminars, making presentations and acting as an opponent. The assessment criteria are based on the learning outcomes of the course. The more detailed assessment criteria is found on Optima.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Professor Timo Jämsä

Other information:

Also for doctoral studies

580201A: Biomedical Engineering Programming Study, 5 op

Voimassaolo: 01.08.2008 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credit points / 135 hours of work.

Language of instruction:

Finnish or English

Timing:

Bachelor of Master studies, elective course.

Learning outcomes:

The student can design a solution to a programmig problem related to medical technology, can solve the task and report this in written form.

Contents:

Independent computer programming using modern programming tools, a written report.

Mode of delivery:

Independent work.

Learning activities and teaching methods:

Students carry out an assigned programming project individually or in pairs and write out a report.
Self-study or group work 135hours.

Target group:

Student of Medical and Wellness Technology.

Prerequisites and co-requisites:

521141P Basic of Programming, 764627A/S Virtual Measurement Environments or similar knowledge.

Assessment methods and criteria:

The program and the report are assessed by the supervisor.

Grading:

The course utilizes grading: pass or fail.

Person responsible:

Professor Timo Jämsä

Working life cooperation:

No

Other information:

More information on the available topics can be inquired on the teachers of the department.

580201S: Biomedical Engineering Programming Study, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521467A: Digital Image Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521467A	Digital Image Processing (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Lectures in Finnish and exercises in English. Course can be passed in Finnish and English.

Timing:

Autumn, period 1.

Learning outcomes:

1. understands the basic theory of digital image processing and knows its main applications.
2. is able to apply spatial and frequency domain and wavelet based methods in image enhancement, restoration, compression, segmentation and recognition.

Contents:

This course provides an introduction to digital image processing and machine vision. Topics: 1.Introduction, 2.Image enhancement, 3.Image restoration, 4. Color image processing, 5. Wavelets, 6. Image compression,7. Morphological image processing, 8. Image segmentation, 9. Representations and descriptions, 10. Pattern recognition.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 24 h, exercises 14 h and Matlab design exercises 30 h. The rest as independent work.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

In order to obtain deep understanding of the content, it is a benefit if the student has completed the first year mathematic courses in the computer science and engineering BSc program or otherwise has equivalent knowledge.

Recommended or required reading:

Gonzalez, R.C., Woods, R.E.: Digital Image Processing, Second Edition, Addison-Wesley, 2002 (see course website: http://www.ee.oulu.fi/research/imag/courses/dkk/). Lecture notes and exercise material.

Assessment methods and criteria:

The course is passed by a final exam and programming exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Janne Heikkilä

Working life cooperation:

None.

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Esa Rahtu

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521337A	Digital Filters (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish, English study material available

Timing:

Spring, period 3.

Learning outcomes:

1. Student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods.

2. Student is able to solve for the impulse and frequency responses of FIR and IIR filters given as difference equations, transfer functions, or realization diagrams, and can present analyses of the aliasing and imaging effects based on the responses of the f

3. Student is able to explain the impacts of finite word length in filter design.

4. Student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

Contents:

1. Sampling theorem, aliasing and imaging, 2. Discrete Fourier transform, 3. Z-transform and frequency response, 4. Correlation and convolution, 5. Digital filter design, 6. FIR filter design and realizations, 7. IIR filter design and realizations, 8. Finite word length effects and analysis, 9. Multi-rate signal processing.

Mode of delivery:

Face-to-face teaching (Lectures), independent work, group work

Learning activities and teaching methods:

Lectures and exercises 50 h. The design exercises familiarize the students with the methods of digital signal processing using the Matlab software package. The rest as independent work.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

031077P Complex Analysis, 031080A Signal Analysis

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Lecture notes and exercise materials. Material is in Finnish and in English. Course book: Ifeachor, E., Jervis, B.: Digital Signal Processing, A Practical Approach, Second Edition, Prentice Hall, 2002.

