Opasraportti

FSci - Degree Programme in Mathematics and Physics (2018 - 2019)

Tutkintorakenteet

Bachelor of Science degree, Degree Programme in Mathematical and Physical Sciences, Major Subject in Mathematics or Physics or (teacher)

Tutkintorakenteen tila: published

Lukuvuosi: 2018-19

Lukuvuoden alkamispäivämäärä: 01.08.2018

General studies, Language and Communication Studies, Other Compulsory Studies (vähintään 10 op)

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

A300091: Language and Communication Studies, 0 op
- *Compulsory Studies*
  - 902002Y: English 1 (Reading for Academic Purposes), 2 op
  - 902004Y: English 2 (Scientific Communication), 2 op
  - 901034Y: Second Official Language (Swedish), Written Skills, 1 op
  - 901035Y: Second Official Language (Swedish), Oral Skills, 1 op
- *Optinal language and communication studies*
  - 901018Y: Brush-up Course in Swedish, 2 op

A300090: Other Studies, 0 op
- *Major subject in mathematics: select the code 800012Y. Major subject in physics: select the code 761010Y*
  - 761010Y: Orientation course for new students, 3 op
  - 800012Y: Orientation for New Students, 3 op
- *Compulsory Studies*
  - 030005P: Information Skills, 1 op
  - 521141P: Elementary Programming, 5 op
- *Optional courses*
  - 761013Y: Student tutoring, 2 op
  - 800009Y: Acting as a Student Tutor, 2 op
  - 300003Y: Activities in university and student organizations, 1 - 4 op

Major Subject in Mathematics or Physics, Orientatioin Studies

Recommended Studies for Teachers

Studies in Physics (vähintään 15 op)

Major Subject in Physics (teacher), Compulsory Studies in Physics

A325101: Physics, basic studies, 25 - 40 op
Studies in Physics
761108P: Physical world view, 5 op
761118P: Mechanics 1, 5 op
Compulsory
761118P-01: Mechanics 1, lectures and exam, 0 op
761118P-02: Mechanics 1, lab. exercises, 0 op
761115P: Laboratory Exercises in Physics 1, 5 op
761120P: Laboratory Exercises in Physics 2, 5 op
761119P: Electromagnetism 1, 5 op
A325102: Physics, intermediate studies, 35 - 60 op
Compulsory Studies
761312A: Electromagnetism 2, 5 op
761309A: Mechanics 2, 5 op
761313A: Atomic physics 1, 5 op
766344A: Nuclear and particle physics, 5 op
763343A: Solid state physics, 5 op
761314A: Thermophysics, 5 op
766384A: B.Sc. seminar, 4 op
766385A: B.Sc. thesis, 6 op
761386A: Maturity test, 0 op
761310A: Wave motion and optics, 5 op
Compulsory
761310A-01: Wave motion and optics, lectures and exam, 0 op
761310A-02: Wave motion and optics, lab. exercises, 0 op
Electives
761316A: Being a teacher in mathematical subjects, 5 op
761337A: Practical training, 3 - 6 op
764337A: Practical training, 3 - 9 op

Major Subject in Mathematics (teacher), Compulsory Studies in Physics

A325104: Physics Minor, 15 op
General Studies in Physics
761108P: Physical world view, 5 op
761118P: Mechanics 1, 5 op
Compulsory
761118P-01: Mechanics 1, lectures and exam, 0 op
761118P-02: Mechanics 1, lab. exercises, 0 op
761115P: Laboratory Exercises in Physics 1, 5 op
Optional studies in Physics. When you complete 25 ECTS cr from the physics. Choose the 2 courses below. (60 ECTS cr of minor subject are all selected below)
761119P: Electromagnetism 1, 5 op
761313A: Atomic physics 1, 5 op
761314A: Thermophysics, 5 op
761310A: Wave motion and optics, 5 op
Compulsory
761310A-01: Wave motion and optics, lectures and exam, 0 op
761310A-02: Wave motion and optics, lab. exercises, 0 op
If you want to complete 60 ECTS cr in physics. Choose all the courses below
761309A: Mechanics 2, 5 op
761120P: Laboratory Exercises in Physics 2, 5 op
761312A: Electromagnetism 2, 5 op
766344A: Nuclear and particle physics, 5 op
763343A: Solid state physics, 5 op
Obligatory for subject teacher
761316A: Being a teacher in mathematical subjects, 5 op

Studies in Mathematics (vähintään 45 op)

Major Subject in Mathematics (teacher), Compulsory Studies in Mathematics

A325001: Mathematics, basic studies, 25 op
Compulsory Studies
802151P: Introduction to mathematical deduction, 5 op
800119P: Functions and limit, 5 op
802120P: Introduction to Matrices, 5 op
806113P: Introduction to Statistics, 5 op
801195P: Probability Theory, 5 op
A325002: Mathematics, intermediate studies, 35 op
Compulsory Studies
800317A: Continuity and derivative, 5 op
800318A: Integral, 5 op
800328A: Calculus of several variables, 5 op
802320A: Linear Algebra, 5 op
802354A: Basics in Algebra, 5 op
802357A: Euclidean Spaces, 5 op
800331A: Proseminar, 10 op
800300A: Maturity test, 0 op
H325030: Optional studies in mathematics and statistics, 5 - 60 op
Electives
802355A: Algebraic Structures, 5 op
800321A: Series and Approximation, 5 op
802358A: Metric Spaces, 5 op
800320A: Differential equations, 5 op
801396A: Introduction to Probability Theory II, 5 op
800146P: Introduction to teaching, 5 op
802336A: Introduction to Cryptography, 5 op
801399A: Geometry, 5 op
802359A: Advanced Vector Calculus, 5 op
802328A: Basics in Number Theory, 5 op
802334A: A Second Course in Differential Equations, 5 op
031077P: Complex analysis, 5 op
802338A: Complex Analysis II, 5 op
031022P: Numerical Analysis, 5 op
802365A: Introduction to Mathematical Solfware, 5 op
802361A: Numerical Computation, 5 op
031025A: Introduction to Optimization, 5 op
031080A: Signal Analysis, 5 op
802322A: Basics in mathematical modelling, 5 op
805305A: Introduction to Regression and Analysis of Variance, 5 op
805306A: Introduction to Multivariate methods, 5 op
800324A: Practical training, 5 op

Studies in Mathematics, Major Subject in Physics (teacher)

A325004: Mathematics Minor, 25 - 120 op
General Studies in Mathematics (min 45 ECTS cr)
802151P: Introduction to mathematical deduction, 5 op
800119P: Functions and limit, 5 op
800317A: Continuity and derivative, 5 op
800318A: Integral, 5 op
802120P: Introduction to Matrices, 5 op
800328A: Calculus of several variables, 5 op
802320A: Linear Algebra, 5 op
806113P: Introduction to Statistics, 5 op
800320A: Differential equations, 5 op
These courses mandatory in Master studies if not included in Bachelor degree
802354A: Basics in Algebra, 5 op
801195P: Probability Theory, 5 op
802357A: Euclidean Spaces, 5 op
Electives
H325030: Optional studies in mathematics and statistics, 5 - 60 op
Electives

802355A: Algebraic Structures, 5 op
800321A: Series and Approximation, 5 op
802358A: Metric Spaces, 5 op
800320A: Differential equations, 5 op
801396A: Introduction to Probability Theory II, 5 op
800146P: Introduction to teaching, 5 op
802336A: Introduction to Cryptography, 5 op
801399A: Geometry, 5 op
802359A: Advanced Vector Calculus, 5 op
802328A: Basics in Number Theory, 5 op
802334A: A Second Course in Differential Equations, 5 op
031077P: Complex analysis, 5 op
802338A: Complex Analysis II, 5 op
031022P: Numerical Analysis, 5 op
802365A: Introduction to Mathematical Solfware, 5 op
802361A: Numerical Computation, 5 op
031025A: Introduction to Optimization, 5 op
031080A: Signal Analysis, 5 op
802322A: Basics in mathematical modelling, 5 op
805305A: Introduction to Regression and Analysis of Variance, 5 op
805306A: Introduction to Multivariate methods, 5 op
800324A: Practical training, 5 op

Minor subjects

See the study guide

Pedagogic studies for teacher (30 ECTS credits)

Minor in chemistry

Minor in computer science

Other minor studies

Optional courses

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

Bachelor of Science, Degree Programme in Mathematical and Physical Sciences, Major Subject in Physics or Mathematics (researcher)

Tutkintorakenteen tila: published

Lukuvuosi: 2018-19

Lukuvuoden alkamispäivämäärä: 01.08.2018

General studies, Language and Communication Studies, Other Compulsory Studies (vähintään 10 op)

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

A300091: Language and Communication Studies, 0 op
Compulsory Studies
902002Y: English 1 (Reading for Academic Purposes), 2 op

902004Y: English 2 (Scientific Communication), 2 op
901034Y: Second Official Language (Swedish), Written Skills, 1 op
901035Y: Second Official Language (Swedish), Oral Skills, 1 op
Optinal language and communication studies
901018Y: Brush-up Course in Swedish, 2 op
A300090: Other Studies, 0 op
Major subject in mathematics: select the code 800012Y. Major subject in physics: select the code 761010Y
761010Y: Orientation course for new students, 3 op
800012Y: Orientation for New Students, 3 op
Compulsory Studies
030005P: Information Skills, 1 op
521141P: Elementary Programming, 5 op
Optional courses
761013Y: Student tutoring, 2 op
800009Y: Acting as a Student Tutor, 2 op
300003Y: Activities in university and student organizations, 1 - 4 op

Studies in Physics (vähintään 15 op)

Major Subject in Physics, Compulsory Studies in Physics

A325101: Physics, basic studies, 25 - 40 op
Studies in Physics
761108P: Physical world view, 5 op
761118P: Mechanics 1, 5 op
Compulsory
761118P-01: Mechanics 1, lectures and exam, 0 op
761118P-02: Mechanics 1, lab. exercises, 0 op
761115P: Laboratory Exercises in Physics 1, 5 op
761120P: Laboratory Exercises in Physics 2, 5 op
761119P: Electromagnetism 1, 5 op
A325102: Physics, intermediate studies, 35 - 60 op
Compulsory Studies
761312A: Electromagnetism 2, 5 op
761309A: Mechanics 2, 5 op
761313A: Atomic physics 1, 5 op
766344A: Nuclear and particle physics, 5 op
763343A: Solid state physics, 5 op
761314A: Thermophysics, 5 op
766384A: B.Sc. seminar, 4 op
766385A: B.Sc. thesis, 6 op
761386A: Maturity test, 0 op
761310A: Wave motion and optics, 5 op
Compulsory
761310A-01: Wave motion and optics, lectures and exam, 0 op
761310A-02: Wave motion and optics, lab. exercises, 0 op
Electives
761316A: Being a teacher in mathematical subjects, 5 op
761337A: Practical training, 3 - 6 op
764337A: Practical training, 3 - 9 op

Marjor Subject in Mathematics, Compulsory Studies in Physics

A325104: Physics Minor, 15 op
General Studies in Physics
761108P: Physical world view, 5 op
761118P: Mechanics 1, 5 op
Compulsory
761118P-01: Mechanics 1, lectures and exam, 0 op
761118P-02: Mechanics 1, lab. exercises, 0 op
761115P: Laboratory Exercises in Physics 1, 5 op

Optional studies in Physics. When you complete 25 ECTS cr from the physics. Choose the 2 courses below. (60 ECTS cr of minor subject are all selected below)

761119P: Electromagnetism 1, 5 op
761313A: Atomic physics 1, 5 op
761314A: Thermophysics, 5 op
761310A: Wave motion and optics, 5 op

Compulsory

761310A-01: Wave motion and optics, lectures and exam, 0 op
761310A-02: Wave motion and optics, lab. exercises, 0 op

If you want to complete 60 ECTS cr in physics. Choose all the courses below

761309A: Mechanics 2, 5 op
761120P: Laboratory Exercises in Physics 2, 5 op
761312A: Electromagnetism 2, 5 op
766344A: Nuclear and particle physics, 5 op
763343A: Solid state physics, 5 op

Obligatory for subject teacher

761316A: Being a teacher in mathematical subjects, 5 op

Studies in Mathematics (45 - 70 op)

Major Subject in Physics, Compulsory Studies in Mathematics

A325004: Mathematics Minor, 25 - 120 op

General Studies in Mathematics (min 45 ECTS cr)

802151P: Introduction to mathematical deduction, 5 op
800119P: Functions and limit, 5 op
800317A: Continuity and derivative, 5 op
800318A: Integral, 5 op
802120P: Introduction to Matrices, 5 op
800328A: Calculus of several variables, 5 op
802320A: Linear Algebra, 5 op
806113P: Introduction to Statistics, 5 op
800320A: Differential equations, 5 op

These courses mandatory in Master studies if not included in Bachelor degree

802354A: Basics in Algebra, 5 op
801195P: Probability Theory, 5 op
802357A: Euclidean Spaces, 5 op

Electives

H325030: Optional studies in mathematics and statistics, 5 - 60 op

Electives

802355A: Algebraic Structures, 5 op
800321A: Series and Approximation, 5 op
802358A: Metric Spaces, 5 op
800320A: Differential equations, 5 op
801396A: Introduction to Probability Theory II, 5 op
800146P: Introduction to teaching, 5 op
802336A: Introduction to Cryptography, 5 op
801399A: Geometry, 5 op
802359A: Advanced Vector Calculus, 5 op
802328A: Basics in Number Theory, 5 op
802334A: A Second Course in Differential Equations, 5 op
031077P: Complex analysis, 5 op
802338A: Complex Analysis II, 5 op
031022P: Numerical Analysis, 5 op
802365A: Introduction to Mathematical Solfware, 5 op
802361A: Numerical Computation, 5 op
031025A: Introduction to Optimization, 5 op
031080A: Signal Analysis, 5 op
802322A: Basics in mathematical modelling, 5 op
805305A: Introduction to Regression and Analysis of Variance, 5 op
805306A: Introduction to Multivariate methods, 5 op
800324A: Practical training, 5 op

