Opasraportti

FSci - Courses for exchange students, Physics (2020 - 2021)

University's new study guide for academic year 2020-2021 is published at https://opas.peppi.oulu.fi.

The study guide includes information on degrees, curriculums, courses and course timetables. Course registrations are still done in Oodi.

If you have questions on information in the study guide, please contact the study field's Academic Affairs Service Team https://www.oulu.fi/forstudents/faculty-study-affairs.

Courses in English for exchange students at the Field of Physics 2020-21

This Course Catalogue lists courses taught in English that are available for exchange students at the Field of Physics, Faculty of Science during academic year 2020-21.

When preparing your study plan please use the information provided under the **Courses** tab in this catalogue. Read carefully the information of each course you wish to take (language of instruction, target group, course content, timing, preceding studies, additional information etc.).

For information on the exchange application process please see www.oulu.fi/university/studentexchange. All exchange applicants must submit their exchange application through SoleMOVE by the deadline given, proposed study plan is attached to the on-line application.

Accepted exchange students are required to register to all courses. Course registration takes place once you have received your University of Oulu login information, this takes place close to the start of your exchange period. When registering you will be able to find detailed information on teaching and schedule under the **Instruction** tab.

Teaching periods for 2020-21
Autumn term 2020
Period 1: Sept 1 - Oct 25, 2020
Period 2: Oct 26 – Dec 18, 2020

Spring term 2021
Period 3: Jan 5 – March 14, 2021
Period 4: March 15 – May 9, 2021

For arrival and orientation dates see www.oulu.fi/university/studentexchange/academic-calender

Any questions on courses at the Field of Physics, Faculty of Science should be addressed to:

Outi Kivelä
study.science(at)oulu.fi

Further information on application process and services for incoming exchange students:
www.oulu.fi/university/studentexchange or international.office(at)oulu.fi

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

766674S: Applications of synchrotron radiation, 5 op
765642S: Astrophysics of Interacting Binary Stars, 5 op
766355A: Basics of space physics, 5 op
900013Y: Beginners' Finnish Course 1, 3 op
900053Y: Beginners' Finnish Course 2, 5 op
764639S: Cell membrane biophysics, 5 op
764339A: Cell membrane biophysics, 5 op
766663S: Computational physics and chemistry , 5 op
763628S: Condensed matter physics, 10 op
900054Y: Conversational Skills in Finnish, 3 op
761687S: Electromagnetic waves, 5 op
764635S: Electrophysiological recordings, 5 op
765309A: Galaxies, 5 op
766636S: Heliospheric physics, 10 op
900015Y: Intermediate Finnish Course 1, 5 op
900016Y: Intermediate Finnish Course 2, 5 op
761631S: Magnetospheric physics, 10 op
766667S: Modern characterization methods, 5 op
766666S: NMR spectroscopy , 10 op
765640S: Observational astronomy, 5 op
761685S: Optics, 5 op
763635S: Quantum information, 5 op
763312A: Quantum mechanics I, 10 op
763612S: Quantum mechanics I, 10 op
763613S: Quantum mechanics II, 10 op
763313A: Quantum mechanics II, 10 op
766662S: Radio waves in the ionosphere, 10 op
765307A: Research Project of Astronomy I, 5 op
766652S: Solar physics, 10 op
900027Y: Special Course in Finnish: Writing Skills, 3 op
900017Y: Survival Finnish, 2 op
766381A: Sustainable.now, 5 op
766673S: Synchrotron radiation, 5 op
767301A: Time Series Analysis in Astronomy, 5 op
767601S: Time Series Analysis in Astronomy, 5 op

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

766674S: Applications of synchrotron radiation, 5 op

Voimassaolo: 01.08.2020 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Lauri Hautala

Opintokohteen kielet: Finnish, English

ECTS Credits:
5 ECTS credits / 135 hours of work
Language of instruction:
Finnish or English depending on the students.
Timing:
The course is held in the autumn semester, during period 2 on even years. On odd years, the course can be completed with self-study as a book exam. It is recommended to complete the course during master's degree studies or at the end of bachelor's degree studies.
Learning outcomes:
After completing the course, the student:

- knows what kind of information synchrotron radiation-based materials characterization methods can provide, and
- understands on a general level how the presented characterization methods qualitatively function.

Contents:
The course deals with synchrotron radiation-based scattering, spectroscopic and imaging methods for materials characterization. Covering nearly 20 different methods, the course aims at providing a big picture of what is possible with synchrotron radiation. Course topics include e.g. structural characterization with scattering methods, composition and quantity characterization with spectroscopic methods, and different types of imaging methods which can provide three-dimensional structural and compositional information. The presented techniques are illustrated with examples from different fields of study.
Mode of delivery:
Online teaching
Learning activities and teaching methods:
The course consists primarily of self-study using the given videos, reading material and exercise problems. More detailed instructions will be given at the beginning of the course.
Target group:
Students in the physics degree program and anyone else who is interested to learn about materials characterization methods.
Prerequisites and co-requisites:
Basic and intermediate level courses in physics are useful. 766673S Synchrotron radiation 1 -course is also recommended but not absolutely necessary.
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 chapters 6-8 of the following book which is used as the main reading material:
An introduction to synchrotron radiation: Techniques and applications, Philip Willmott, 2nd edition, John Wiley & Sons, (2019).
Assessment methods and criteria:
The course utilizes continuous assessment which is based on completing the given assignments. More detailed instructions will be given at the beginning of the course.
Grading:
The course utilizes a numerical grading scale 0-5 where zero stands for a fail.
Person responsible:
Lauri Hautala
Working life cooperation:
The course does not contain working life cooperation.
Other information:
Timetables, further instructions and materials can be found from the course website in Moodle (moodle.oulu.fi).
766673S Synchrotron radiation 1 (5 ECTS) and 766674S Synchrotron radiation 2 (5 ECTS) courses will substitute the earlier held 766682S Synchrotron radiation techniques and applications (10 ECTS) course.