Assessment methods and criteria:

The course can be passed either with week exams or a final exam. In addition, the exercises need to be returned and accepted.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Esa Rahtu

Working life cooperation:

None.

521273S: Biosignal Processing I, 5 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Tapio Seppänen
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English. Examination can be taken in English or Finnish.

Timing:

The course unit is held in the autumn semester, during period II. It is recommended to complete the course at the end of studies.

Learning outcomes:

1. knows special characteristics of the biosignals and typical signal processing methods

2. can solve small-scale problems related to biosignal analysis

3. implement small-scale software for signal processing algorithms

Contents:

Biomedical signals. Digital filtering. Analysis in time-domain and frequency domain. Nonstationarity. Event detection. Signal characterization.

Mode of delivery:

Face-to-face teaching and guided laboratory work.

Learning activities and teaching methods:

Lectures 10h, Laboratory work 20h, Self-study 20h, written examination.

Target group:

Students interested in biomedical engineering, at their master's level studies.
Students of the University of Oulu.

Prerequisites and co-requisites:

The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Programming skills, especially basics of the Matlab. Basic knowledge of digital signal processing.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

The course is based on selected chapters of the book "Biomedical Signal Analysis", R.M Rangayyan, 2nd edition (2015). + Lecture slides + Task assignment specific material.

Assessment methods and criteria:

Laboratory work is supervised by assistants who also check that the task assignments are completed properly. The course ends with a written exam. Read more about assessment criteria at the University of Oulu webpage.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Tapio Seppänen

Working life cooperation:

No.

521093S: Biomedical Instrumentation, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Igor Meglinski

Opintokohteen kielet: Finnish

Leikkaavuudet:

521107S	Biomedical Instrumentation	6.0 op

ECTS Credits:

5

Language of instruction:

English.

Timing:

Period 3.

Learning outcomes:

After the course the student is capable to explain principles, applications and design of medical instruments most commonly used in hospitals. He/she can describe the electrical safety aspects of medical instruments and can present the physiological effects of electric current on humans. In addition the student is able to explain medical instrumentation development process and the factors affecting it. He/she also recognizes typical measurands and measuring spans and is able to plan and design a biosignal amplifier.

Contents:

Diagnostic instruments (common theories for medical devices, measurement quantities, sensors, amplifiers and registering instruments). Bioelectrical measurements (EKG, EEG, EMG, EOG, ERG), blood pressure and flow meters, respiration studies, measurements in a clinical laboratory, introduction to medical imaging methods and instruments, ear measurements, heart pacing and defibrillators, physical therapy devices, intensive care and operating room devices and electrical safety aspects.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures/exercises 42 h and self-study 100 h.

Target group:

Students interested in biomedical measurements.

Prerequisites and co-requisites:

None

Recommended optional programme components:

Course replaces earlier courses Biomedical measurements and Biomedical instrumentation.

Recommended or required reading:

R. S. Khandpur: Biomedical Instrumentation, Technology and Applications, McGraw-Hill, 2005 and J. G. Webster: Medical Instrumentation, Application and Design, 4th edition, John Wiley & Sons, 2010.

Assessment methods and criteria:

The course is passed by the final exam or optionally with the assignments/test agreed at the first lecture.

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

Grading:

1 - 5.

Person responsible:

Igor Meglinski

Working life cooperation:

No.

521072S: Microsensors, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Hannu

Opintokohteen kielet: Finnish

Leikkaavuudet:

521228S	Microsensors	4.0 op

ECTS Credits:

5 ECTS credits / 132,5 hours of work

Language of instruction:

English. Guidance and exams also possible in Finnish.

Timing:

The course is held in the 2nd period. Teaching is available every second year. The next arragment is autumn 2016.

Learning outcomes:

1. After completing the course, student can explain the basic concepts of sensor theory and technology, classification of sensors, properties of ideal and real sensors, pros and cons of integrated smart sensor systems, and the interface between sensor and pro

2. Student can explain the main fabrication methods, including thin-film technologies, micromachining methods, wet and dry etching techniques, and both laser and ion beam milling methods and their applications in microsensor fabrication.