Major Subject in Mathematics, Compulsory Studies in Mathematics

A325001: Mathematics, basic studies, 25 op
Compulsory Studies
802151P: Introduction to mathematical deduction, 5 op
800119P: Functions and limit, 5 op
802120P: Introduction to Matrices, 5 op
806113P: Introduction to Statistics, 5 op
801195P: Probability Theory, 5 op
A325002: Mathematics, intermediate studies, 35 op
Compulsory Studies
800317A: Continuity and derivative, 5 op
800318A: Integral, 5 op
800328A: Calculus of several variables, 5 op
802320A: Linear Algebra, 5 op
802354A: Basics in Algebra, 5 op
802357A: Euclidean Spaces, 5 op
800331A: Proseminar, 10 op
800300A: Maturity test, 0 op
H325030: Optional studies in mathematics and statistics, 5 - 60 op
Electives
802355A: Algebraic Structures, 5 op
800321A: Series and Approximation, 5 op
802358A: Metric Spaces, 5 op
800320A: Differential equations, 5 op
801396A: Introduction to Probability Theory II, 5 op
800146P: Introduction to teaching, 5 op
802336A: Introduction to Cryptography, 5 op
801399A: Geometry, 5 op
802359A: Advanced Vector Calculus, 5 op
802328A: Basics in Number Theory, 5 op
802334A: A Second Course in Differential Equations, 5 op
031077P: Complex analysis, 5 op
802338A: Complex Analysis II, 5 op
031022P: Numerical Analysis, 5 op
802365A: Introduction to Mathematical Solfware, 5 op
802361A: Numerical Computation, 5 op
031025A: Introduction to Optimization, 5 op
031080A: Signal Analysis, 5 op
802322A: Basics in mathematical modelling, 5 op
805305A: Introduction to Regression and Analysis of Variance, 5 op
805306A: Introduction to Multivariate methods, 5 op
800324A: Practical training, 5 op

Orientation Studies (vähintään 25 op)

Major Subject in Mathematics. Orientation Mathematics (25 ECTS cr)

802355A: Algebraic Structures, 5 op
H325030: Optional studies in mathematics and statistics, 5 - 60 op
Electives
802355A: Algebraic Structures, 5 op
800321A: Series and Approximation, 5 op
802358A: Metric Spaces, 5 op
800320A: Differential equations, 5 op
801396A: Introduction to Probability Theory II, 5 op
800146P: Introduction to teaching, 5 op
802336A: Introduction to Cryptography, 5 op
801399A: Geometry, 5 op
802359A: Advanced Vector Calculus, 5 op
802328A: Basics in Number Theory, 5 op
802334A: A Second Course in Differential Equations, 5 op

031077P: Complex analysis, 5 op
802338A: Complex Analysis II, 5 op
031022P: Numerical Analysis, 5 op
802365A: Introduction to Mathematical Solfware, 5 op
802361A: Numerical Computation, 5 op
031025A: Introduction to Optimization, 5 op
031080A: Signal Analysis, 5 op
802322A: Basics in mathematical modelling, 5 op
805305A: Introduction to Regression and Analysis of Variance, 5 op
805306A: Introduction to Multivariate methods, 5 op
800324A: Practical training, 5 op
800321A: Series and Approximation, 5 op

Major Subject in Mathematics. Orientation Statistics (25 ECTS cr)

A326602: Statistics, intermediate studies, 35 op
Compulsory Studies
805305A: Introduction to Regression and Analysis of Variance, 5 op
805306A: Introduction to Multivariate methods, 5 op
Choose from the following 15 ECTS cr
805349A: Likelihood and Bayesian Inference, 5 op
805350A: Estimation and Test Theory, 5 op
805351A: Linear Regression, 5 op
805353A: Statistical Software, 5 op
801396A: Introduction to Probability Theory II, 5 op

Major Subject in Physics. Orientation General Physics (25 credits)

H325104: General Physics, 25 op
Basic and intermediate studies in general physics
766116P: Radiation physics, biology and safety, 5 op
761315A: Laboratory Exercises in Physics 3, 5 op
763312A: Quantum mechanics I, 10 op
At least one of the courses listed below must be chosen
766355A: Basics of space physics, 5 op
761359A: Spectroscopic methods, 5 op

Major Subject in Physics. Orientation Astronomy (25 ECTS credits)

A325704: Astronomy Minor, 25 - 40 op
Compulsory
765114P: Fundamentals of astronomy I, 5 op
765115P: Fundamentals of astronomy II, 5 op
765309A: Galaxies, 5 op
765384A: Physics of the solar system I, 5 op
Choose another: Major Students of Astronomy take 765307A Research project of astronomy and Minor Students of Astronomy take 765308A History of astronomy.
765307A: Research Project of Astronomy I, 5 op
765308A: History of astronomy, 5 op
Electives
765304A: Celestial mechanics I, 5 - 8 op
765386A: Interstellar Matter, 5 op
765358A: Cosmology, 5 op
765301A: Introduction to Nonlinear Dynamics, 5 op
767303A: Observational Astronomy I, 5 op
767302A: Physics of the solar system II, 5 op
767301A: Time Series Analysis in Astronomy, 5 op
767300A: Observational astronomy II, 5 op

Minor Subject in Physics. Orientation Theoretical Physics (25 ECTS credits)

A325304: Theoretical Physics Minor, 25 op
Intermediate studies in theoretical physics

763312A: Quantum mechanics I, 10 op
763313A: Quantum mechanics II, 10 op

Major Subject in Physics. Orientation Biomedical Physics (25 ECTS credits)

A326010: Biomedical Physics Minor, 25 op
Compulsory Studies (25 ECTS cr)
764163P: Introduction to Biomedical Physics, 5 op
764125P: Foundations of cellular biophysics, 5 op
766116P: Radiation physics, biology and safety, 5 op
761359A: Spectroscopic methods, 5 op
764338A: Basic Neuroscience, 5 op
Recommended Optional Studies
080925A: Anatomy and Physiology for Biomedical Engineering, 5 op
764322A: Cell membrane biophysics, 10 op
761317A: Numerical Programming, 5 op

Minor Subjects

The Bachelor's degree can also be included as a minor subject in the teaching pedagogical studies 30 ECTS cr.

A minor subject notation can be given to study modules that are worth at least 15 credits.

Biomedical engineering (BME)

A300006: Medical Engineering Minor, 15 - 25 op
Alternative studies, if they are not included already in other subjects.
031022P: Numerical Analysis, 5 op
031077P: Complex analysis, 5 op
080925A: Anatomy and Physiology for Biomedical Engineering, 5 op
764327A: Virtual measurement environments, 5 op
080901A: Introduction to Technology in Clinical Medicine, 5 op
521242A: Introduction to Biomedical Engineering, 5 op
031080A: Signal Analysis, 5 op
080926A: Introduction to Biomedical Imaging Methods, 1 - 3 op
Electives
521273S: Biosignal Processing I, 5 op
521282S: Biosignal Processing II, 5 op
521093S: Biomedical Instrumentation, 5 op
521124S: Sensors and Measuring Techniques, 5 op
521240S: Biophotonics and Biomedical Optics, 5 op
080915S: Tissue Biomechanics, 5 op
080916S: Biomechanics of Human Movement, 5 op

Computer science for students of data science (minor studies)

Minor in computer science and engineering

Minor in Computer science

Minor in Chemistry

Pedagogical Studies

Other Minor Studies

Optional courses

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

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

806119P: A Second Course in Statistics, 5 op
763314A: Analytical mechanics, 5 op
801389A: Basic Geometry, 6 op
802339A: Basic course in inverse problems, 5 op
802159P: Basic method in Analysis for Economic Sciences, 5 op
805352A: Generalized Linear Models, 5 op
800149P: Introduction to LateX, 2 op
806354A: Introduction to Sampling Methods, 4 op
806118P: Introduction to Statistics, 5 op
802158P: Mathematics for Economic Sciences, 7 op
802160P: Matrices and optimization for Economic Sciences, 5 op
802333A: Permutations, Fields and Galois Theory, 10 op
805331A: Project seminar I, 6 op
801323A: Seminar, 6 op
806361A: Statistical analysis with missing data, 5 op
805309A: Statistical methods in epidemiology, 9 op
806116P: Statistics for Economic Sciences, 5 op
805324A: Time series analysis, 5 op

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuuluvien opintokohteiden kuvaukset

A300091: Language and Communication Studies, 0 op

Opiskelumuoto: Language and Communication Studies
Laji: Study module
Vastuuyksikkö: Faculty of Science
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.

Compulsory Studies

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

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

Opintokohteen kielet: English

Proficiency level:

B2/C1 on the Common European Framework of Reference scale.

Status:

This course is mandatory for students who choose English as their foreign language in the following B.Sc. degree programmes:
Faculty of Natural Sciences
•Biology
•Mathematical and Physical Sciences

Faculty of Technology
•Department of Chemistry
Oulu Mining School
•Geosciences degree programme

Please consult your faculty's Study Guide to establish the language requirements for your own degree program.

Required proficiency level:

English must have been the A1 or A2 language at school or equivalent English skills should have been acquired otherwise.

ECTS Credits:

2 ECTS / 54 hours of work

Language of instruction:

English

Timing:

Biology: 1st year spring term (periods 3 and 4)
Mathematical and Physical Sciences: 1st year autumn term (periods 1 and 2)
Chemistry: 1st year autumn term (periods 1 and 2)
Geosciences: 1st year spring term (periods 3 and 4)

Learning outcomes:

By the end of the course, you are expected to

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

Contents:

The course will focus on reading strategies; these include recognising how texts are organised, identifying key points in a text, and understanding words in context. Vocabulary work in the course will focus on: a) academic vocabulary, as used in formal scientific writing, and b) using your knowledge of the meanings of parts of words (affixes) to infer meaning.

Mode of delivery:

Contact teaching and independent study

Learning activities and teaching methods:

The English 1 course is adapted to accommodate many different fields of study, and thus the materials and implementation methods of the course vary. There will be 26 hours of guided teaching events and 28 hours of independent study, either individually or in a group. A more detailed course description and list of homework tasks will be provided by the teacher.

Target group:

Faculty of Natural Sciences: Biology, Mathematical & Physical Sciences
Faculty of Technology: Chemistry
Oulu Mining School: Geosciences

Prerequisites and co-requisites:

-

Recommended optional programme components:

Students are also required to take English 2 902004Y, or English 4 902005Y, AFTER completion of this course.

Recommended or required reading:

Course materials will be provided in electronic form or will be accessible from the university library.

Assessment methods and criteria:

Student work is monitored by continuous assessment, and students are required to participate regularly and actively in all contact teaching provided. During the course, there will be three monthly tests on material covered so far. The assessment of the course is based on the learning outcomes listed above. Read more about assessment criteria at the University of Oulu webpage.

Grading:

Pass/Fail

Person responsible:

Karen Niskanen

Working life cooperation:

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Other information:

N.B. Students with grades *laudatur* or *eximia* in their A1 English school-leaving examination can be exempted from this course and will be granted the credits. Please contact your own faculty for information.

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

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Leikkaavuudet:

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

Proficiency level:

B2/C1 on the Common European Framework of Reference scale.

Status:

This course is mandatory for students who choose English as their foreign language in the following B.Sc. degree programmes:
Faculty of Natural Sciences:
Biology
Mathematical & Physical Sciences

Faculty of Technology:
Chemistry
Oulu Mining School:
Geoscience degree programme

Note: Information Processing Science students who began their studies in autumn 2017 or later will take English 4 instead.
Please consult your faculty's study guide to establish the language requirements of your own degree programme.

Required proficiency level:

Students taking this course must have had English as the A1 or A2 language at school or have equivalent skills. The course English 1 (902002Y) is a pre-requisite, unless exempted.

ECTS Credits:

2 ECTS credits / 54 hours work.

Language of instruction:

English

Timing:

Biology: 2nd year autumn term (periods 1 and 2)
Mathematic and Physical Sciences 1st year spring term (periods 3 and 4)

Chemistry: 2nd year spring term (periods 3 and 4)
Geosciences: 2nd year spring term (periods 3 and 4)

Learning outcomes:

By the end of the course, you are expected to have demonstrated the ability to:

- **use appropriate strategies and techniques for communicating effectively** in English in an academic context
- **prepare and present scientific subjects** to your classmates, using appropriate field-related vocabulary.

Contents:

Skills in listening, speaking, and presenting academic topics are practised in the classroom, where there is an emphasis on working in pairs and small groups. Homework is given to support the classroom learning.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

The English 2 course is tailored to the needs of students in different fields of study, and thus the materials and implementation methods of the course vary between groups. The teacher will provide a more detailed schedule and list of homework tasks. There will be 26 hours of guided teaching events and 28 hours of independent work, including both individual and group work.
Individual learning methods: autonomous learning tasks, practice in lecture listening and written tasks in preparation for classroom lessons
Group work: Preparation of presentations in groups

Target group:

2nd year students of Biology, Chemistry, Geoscience
1st year students of Mathematical and Physical Sciences (new programme)

Prerequisites and co-requisites:

Pre-requisite course: 902002Y Englannin kieli 1

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Continuous assessment is based on regular attendance, active participation in all lessons and the successful completion of all homework tasks.
The assessment of the course is based on the learning outcomes of the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Pass / fail.