765642S: Astrophysics of Interacting Binary Stars, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Vitaly Neustroev

Opintokohteen kielet: English, Finnish

ECTS Credits:
5 ECTS 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 28 h, exercise sessions 6 h, home exercises (30% of the final score), short essay and presentation (20%)
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. Recommended: Stellar atmospheres, Time-series analysis in Astronomy.
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.
Assessment methods and criteria:
One written examination
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Vitaly Neustroev

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 ECTS credits
Language of instruction:
Finnish / English

Timing:
Every year.
Learning outcomes:
The student identifies and is capable of naming the basic concepts and processes of the Sun, solar wind, magnetosphere and ionosphere. She/he can explain the reasons for different phenomena in space physics and apply the theory to solve simple problems.
Contents:
This lecture course gives the basic knowledge of the processes taking place in the near-Earth space. In the interplanetary space, 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. Bursts of plasma and high-energy particles from the Sun cause disturbances in the surrounding space. These phenomena create the varying space weather. The space weather may affect e.g. telecommunication links, electrical power networks, operation of satellites and safety of astronauts. Northern lights is one form of space weather. This course deals the phenomena described above.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 28 h, exercises 14 h (7 pcs), 85 h of self-studies.
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 knowledge of mechanics and electromagnetism.
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 on Moodle).
Supporting material: H. Koskinen: Johdatus plasmafysiikkaan ja sen avaruussovellutuksiin (Limes ry); A. Brekke: Physics of the upper polar atmosphere (Wiley & Sons).
Assessment methods and criteria:
Final examination, see details on course Moodle page.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Anita Aikio
Working life cooperation:
No work placement period

900013Y: Beginners' Finnish Course 1, 3 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay900013Y	Beginners' Finnish Course 1 (OPEN UNI)	2.0 op

Proficiency level:
A1 (target level A1.2)
Status:
The course is intended for the international students in every faculty of Oulu University.
Required proficiency level:
A1.1, Completion of the Survival Finnish course (900017Y) or the equivalent language skills.
ECTS Credits:
3 ECTS credits
Language of instruction:
As much Finnish as possible; English will be used as a help language.

Timing:
-
Learning outcomes:
By the end of the course the student can understand and use some familiar and common everyday expressions relating to her/himself and everyday situations. S/he can interact in a simple way provided the other person talks slowly and clearly and is willing to help. The student is able to read short simple texts and messages dealing with familiar topics. S/he also deepens her/his understanding of the Finnish language and communication styles.
Contents:
This is lower elementary course which aims to help students to learn communication skills in ordinary everyday situations. During the course, students broaden their vocabulary and knowledge of grammar and principles of pronunciation. They also practise to understand easy Finnish talk about everyday subjects, and reading and writing short and simple texts/messages.

The topics and communicative situations covered in the course are: talking about oneself, one's family, studies and daily routines, as well as asking about these things from other person; expressing opinions; food, drink and transactions in the grocery; accommodation and describing it; colours and adjectives.

The structures studied are: verb types, basics of the change of the consonants k, p and t in verbs and nouns, basics of the partitive and genitive cases, possessive structure, some declension types for nouns (word types) and the basics of the local cases.
Mode of delivery:
Contact teaching and guided self study
Learning activities and teaching methods:
Lessons 2 times a week (26 h, including the final exam) and guided self study (55 h)
Target group:
International degree and post-graduate degree students, exchange students and the staff members of the University.
Prerequisites and co-requisites:
Completion of the Survival Finnish Course
Recommended optional programme components:
-
Recommended or required reading:
Kuparinen, K. & Tapaninen, T. Oma suomi 1 (chapter 2 - 5)
Assessment methods and criteria:
Regular and active participation in the weekly lessons (twice a week), homework assignments and written exam at the end of the course will be observed in assessment.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grading scale is 1-5.
Person responsible:
Anne Koskela
Working life cooperation:
-
Other information:
Sign-up in WebOodi or Tuudo. The course will start right after the Survival Finnish course.

900053Y: Beginners' Finnish Course 2, 5 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay900053Y	Beginners' Finnish Course 2 (OPEN UNI)	4.0 op

Proficiency level:
A1.3
Status:

International degree and post-graduate degree students, exchange students and the staff members of the University.
Students of the Oulu University of Applied Sciences (OAMK) students and OAMK's international and exchange students may also participate to this cross-institutional study. The quota principle is as follows: at least two OAMK students in a course and if there are more places, they are filled according to the queuing principle.
See more information for OAMK students https://www.oulu.fi/forstudents/crossinstitutionalstudy.

Required proficiency level:
A1.2, completion of the Beginners' Finnish course 1 (900013Y) or the equivalent language skills.

ECTS Credits:
5 ECTS credits

Language of instruction:
As much Finnish as possible; English will be used as a help language.

Timing:
-

Learning outcomes:
By the end of the course the student can understand and use some very common everyday expressions and sentences. S/he can communicate in easy and routine tasks requiring a simple and direct exchange of information on familiar everyday matters. The student understands different kinds of short texts. S/he can for example locate important information in them. In addition, s/he has acquired more detailed knowledge of the language and culture.

Contents:
This is a post-elementary course. During the course students learn more about communication in ordinary everyday situations in Finnish. They also extend their vocabulary and knowledge of grammar. Students practise understanding simple Finnish talk and short texts.