3. Students can explain the basic structures, physical operation principles, and fabrication processes of main sensor types for different forms of energy.

Contents:

The principles of microsensors, physical magnitudes which can be measured and manufacturing technologies for microsensors.

Mode of delivery:

Blended teaching (web-based and face-to-face teaching).

Learning activities and teaching methods:

The course will be arranged utilizing activating teaching methods agreed on together with the students. There will be 14 hours of guided teaching events and 118,5 hours of teaching with web-based guidance either privately or in a group.

Target group:

Master students in electrical engineering.

Prerequisites and co-requisites:

Recommended prerequisite is Bachelors degree in Electrical Engineering.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Will be informed at the beginning of the course.

Assessment methods and criteria:

This course utilizes continuous assessment. The method will be informed at the beginning of the course.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Jari Hannu

Working life cooperation:

No

521300S: Electronics Design and Construction Exercise, 6 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Määttä

Opintokohteen kielet: Finnish

Leikkaavuudet:

521441S	Electronics Design and Construction Exercise	6.5 op

ECTS Credits:

6

Language of instruction:

Finnish, English

Timing:

Periods 3-4

Learning outcomes:

1 is able to carry out all the stages needed to develop an electronic circuit or device starting from independent creation and design work to realization, testing and technical documentation.
2 is able to use independently without any help professional methods, software packages, measurement devices and tools.
3 Objective: To familiarize the student with independent electrical circuit and system design and with the methods and tools used in the design process. The course prepares the student for the diploma work in the area of circuits and system design.

Contents:

Design and construction of an electronic device or a part of a device according to the given specification. The task can be part of an industrial research or a product design project or part of the research project going on in Electronics or other laboratory. The subject of the work can be own suggestion of the student or a pre-selected course subject, which enables comprehensive training of skills needed for the design of a modern electronic device.

Mode of delivery:

Independent work.

Learning activities and teaching methods:

Independent design and construction work 180h

Target group:

Primarily in electrical engineering students. Other University of Oulu students can complete the course

Prerequisites and co-requisites:

Student must have passed following courses: Analogue Electronics I-II, Digital Techniques I-II, Electronic System Design and Filter Theory.

Recommended optional programme components:

The course is an independent entity and does not require other studies carried out at the same time.

Recommended or required reading:

Not defined

Assessment methods and criteria:

The task can be carried out by a student or by a team of two students. The grade will be decided on the basis of the statement of the instructor, realization of the device and the report provided by the student. Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 0 - 5. In the numerical scale 0 stands for a fail.

Person responsible:

Kari Määttä

Working life cooperation:

No

521405A: Electronic System Design, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Määttä

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Period 1

Learning outcomes:

1. is able to choose the optimum method of the choices presented in the course in the field of power supply, thermal design, grounding, and routing of the high speed signals.
2. is able to calculate problems, caused by electrical disturbances, crosstalk and non-idealities of electrical components.
3. can calculate reliability of an electrical device or system.
4. The main goal of the course is to introduce methods and techniques needed in designing larger electronic entities such as equipment and systems.

Contents:

Power supplies, thermal design, grounding, transmission of fast signals by using transmission lines, electrical disturbances, crosstalk, non-idealities of electrical components, reliability of electronics.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

The course includes 30 h of lectures and 20 h of exercises.

Target group:

Primarily in electrical engineering students. Other University of Oulu students can complete the course.

Prerequisites and co-requisites:

Both Principles of Electronics Design and Analogue Electronics I must have been accepted.

Recommended optional programme components:

The course is an independent entity and does not require other studies carried out at the same time.

Recommended or required reading:

Lecture notes. Ward & Angus: Electronic Product Design, Hall&Hall&McCall: High speed Digital Design, Montrose: EMC and the Printed Circuit Board, Ott: Noise Reduction Techniques. Eric Bogatin: Signal and Power Integrity – Simplified, 2. ed.