Person responsible:

Karen Niskanen

Working life cooperation:

-

Other information:

-

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

Voimassaolo: 01.08.2014 -
Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Opintokohteen kielet: Swedish
Leikkaavuudet:

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

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

Voimassaolo: 01.08.2014 -
Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Opintokohteen kielet: Swedish
Leikkaavuudet:

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

Optinal language and communication studies

901018Y: Brush-up Course in Swedish, 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:

ay901018Y Brush-up Course in Swedish (OPEN UNI) 2.0 op

Voidaan suorittaa useasti: Kyllä

Proficiency level:

-

Status:

For students whose proxiciency level in Swedish is not sufficient.

Required proficiency level:

See status

ECTS Credits:

2 ECTS credits

Language of instruction:

Swedish and Finnish

Timing:

before the obligatory Swedish course, see Status

Learning outcomes:

See Contents

Contents:

Throughout the course unit the student brushes up on his/her Swedish skills. Various oral and written exercises aim to improve his/her command of essential grammatical structures and vocabulary and his/her ability to understand spoken Swedish.

Mode of delivery:

contact teaching

Learning activities and teaching methods:

Contact teaching and independent study.

Target group:

See Status

Prerequisites and co-requisites:

See Status

Recommended optional programme components:

before the obligatory Swedish course, see Status

Recommended or required reading:

Will be agreed on in the class.

Assessment methods and criteria:

Active participation and a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

pass / fail

Person responsible:

See Contact teachers

Working life cooperation:

-

Other information:

Registration in WebOodi. Registration is binding and cancellation is subject to a charge unless done before the registration closes.
This course is also offered by the Summer University.

A300090: Other Studies, 0 op

Opiskelumuoto: Other Studies

Laji: Study module

Vastuuyksikkö: Faculty of Science

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.

Major subject in mathematics: select the code 800012Y. Major subject in physics: select the code 761010Y

761010Y: Orientation course for new students, 3 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: General Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Seppo Alanko

Opintokohteen kielet: Finnish

Leikkaavuudet:

761011Y Orientation course for new students 2.0 op

761011Y-01 Orientation course, Small groups 0.0 op

761011Y-02 Orientation course, Research groups 0.0 op

ECTS Credits:

3 ECTS credits / 80 hours of work

Language of instruction:

Finnish

Timing:

1 st autumn

Learning outcomes:

After the course, the student is able to plan her/his studies and find answers to questions regarding teaching and studying.

Contents:

During the course, older students introduce the new students to the studying environment and the university organization, provide information on the subject matters, aims and prospects related to the field of study, and help with the practical issues connected to the beginning of the studies. The course includes an introduction to different profiles in the degree programme, teacher tutor meetings and guidance for making a personal study plan.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Group work 10-15 h, lectures 10 h, teacher tutor meetings

Target group:

Students in mathematical and physical sciences

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

Coincides with 800012Y

Recommended or required reading:

Handouts

Assessment methods and criteria:

Participation to meetings, producing a personal study plan.

Grading:

pass/fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

800012Y: Orientation for New Students, 3 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: General Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

3 ECTS credits / 80 hours of work

Language of instruction:

Finnish

Timing:

1 st autumn

Learning outcomes:

After the course, the student is able to plan her/his studies and find answers to questions regarding teaching and studying.

Contents:

During the course, older students introduce the new students to the studying environment and the university organization, provide information on the subject matters, aims and prospects related to the field of study, and help with the practical issues connected to the beginning of the studies. The course includes an introduction to different profiles in the degree programme, teacher tutor meetings and guidance for making a personal study plan.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Group work 10-15 h, lectures 10 h, teacher tutor meetings

Target group:

Students in mathematical and physical sciences

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

Coincides with 761010Y

Recommended or required reading:

Handouts

Assessment methods and criteria:

Participation to meetings, producing a personal study plan.

Grading:

Pass/fail

Person responsible:

Pekka Salmi

Working life cooperation:

No work placement period

Compulsory Studies

030005P: Information Skills, 1 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Faculty of Technology

Arvostelu: 1 - 5, pass, fail

Opettajat: Ursula Heinikoski

Opintokohteen kielet: Finnish

Leikkaavuudet:

030004P Introduction to Information Retrieval 0.0 op

ECTS Credits:

1 ECTS credits / 27 hours of work

Language of instruction:

Finnish

Timing:

Architecture 3. spring semester, period I; Biochemistry 3. autumn semester; Biology 3. autumn semester, period I; Chemistry 3. autumn semester, period II; Computer Science and Engineering 2. spring semester, period IV; Electronics and Communications Engineering 3. spring semester; Geosciences 2. spring semester, period IV; Geography 1. and 3. spring semester, period III; I ndustrial Engineering and Management 3. year (Master's degree students in Industrial Engineering and Management 1st year.); Information Processing Sciences 1. year; Mathematics and Physics 1. spring semester, period III; Mechanical Engineering 3. year; Mining Engineering and Mineral Processing 3. year; Process and Environmental Engineering 2. year, period II.

Learning outcomes:

Upon completion of the course, the students:
- can search scientific information,
- can use the most important databases of their discipline,
- know how to evaluate search results and information sources,
- can use the reference management tool

Contents:

Scientific information retrieval process, the most important databases and publication channels of the discipline, evaluation of the reliability of information sources and RefWorks reference management tool.

Mode of delivery:

Blended teaching: classroom training, web-based learning material and exercises, a group assignment.

Learning activities and teaching methods:

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

Target group:

Compulsory for all bachelor degree students of Faculty of Information Technology and Electrical Engineering, Faculty of Technology and Faculty of Science. Compulsory also for those Master's degree students in Industrial Engineering and Management who have no earlier studies in the information skills. Optional for the students of biochemistry.

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Web learning material Tieteellisen tiedonhankinnan opas http://libguides.oulu.fi/tieteellinentiedonhankinta (in Finnish)

Assessment methods and criteria:

Passing the course requires participation in the training sessions and successful completion of the course assignments.

Grading:

pass/fail

Person responsible:

Ursula Heinikoski

Working life cooperation:

-

Other information:

-

521141P: Elementary Programming, 5 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Mika Oja
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay521141P	Elementary Programming (OPEN UNI)	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 ECTS Cr

Language of instruction:

Lectures and learning material are in Finnish. The course is not available English

Timing:

Fall, periods 1-2.

Learning outcomes:

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

2. Understands the basic concepts of programming

3. Knows the basics of the Python programming language

4. Is able to implement programs independently

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

Contents:

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

Mode of delivery:

Web-based teaching + face-to-face teaching

Learning activities and teaching methods:

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

Target group:

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

Prerequisites and co-requisites:

None.

Recommended optional programme components:

The course provides a basis for subsequent programming courses.

Recommended or required reading:

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

Assessment methods and criteria:

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

Grading:

pass/fail.

Person responsible:

Mika Oja

Working life cooperation:

-

Optional courses

761013Y: Student tutoring, 2 op

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

ECTS Credits:

2 credits

Language of instruction:

Finnish

Timing:

2nd – 5th autumn

Learning outcomes:

The student can guide study groups in matters of studying and the organization of university.

Contents:

A student who has been at the university for a few years, is actively involved and has an interest in new students may serve as a tutor for the course 761011Y Orientation course for new students.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Tutoring 10 – 15 h

Target group:

Optional for the students in physics

Prerequisites and co-requisites:

First year studies

Recommended optional programme components:

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

Recommended or required reading:

Handouts

Assessment methods and criteria:

Tutoring 10-15 h
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Scale pass/fail

Person responsible:

NN

Working life cooperation:

No work placement period

800009Y: Acting as a Student Tutor, 2 op

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

300003Y: Activities in university and student organizations, 1 - 4 op

Voimassaolo: 01.01.2010 -
Opiskelumuoto: General Studies
Laji: Course
Vastuuyksikkö: Faculty of Science
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

ECTS Credits:
1-4 credits
Language of instruction:
Finnish
Timing:
1st-5th year

A325101: Physics, basic studies, 25 - 40 op

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

Ei opintojaksokuvauksia.

Studies in Physics

761108P: Physical world view, 5 op

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

761112P	Physical world view	3.0 op

ECTS Credits:
5 ECTS credits / 133 hours of work
Language of instruction:

Finnish

Timing:

Autumn

Learning outcomes:

After the course student can see the position of physics in the advancement of scientific world view and technology. The student has a comprehensive view of different learning and studying methods (s)he can use later on.

Contents:

The forming of key concepts in physics, using models and observations in advancing both classical and modern physics. The meaning of applying physics in modern society. Getting to know different areas of physics research.

Mode of delivery:

Multiform teaching

Learning activities and teaching methods:

48 h face-to-face teaching, 85 h independent work including course work and group work

Target group:

Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

Feynman, R. The Character of Physical Law, Penguin Books 1992 (or equivalent, there are several prints). The original Massenger Lectures by Richard Fenyman in 1965 (7x55min) can be found online with search "Richard Feynman messenger lectures".

Assessment methods and criteria:

Passed course work or final exam

Grading:

Numerical grading scale 0-5, where 0 = fail

Person responsible:

Laura Timonen

Working life cooperation:

No work placement period

Other information:

https://wiki.oulu.fi/display/761112P/

761118P: Mechanics 1, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Vaara, Juha Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

766343A	Mechanics	7.0 op
761111P	Basic mechanics	5.0 op
761101P	Basic Mechanics	4.0 op

766323A	Mechanics	6.0 op
761323A	Mechanics	6.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work
- 761118P-01, Lectures and exam (4 cr)
- 761118P-02, Lab. exercises (1 cr)

Language of instruction:

The lectures will be in Finnish. The textbook is in English and exercises are selected from the textbook. For further information, contact the responsible person of the course.

Timing:

Autumn

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, 7 exercises (14 h), 2 laboratory exercises (3 hours/exercise), self-study 83 h

Target group:

For the students of the University of Oulu.

Prerequisites and co-requisites:

Knowledge of vector calculus and basics of differential and integral calculus.

Recommended optional programme components:

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

Recommended or required reading:

Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 13th edition, 2012, chapters 1-14. Also older editions can be used. Lecture material: Finnish lecture material will be available on the web page of the course.

Assessment methods and criteria:

Both parts (761118P-01 and 761118P-02) will be graded separately. The final grade of the course is the weighted average of the grades of part 1 (4 cr) and part 2 (1 cr).
761118P-01: Three midterm exams or final examination
761118P-02: Two laboratory exercises
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Juha Vaara

Working life cooperation:

No work placement period

Other information:

https://wiki.oulu.fi/display/761118P

Compulsory

761118P-01: Mechanics 1, lectures and exam, 0 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Basic Studies

Laji: Partial credit

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Vaara, Juha Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

766343A	Mechanics	7.0 op
761111P-02	Basic mechanics, lab. exercises	0.0 op
761111P-01	Basic mechanics, lectures and exam	0.0 op
761111P	Basic mechanics	5.0 op
761121P	Physical Measurements I	3.0 op
761101P	Basic Mechanics	4.0 op
761323A	Mechanics	6.0 op
766323A	Mechanics	6.0 op

Language of instruction:

The lectures will be in Finnish. The textbook is in English and exercises are selected from the textbook. For further information, contact the responsible person of the course.

Timing:

Autumn

Learning outcomes:

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

Contents:

We encounter many phenomena related to mechanics in our everyday life. Most engineering sciences are based on mechanics and mechanics forms the basis of many other fields of physics, including modern physics. Contents in brief: Short summary of vector calculus. Kinematics, projectile motion and circular motion. Newton’s laws of motion. Work and different forms of energy. Momentum, impulse and collisions. Rotational motion and moment of inertia. Torque and angular momentum. Rigid body equilibrium problems. Gravitation. Periodic motion. Fluid mechanics.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

The whole course: Lectures 30 h, 7 exercises (14 h), 2 laboratory exercises (3 hours/exercise), self-study 83 h

Target group:

For the students of the University of Oulu

Prerequisites and co-requisites:

Knowledge of vector calculus and basics of differential and integral calculus.

Recommended optional programme components:

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

Recommended or required reading:

Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 13th edition, 2012, chapters 1-14. Also older editions can be used. Lecture material: Finnish lecture material will be available on the web page of the course.

Assessment methods and criteria:

761118P-01: Three midterm exams or final examination

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Juha Vaara

Working life cooperation:

No work placement period

Other information:

Course website
Both parts (761118P-01 and 761118P-02) will be graded separately. The final grade of the course is the weighted average of the grades of part 1 (4 cr) and part 2 (1 cr).

761118P-02: Mechanics 1, lab. exercises, 0 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Basic Studies

Laji: Partial credit

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766343A	Mechanics	7.0 op
761111P-01	Basic mechanics, lectures and exam	0.0 op
761111P-02	Basic mechanics, lab. exercises	0.0 op
761111P	Basic mechanics	5.0 op
761101P	Basic Mechanics	4.0 op
761323A	Mechanics	6.0 op
766323A	Mechanics	6.0 op

Timing:

Autumn

Learning outcomes:

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

Contents:

We encounter many phenomena related to mechanics in our everyday life. Most engineering sciences are based on mechanics and mechanics forms the basis of many other fields of physics, including modern physics. Contents in brief: Short summary of vector calculus. Kinematics, projectile motion and circular motion. Newton’s laws of motion. Work and different forms of energy. Momentum, impulse and collisions. Rotational motion and moment of inertia. Torque and angular momentum. Rigid body equilibrium problems. Gravitation. Periodic motion. Fluid mechanics.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

The whole course: Lectures 30 h, 7 exercises (14 h), 2 laboratory exercises (3 hours/exercise), self-study 83 h

Target group:

For the students of the University of Oulu

Prerequisites and co-requisites:

Knowledge of vector calculus and basics of differential and integral calculus.