The topics and communicative situations covered in the course are: talking about weather, carrying out transactions in clothing stores and at the doctor's, asking about location, asking for help/favours, expressing how you are feeling, writing an invitation and email; talking about past, describing people and things; seasons, the names of the months, travelling, vehicles, body parts, adjectives, food, drink and parties.
The structures studied are: the local cases, more about the change of the consonants k, p and t, more declension types for nouns (word types), nominative plural (basic form plural), basics of the imperfect (past tense of verbs), basics of the object cases, some postposition structures, some sentence types (predicative and necessity sentences).

Mode of delivery:
Contact teaching and quided self study

Learning activities and teaching methods:
Lessons 2 times a week (52 h, including the tests) and guided self study (83 h)

Target group:
International degree and post-graduate degree students, exchange students and the staff members of the University.
Students of the Oulu University of Applied Sciences (OAMK) students and OAMK's international and exchange students may also participate to this cross-institutional study. The quota principle is as follows: at least two OAMK students in a course and if there are more places, they are filled according to the queuing principle.
See more information for OAMK students https://www.oulu.fi/forstudents/crossinstitutionalstudy.

Prerequisites and co-requisites:
Completion of the Beginners' Finnish Course 1 or the equivalent language skills.

Recommended optional programme components:
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Recommended or required reading:
Kuparinen, K. & Tapaninen, T. Oma suomi 1 (chapters 6 - 10)

Assessment methods and criteria:
Regular and active participation in the weekly lessons (twice a week), homework assignments and tests will be taken into consideration in the assessment.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
Grading scale is 1-5.

Person responsible:
Arja Haapakoski

Working life cooperation:
-

Other information:
Sign-up in WebOodi or Tuudo. Staff members in staff training portal.

764639S: Cell membrane biophysics, 5 op

Voimassaolo: 01.01.2019 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opettajat: Kyösti Heimonen
Opintokohteen kielet: Finnish, English

ECTS Credits:
5 ECTS credits / 133 h of student work
Language of instruction:
English, if international students are present. Course materials are in English. Lectures take place in Finnish, if only Finnish-speaking students are present.
Timing:
The course is organized in the autumn semester, during period 2. It is recommended to take and complete the course during the 4th autumn. However, it is also possible to complete it already during the 3rd autumn.
Learning outcomes:
Upon completion of the course, the student is able to describe the basics of cell membrane and ion channel 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.
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 and its ion channels, their ion permeation and selectivity, ion channels function and kinetics. In addition, they will learn to know the theoretical basics of the electrophysiological cell membrane recording methods, especially voltage-clamp, and the biophysical models describing the electrical function of the cell membrane, especially the Hodgkin-Huxley model.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 28 h, calculation exercises 14 h, weekly assignments, self-study 91 h
Target group:
Students of Biomedical physics (voluntary in BSc minor, mandatory in MSc). Also the other students of the University of Oulu having necessary background knowledge.
Prerequisites and co-requisites:
Introduction to biomedical physics (764163P) and Foundations of cellular biophysics (764125P) are recommended to be completed before this course. In addition, completion or knowledge of basic university mathematics or calculus is recommended.
Recommended optional programme components:
Does not require additional studies at the same time.
Recommended or required reading:
Lecture handouts and scientific articles presented during the lectures. Recommended additional reading: D. Johnston, S. Wu: Foundations of Cellular Neurophysiology, MIT Press, Cambridge MA, 1995 (partly); B. Hille: Ion channels of excitable membranes, Sinauer Associates Inc., Sunderland, Massachusetts USA, 3rd edition, 2001 (partly).
Assessment methods and criteria:
Both written exam and home exam are mandatory to pass to complete the course. Also, students can earn extra points on top of passed exam points by solving and answering voluntary weekly assignments and calculation exercises evaluated by the teachers.
Grading:
Numerical grading scale 0 – 5, where 0 = fail.
Person responsible:
Kyösti Heimonen
Working life cooperation:
Does not contain working life cooperation.

764339A: Cell membrane biophysics, 5 op

Voimassaolo: 01.01.2019 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opettajat: Kyösti Heimonen
Opintokohteen kielet: English, Finnish

ECTS Credits:
5 ECTS credits / 133 h of student work
Language of instruction:
English, if international students are present. Course materials are in English. Lectures take place in Finnish, if only Finnish-speaking students are present.
Timing:
The course is organized in the autumn semester, during period 2. It is recommended to take and complete the course during the 4th autumn. However, it is also possible to complete it already during the 3rd autumn.
Learning outcomes:
Upon completion of the course, the student is able to describe the basics of cell membrane and ion channel 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.
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 and its ion channels, their ion permeation and selectivity, ion channels function and kinetics. In addition, they will learn to know the theoretical basics of the electrophysiological cell membrane recording methods, especially voltage-clamp, and the biophysical models describing the electrical function of the cell membrane, especially the Hodgkin-Huxley model.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 28 h, calculation exercises 14 h, weekly assignments, self-study 91 h
Target group:
Students of Biomedical physics (voluntary in BSc minor, mandatory in MSc). Also the other students of the University of Oulu having necessary background knowledge.
Prerequisites and co-requisites:
Introduction to biomedical physics (764163P) and Foundations of cellular biophysics (764125P) are recommended to be completed before this course. In addition, completion or knowledge of basic university mathematics or calculus is recommended.
Recommended optional programme components:
Does not require additional studies at the same time.
Recommended or required reading:
Lecture handouts and scientific articles presented during the lectures. Recommended additional reading: D. Johnston, S. Wu: Foundations of Cellular Neurophysiology, MIT Press, Cambridge MA, 1995 (partly); B. Hille: Ion channels of excitable membranes, Sinauer Associates Inc., Sunderland, Massachusetts USA, 3rd edition, 2001 (partly).
Assessment methods and criteria:
Both written exam and home exam are mandatory to pass to complete the course. Also, students can earn extra points on top of passed exam points by solving and answering voluntary weekly assignments and calculation exercises evaluated by the teachers.
Grading:
Numerical grading scale 0 – 5, where 0 = fail.
Person responsible:
Kyösti Heimonen
Working life cooperation:
Does not contain working life cooperation.