Assessment methods and criteria:

The course is passed by means of a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 0 - 5. In the numerical scale 0 stands for a fail.

Person responsible:

Kari Määttä

Working life cooperation:

No.

521094S: Optoelectronic Measurements, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Igor Meglinski

Opintokohteen kielet: Finnish

Leikkaavuudet:

521238S	Optoelectronic Measurements	4.0 op

ECTS Credits:

5

Language of instruction:

English

Timing:

Period 4

Learning outcomes:

Objective: The goal of this course is to make the student familiar with optical measurement principles, sensors and device configurations used in industrial inspection tasks.
Learning outcomes: Upon completion of the course, the student is able to explain the operating principles of the most common optical measurement methods used in industrial production, name the factors affecting their performance, design certain sensor systems and evaluate the applicability of measurement methods for various measurement tasks. Additionally he is able to independently find information and discover the operating principles of various optical measurements and to condense the collected information into written and verbal report.

Contents:

Principles of optical measurements. Surface inspection, distance and profile measurements. Non-destructive testing methods. Optical measurements for process control. Material analyses with optical methods.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

The course includes 42 h lectures or calculation exercises and 100 h self-studies.

Target group:

4th year students

Prerequisites and co-requisites:

Completion of the course 766329A Wave Motion and Optics is recommended.

Recommended optional programme components:

Course replaces earlier by same name but different code and credit points.

Recommended or required reading:

Lecture handouts and discourse material prepared by students. Delivery through Optima.

Assessment methods and criteria:

Final exam and a passed discourse.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Igor Meglinski

Working life cooperation:

No.

A450002: Signal Processing Minor, 17 op

Opiskelumuoto: Other Entity
Laji: Study module
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Selected from at least 15 ECTS cr

031080A: Signal Analysis, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Kotila, Vesa Iisakki
Opintokohteen kielet: Finnish
Leikkaavuudet:

031050A	Signal Analysis	4.0 op

Ei opintojaksokuvauksia.

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Esa Rahtu
Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521337A	Digital Filters (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish, English study material available

Timing:

Spring, period 3.

Learning outcomes:

1. Student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods.

2. Student is able to solve for the impulse and frequency responses of FIR and IIR filters given as difference equations, transfer functions, or realization diagrams, and can present analyses of the aliasing and imaging effects based on the responses of the f

3. Student is able to explain the impacts of finite word length in filter design.

4. Student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

Contents:

1. Sampling theorem, aliasing and imaging, 2. Discrete Fourier transform, 3. Z-transform and frequency response, 4. Correlation and convolution, 5. Digital filter design, 6. FIR filter design and realizations, 7. IIR filter design and realizations, 8. Finite word length effects and analysis, 9. Multi-rate signal processing.

Mode of delivery:

Face-to-face teaching (Lectures), independent work, group work

Learning activities and teaching methods:

Lectures and exercises 50 h. The design exercises familiarize the students with the methods of digital signal processing using the Matlab software package. The rest as independent work.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

031077P Complex Analysis, 031080A Signal Analysis

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Lecture notes and exercise materials. Material is in Finnish and in English. Course book: Ifeachor, E., Jervis, B.: Digital Signal Processing, A Practical Approach, Second Edition, Prentice Hall, 2002.

Assessment methods and criteria:

The course can be passed either with week exams or a final exam. In addition, the exercises need to be returned and accepted.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Esa Rahtu

Working life cooperation:

None.

521467A: Digital Image Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521467A	Digital Image Processing (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Lectures in Finnish and exercises in English. Course can be passed in Finnish and English.

Timing:

Autumn, period 1.

Learning outcomes:

1. understands the basic theory of digital image processing and knows its main applications.
2. is able to apply spatial and frequency domain and wavelet based methods in image enhancement, restoration, compression, segmentation and recognition.