Recommended optional programme components:

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

Other information:

Course website

761115P: Laboratory Exercises in Physics 1, 5 op

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

761121P	Physical Measurements I	3.0 op
761121P-01	Physical measurements I, exam	0.0 op
761121P-02	Physical measurements I, lab. exercises	0.0 op
800149P	Introduction to LateX	2.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Spring

Learning outcomes:

The student can safely make physical measurements, use different measurement tools, read different scales, handle the data, calculate the error estimations and make a sensible report of his laboratopy measurements.

Contents:

The skill to make laboratory measurements is important for physicists. This is an introductory course how to make physical measurements and how to treat the measured data. Laboratory works are made in groups. The laboratory security is an essential part also in physics. Measurements are made with different instruments. As a result the most probable value is determined as well as its error. The skills obtained during this course can be applied in the other laboratory courses Laboratory exercises in physics 2 and 3.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 10 h, exercises 20 h (5 x 4 h). Five different works will be made during the course in groups. Self-study 103 h.

Target group:

For the students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites.

Recommended optional programme components:

800149P Introduction to LaTex

Recommended or required reading:

Lecture material is in Finnish. Work instructions are available also in English.

Assessment methods and criteria:

Written reports of the experiments and one written examination.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

Other information:

Includes parts:
761115P-01 Laboratory Exercises in Physics 1, lecture and exam
761115P-02 Laboratory Exercises in Physics 1, laboratory exercises
761115P-03 Laboratory Exercises in Physics 1, Introduction to LateX

761120P: Laboratory Exercises in Physics 2, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766106P	Laboratory exercises in physics 2	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1. spring - 3. autumn

Learning outcomes:

After completing the course, the student can rather independently work with the most important measuring instruments used in physics and has experience in planning and conducting different measurements. The student is also able to critically assess her/his own results and report them to a group of peers.

Contents:

The laboratory exercises (0,5 ECTS per exercise) train the student in applying measurements to research into different physical phenomena. The exercises include practising how to plan the measurements, learning how to use the measuring instruments, processing and assessing the results, and drawing up scientific reports. Some of the exercises can be chosen according to the student´s own interest.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Per one exercise, 4 h of measurements in the laboratory and 5-9 h of preparation and drawing up a report independently.

Target group:

No specific target qroup

Prerequisites and co-requisites:

Recommended: 761121P/761115P Laboratory exercises in physics 1.

Recommended optional programme components:

Each exercise is closely related to a basic or intermediate course in physics, because the phenomena connected to the measurements and their theory are discussed in the lectures for the courses.

Recommended or required reading:

The exercise work instructions and guidelines for the work report, which can be found on the website of the course.

Assessment methods and criteria:

Adequate familiarization with the phenomenon under scrutiny and the measurements before the exercise (oral or written questions), successfully completing the guided measurements, reporting on the exercise (the work report will be graded).
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

Other information:

Course webpage

761119P: Electromagnetism 1, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Timo Asikainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

761113P-01	Electricity and magnetism, lectures and exam	0.0 op
761113P-02	Electricity and magnetism, lab. exercises	0.0 op
761113P	Electricity and magnetism	5.0 op
766319A	Electromagnetism	7.0 op
761103P	Electricity and Magnetism	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work
- 761119P-01, Lectures and exam (4 cr)
- 761119P-02, Lab. exercises (1 cr)

Language of instruction:

Finnish

Timing:

Second fall term

Learning outcomes:

The student will be able to understand the basic concepts of electromagnetism and can apply this understanding to solve problems related to electromagnetism.

Contents:

Basic principles of electromagnetic phenomena and their physical and geometric interpretation. More detailed contents will be presented later.

Mode of delivery:

face-to-face teaching

Learning activities and teaching methods:

Lectures 32 h, 7 exercises (14 h), 2 laboratory exercises (3 hours/exercise), self-study 83 h

Target group:

For the students of the University of Oulu.

Prerequisites and co-requisites:

Knowledge of vector calculus and basics of differential and integral calculus.

Recommended optional programme components:

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

Recommended or required reading:

Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 13. ed., chapters 21-31. Also other editions can be used. Lecture material in finnish.

Assessment methods and criteria:

Both parts (761119P-01 and 761119P-02) will be graded separately. The final grade of the course is the weighted average of the grades of part 1 (4 cr) and part 2 (1 cr).
761119P-01: Three small midterm exams or final examination
761119P-02: Two laboratory exercises
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Timo Asikainen

A325102: Physics, intermediate studies, 35 - 60 op

Opiskelumuoto: Intermediate Studies

Laji: Study module

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory Studies

761312A: Electromagnetism 2, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Anita Aikio

Opintokohteen kielet: Finnish

Leikkaavuudet:

766319A	Electromagnetism	7.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Second spring term

Learning outcomes:

The student will be able to derive the individual results like electric fields produced by charge distributions, magnetic field by current systems and solve problems related to electromagnetic induction. The student can derive the wave equation for electromagnetic waves.

Contents:

The foundations of the electromagnetic field theory. Exact contents to be specified later.

Mode of delivery:

face-to-face teaching

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Anita Aikio

761309A: Mechanics 2, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Second year fall term

Learning outcomes:

Students can apply the Lagrange's and Hamilton's methods to various problems in classical mechanics, and are aware of their connection to quantum mechanics. They can explain why the theory of relativity is needed, apply the Lorentz-transformation, explain why faster-than-light signals do not exist, and undestand the equivalence between mass and energy.

Contents:

In the first of the course part we discuss the Lagrangian and Hamiltonian formulations of classical mechanics. They are alternative but equivalent ways to formulate the equations of motion that follow from Newtons laws. We will also encounter some new mathematical tools, such as calculus of variations, which can be used to solve various minimization problems. Possible symmetries and conservation laws are emphasized in the Lagrangian and Hamiltonian equations of motion, which often simplify the study of complex dynamical systems. Many important concepts in quantum mechanics have counterparts in the Lagrangian and Hamiltonian formulations of classical mechanics. In the second half of the course we go beyond the realm of Newtonian mechanics and study the principles of the (special) theory of relativity. We will derive the Lorentz-transformation of coordinates by starting from Einstein's basic assumptions, and study motion in flat spacetime. Among other things we will derive the equivalence of mass and energy (E=m*c^2) and discuss various apparent paradoxes.

Mode of delivery:

face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, 7 exercises (14 h), self-study 91 h

Target group:

For the students of the University of Oulu

Prerequisites and co-requisites:

Basics of differential and integral calculus. Mechanics 1.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes in Finnish. Other recommended material will be specified later.

Assessment methods and criteria:

Two written intermediate examinations or one final examination.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Heikki Vanhamäki

Working life cooperation:

No work placement period

Other information:

Lectured for the 1st time during period 1 in autumn 2018.

761313A: Atomic physics 1, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Saana-Maija Aho

Opintokohteen kielet: Finnish

Leikkaavuudet:

766326A	Atomic physics 1	6.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

Second autumn term

Learning outcomes:

Student can explain the development of the atomic model. Student is able to describe some interaction mechanisms of electromagnetic radiation and matter. Student can resolve easy quantum mechanical problems. Student can describe the principles used when the wave functions and energies of some simple systems are determined. Student can take advantage of the periodic table of elements in finding the chemical and physical properties of atoms based on its electronic structure.

Contents:

In the beginning of the course, the historical events which led to the development of the quantum mechanics and the modern atomic model in the early 20th century are discussed. In this context, the interaction processes between matter and electromagnetic radiation, like black-body radiation, the photoelectric effect, and scattering, are examined. In quantum mechanics, particles are usually described with the aid of wave functions. De Broglie wavelength, the group and phase velocities of particles, and Heisenberg uncertainty principle serve as an introduction to the wave properties of particles. The Bohr's atomic model, electronic transitions of atoms, and emission spectra of atoms are also discussed. The first touch to the quantum mechanics is the solutions of wave functions and energies for some simple systems, like hydrogen atom, are described. Additionally, many-electron atoms are discussed briefly. Some modern research methods which are used to study the atomic physics are introduced. Applications which exploit the atom physical phenomena in everyday life are also discussed.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, 7 exercises, self-study 90 h

Target group:

No specific target qroup

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

Books: A. Beiser: Concepts of Modern Physics, McGraw-Hill Inc.

Assessment methods and criteria:

Group excercises, lectures, webexcercises or two exams.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Saana-Maija Huttula

Working life cooperation:

No work placement period

766344A: Nuclear and particle physics, 5 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766330A-01	Structure of matter, part 1: Solid state physics	0.0 op
766330A-02	Structure of matter, part 2: Nuclear and particle physics	0.0 op
766334A	Structure of matter II	2.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd spring

Learning outcomes:

The student knows the structure and key properties of atomic nuclei, the most important ways in which the nuclei undergo radioactive decay, and is familiar with some technological applications based on nuclear properties and radioactivity. The student can explain fission and fusion reactions.
The student knows the key varieties of subatomic particles, their properties and interactions. The student can explain main principles of particle accelerators and detectors, and how they are used in research.

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, 8 exercises (16 h), self-study 87 h

Target group:

Primarily for the students of the degree programme in physics.
Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

Atomic physics 1 (766326A), Electromagnetism (766319A). An important supporting course is Thermophysics (766328A/766348A).

Recommended optional programme components:

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

Recommended or required reading:

Textbooks: H. D. Young and R. A. Freedman: University Physics, 13th edition, Pearson Addison-Wesley, 2012, or earlier editions (in part), R. Eisberg and R. Resnick: Quantum physics of atoms, molecules, solids, nuclei, and particles, John Wiley & Sons (in part). Additional material available from the web pages of the course.
Course material availability can be checked here.

Assessment methods and criteria:

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

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Minna Patanen

Working life cooperation:

No work placement period

Other information:

Course website

763343A: Solid state physics, 5 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766330A	Structure of matter	6.0 op
766330A-02	Structure of matter, part 2: Nuclear and particle physics	0.0 op
766330A-01	Structure of matter, part 1: Solid state physics	0.0 op
763333A	Structure of matter I	4.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd spring

Learning outcomes:

To learn to explain the basics of solid state physics such as lattice structure, binding interactions, lattice vibrations, band structure and its effect on conductivity, conductivity of semiconductors, the interaction between light and matter, magnetism and superconductivity, and to apply these to different materials.

Contents:

The rapid development of technology is largely based on understanding the properties of the solid state. There are many interesting phenomena in solid state physics, which are consequences of very large number of particles and their interactions. The course starts with symmetry of crystal lattices and their experimental determination. Different binding forces of solids are discussed. Lattice vibrations and their contribution to specific heat are studied. Especial emphasis is put on electronic structure, and it is used to explain the electric conduction in metals, insulators and semiconductors. Also experimental methods, magnetism and superconductivity are discussed.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, exercises 16 h, self-study 87 h

Target group:

Primarily for the students of the degree programme in physics.
Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

Atomic physics 1 (766326A), Electromagnetism (766319A). An important supporting course is Thermophysics (766328A/766348A).

Recommended optional programme components:

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

Recommended or required reading:

E. Thuneberg: Kiinteä aineen fysiikka (lecture notes), C. Kittel: Introduction to solid state physics.

Assessment methods and criteria:

Examination

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Matti Alatalo

Working life cooperation:

No work placement period

Other information:

https://noppa.oulu.fi/noppa/kurssi/763343a/

761314A: Thermophysics, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Perttu Lantto

Opintokohteen kielet: Finnish

Leikkaavuudet:

766348A	Thermophysics	7.0 op
766328A	Thermophysics	6.0 op
761328A	Thermophysics	4.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

Third autumn semester

Learning outcomes:

The student knows the structure and key properties of atomic nuclei, the most important ways in which the nuclei undergo radioactive decay, and is familiar with some technological applications based on nuclear properties and radioactivity. The student can explain fission and fusion reactions.
The student knows the key varieties of subatomic particles, their properties and interactions. The student can explain main principles of particle accelerators and detectors, and how they are used in research.

Contents:

The goal of the course is to explain how the macroscopic thermophysical properties of a system (e.g., equation of state) can be derived from its fundamental microscopic properties (e.g., from the behavior of the molecules). For this purpose, the students are given a physically clear understanding of the basic principles of thermophysics, recognizing the fundamental role of its statistical nature. Topics will include: Basic concepts, The first law, Thermal expansion, heat transfer, and diffusion, The second law, The combined law, Heat engines and refrigerators, Thermodynamic potentials, Phases of matter, Classical ideal gas, Classical and open systems, Quantal ideal gas.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 32 h, 9 exercises (18 h), self-study 83 h

Target group:

Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

Textbooks: H. D. Young and R. A. Freedman: University Physics, 13th edition, Pearson Addison-Wesley, 2012, or earlier editions (in part), F. Mandl: Statistical Physics, second edition, John Wiley & Sons Ltd., 1988 (in part).
Lecture notes: Juhani Lounila: 766328A Termofysiikka, Oulun yliopisto, 2015.

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:

Perttu Lantto

Working life cooperation:

No work placement period

766384A: B.Sc. seminar, 4 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:

4 ECTS cr

Language of instruction:

Finnish

Timing:

3rd autumn

Learning outcomes:

The student is familiar with the special requirements of a scientific text and is aware of physics' common practices in scientific writing. The student has the basic knowledge of scientific writing enabling the student to write her/his B.Sc. thesis under a supervision. The student learns important scientific communication skills necessary in scientific research in physics.