766663S: Computational physics and chemistry , 5 op

Voimassaolo: 01.08.2017 -
Opiskelumuoto: Advanced Studies
Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Perttu Lantto

Opintokohteen kielet: Finnish, English

ECTS Credits:
5 ECTS credits / 133 hours of work
Language of instruction:
English
Timing:
3.-4. period. Every second year (odd year), spring.
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.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 30 h, 4 practical works, self-study 103 h
Target group:
Advanced undergraduate students in physics, chemistry and materials sciences and graduate students.
Prerequisites and co-requisites:
Atomic Physics 1, Thermophysics, and Molecular Quantum Mechanics 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).
Assessment methods and criteria:
One written examination.
Grading:
Numerical grading scale 0 - 5, where 0 = fail
Person responsible:
Perttu Lantto
Working life cooperation:
No work placement period

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 ECTS 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.
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.

900054Y: Conversational Skills in Finnish, 3 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Proficiency level:
B1/B2 , according to the Common European Framework.
Status:
The course is intended for the international students in every faculty at the University of Oulu. Students of the Oulu University of Applied Sciences (OAMK) may also participate to this cross-institutional study. See courses, student quota and applying for OAMK students https://www.oulu.fi/forstudents/crossinstitutionalstudy.
Required proficiency level:
A2.2
Completion of Intermediate Finnish 2 (900016Y) or the equivalent language skills.
ECTS Credits:
3 ECTS credits
Language of instruction:

Finnish
Timing:
-
Learning outcomes:
By the end of the course the student can interact with a degree of fluency (and spontaneity) that makes regular interaction with native speakers quite possible. S/he can describe and explain (clearly and in detail) on a wide range of objects, experiences and events, dreams, hopes and ambitions. The student can bring out opinions, give reasons and explanations for them and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options. S/he is also able to give a (clear) prepared presentation and answer the questions posed by the audience.
Contents:
During the course students strengthen their communication skills in formal and informal situations. The goal is to activate the student's Finnish skills and encourage him/her to use them in different situations. There will be various types of situational dialogue, conversation and listening exercises in the course. In addition, students will conduct a short survey which will also be reported to other students in the class.
Mode of delivery:
Contact teaching and guided self study
Learning activities and teaching methods:
Lessons twice a week (28-30 h), group work (15 h) and guided self study (36 h)
Target group:
International degree and post-graduate degree students, exchange students and the staff members of the University. Students of the Oulu University of Applied Sciences (OAMK) may also participate to this cross-institutional study. See courses, student quota and applying for OAMK students https://www.oulu.fi/forstudents/crossinstitutionalstudy.
Prerequisites and co-requisites:
Completion of Intermediate Finnish 2 (900016Y) or equivalent skills
Recommended optional programme components:
-
Recommended or required reading:
Will be provided during the course.
Assessment methods and criteria:
To pass the course, students must attend class on a regular basis and complete group work tasks and homework assignments.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grading is on a pass/fail basis.
Person responsible:
Anne Koskela
Working life cooperation:
-
Other information:
Sign-up in WebOodi or Tuudo. Staff members in in staff training portal.

761687S: Electromagnetic waves, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Vaara, Juha Tapani

Opintokohteen kielet: English, Finnish

ECTS Credits:
5 ECTS credits / 133 hours of work
Language of instruction:
English
Timing:
Lectured every second year (odd years) in the spring term.
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. Suitable for teachers.

Contents:
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 30 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. Teacher students.

Prerequisites and co-requisites:
761312A Electromagnetism 2 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, chapters 10-14); F.H. Read, Electromagnetic Radiation (Wiley & Sons, chapters 3,4,8).

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

764635S: Electrophysiological recordings, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kyösti Heimonen, Esa-Ville Immonen

Opintokohteen kielet: Finnish, English

ECTS Credits:
5 ECTS credits

Language of instruction:
Finnish (depending on students also English)

Timing:
4th-5th spring (organized every second year or even less frequently)

Learning outcomes:
After taking the course student can describe the principles of the included electrophysiological methods and their benefits and limitations. The student can also analyze some of the results produced during the recordings. In addition, the student has successfully done all the central work phases of the methods in question, and thus, is able to continue to further practice them independently when necessary.

Contents:
The course provides theoretical and hands-on practical introduction on the electrophysiological methods (e.g. intra- and/or extracellular as well as patch-clamp recordings) that enable recording of electrical signals generated by the nervous system and muscle cells. During the laboratory exercises students do all work phases of the methods in question and learn to know the function and usage of the electrophysiological setups used.

Mode of delivery:
Individual teaching

Learning activities and teaching methods:
15 h of laboratory demonstrations, 30 h of practical lab-work, and 90 h of self-study

Target group:

Organized on the basis of need and a separate agreement for the 4th year or older biomedical physics MSc or PhD students.
Prerequisites and co-requisites:
764338A Basic neuroscience and 764639S Cell membrane biophysics are highly recommended to be done before this course, and when possible 764680S Neural information processing is useful to be done before this as well.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously.
Recommended or required reading:
Materials are agreed upon and given to the students based on each course separately.
Assessment methods and criteria:
Practical laboratory skills, work reports and an oral examination.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Esa-Ville Immonen, Kyösti Heimonen
Working life cooperation:
No work placement period
Other information:
(A Moodle page to be done later)

765309A: Galaxies, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Leikkaavuudet:

765630S	Galaxies	6.0 op
765330A	Galaxies and cosmology	6.0 op

ECTS Credits:
5 ECTS credits / 133 hour of work
Language of instruction:
English
Timing:
2nd - 4th year, period 2.
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 of course units that should be completed simultaneuously.
Recommended or required reading:

Sparke, L., Gallagher, J.: Galaxies in the Universe, Cambridge, 2nd ed., 2007.
Assessment methods and criteria:
One written examination.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Aku Venhola, Joachim Janz
Working life cooperation:
No work placement period

766636S: Heliospheric physics, 10 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Mursula, Kalevi Juhani

Opintokohteen kielet: English, Finnish

ECTS Credits:
10 ECTS 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.
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.