Contents:

This course provides an introduction to digital image processing and machine vision. Topics: 1.Introduction, 2.Image enhancement, 3.Image restoration, 4. Color image processing, 5. Wavelets, 6. Image compression,7. Morphological image processing, 8. Image segmentation, 9. Representations and descriptions, 10. Pattern recognition.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 24 h, exercises 14 h and Matlab design exercises 30 h. The rest as independent work.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

In order to obtain deep understanding of the content, it is a benefit if the student has completed the first year mathematic courses in the computer science and engineering BSc program or otherwise has equivalent knowledge.

Recommended or required reading:

Gonzalez, R.C., Woods, R.E.: Digital Image Processing, Second Edition, Addison-Wesley, 2002 (see course website: http://www.ee.oulu.fi/research/imag/courses/dkk/). Lecture notes and exercise material.

Assessment methods and criteria:

The course is passed by a final exam and programming exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Janne Heikkilä

Working life cooperation:

None.

521259S: Digital Video Processing, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521279S: Signal Processing Systems, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Esa Rahtu
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English

Timing:

Autumn, period 1.

Learning outcomes:

1. Student can explain the challenges of signal processing hardware, software, and design methodologies.

2. Student is able to transform a digital filter designed with floating point arithmetic into a fixed point precision implementation, optimizing the word lengths to achieve the performance specifications.

3. Student is able to explain the most important algorithm implementation structures and can identify their usage contexts.

4. Student has rudimentary practical skills in modeling, designing, and judging finite word length signal processing algorithms with Matlab and Simulink software tools.

Contents:

Binary and floating point arithmetic, DSP programming models and co-design, digital signal processors, algorithms and implementations, including CORDIC, transforms (FFT and DCT), multi-rate signal processing, polyphase filters, filter banks, adaptive algorithms and applications. The software environments of the course are Matlab with the Fixed Point Toolbox extension and Simulink with the DSP Blockset extension.

Mode of delivery:

Lectures, independent work, group work.

Learning activities and teaching methods:

The course consists of lectures (30 h) and design exercises (6-12 h). the rest as independent work (33h).

Target group:

Computer Science and Engineering students: This is an advanced-level course intended for masters-level students, especially to those that are specializing into signal processing. + Other Students of the University of Oulu.

Prerequisites and co-requisites:

521337A Digital Filters, 521267A Computer Engineering or 521286A Computer Systems, 8 ECTS cr or 521287A Introduction to Computer Systems, 5 ECTS cr

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

Lecture notes and exercise materials. Material is in English.

Assessment methods and criteria:

Final exam and approved design exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Esa Rahtu

Working life cooperation:

None.

521273S: Biosignal Processing I, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English. Examination can be taken in English or Finnish.

Timing:

The course unit is held in the autumn semester, during period II. It is recommended to complete the course at the end of studies.

Learning outcomes:

1. knows special characteristics of the biosignals and typical signal processing methods

2. can solve small-scale problems related to biosignal analysis

3. implement small-scale software for signal processing algorithms

Contents:

Biomedical signals. Digital filtering. Analysis in time-domain and frequency domain. Nonstationarity. Event detection. Signal characterization.

Mode of delivery:

Face-to-face teaching and guided laboratory work.

Learning activities and teaching methods:

Lectures 10h, Laboratory work 20h, Self-study 20h, written examination.

Target group:

Students interested in biomedical engineering, at their master’s level studies.
Students of the University of Oulu.

Prerequisites and co-requisites:

The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Programming skills, especially basics of the Matlab. Basic knowledge of digital signal processing.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:

The course is based on selected chapters of the book "Biomedical Signal Analysis", R.M Rangayyan, 2nd edition (2015). + Lecture slides + Task assignment specific material.

Assessment methods and criteria:

Laboratory work is supervised by assistants who also check that the task assignments are completed properly. The course ends with a written exam. Read more about assessment criteria at the University of Oulu webpage.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Tapio Seppänen

Working life cooperation:

No.