Contents:

Both written and oral reporting is essential part of the scientific research. During the course, the students participate in the seminars, act as opponents and present a seminar talk. The course gives basic knowledge of scientific writing so that the student can start to write her/his B. Sc. thesis.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Compulsory for Bachelor of Science in physics. In seminars 80 % obligatory attendance.

Prerequisites and co-requisites:

Introduction to information retrieval (030005P).

Recommended optional programme components:

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

Recommended or required reading:

Material available from the web pages of the course.

Assessment methods and criteria:

Students have to attend the lectures (ca. 80 %) and be an opponent for two seminar talks. Students have to give a seminar talk, which is graded (0-5). Possible homework.

Grading:

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

Person responsible:

Minna Patanen

Working life cooperation:

No work placement period

Other information:

Course website

766385A: B.Sc. thesis, 6 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:

6 credits

Language of instruction:

Finnish or English

Timing:

3rd year

Learning outcomes:

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

Contents:

Both written and oral reporting is essential part of the scientific research. In the course, the students write a candidate thesis. The candidate thesis is about 20 pages. Thesis is written about subject given by and under supervision of a senior researcher.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Self-study 160 h.

Target group:

Compulsory for Bachelor of Science in physics.

Prerequisites and co-requisites:

Introduction to information retrieval (030005P).

Recommended optional programme components:

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

Recommended or required reading:

Material available from the web pages of the course.

Assessment methods and criteria:

B.Sc. thesis

Grading:

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

Person responsible:

Marko Huttula

Working life cooperation:

No work placement period

Other information:

Course website ???

761386A: Maturity test, 0 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

0 credits

Language of instruction:

English

Timing:

3rd autumn or spring

Learning outcomes:

The student knows the vocabulary of the research field of his/her thesis and can independently produce text related to the thesis.

Contents:

Written test about a subject of the B.Sc. Thesis. The length of the text is recommended to be one exam paper.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Independent work

Target group:

Compulsory in B.Sc. degree for student of physics.

Prerequisites and co-requisites:

B.Sc. thesis

Recommended optional programme components:

No alternative course units

Recommended or required reading:

No reading

Assessment methods and criteria:

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

Grading:

Scale pass/fail

Person responsible:

Professors

Working life cooperation:

No work placement period

761310A: Wave motion and optics, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Seppo Alanko

Opintokohteen kielet: Finnish

Leikkaavuudet:

766349A	Wave motion and optics	7.0 op
761114P	Wave motion and optics	5.0 op
761114P-02	Wave motion and optics, lab. exercises	0.0 op
761114P-01	Wave motion and optics, lectures and exam	0.0 op
766329A	Wave motion and optics	6.0 op
761104P	Wave Motion	3.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

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

Timing:

First spring

Learning outcomes:

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

Contents:

General principles of wave motion, sound, electromagnetic waves, propagation of light, image formation in mirrors and lenses, optical instruments, interference, Fraunhofer diffraction, diffraction grating.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h, 2 laboratory exercises (3 hours/exercise), self-study 90 h

Target group:

No specific target qroup

Prerequisites and co-requisites:

Basic skills in mathematics.

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

Two written intermediate examinations or one final examination

Grading:

Numerical grading scale 0 – 5, where 0 is fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

Other information:

Includes parts:
761310A-01 Wave motion and optics, lectures and exam
761310A-02 Wave motion and optics, lab. exercises

Compulsory

761310A-01: Wave motion and optics, lectures and exam, 0 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Seppo Alanko

Opintokohteen kielet: Finnish

Leikkaavuudet:

766349A	Wave motion and optics	7.0 op
761114P	Wave motion and optics	5.0 op

761114P-01 Wave motion and optics, lectures and exam 0.0 op
761114P-02 Wave motion and optics, lab. exercises 0.0 op
766329A Wave motion and optics 6.0 op
761104P Wave Motion 3.0 op

Language of instruction:

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

Timing:

Firts spring

Learning outcomes:

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

Contents:

General principles of wave motion, sound, electromagnetic waves, propagation of light, image formation in mirrors and lenses, optical instruments, interference, Fraunhofer diffraction, diffraction grating.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h, 2 laboratory exercises (3 hours/exercise), self-study 90 h

Target group:

No specific target qroup

Prerequisites and co-requisites:

Basic skills in mathematics

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

Two written intermediate examinations or one final examination

Grading:

Numerical grading scale 0 – 5, where 0 is fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

761310A-02: Wave motion and optics, lab. exercises, 0 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766349A Wave motion and optics 7.0 op
761114P Wave motion and optics 5.0 op

761114P-01 Wave motion and optics, lectures and exam 0.0 op
761114P-02 Wave motion and optics, lab. exercises 0.0 op
766329A Wave motion and optics 6.0 op
761104P Wave Motion 3.0 op

Ei opintojaksokuvauksia.

Electives

761316A: Being a teacher in mathematical subjects, 5 op

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

766339A Physics for teachers 5.0 op
766338A Physics for teachers 4.0 op

Ei opintojaksokuvauksia.

761337A: Practical training, 3 - 6 op

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

ECTS Credits:

3 - 6 credits

Language of instruction:

English or Finnish

Timing:

2nd - 5th year

Learning outcomes:

After the practical training, the student is able to participate in scientific research in his/her own field.

Contents:

A job, e.g. a summer job, which supports studies in physics, and could be accepted as a practical training. One month of employment corresponds 1.5 study points. Maximum of 6 credits from practical training can be included in Bachelor and/or Master of Science studies in physics.

Mode of delivery:

A summer job, for example

Learning activities and teaching methods:

Training and a written report

Target group:

Students in physics

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

No specific material

Assessment methods and criteria:

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

Grading:

Scale pass/fail

Person responsible:

Lauri Hautala

Working life cooperation:

Work placement period

764337A: Practical training, 3 - 9 op

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

ECTS Credits:

3 - 9 credits

Language of instruction:

English or Finnish

Timing:

2nd - 5th year

Learning outcomes:

After practical training the student understands better the actual needs of employment.

Contents:

Have you found a job, e.g. a summer job, which supports your studies in biophysics, and could be accepted as a practical training? One month of employment corresponds 1.5 study points.

Mode of delivery:

A summer job, for example

Learning activities and teaching methods:

Practical training and report

Target group:

Students in biophysics

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

No specific material

Assessment methods and criteria:

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

Grading:

Scale pass/fail

Person responsible:

Kyösti Heimonen

Working life cooperation:

Work placement period

A325104: Physics Minor, 15 op

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

Ei opintojaksokuvauksia.

General Studies in Physics

761108P: Physical world view, 5 op

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

761112P	Physical world view	3.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Autumn

Learning outcomes:

After the course student can see the position of physics in the advancement of scientific world view and technology. The student has a comprehensive view of different learning and studying methods (s)he can use later on.

Contents:

The forming of key concepts in physics, using models and observations in advancing both classical and modern physics. The meaning of applying physics in modern society. Getting to know different areas of physics research.

Mode of delivery:

Multiform teaching

Learning activities and teaching methods:

48 h face-to-face teaching, 85 h independent work including course work and group work

Target group:

Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

Feynman, R. The Character of Physical Law, Penguin Books 1992 (or equivalent, there are several prints). The original Massenger Lectures by Richard Fenyman in 1965 (7x55min) can be found online with search "Richard Feynman messenger lectures".

Assessment methods and criteria:

Passed course work or final exam

Grading:

Numerical grading scale 0-5, where 0 = fail

Person responsible:

Laura Timonen

Working life cooperation:

No work placement period

Other information:

https://wiki.oulu.fi/display/761112P/

761118P: Mechanics 1, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Vaara, Juha Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

766343A	Mechanics	7.0 op
761111P	Basic mechanics	5.0 op
761101P	Basic Mechanics	4.0 op
766323A	Mechanics	6.0 op
761323A	Mechanics	6.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work
- 761118P-01, Lectures and exam (4 cr)
- 761118P-02, Lab. exercises (1 cr)

Language of instruction:

The lectures will be in Finnish. The textbook is in English and exercises are selected from the textbook. For further information, contact the responsible person of the course.

Timing:

Autumn

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, 7 exercises (14 h), 2 laboratory exercises (3 hours/exercise), self-study 83 h

Target group:

For the students of the University of Oulu.

Prerequisites and co-requisites:

Knowledge of vector calculus and basics of differential and integral calculus.

Recommended optional programme components:

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

Recommended or required reading:

Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 13th edition, 2012, chapters 1-14. Also older editions can be used. Lecture material: Finnish lecture material will be available on the web page of the course.

Assessment methods and criteria:

Both parts (761118P-01 and 761118P-02) will be graded separately. The final grade of the course is the weighted average of the grades of part 1 (4 cr) and part 2 (1 cr).
761118P-01: Three midterm exams or final examination
761118P-02: Two laboratory exercises
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Juha Vaara

Working life cooperation:

No work placement period

Other information:

https://wiki.oulu.fi/display/761118P

Compulsory

761118P-01: Mechanics 1, lectures and exam, 0 op

Voimassaolo: 01.01.2017 -
Opiskelumuoto: Basic Studies
Laji: Partial credit
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opettajat: Vaara, Juha Tapani
Opintokohteen kielet: Finnish
Leikkaavuudet:

766343A	Mechanics	7.0 op
761111P-02	Basic mechanics, lab. exercises	0.0 op
761111P-01	Basic mechanics, lectures and exam	0.0 op
761111P	Basic mechanics	5.0 op
761121P	Physical Measurements I	3.0 op
761101P	Basic Mechanics	4.0 op
761323A	Mechanics	6.0 op

766323A Mechanics 6.0 op

Language of instruction:

The lectures will be in Finnish. The textbook is in English and exercises are selected from the textbook. For further information, contact the responsible person of the course.

Timing:

Autumn

Learning outcomes:

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

Contents:

We encounter many phenomena related to mechanics in our everyday life. Most engineering sciences are based on mechanics and mechanics forms the basis of many other fields of physics, including modern physics. Contents in brief: Short summary of vector calculus. Kinematics, projectile motion and circular motion. Newton’s laws of motion. Work and different forms of energy. Momentum, impulse and collisions. Rotational motion and moment of inertia. Torque and angular momentum. Rigid body equilibrium problems. Gravitation. Periodic motion. Fluid mechanics.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

The whole course: Lectures 30 h, 7 exercises (14 h), 2 laboratory exercises (3 hours/exercise), self-study 83 h

Target group:

For the students of the University of Oulu

Prerequisites and co-requisites:

Knowledge of vector calculus and basics of differential and integral calculus.

Recommended optional programme components:

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

Recommended or required reading:

Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 13th edition, 2012, chapters 1-14. Also older editions can be used. Lecture material: Finnish lecture material will be available on the web page of the course.

Assessment methods and criteria:

761118P-01: Three midterm exams or final examination

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Juha Vaara

Working life cooperation:

No work placement period

Other information:

Course website
Both parts (761118P-01 and 761118P-02) will be graded separately. The final grade of the course is the weighted average of the grades of part 1 (4 cr) and part 2 (1 cr).

761118P-02: Mechanics 1, lab. exercises, 0 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Basic Studies

Laji: Partial credit

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766343A	Mechanics	7.0 op
761111P-01	Basic mechanics, lectures and exam	0.0 op
761111P-02	Basic mechanics, lab. exercises	0.0 op
761111P	Basic mechanics	5.0 op
761101P	Basic Mechanics	4.0 op
761323A	Mechanics	6.0 op
766323A	Mechanics	6.0 op

Timing:

Autumn

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

The whole course: Lectures 30 h, 7 exercises (14 h), 2 laboratory exercises (3 hours/exercise), self-study 83 h

Target group:

For the students of the University of Oulu

Prerequisites and co-requisites:

Knowledge of vector calculus and basics of differential and integral calculus.

Recommended optional programme components:

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

Other information:

Course website

761115P: Laboratory Exercises in Physics 1, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761121P	Physical Measurements I	3.0 op
761121P-01	Physical measurements I, exam	0.0 op
761121P-02	Physical measurements I, lab. exercises	0.0 op
800149P	Introduction to LateX	2.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Spring

Learning outcomes:

The student can safely make physical measurements, use different measurement tools, read different scales, handle the data, calculate the error estimations and make a sensible report of his laboratopy measurements.

Contents:

The skill to make laboratory measurements is important for physicists. This is an introductory course how to make physical measurements and how to treat the measured data. Laboratory works are made in groups. The laboratory security is an essential part also in physics. Measurements are made with different instruments. As a result the most probable value is determined as well as its error. The skills obtained during this course can be applied in the other laboratory courses Laboratory exercises in physics 2 and 3.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 10 h, exercises 20 h (5 x 4 h). Five different works will be made during the course in groups. Self-study 103 h.

Target group:

For the students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites.

Recommended optional programme components:

800149P Introduction to LaTex

Recommended or required reading:

Lecture material is in Finnish. Work instructions are available also in English.

Assessment methods and criteria:

Written reports of the experiments and one written examination.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

Other information:

Includes parts:
761115P-01 Laboratory Exercises in Physics 1, lecture and exam
761115P-02 Laboratory Exercises in Physics 1, laboratory exercises
761115P-03 Laboratory Exercises in Physics 1, Introduction to LateX

Optional studies in Physics. When you complete 25 ECTS cr from the physics. Choose the 2 courses below. (60 ECTS cr of minor subject are all selected below)

761119P: Electromagnetism 1, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Timo Asikainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

761113P-01	Electricity and magnetism, lectures and exam	0.0 op
761113P-02	Electricity and magnetism, lab. exercises	0.0 op
761113P	Electricity and magnetism	5.0 op
766319A	Electromagnetism	7.0 op
761103P	Electricity and Magnetism	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work
- 761119P-01, Lectures and exam (4 cr)
- 761119P-02, Lab. exercises (1 cr)

Language of instruction:

Finnish

Timing:

Second fall term

Learning outcomes:

The student will be able to understand the basic concepts of electromagnetism and can apply this understanding to solve problems related to electromagnetism.