900015Y: Intermediate Finnish Course 1, 5 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay900015Y Intermediate Finnish Course 1 (OPEN UNI) 4.0 op

Proficiency level:
A2.1
Status:
The course is intended for the international students in every faculty at the University of Oulu.
Required proficiency level:
A1.3, Completion of the Beginners' Finnish course 2 (900053Y) or the equivalent language skills.
ECTS Credits:
5 ECTS credits
Language of instruction:
Mainly Finnish
Timing:
-
Learning outcomes:
By the end of the course the student can communicate in ordinary everyday situations when the topics are familiar or connected with everyday matters. S/he can search for and locate key informational content in different kinds of texts. The student can also identify the topic and some details of the discussion around her/him. S/he can describe activities and personal experiences both orally and in writing and s/he also knows the difference between spoken/colloquial and written/standard language. The student knows how things can be expressed with different degrees of politeness and can apply that information in her/his own communication.
Contents:
The course is a lower intermediate course. During the course students strengthen their communication skills in ordinary everyday situations and acquire a wider vocabulary and more thorough knowledge of grammar. In addition, students practise understanding and producing Finnish talk and reading newspaper articles.

The topics and communicative situations covered in the course are: requesting different kinds of requests, expressing politeness, making appointments with friends, giving directions, doing the shopping, talking about the past and talking about his/her future plans, hobbies, transactions e.g. in the doctor's and post office.

The structures studied are: more about the imperative, the verb rections, the deverbal noun (-minen), passive present tense, part of the plural declension of nouns, the third infinitive (ma-infinitive), more about sentence types, perfect tense, more about object cases.
Mode of delivery:
Contact teaching and guided self-study.
Learning activities and teaching methods:
Lessons 2 times a week (52 h, including the tests) and guided self-study (83 h)
Target group:
International degree and post-graduate degree students, exchange students and the staff members of the University
Prerequisites and co-requisites:
Completion of the Beginners' Finnish Course 2
Recommended optional programme components:
-
Recommended or required reading:

Gehring, S. & Heinzmann, S.: **Suomen mestari 2,** (chapters 1 - 5)
Assessment methods and criteria:
Regular and active participation in the weekly lessons (twice a week), homework assignments and the tests will be taken into consideration in the assessment.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grading scale is 1-5.
Person responsible:
Anne Koskela
Working life cooperation:
-
Other information:
Sign-up in WebOodi or Tuudo.

900016Y: Intermediate Finnish Course 2, 5 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Proficiency level:
A2.2
Status:
The course is intended for the international students in every faculty at the University of Oulu.
Also students of the Oulu University of Applied Sciences (OAMK) may also participate to this cross-institutional study. See courses, student quota and applying for OAMK students https://www.oulu.fi/forstudents/crossinstitutionalstudy.
Required proficiency level:
A2.1, Completion of the Intermediate Finnish course 1 (900015Y) or the equivalent language skills.
ECTS Credits:
5 ECTS credits
Language of instruction:
Finnish
Timing:
-
Learning outcomes:
By the end of the course the student can communicate in various informal situations in Finnish. The student understands the main points of messages and talk around her/him. S/he can produce simple connected text on topics which are familiar or of personal interest and describe experiences and also report heard content to others.
Contents:
The course is an upper intermediate course. During the course students learn the necessary written and oral skills to be able to cope in informal situations arising during everyday life, work and study. In the course, students practise understanding more Finnish talk and written texts, and finding information and talking about it to other people. In the classes the main stress is on oral exercises and group work.
The topics and communicative situations covered in the course are: transactions e.g. in clothes shops and on the phone, Finnish small talk, reacting in different situations, information and facts about Finnish celebrations and features of colloquial/spoken language.
The structures studied are: the perfect and pluperfect, revision of all the verb tenses, comparison of adjectives, conditional, more about the plural declension of nouns (particularly the plural partitive case), more about object and predicative cases, the passive imperfect.
Mode of delivery:
Contact teaching and guided self-study
Learning activities and teaching methods:
Lessons (52 h, including the tests) and guided self-study (83 h).
Target group:
International degree and post-graduate degree students, exchange students and the staff members of the University.

Students of the Oulu University of Applied Sciences (OAMK) students and OAMK's international and exchange students may also participate to this cross-institutional study. The quota principle is as follows: at least two OAMK students in a course and if there are more places, they are filled according to the queuing principle.
See more information https://www.oulu.fi/forstudents/crossinstitutionalstudy.
Prerequisites and co-requisites:
Completion of the Intermediate Finnish Course 1 or equivalent skills
Recommended optional programme components:
-
Recommended or required reading:
Gehring, S. & Heinzmann, S.: **Suomen mestari 2 (chapters 6 - 8).**
Assessment methods and criteria:
Regular and active participation in the weekly lessons (twice a week), homework assignments and the tests will be taken into consideration in the assessment.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grading scale is 1-5.
Person responsible:
Anne Koskela
Working life cooperation:
-
Other information:
Sign-up in WebOodi or Tuudo.