521288S: Multiprocessor Programming, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Nyländen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521280S	DSP Laboratory Work	5.0 op

ECTS Credits:

5

Language of instruction:

English

Timing:

Periods 3-4

Learning outcomes:

The course concentrates on implementing basic algorithms and functions of digital signal processing using heterogeneous computing platforms.
After the course the student is able to use integrated design environments and OpenCL framework for designing, implementing and testing signal processing algorithms.

Contents:

Algorithm design, GPGPU, heterogeneous computing, OpenCL coding and optimization

Mode of delivery:

Starting lecture and independent exercises.

Learning activities and teaching methods:

The course is based on a starting lecture and exercises. The exercises are performed using desktop and mobile platforms featuring different type of accelerators, and the respective software development tools. The course is passed by accepted and documented exercises.

Target group:

Students interested in signal processing, processor architectures, embedded systems programming. Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

Digital filters, computer engineering, programming skills.

Recommended optional programme components:

Signal processing systems

Recommended or required reading:

Exercise instruction booklet, processor handbooks and development environment handbooks. All material is in English.

Assessment methods and criteria:

The exercises will be passed or failed according to the functionality and overall quality.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5; zero stands for a fail.

Person responsible:

Teemu Nyländen

Working life cooperation:

-

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

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/

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:
Matti Alatalo
Other information:
Course website

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

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 programmes 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:
Course website

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/

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 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 deep understanding of the structure of many-electron atoms and their electron-electron interactions and electron dynamics. The quantum mechanical formalisms are applied to the description of quantum states and transitions in a many-electron atoms. 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:
766326A Atomic physics 1 and 763312A Quantum mechanics I
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:
Course website

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/

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:
Kurssin sivu

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/

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:
Ilya Usoskin
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/766655S/

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/

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/

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/

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/

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/

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:
This course is aiming to give an overview of advances in materials characterization methods**.** Through the course, students are expect to master basic characterization methods, and correlate observed phenomena to materials properties. Techniques are dedicated to determinations of morphologies and electronic structures of bulk, nano-films as well as free and deposited clusters.
Contents:
The course will be focused on methods and special requirements on experimental researches in the field of materials science. The lessons and demonstration include principles related to conventional characterization methods,

microscopic detections, and the latest synchrotron-radiation-based techniques. Students will be guided to practice laboratory works of the vapor deposit sample growth system, morphological, and electronic structure measurements through SEM and the XPS. The course will also cover introduction to inorganic material growth methods, requirements to select different techniques, and physical insights within materials functionalities.
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 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
Other information:
Course website

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 programmes 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:
Course website

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 programmes 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:
Course website

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 programmes 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:
Course website

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 numerical methods in function interpolation, integration, derivation and solving sets of linear equations. The student knows how to solve the eigenvalues and eigenvectors of a symmetric matrix. 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 for differentiation, special functions, integration, derivation, interpolation and Fourier transform. Ordinary differential equations and differential equations with eigenvalues are solved. Algorithms for linear equations and matrix equations with eigenvalues are given. The programming language can be chosen freely. Examples are given in Fortran and Mathematica languages.
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:
Course website

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/

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/

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/

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

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/

H325115: Advanced studies in physics (Theoretical Physics), 45 - 999 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Study module

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Advanced Studies in Astronomy, at least 45 ECTS cr from the following

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:

Matti Alatalo

Working life cooperation:

No work placement period

Other information:

Course website

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

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:

Matti Alatalo

Working life cooperation:

No work placement period

Other information:

Course website

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/

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:

Erkki Thuneberg

Working life cooperation:

No work placement period

Other information:

Course website

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:

Course website

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:

Course website

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

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:

Course website

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 numerical methods in function interpolation, integration, derivation and solving sets of linear equations. The student knows how to solve the eigenvalues and eigenvectors of a symmetric matrix. 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 for differentiation, special functions, integration, derivation, interpolation and Fourier transform. Ordinary differential equations and differential equations with eigenvalues are solved. Algorithms for linear equations and matrix equations with eigenvalues are given. The programming language can be chosen freely. Examples are given in Fortran and Mathematica languages.