Contents:

Basic principles of electromagnetic phenomena and their physical and geometric interpretation. More detailed contents will be presented later.

Mode of delivery:

face-to-face teaching

Learning activities and teaching methods:

Lectures 32 h, 7 exercises (14 h), 2 laboratory exercises (3 hours/exercise), self-study 83 h

Target group:

For the students of the University of Oulu.

Prerequisites and co-requisites:

Knowledge of vector calculus and basics of differential and integral calculus.

Recommended optional programme components:

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

Recommended or required reading:

Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 13. ed., chapters 21-31. Also other editions can be used. Lecture material in finnish.

Assessment methods and criteria:

Both parts (761119P-01 and 761119P-02) will be graded separately. The final grade of the course is the weighted average of the grades of part 1 (4 cr) and part 2 (1 cr).
761119P-01: Three small midterm exams or final examination
761119P-02: Two laboratory exercises
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Timo Asikainen

761313A: Atomic physics 1, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Saana-Maija Aho

Opintokohteen kielet: Finnish

Leikkaavuudet:

766326A	Atomic physics 1	6.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

Second autumn term

Learning outcomes:

Student can explain the development of the atomic model. Student is able to describe some interaction mechanisms of electromagnetic radiation and matter. Student can resolve easy quantum mechanical problems. Student can describe the principles used when the wave functions and energies of some simple systems are determined. Student can take advantage of the periodic table of elements in finding the chemical and physical properties of atoms based on its electronic structure.

Contents:

In the beginning of the course, the historical events which led to the development of the quantum mechanics and the modern atomic model in the early 20th century are discussed. In this context, the interaction processes between matter and electromagnetic radiation, like black-body radiation, the photoelectric effect, and scattering, are examined. In quantum mechanics, particles are usually described with the aid of wave functions. De Broglie wavelength, the group and phase velocities of particles, and Heisenberg uncertainty principle serve as an introduction to the wave properties of particles. The Bohr's atomic model, electronic transitions of atoms, and emission spectra of atoms are also discussed. The first touch to the quantum mechanics is the solutions of wave functions and energies for some simple systems, like hydrogen atom, are described. Additionally, many-electron atoms are discussed briefly. Some modern research methods which are used to study the atomic physics are introduced. Applications which exploit the atom physical phenomena in everyday life are also discussed.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, 7 exercises, self-study 90 h

Target group:

No specific target qroup

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

Books: A. Beiser: Concepts of Modern Physics, McGraw-Hill Inc.

Assessment methods and criteria:

Group excercises, lectures, webexcercises or two exams.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Saana-Maija Huttula

Working life cooperation:

No work placement period

761314A: Thermophysics, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Perttu Lantto

Opintokohteen kielet: Finnish

Leikkaavuudet:

766348A	Thermophysics	7.0 op
766328A	Thermophysics	6.0 op
761328A	Thermophysics	4.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

Third autumn semester

Learning outcomes:

The student knows the structure and key properties of atomic nuclei, the most important ways in which the nuclei undergo radioactive decay, and is familiar with some technological applications based on nuclear properties and radioactivity. The student can explain fission and fusion reactions.
The student knows the key varieties of subatomic particles, their properties and interactions. The student can explain main principles of particle accelerators and detectors, and how they are used in research.

Contents:

The goal of the course is to explain how the macroscopic thermophysical properties of a system (e.g., equation of state) can be derived from its fundamental microscopic properties (e.g., from the behavior of the molecules). For this purpose, the students are given a physically clear understanding of the basic principles of thermophysics, recognizing the fundamental role of its statistical nature. Topics will include: Basic concepts, The first law, Thermal expansion, heat transfer, and diffusion, The second law, The combined law, Heat engines and refrigerators, Thermodynamic potentials, Phases of matter, Classical ideal gas, Classical and open systems, Quantal ideal gas.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 32 h, 9 exercises (18 h), self-study 83 h

Target group:

Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

Textbooks: H. D. Young and R. A. Freedman: University Physics, 13th edition, Pearson Addison-Wesley, 2012, or earlier editions (in part), F. Mandl: Statistical Physics, second edition, John Wiley & Sons Ltd., 1988 (in part).
Lecture notes: Juhani Lounila: 766328A Termofysiikka, Oulun yliopisto, 2015.

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:

Perttu Lantto

Working life cooperation:

No work placement period

761310A: Wave motion and optics, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Seppo Alanko

Opintokohteen kielet: Finnish

Leikkaavuudet:

766349A	Wave motion and optics	7.0 op
761114P	Wave motion and optics	5.0 op
761114P-02	Wave motion and optics, lab. exercises	0.0 op
761114P-01	Wave motion and optics, lectures and exam	0.0 op
766329A	Wave motion and optics	6.0 op
761104P	Wave Motion	3.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

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

Timing:

First spring

Learning outcomes:

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

Contents:

General principles of wave motion, sound, electromagnetic waves, propagation of light, image formation in mirrors and lenses, optical instruments, interference, Fraunhofer diffraction, diffraction grating.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h, 2 laboratory exercises (3 hours/exercise), self-study 90 h

Target group:

No specific target qroup

Prerequisites and co-requisites:

Basic skills in mathematics.

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

Two written intermediate examinations or one final examination

Grading:

Numerical grading scale 0 – 5, where 0 is fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

Other information:

Includes parts:
761310A-01 Wave motion and optics, lectures and exam
761310A-02 Wave motion and optics, lab. exercises

Compulsory

761310A-01: Wave motion and optics, lectures and exam, 0 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Seppo Alanko

Opintokohteen kielet: Finnish

Leikkaavuudet:

766349A Wave motion and optics 7.0 op

761114P Wave motion and optics 5.0 op

761114P-01 Wave motion and optics, lectures and exam 0.0 op

761114P-02 Wave motion and optics, lab. exercises 0.0 op

766329A Wave motion and optics 6.0 op

761104P Wave Motion 3.0 op

Language of instruction:

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

Timing:

Firts spring

Learning outcomes:

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

Contents:

General principles of wave motion, sound, electromagnetic waves, propagation of light, image formation in mirrors and lenses, optical instruments, interference, Fraunhofer diffraction, diffraction grating.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h, 2 laboratory exercises (3 hours/exercise), self-study 90 h

Target group:

No specific target qroup

Prerequisites and co-requisites:

Basic skills in mathematics

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

Two written intermediate examinations or one final examination

Grading:

Numerical grading scale 0 – 5, where 0 is fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

761310A-02: Wave motion and optics, lab. exercises, 0 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766349A Wave motion and optics 7.0 op

761114P Wave motion and optics 5.0 op

761114P-01 Wave motion and optics, lectures and exam 0.0 op

761114P-02 Wave motion and optics, lab. exercises 0.0 op

766329A Wave motion and optics 6.0 op

761104P Wave Motion 3.0 op

Ei opintojaksokuvauksia.

If you want to complete 60 ECTS cr in physics. Choose all the courses below

761309A: Mechanics 2, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Second year fall term

Learning outcomes:

Students can apply the Lagrange's and Hamilton's methods to various problems in classical mechanics, and are aware of their connection to quantum mechanics. They can explain why the theory of relativity is needed, apply the Lorentz-transformation, explain why faster-than-light signals do not exist, and undestand the equivalence between mass and energy.

Contents:

In the first of the course part we discuss the Lagrangian and Hamiltonian formulations of classical mechanics. They are alternative but equivalent ways to formulate the equations of motion that follow from Newtons laws. We will also encounter some new mathematical tools, such as calculus of variations, which can be used to solve various minimization problems. Possible symmetries and conservation laws are emphasized in the Lagrangian and Hamiltonian equations of motion, which often simplify the study of complex dynamical systems. Many important concepts in quantum mechanics have counterparts in the Lagrangian and Hamiltonian formulations of classical mechanics. In the second half of the course we go beyond the realm of Newtonian mechanics and study the principles of the (special) theory of relativity. We will derive the Lorentz-transformation of coordinates by starting from Einstein's basic assumptions, and study motion in flat spacetime. Among other things we will derive the equivalence of mass and energy (E=m*c^2) and discuss various apparent paradoxes.

Mode of delivery:

face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, 7 exercises (14 h), self-study 91 h

Target group:

For the students of the University of Oulu

Prerequisites and co-requisites:

Basics of differential and integral calculus. Mechanics 1.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes in Finnish. Other recommended material will be specified later.

Assessment methods and criteria:

Two written intermediate examinations or one final examination.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Heikki Vanhamäki

Working life cooperation:

No work placement period

Other information:

Lectured for the 1st time during period 1 in autumn 2018.

761120P: Laboratory Exercises in Physics 2, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766106P	Laboratory exercises in physics 2	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1. spring - 3. autumn

Learning outcomes:

After completing the course, the student can rather independently work with the most important measuring instruments used in physics and has experience in planning and conducting different measurements. The student is also able to critically assess her/his own results and report them to a group of peers.

Contents:

The laboratory exercises (0,5 ECTS per exercise) train the student in applying measurements to research into different physical phenomena. The exercises include practising how to plan the measurements, learning how to use the measuring instruments, processing and assessing the results, and drawing up scientific reports. Some of the exercises can be chosen according to the student´s own interest.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Per one exercise, 4 h of measurements in the laboratory and 5-9 h of preparation and drawing up a report independently.

Target group:

No specific target qroup

Prerequisites and co-requisites:

Recommended: 761121P/761115P Laboratory exercises in physics 1.

Recommended optional programme components:

Each exercise is closely related to a basic or intermediate course in physics, because the phenomena connected to the measurements and their theory are discussed in the lectures for the courses.

Recommended or required reading:

The exercise work instructions and guidelines for the work report, which can be found on the website of the course.

Assessment methods and criteria:

Adequate familiarization with the phenomenon under scrutiny and the measurements before the exercise (oral or written questions), successfully completing the guided measurements, reporting on the exercise (the work report will be graded).
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

Other information:

Course webpage

761312A: Electromagnetism 2, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Anita Aikio

Opintokohteen kielet: Finnish

Leikkaavuudet:

766319A Electromagnetism 7.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Second spring term

Learning outcomes:

The student will be able to derive the individual results like electric fields produced by charge distributions, magnetic field by current systems and solve problems related to electromagnetic induction. The student can derive the wave equation for electromagnetic waves.

Contents:

The foundations of the electromagnetic field theory. Exact contents to be specified later.

Mode of delivery:

face-to-face teaching

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Anita Aikio

766344A: Nuclear and particle physics, 5 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766330A-01 Structure of matter, part 1: Solid state physics 0.0 op

766330A-02 Structure of matter, part 2: Nuclear and particle physics 0.0 op

766334A Structure of matter II 2.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd spring

Learning outcomes:

The student knows the structure and key properties of atomic nuclei, the most important ways in which the nuclei undergo radioactive decay, and is familiar with some technological applications based on nuclear

properties and radioactivity. The student can explain fission and fusion reactions.
The student knows the key varieties of subatomic particles, their properties and interactions. The student can explain main principles of particle accelerators and detectors, and how they are used in research.

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, 8 exercises (16 h), self-study 87 h

Target group:

Primarily for the students of the degree programme in physics.
Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

Atomic physics 1 (766326A), Electromagnetism (766319A). An important supporting course is Thermophysics (766328A/766348A).

Recommended optional programme components:

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

Recommended or required reading:

Textbooks: H. D. Young and R. A. Freedman: University Physics, 13th edition, Pearson Addison-Wesley, 2012, or earlier editions (in part), R. Eisberg and R. Resnick: Quantum physics of atoms, molecules, solids, nuclei, and particles, John Wiley & Sons (in part). Additional material available from the web pages of the course.
Course material availability can be checked here.

Assessment methods and criteria:

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

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Minna Patanen

Working life cooperation:

No work placement period

Other information:

Course website

763343A: Solid state physics, 5 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766330A	Structure of matter	6.0 op
766330A-02	Structure of matter, part 2: Nuclear and particle physics	0.0 op
766330A-01	Structure of matter, part 1: Solid state physics	0.0 op
763333A	Structure of matter I	4.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd spring

Learning outcomes:

To learn to explain the basics of solid state physics such as lattice structure, binding interactions, lattice vibrations, band structure and its effect on conductivity, conductivity of semiconductors, the interaction between light and matter, magnetism and superconductivity, and to apply these to different materials.

Contents:

The rapid development of technology is largely based on understanding the properties of the solid state. There are many interesting phenomena in solid state physics, which are consequences of very large number of particles and their interactions. The course starts with symmetry of crystal lattices and their experimental determination. Different binding forces of solids are discussed. Lattice vibrations and their contribution to specific heat are studied. Especial emphasis is put on electronic structure, and it is used to explain the electric conduction in metals, insulators and semiconductors. Also experimental methods, magnetism and superconductivity are discussed.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, exercises 16 h, self-study 87 h

Target group:

Primarily for the students of the degree programme in physics.
Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

Atomic physics 1 (766326A), Electromagnetism (766319A). An important supporting course is Thermophysics (766328A/766348A).