761631S: Magnetospheric physics, 10 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Timo Asikainen

Opintokohteen kielet: English, Finnish

ECTS Credits:
10 ECTS 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: T. Asikainen, Magnetospheric physics.

Assessment methods and criteria:
One written examination.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Timo Asikainen
Working life cooperation:
No work placement period

766667S: Modern characterization methods, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Wei Cao

Opintokohteen kielet: English, Finnish

ECTS Credits:
5 ECTS 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

766666S: NMR spectroscopy , 10 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ville-Veikko Telkki

Opintokohteen kielet: English, Finnish

ECTS Credits:
10 ECTS 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 52 h, exercises and demonstrations 24 h, self-study 190 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:
Ei vaihtoehtoisia tai samanaikaisesti suoritettavia opintojaksoja.
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).

Assessment methods and criteria:
One written examination.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Ville-Veikko Telkki
Working life cooperation:

Ei sisällä työharjoittelua.

765640S: Observational astronomy, 5 op

Voimassaolo: 01.08.2020 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opettajat: Vitaly Neustroev
Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work
Language of instruction:
English
Timing:
Not lecturerd 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 24 h, exercises 8 h, 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:
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 - Birney, D. S., Gonzalez, G. & Oesper, D.: Observational Astronomy (2nd Edition - 2006).
Assessment methods and criteria:
One written examination
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Vitaly Neustroev
Working life cooperation:
No work placement period.

761685S: Optics, 5 op

Voimassaolo: 01.08.2017 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail

Opettajat: Seppo Alanko

Opintokohteen kielet: Finnish

Leikkaavuudet:

761665S Optics 6.0 op

ECTS Credits:
5 ECTS credits
Language of instruction:
English / Finnish.
Timing:
Twice every year, periods 1 and 3.
Learning outcomes:
The course deepens and broadens the knowledge provided by the subject level course Wave motion and optics. After completing the course the student will be able to grasp the issues of modern optics and apply her/his knowledge in the field of optics education, research and industry.
Contents:
Electromagnetic theory, photons and light, The propagation of light, Polarization, Interference, Diffraction, Basics of coherence theory, Lasers and laserlight.
Mode of delivery:
Moodle-based self-study and exam
Target group:
The course is for students of the Master's program in Physics. The course is also suitable for further training of persons applying optics in industry, research or teaching.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously.
Recommended or required reading:
Optics by Eugene Hecht
Assessment methods and criteria:
Continuous evaluation and final examination.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Seppo Alanko
Working life cooperation:
The course does not contain working life cooperation.
Other information:
moodle.oulu.fi

763635S: Quantum information, 5 op

Voimassaolo: 01.01.2019 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Matti Silveri

Opintokohteen kielet: Finnish, English

ECTS Credits:
5 ECTS credits / 135 hours of work
Language of instruction:
English
Timing:
The course is held in the autumn semester, during period 1. It is recommended to complete the course during the MSc phase of studies.
Learning outcomes:
Upon completion of the course, the student will be able to:
* understand and apply the central concepts of quantum mechanics such as entanglement, no-cloning theorem, and unitary operations with qubits

* knows how quantum communication and quantum cryptography works through quantum teleportation and BB84 protocols
* knows principles of quantum computation based on quantum mechanical search and simulation algorithms
* knows basics of quantum error correction
* is able to explain what are the modern materials and platforms used to pursuit future quantum technologies and quantum computers

Contents:
Introduction to quantum mechanical communication, crytography, computation and quantum error correction through elementary algorithms and protocols. Furthermore, the course gives an overview on the modern materials and platforms of quantum technologies.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 26 h, exercises 14 h, group work 10 h, self-study 85 h
Target group:
Advanced undergraduate and beginning graduate students of physics. Everyone, who is interested in quantum information.
Prerequisites and co-requisites:
The recommended prerequisite is the courses of 763312A/763612S Quantum mechanics I and 763313A /763613S Quantum mechanics II or corresponding knowledge.
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
Assessment methods and criteria:
Final examination.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Matti Silveri
Working life cooperation:
The course does not contain working life cooperation.

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 ECTS credits
Language of instruction:
Finnish / English depending on the audience
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 classical state of the particles 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. 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. The properties of the general theory are illustrated in terms of the two quantum paradigms: the two-level system and the
harmonic oscillator.
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).
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

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 ECTS credits
Language of instruction:
Finnish / English depending on the audience
Timing:
First and second period, 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 classical state of the particles 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. 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. The properties of the general theory are illustrated in terms of the two quantum paradigms: the two-level system and the harmonic oscillator.

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).
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

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 ECTS credits
Language of instruction:
English (or Finnish, depending on the participants)
Timing:
3rd-4th period, 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:
Quantum mechanics of two and many particle systems is discussed in the context of, e.g.the periodic table of elements and the band structure of solids. 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 such as 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).
Assessment methods and criteria:
Two written intermediate examinations or one final examination.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Matti Silveri
Working life cooperation:
No work placement period

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 ECTS 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:
Quantum mechanics of two and many particle systems is discussed in the context of, e.g.the periodic table of elements and the band structure of solids. 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 such as 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).
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 Silveri
Working life cooperation:
No work placement period

766662S: Radio waves in the ionosphere, 10 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Anita Aikio