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:

Course website

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:

Course website

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:

Course website

Other Recommended advanced physics studies

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/

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/

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 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 deep understanding of the structure of many-electron atoms and their electron-electron interactions and electron dynamics. The quantum mechanical formalisms are applied to the description of quantum states and transitions in a many-electron atoms. 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:

766326A Atomic physics 1 and 763312A Quantum mechanics I

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:

Course website

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/

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/

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

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

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

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

Ei opintojaksokuvauksia.

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

Ei opintojaksokuvauksia.

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 20 h lectures, 10 h exercises and 50 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/

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/
In the autumn 2016, this course will be divided into two parts: 766385A B.Sc. thesis (6 credits) ja 766384A B.Sc. seminar (4 credits)

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 Introduction to biomedical physics.
Person responsible:
Kyösti Heimonen

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 28 h, 7 exercises (14 h), 2 laboratory exercises (8 h), self-study 83 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

766345A: Basics of space physics, 6 op

Voimassaolo: 01.12.2015 - 31.12.2018

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766355A	Basics of space physics	5.0 op

ECTS Credits:
6 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 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:
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:
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:
Course website
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 - 5th spring (organized only during even-numbered years or even more rarely)
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:
Kyösti Heimonen
Working life cooperation:
No work placement period
Other information:
Course website

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

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.

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 30 h, 6 exercises (12 h), 2 laboratory exercises (8 h), self-study 83 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/

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

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 (organized only during odd-numbered years or even more rarely)
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:
Kyösti Heimonen
Working life cooperation:
No work placement period
Other information:
Course website

766693S: Industrial physics, 5 op

Voimassaolo: 01.01.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits
Language of instruction:
Lectures either in Finnish or in English depending on the students. The lecture notes are written in English.
Timing:
Advanced studies, doctoral studies
Learning outcomes:

The student learns the methodologies of the industrial product development process and the basic principles how to productize physics research results.

Contents:

The course will consist of the methodologies used in physics research and product development and commercialization of physical instruments, sensors, components and system products. The course will cover e.g. product development process, innovation, quality systems and commercialization processes from the industrial physicist's point of view and aspects of the theory of instrumentation as a part of a company's quality system.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 16 h (8 x 2h). Excercises 4–6 times. Essee. Self-study. The first lecture on September 2016.

Target group:

Students interested industrial physics and product development.

Prerequisites and co-requisites:

Recommendable: most of the physics courses in intermediate level finalized.

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. Additional literature to be announced later.

Assessment methods and criteria:

Assessment methods and dates will be discussed at the first lecture. Lectures, excercises, essay, exam.

Grading:

Numerical grading scale 0 – 5, where 0 = fail.

Person responsible:

Panu Jalas (panu.jalas at oulu.fi)

Working life cooperation:

No work placement period.

Other information:

Course home page

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/

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:

Kyösti Heimonen
Working life cooperation:
Work placement period

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:
Kyösti Heimonen
Working life cooperation:
Work placement period

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/

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/

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:
Kyösti Heimonen
Working life cooperation:
No work placement period

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

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 (organized only rarely)
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:
Kyösti Heimonen
Working life cooperation:
No work placement period

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

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

766359A: Spectroscopic methods, 7 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761359A	Spectroscopic methods	5.0 op

ECTS Credits:
7 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 117 h
Target group:
Optional 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:
Course website

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:
Lectured in the spring of 2016.
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
Part 2: Juhani Lounila
Working life cooperation:

No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/766330A/etusivu

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:
NN
Working life cooperation:
No work placement period

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 30 h, exercises 10 h, 2 laboratory exercises (8 h), self-study 85 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:
Saana-Maija Huttula
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/761114p/etusivu