Recommended optional programme components:

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

Recommended or required reading:

E. Thuneberg: Kiinteä aineen fysiikka (lecture notes), C. Kittel: Introduction to solid state physics.

Assessment methods and criteria:

Examination

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Matti Alatalo

Working life cooperation:

No work placement period

Other information:

https://noppa.oulu.fi/noppa/kurssi/763343a/

Obligatory for subject teacher

761316A: Being a teacher in mathematical subjects, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Saana-Maija Aho

Opintokohteen kielet: Finnish

Leikkaavuudet:

766339A	Physics for teachers	5.0 op
766338A	Physics for teachers	4.0 op

Ei opintojaksokuvauksia.

A325001: Mathematics, basic studies, 25 op

Opiskelumuoto: Basic Studies
Laji: Study module
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Kari Myllylä
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory Studies

802151P: Introduction to mathematical deduction, 5 op

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

ay802151P	Introduction to mathematical deduction (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

First period at the first semester.

Learning outcomes:

After completing the course, student is:
- able to use different methods proving techniquesis
- able to use basic set theoretic concepts and definitionsis
- able to define and apply basic definitions related to functions

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h

Target group:

Major and minor students

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

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

Grading:

Pass/Fail

Person responsible:

Marko Leinonen

Working life cooperation:

-

800119P: Functions and limit, 5 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Salmi

Opintokohteen kielet: Finnish

Leikkaavuudet:

802162P	Continuity and Limit	5.0 op
802155P	Continuity and limit	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1st year, 1st period

Learning outcomes:

Upon completing the course the student is
- able to apply the triangle inequality and make approximations
- able to manipulate elementary functions such as polynomials and trigonometric functions
- able to define the limit of a sequence and the limit of a function as well as apply these definitions
- able to apply different techniques to determine limits.

Contents:

The course concerns real-valued functions of one variable. In particular elementary functions are defined and the monotonicity of functions is studied. The notion of absolute value is reviewed and applied to approximation. Also the triangle inequality is used in approximation. The central concept is the limit of a function, which is introduced via the limit of a sequence. The aim of the course is to improve deductive skills as well as computational skills.

Mode of delivery:

Face-to-face teaching, computer exercises

Learning activities and teaching methods:

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

Target group:

1st year mathematics and physics students as well as students taking mathematics as a minor subject

Prerequisites and co-requisites:

Introduction to mathematical deduction 802151P is recommended to be taken simultaneously (or earlier).

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes, STACK exercises. Additional material: for example the book P. Harjulehto, R. Klén, M. Koskenoja, Analyysiä reaaliluvuilla.

Assessment methods and criteria:

Final exam, exercises

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

No

Other information:

Replaces the course 802162P Continuity and Limit.

802120P: Introduction to Matrices, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802118P	Linear Algebra I	4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

1. year, 4. period

Learning outcomes:

After completing the course the student is able to
- apply arithmetic operations of matrices
- solve system of linear equations by matrix methods
- study linear depence and linear indepence of vectors
- recognize the subspace of R^n and understands the concepts of basis and dimension of a vector space
- analyse matrices by the parameters and the vectors

Contents:

Vectors and matrices, Systems of linear equations, determinant of a matrix, subspaces of R^n, linear depence and linear indepence of vectors, base, dimension, eigenvalues and eigenvectors of a matrix, diagonalization.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, Exercises 14 h

Target group:

Major and minor studies

Prerequisites and co-requisites:

802151P Introduction to Mathematical Deduction

Recommended or required reading:

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

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Marko Leinonen

Working life cooperation:

-

806113P: Introduction to Statistics, 5 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Hanna Heikkinen

Opintokohteen oppimateriaali:
Wild, Christopher J. , , 2000
Grönroos, Matti (2) , , 2003
Opintokohteen kielet: Finnish

Leikkaavuudet:

806118P	Introduction to Statistics	5.0 op
806119P	A Second Course in Statistics	5.0 op
806116P	Statistics for Economic Sciences	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

4th period. 1st or 2nd year of studies.

Learning outcomes:

Upon completion of the course, student will be
- able to identify and define the main principles of statistical research, collection of the data and analysis
- able to apply basic methods of descriptive statistics and statistical inference in simple quantitative research using a statistical software
- able to critically evaluate results of the statistical research presented in media
- prepared for teaching statistics in secondary school and high school
- prepared for participating in a group.

Contents:

- the nature and the meaning of statistics
- data and the acquisition of them: observations, variables, measuring and designs of a study
- the descriptive statistics of empirical distributions: tables, graphical presentations and descriptive measures of center, variation and dependence
- the most important probability distributions
- the principles and the basic methods of statistical inference: random sample, sample statistics, point estimation, confidence intervals and statistical testing of hypotheses.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 16 h (partly compulsory) / instructed group work (28 h) / independent work 80 h. Group works will be returned. Additional independently implemented learning diary tasks. Independent work contains also preparation for group work and peer assessment.

Target group:

Students of mathematical and physical sciences.

Prerequisites and co-requisites:

The recommended prerequisite prior to enrolling for the course is the completion of the courses: 802151P Introduction to mathematical deduction and 800119P Functions and limit.

Recommended optional programme components:

After the course, student is able to continue other statistics courses.

Recommended or required reading:

Lecture notes.

Assessment methods and criteria:

This course utilizes continuous assessment. Practical works and learning diaries are assessed weekly. In addition web tests and learning tasks. The assessment of the course is based on the learning outcomes of the course. The more detailed assessment criteria is available in the beginning of the course. In addition one compulsory lecture and peer assessment.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Hanna Heikkinen

Working life cooperation:

No

801195P: Probability Theory, 5 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:
Tuominen, P., , 1993
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year, 2nd period.

Learning outcomes:

Upon completing the course the student will be able to
- solve simple practical problems associated with probability
- solve simple theoretical problems associated with probability
- derive the basic properties of probability, starting from the axioms

Contents:

The course is an introduction to probability. In the beginning high school level probability is reviewed and after that axiomatic treatment of the theory starts. The central concepts discussed include probability space, conditional probability, independence, and random variable together with its distribution and expected value.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors and minors

Prerequisites and co-requisites:

Integral 800318A

Recommended optional programme components:

-

Recommended or required reading:

Lectures.
Text book: Pekka Tuominen: Todennäköisyyslaskenta I, Limes ry, Helsinki.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Hanna Heikkinen

Working life cooperation:

-

A325002: Mathematics, intermediate studies, 35 op

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

Ei opintojaksokuvauksia.

Compulsory Studies

800317A: Continuity and derivative, 5 op

Voimassaolo: 01.01.2017 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802163P	Derivative	5.0 op
802156P	Derivative	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1st year, 2nd period

Learning outcomes:

Upon completing the course the student is
- able to define the concept of continuous function and apply this definition in examples and deductions
- able to determine derivatives of functions
- able to apply derivative to study functions
- able to appy the concepts of continuity and derivative in various problems, including deductions

Contents:

The course concerns continuity and derivative of real-valued functions of one variable. The central topics are the intermediate value theorem, the chain rule, the derivative of inverse functions, the mean value theorem and its applications. Differential calculus is also applied to various problems. The aim of the course is to improve mathematical thinking as well as computational skills.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

1st year mathematics and physics students as well as students taking mathematics as a minor subject

Prerequisites and co-requisites:

Functions and limit 800119P, Introduction to mathematical deduction 802151P

Recommended optional programme components:

-

Recommended or required reading:

In addition to the material hand out in the course, for example the book P. Harjulehto, R. Klén, M. Koskenoja, Analyysiä reaaliluvuilla.

Assessment methods and criteria:

Final exam, exercises

Grading:

1-5, fail

Person responsible:

Esa Järvenpää

Working life cooperation:

no

Other information:

Replaces the course 802163P Derivative.

800318A: Integral, 5 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ville Suomala

Opintokohteen kielet: Finnish

Leikkaavuudet:

802164P	Series and Integral	5.0 op
802353A	Series and Integrals	6.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1st year 3rd period

Learning outcomes:

After completing the course, the student
- manages the basics of integration theory
- understands the connection and differences between definite and indefinite integral
- is able to understand the connetcion between the integral and the derivative
- is able to use appropriate integration methods and knows where integration theory is applied

Contents:

Introduction to integration theory. Riemann-integral, The fundamental theorem of Calculus, Eksponent function and logarithm, integration by parts, integration by substitution, improper integral. Applications of integration theory.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h, independent work

Target group:

1st year mathematics and physics students as well as students taking mathematics as a minor subject

Prerequisites and co-requisites:

Functions and limit, Continuity and derivative

Recommended or required reading:

In addition to the material hand out in the course, for example the book P. Harjulehto, R. Klén, M. Koskenoja, Analyysiä reaaliluvuilla.

Assessment methods and criteria:

Final exam

Grading:

1-5

Person responsible:

Ville Suomala

Working life cooperation:

no

Other information:

Replaces the course 802164P Series and integral.

800328A: Calculus of several variables, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802351A	Vector Calculus	5.0 op
800322A	Multidimensional analysis	8.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd year, 1st period

Learning outcomes:

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

Contents:

The course concerns calculus of severable variables. The central concepts of the course are partial derivative, gradient, divergence, curl and multiple integral. Integral theorems related to functions of several variables are also presented. In addition power series are introduced. The course offers basic tools for applications.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics and physics major and minor students

Prerequisites and co-requisites:

Continuity and derivative 800317A, Integral 800318A, Introduction to matrices 802120P

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Mahmoud Filali

Working life cooperation:

No

Other information:

Replaces the course 802351A Vector calculus

802320A: Linear Algebra, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802119P	Linear Algebra II	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish and English

Timing:

2nd year, 2nd period

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors and minors students

Prerequisites and co-requisites:

802120P Introduction to Matrices

Recommended optional programme components:

-

Recommended or required reading:

http://cc.oulu.fi/~tma/OPETUS.html

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Tapani Matala-aho

Working life cooperation:

No

Other information:

-

802354A: Basics in Algebra, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Myllylä

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay802354A Number Theory and Groups (OPEN UNI) 5.0 op

800333A Algebra I 8.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

1. year, 3. period

Learning outcomes:

After completing the course, student is able to

- derive and proof main results in the course
- use and apply different proof techniques
- recognize algebraic structures and the concepts
- see connections and differences between different algebraic structures

Contents:

The course includes basics in arithmetics and algebraic structures, such as, congruence, residue classes, prime numbres, Euclidean algorithm, the fundamental theorem of arithmetic, Euler-Fermat formula, groups and morphisms. The course gives an understanding of
algebraic terms and concepts used in mathematics and physics.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28 h lectures, 14 h exercises

Target group:

Major and minor students

Prerequisites and co-requisites:

802151P Introduction to mathematical deduction

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

1-5

Person responsible:

Kari Myllylä

Working life cooperation:

-

802357A: Euclidean Spaces, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ville Suomala

Opintokohteen kielet: Finnish

Leikkaavuudet:

802352A	Euclidean Topology	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

2nd year 2nd period

Learning outcomes:

After passing the course the student
- will be able to define basic topological concepts
- will be able to handle sequences
- will be able to justify basic properties of continuous vector valued functions

Contents:

Sequences, continuity and limit of a vector valued function, basic topological concepts

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

28 hours of lectures, 14 hours of excercises, independent work

Target group:

Major and minor students

Prerequisites and co-requisites:

Functions and limits, Continuity and derivative, Introduction to Matrices, Integral

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Ville Suomala

Working life cooperation:

No

Other information:

-

800331A: Proseminar, 10 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Myllylä

Opintokohteen kielet: Finnish

Leikkaavuudet:

801323A Seminar 6.0 op

ECTS Credits:

10 ECTS credits / 266 hours of work

Language of instruction:

Finnish

Timing:

2nd and 3rd year

Learning outcomes:

After completing the Bachelor's thesis:
1) student is able to form a clear and logical
2) student is able to concentrate to important and essential details in the subject of thesis
3) student gain experience presenting mathematical concept and research studies

Contents:

Proseminar (Bachelor's thesis) is a small mathematical study based on literature. Student is familiarized to write mathematical texts and obtain information using literature. Thesis includes a oral presentation from the subject of the thesis.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Seminars and own work

Target group:

Major students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies

Recommended optional programme components:

Maturity test is written from the topic of Bachelor's thesis

Assessment methods and criteria:

Bachelor's thesis

Grading:

Pass/Fail

Person responsible:

Kari Myllylä

800300A: Maturity test, 0 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

0 cr

Language of instruction:

Finnish/Swedish

Timing:

Third year

Learning outcomes:

Maturity test

Contents:

Students must take a written maturity test to demonstrate their language skills and how well they know the topic of their thesis. The maturity test is taken in the language in which the student has received his or her education in Finland. If the student has received his or her education in a language other than Finnish or Swedish, the degree programme determines the language of the maturity test. In such cases only the contents of the maturity test is evaluated, not the language.

Mode of delivery:

Maturity test written in examination room.