Opintokohteen kielet: Finnish, English

ECTS Credits:
10 ECTS credits
Language of instruction:
English or Finnish (depending on participants)
Timing:
Lectured every 2-3 year
Learning outcomes:
After passing the course, the student knows the ionospheric regions and can study theoretically how radio waves propagate in the ionosphere. The student can also describe how the scientific radiowave-based instruments, like the ionosonde, riometer and incoherent scatter radar, work and utilize the knowledge in space physics research.
Contents:
The first part of the course contains a short description of the Earth's ionosphere and its variability, basic theory of radio waves, radio wave propagation in the ionosphere, Appleton-Hartree equation, ionospheric sounding and ionosonde, and principle of a riometer. The second part of the course discusses first radars including basics of signal theory, radar antennas, and principle of a radar. The focus is then shifted to incoherent scatter radars, including theory of radiowave scattering in an ionized medium, ion acoustic and Langmuir waves, incoherent scatter spectrum shape, and plasma parameter estimation from spectra.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
40 h lectures, 16 h exercises, 157 h independent studying
Target group:
Primarily for the students of the degree programme in physics, specifically space physics students. Also for the other students of the University of Oulu that are interested in the topic.
Assessment methods and criteria:
Final examination
Grading:
The course utilizes a numerical grading scale 0-5. In the numerical scale zero stands for a fail.

Person responsible:
Anita Aikio

765307A: Research Project of Astronomy I, 5 op

Voimassaolo: 01.08.2017 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opettajat: Heikki Salo
Opintokohteen kielet: Finnish
Leikkaavuudet:

765332A	Study project in astronomy 1	5.0 op
765332A-01	Data processing in astronomy	0.0 op
765332A-02	Study project	0.0 op
765135P	Data processing in astronomy	2.0 op

ECTS Credits:
5 ECTS credits / 133 hours of work
Language of instruction:
Finnish or English
Timing:
3rd-4th period, 2nd Spring
Learning outcomes:
Student is able to use computer in processing and visualizing astronomical data.
Mode of delivery:
Face-to-face teaching, independent study
Learning activities and teaching methods:
Lectures 21 h and study project, self-study 115 h
Target group:
Students in astronomy
Prerequisites and co-requisites:
No
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously.
Recommended or required reading:
Lecture material
Assessment methods and criteria:
Quality of the project report
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Heikki Salo, Vitaly Neustroev, Sebastien Comeron, Jürgen Schmidt, Aaron Watkins, Joachim Janz, Xiaodong Liu
Working life cooperation:
No

766652S: Solar physics, 10 op

Voimassaolo: 01.08.2020 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opettajat: Ilya Usoskin
Opintokohteen kielet: English, Finnish

ECTS Credits:
10 ECTS 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.
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:
Ilya Usoskin
Working life cooperation:
No work placement period.

900027Y: Special Course in Finnish: Writing Skills, 3 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Proficiency level:
B1/B2, according to the Common European Framework.
Status:
Course is intended for the international students in every faculty at the University of Oulu.
Students of the Oulu University of Applied Sciences (OAMK) students and OAMK's international and exchange students may also participate to this cross-institutional study. The quota principle is as follows: at least two OAMK students in a course and if there are more places, they are filled according to the queuing principle.See more information https://www.oulu.fi/forstudents/crossinstitutionalstudy.
Required proficiency level:

A2.2 Completion of the Finnish for Advanced Students (900020Y) or the equivalent language skills.
ECTS Credits:
3 ECTS credits
Language of instruction:
Finnish
Timing:
-
Learning outcomes:
By the end of the course the student can write coherent and detailed descriptions and summaries about various matters. S/he is able to summarize text and justify his/her own statements of opinions. In addition, the student knows the steps of the writing process and understands the significance of a text's function and target audience. S /he can also differentiate between formal and informal writing styles.
Contents:
During the course students develop their writing skills in Finnish and are guided in the drafting of different text types and documents needed in studies and work. In the course students learn how to write informal and formal letters, an argument-essay, a summary, a job application and a report.
Mode of delivery:
One contact lesson at the beginning of the course and guided independent studying using online
Learning activities and teaching methods:
The course will be held online using a Moodle environment.
Target group:
Course is intended for the international students in every faculty at the University of Oulu.
Students of the Oulu University of Applied Sciences (OAMK) students and OAMK's international and exchange students may also participate to this cross-institutional study. The quota principle is as follows: at least two OAMK students in a course and if there are more places, they are filled according to the queuing principle.See more information https://www.oulu.fi/forstudents/crossinstitutionalstudy.
Prerequisites and co-requisites:
Completion of the Intermediate Finnish Course 2
Recommended optional programme components:
-
Recommended or required reading:
Web based material in Moodle.
Assessment methods and criteria:
To pass the course, the student must complete all the required writing assignments.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grading is on a pass/fail basis.
Person responsible:
Anne Koskela
Working life cooperation:
-
Other information:
Sign-up in WebOodi or in Tuudo. Staff members in staff training portal.

900017Y: Survival Finnish, 2 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay900017Y	Survival Finnish Course (OPEN UNI)	2.0 op

Proficiency level:
A1.1
Status:
The course is intended for the international students in every faculty at the University of Oulu.
Required proficiency level:

No previous Finnish studies.
ECTS Credits:
2 ECTS cr
Language of instruction:
Finnish and English.
Timing:
-
Learning outcomes:
By the end of the course the student can understand and use some very common everyday expressions and phrases, and s/he can locate informational content in simple texts and messages. The student also knows the basic characteristics of Finnish language and Finnish communication styles.
Contents:
This is an introductory course which aims to help students to cope with the most common everyday situations in Finnish. During the course, students learn some useful everyday phrases, some general features of the vocabulary and grammar, and the main principles of pronunciation.

The topics and communicative situations covered in the course are: general information about the Finnish language, some politeness phrases (how to greet people, thank and apologize), introducing oneself, giving and asking for basic personal information, numbers, some time expressions (how to tell and ask the time, days of the week, time of day), food, drink and asking about prices.

The structures studied are: personal pronouns and their possessive forms, forming affirmative, negative and interrogative sentences, the conjugation of some verbs, the basics of the partitive singular and some local cases for answering the ‘where'-question.
Mode of delivery:
Contact teaching, on-line learning and independent work. There will be organized also one on-line group in each semester.
Learning activities and teaching methods:
Lessons 2 times a week (26 h, including the final exam) and guided self study (24 h).
Target group:
International degree and post-graduate degree students, exchange students and the staff members of the University.
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
Will be provided during the course.
Assessment methods and criteria:
Regular and active participation in the weekly lessons (twice a week), homework assignments and written exam at the end of the course will be observed in assessment.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grading scale is on a pass/fail basis.
Person responsible:
Arja Haapakoski
Working life cooperation:
-
Other information:
Sign-up in WebOodi or in Tuudo.

766381A: Sustainable.now, 5 op

Voimassaolo: 01.01.2020 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jussi Malila

Opintokohteen kielet: Finnish, English

ECTS Credits:
5 ECTS credits / 135 hours of work
Language of instruction:
Course will be given in Finnish and English
Timing:
The course is held during the 2nd period.
Learning outcomes:
1) The student understands the intersectional, partly contradictory, goals and interdimensionality of the climate challenge and the challenges of sustainable development.
2) After completing the course, students will be familiar with the multidisciplinary links between climate change and different goals of sustainable development, and will identify different tools for solving problems.
3) The student understands the importance of positivity and solution orientation both through the global responsibility of individuals and through the transformation of existing structures.
Mode of delivery:
Course will be delivered using blended teaching; it is possible to participate the course completely through web-based teaching.
Learning activities and teaching methods:
Course implementation is based on e-learning material available in DigiCampus-platform. Forms of teaching: contact teaching/alternative tasks 12 h / studying of electronic material 86 h / learning diary 14 h / group work 23 h.
Target group:
Course is open for all students.
Prerequisites and co-requisites:
No required prerequisite
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:
Learning material in DigiCampus.
Assessment methods and criteria:
Course assessment is based on the summary of the learning diary and group work.
Grading:
The course utilizes a numerical grading scale 0-5. In the numerical scale 0 stands for a fail.
Person responsible:
Jussi Malila
Working life cooperation:
Sustainability challenges processed during the group work can also come from working life.
Other information:
Please contact Person responsible for more information and registration for online course,

766673S: Synchrotron radiation, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Lauri Hautala

Opintokohteen kielet: Finnish, English

ECTS Credits:
5 ECTS credits / 135 hours of work
Language of instruction:
Finnish or English depending on the students.
Timing:
The course is held in the autumn semester, during period 1 on even years. On odd years, the course can be completed with self-study as a book exam. It is recommended to complete the course during master's degree studies or at the end of bachelor's degree studies.
Learning outcomes:
After completing the course, the student:

- can explain how x-rays interact with matter.
- knows the structure and function of modern synchrotron light source.
- knows how synchrotron radiation is produced and what properties it has.

Contents:
Synchrotron radiation is electromagnetic radiation produced by accelerated charged particles moving close to the speed of light. Synchrotron light sources and free-electron lasers are purpose-built facilities designed for production of synchrotron radiation which is especially applied to various material characterization needs. The course encompasses e.g. how synchrotron radiation is born, what properties it has, how x-rays interact with matter and what is the structure of a modern synchrotron light source. In addition, the course gives useful background information for the course 766674S Synchrotron radiation 2, which focuses on synchrotron radiation-based material characterization techniques and their applications.
Mode of delivery:
Online teaching
Learning activities and teaching methods:
The course consists primarily of self-study using the given videos, reading material and exercise problems. More detailed instructions will be given at the beginning of the course.
Target group:
Students in physics degree program. Other students studying in University of Oulu can also participate to the course.
Prerequisites and co-requisites:
Basic and intermediate studies in physics are recommended. Especially courses in atomic physics, electricity and magnetism, special relativity and optics can be helpful.
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 chapters 1-5 of the following book which is used as the main reading material:
An introduction to synchrotron radiation: Techniques and applications, Philip Willmott, 2nd edition, John Wiley & Sons, (2019).
Assessment methods and criteria:
The course utilizes continuous assessment which is based on completing the given assignments. More detailed instructions will be given at the beginning of the course.
Grading:
The course utilizes a numerical grading scale 0-5 where zero stands for a fail.
Person responsible:
Lauri Hautala
Working life cooperation:
The course does not contain working life cooperation.
Other information:
Timetables, further instructions and materials can be found from the course website in Moodle (moodle.oulu.fi).
766673S Synchrotron radiation 1 (5 ECTS) and 766674S Synchrotron radiation 2 (5 ECTS) courses will substitute the earlier held 766682S Synchrotron radiation techniques and applications (10 ECTS) course.

767301A: Time Series Analysis in Astronomy, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Vitaly Neustroev

Opintokohteen kielet: Finnish, English

Leikkaavuudet:

767601S	Time Series Analysis in Astronomy	5.0 op
765368A	Time Series Analysis in Astronomy	6.0 op
765668S	Time Series Analysis in Astronomy	6.0 op

ECTS Credits:
5 ECTS credits / 133 hours of work
Language of instruction:
English
Timing:
Not lectured every year, Period 4

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

767601S: Time Series Analysis in Astronomy, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Vitaly Neustroev

Opintokohteen kielet: English, Finnish

Leikkaavuudet:

767301A	Time Series Analysis in Astronomy	5.0 op
765368A	Time Series Analysis in Astronomy	6.0 op
765668S	Time Series Analysis in Astronomy	6.0 op

ECTS Credits:
5 ECTS credits / 133 hours of work
Language of instruction:
English
Timing:
Not lectured every year, Period 4
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.
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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