Learning activities and teaching methods:

Maturity test

Target group:

Major students

Prerequisites and co-requisites:

Bachelor's degree (or similar)

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

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

Grading:

Pass/Fail

Person responsible:

Supervisor of thesis

Working life cooperation:

-

H325030: Optional studies in mathematics and statistics, 5 - 60 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Optional Studies

Laji: Study module

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Electives

802355A: Algebraic Structures, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Myllylä

Opintokohteen kielet: Finnish

Leikkaavuudet:

800333A Algebra I 8.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

Second year, 1. period

Learning outcomes:

After completing the course, student is able to

- derive and proof main results in the course
- use and apply different proof techniques
- recognize algebraic structures and the concepts
- see connections and differences between different algebraic structures

Contents:

The course introduces algebraic structures, such as rings, subrings, ideals, integral domains, fields and finite fields. The course gives an understanding of algebraic terms and concepts used in mathematics and physics.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28 h lectures, 14 h exercises

Target group:

Major students

Prerequisites and co-requisites:

802354A Basics in Algebra

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

1-5

Person responsible:

Kari Myllylä

Working life cooperation:

-

800321A: Series and Approximation, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

2nd year

Learning outcomes:

Upon completing the course the student is
- able to manipulate series and investigate their convergence
- able to explain the difference between uniform and pointwise convergence
- able to study the uniform and pointwise convergence of function sequences and series
- able to use power series in approximation

Contents:

The course concerns both number series and function series. The central topics are convergence tests, pointwise and uniform convergence, power series and the Taylor series. The course gives also an introduction to approximation of functions by polynomials for example.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors

Prerequisites and co-requisites:

Continuity and derivative 800317A and Integral 800318A

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Mahmoud Filali

Working life cooperation:

no

802358A: Metric Spaces, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802356A	Metric Topology	5.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year, 4th period

Learning outcomes:

After the course the student is able to
- define metric spaces
- give examples of metric spaces
- define elementary topological concepts (open and closed sets, accumulation point, etc)
- apply the definitions from elementary topology in examples and proofs

Contents:

The goal of the courses is to expand student's knowledge and understanding of continuity and to introduce to other topological concepts in the setting of metric spaces. Course considers basic topology of n-dimensional Euclidean space and introduces also other metric spaces as examples. Central concepts are open and closed sets, compactness and completeness.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors (obligatory for mathematics majors except for subject teacher students)

Prerequisites and co-requisites:

802357A Euclidean spaces OR 802357A Introduction to Real Analysis

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Midterm exams or final exam

Grading:

1-5

Person responsible:

Mahmoud Filali

Working life cooperation:

-

Other information:

-

800320A: Differential equations, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Erkki Laitinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

031076P	Differential Equations	5.0 op
031017P	Differential Equations	4.0 op
800345A	Differential Equations I	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

2nd year

Learning outcomes:

Upon completing the course the student
- is able to classify differential equations and is able to apply correct solution methods to them
- knows the conditions that guarantee the unique solvability of an equation
- understands the concept of implicitly defined solution

Contents:

The course is devoted to ordinary differential equations. Central part is formed by first order differential equations (separable, homogeneous, linear, exact equations and certain equations which can be transformed into these). The equations are solved using algebraic, iterative and numerical methods. The second part which is central to applications is formed by linear inhomogeneous differential equations with constant coefficients and linear second order equations with continuous coefficient functions. In addition, systems of differential equations are considered. Certain second order linear differential equatoins (e.g. Legendre's equation) is solved via power series.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h, independent work

Target group:

Major and minor students

Prerequisites and co-requisites:

Continuity and derivative 800317A and Integral 800318A

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

1-5

Working life cooperation:

no

Other information:

Homepage in Noppa portal.

801396A: Introduction to Probability Theory II, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:
Tuominen, P., , 1993

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

On successful completion of this course, the student will be able to:
- work with random variables both in theory and applications
- explain the central results in probability theory such that Law of large numbers and the Central limit theorem
- determine generating functions of random variables and apply them for example to calculate moments
- apply various stocastic models
- derive the basic results associated with the new concepts introduced
- use two-dimensional distributions
- work with conditional distributions

Contents:

The central topics are the moments of a distribution, the probability generating function, the Law of Large Numbers, the Central Limit Theorem, two-dimensional distibutions as well as conditional distributions.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics major and minor students. Recommended for students aiming for the profile of computational mathematics and data science.

Prerequisites and co-requisites:

801195P Introduction to probability I, 800328A Calculus of several variables (or Vector Calculus)

Recommended or required reading:

P. Tuominen: Todennäköisyyslaskenta I, Limes 2002 and other books on probability.

Assessment methods and criteria:

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

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

-

800146P: Introduction to teaching, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

801329A	Mathematics in Teaching	3.0 op
802157P	Mathematics in teaching	2.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1st year, 3th period

Learning outcomes:

After the course, the student is able to reflect critically on the learning and teaching of mathematics. The student can discuss and explain the connection between mathematics at school and at university.

Contents:

Learning and teaching mathematics and physics are thought about and discussed.
The course consists of reflective exercises, reading articles and seminar meetings where the exercises are discussed. The student writes a learning journal.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28 h seminar meetings, 105 h independent work and group work

Target group:

1st year mathematics and physics teacher students

Prerequisites and co-requisites:

-

Assessment methods and criteria:

Participating in the meetings, writing a learning diary, group work tasks

Grading:

pass/fail

Person responsible:

Marko Leinonen

Working life cooperation:

No

Other information:

Replaces the course 801329A Mathematics in teaching.

802336A: Introduction to Cryptography, 5 op

Voimassaolo: 01.06.2016 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay802336A Introduction to Cryptography (OPEN UNI) 5.0 op

801346A Introduction to Cryptography 4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year or later, every period

Learning outcomes:

After completeing the course, student
- knows the principles of sime traditianl symmetric key methods
- knows how public key methods (RSA, discrete logarithm, knapsack) work
- is familiar with the possibility to use and apply number theory in cryptography

Contents:

The course considers some traditional symmetric key methods (affine system, matrix cryptography) and three public key methods, namely RSA, discrete logarithm and knapsack.

Mode of delivery:

Independent work

Learning activities and teaching methods:

Net course; Lecture slides, exercisis, solutions of exercisis (in Noppa) + stack-exercisis

Target group:

Major and minor students

Prerequisites and co-requisites:

802354A Basics of Algebra, 802120P Introduction to Matrices

Recommended optional programme components:

-

Recommended or required reading:

Lecture slides, exercisis, solutions of exercisis, stack-exercisis

Assessment methods and criteria:

Final exam or Final exam + stack-exercisis

Grading:

1-5, fail

Person responsible:

Marko Leinonen

Working life cooperation:

No

801399A: Geometry, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

801389A	Basic Geometry for University Students	6.0 op

Ei opintojaksokuvauksia.

802359A: Advanced Vector Calculus, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ville Suomala

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year, 4th period

Learning outcomes:

After completing the course the student is able to
- use derivative as a linear mapping
- formulate and apply Inverse function theorem and Implicit function theorem
- define and calculate Riemann integral in higher dimensions

Contents:

The aim of the course is to deepen the understanding of calculus of severable variables. The derivative is treated as a linear mapping. The central results are the Inverse Function Theorem and the Implicit Function Theorem. In the course the Riemann integral is defined in higher dimension and related basic results are proved

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors

Prerequisites and co-requisites:

802351A Vector Calculus
802164P Series and Integral
802163P Derivative
802358A Metric spaces (or 802357A Euklidean spaces)

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Pekka Salmi

Working life cooperation:

No

Other information:

-

802328A: Basics in Number Theory, 5 op

Voimassaolo: 01.06.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapani Matala-aho

Opintokohteen oppimateriaali:

Hardy, G. H., , 1979
Rosen, Kenneth H., , 1993
Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish/English

Timing:

2.-3. year of studies. Timing varies.

Learning outcomes:

As usual in my mathematical studies I shall be able to solve problems arising from the subject and to prove essential theorems starting from the given definitions using the tools applied in the course. More detailed; For example, when I pass the course with the grade 1/5, I shall recognize most definitions and I am able to solve closely related problems. Also I am able to rewrite short proofs with some understanding. When I pass the course with the grade 5/5, then I shall understand well the given definitions with the proofs of the theorems deduced from them. Further, I am able to solve challenging problems which demand independent deductions with several stages and applications of appropriate tools.

Contents:

In our lectures we consider arithmetical properties of the common numbers involved in studing mathematics and in particular number theory. Also the methods will get a special interest. Examples of the numbers under the research will be binomials, continued fractions, sums of powers and some numbers sharing a name with the mathematicians Bernoulli, Euler, Fermat, Fibonacci, Heron, Lucas, Mersenne, Neper, Pythagoras, Stirling, Wilson and Wolstenholme. From the tools we mention congruences of rational numbers and polynomials, difference operators, generating series, irrationality considerations, matrix presentations, recurrences and telescopes.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures and execises

Target group:

Major and minor students

Prerequisites and co-requisites:

802354A Lukuteoria ja ryhmät
802355A Rings, fields and polynomials
802118P Linear algebra I
802119P Linear algebra II
802352A Euclidean topology
802353A Series and integrals

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes,
G.H. Hardy ja E.M. Wright: An Introduction to the Theory of Numbers;
Kenneth H. Rosen: Elementary number theory and its applications.

Assessment methods and criteria:

Mid-term exams or final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Tapani Matala-aho

Working life cooperation:

-

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

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

800346A	Differential Equations II	4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year or later, 2nd period

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h

Target group:

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

Prerequisites and co-requisites:

Differential equations, Complex analysis

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Working life cooperation:

No

Other information:

-

031077P: Complex analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kemppainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish

Timing:

Fall semester, period 1.

Learning outcomes:

After completing the course the student

1. is able to calculate the derivative and the integral of functions of complex variable,
2. understands the concept of analyticity
3. is capable of calculating the contour integrals and using the theory of residues for computing the line integrals, will be able to apply the techniques of complex analysis to simple problems in signal processing.

Contents:

Complex numbers and functions, complex derivative and analyticity, complex series, Cauchy's integral theorem, Laurent and Taylor expansions, theory of residues, applications to signal analysis.

Mode of delivery:

Face-toface teaching, Stack(web-based too) exercises.

Learning activities and teaching methods:

Lectures 28 h/Exercises 14 h/Self study 93 h.

Target group:

The students in the engineering sciences. The other students are welcome, too.

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses Calculus I and II, Differential Equations.

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 lecture notes

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Jukka Kemppainen

Working life cooperation:

-

Other information:

-

802338A: Complex Analysis II, 5 op

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

ECTS Credits:

5 credits

Contents:

like - terminating, non-terminating, irrationality, periodicity, approximation properties will be studied

Person responsible:

Valery Serov

031022P: Numerical Analysis, 5 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Marko Huhtanen
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish. English speaking students should contact the instructor.
The course can be completed in English by intermediate exams or by a final exam.

Timing:

Spring semester, period 3

Learning outcomes:

Knows numerical algorithms for solving basic problems in computing. Knows basics about numerical linear algebra and some of its applications. Knows how nonlinear systems are solved and how they appear in optimization. Knows how differential equations are solved numerically.

Contents:

Numerical linear algebra, numerical methods for systems of equations, unconstrained optimization, basics of the approximation theory, numerical quadratures, numerical methods for ordinary differential equations.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 22 h / Self-study 85 h.

Target group:

-

Prerequisites and co-requisites:

Completion of courses Calculus I and II, a course on Differential Equations and a Course on Linear Algebra.

Recommended optional programme components:

-

Recommended or required reading:

Material posted on the web-page of the course.

Assessment methods and criteria:

Intermediate exams or a final exam.

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

Grading:

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

Person responsible:

Marko Huhtanen

Working life cooperation:

-

Other information:

-

802365A: Introduction to Mathematical Solfware, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Mikko Orispää

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish (also English if needed)

Timing:

2.-3. year

Learning outcomes:

Upon completion of the course, the student knows the basics of the use of the most common mathematical software, is able to use mathematical software in solving mathematical tasks and problems, and is able to independently deepen her knowledge of different mathematical software as necessary.

Contents:

During the course, the student learns the basics of some of commonly used mathematical software which include Matlab and Python (Numpy/Scipy).

Mode of delivery:

The course is arranged in a computer class as a series of lectures and rehearsals. On the lectures, the students have the possibility to use and try the mathematical software during the lectures. In the rehearsals, different given problems and tasks are solved together.

Learning activities and teaching methods:

Lectures 22 h / Rehearsals 22 h / Self-study 60 h. The self-study contains the independent learning of the software and also the preparation of the final assignments.

Target group:

Anybody interested in mathematical software.

Prerequisites and co-requisites:

The required prerequisite is the completion of following courses (or corresponding knowledge of the subject):
- 802120P Matrix calculus
- 802320A Linear algebra

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 required and recommended reading consists mainly on free material (manuals/tutorial) found in the internet. More information will be given at the beginning of the course.

Assessment methods and criteria:

The course is assessed by final assignments. The student who wish to complete the course at A-level will make two separate assignments of given topics using (at least) two different mathematical software. Those who wish to complete the course in S-level will need to discuss with the lecturer about the extra work needed to pass. For example, it could be possible to do assignments of wider topics, making an assignment (s) with a software not covered in the course, or making an assignment that requires particular skills and knowledge.

Grading:

The course utilizes grading scale pass / fail.

Person responsible:

Mikko Orispää

Working life cooperation:

-

Other information:

-

802361A: Numerical Computation, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

On successful completion of this course, the student will be able to solve basic numerical problems using Fortran programming and to exploit the Unix computers and software libraries for solving numerical problems.

Contents:

On the course students train programming of numerical algorithms using Fortran 95 programming language in Unix (Linux) operating system. On the course, DISLIN subroutine library is used for the visualization of the numerical calculation results.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h + exercises+practical work. Self-study has important role.

Target group:

Major and minor students

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 required and recommended reading consists mainly on free material (manuals/tutorial) found in the internet. More information will be given at the beginning of the course.

Assessment methods and criteria:

The assessment of the course is based on the assesment of practical work at the end of course.

Grading:

The course utilizes verbal grading scale pass / fail.

Person responsible:

Erkki Laitinen

Working life cooperation:

No

Other information:

-

031025A: Introduction to Optimization, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English

Timing:

The course is held in the autumn, during period 1.

Learning outcomes:

After completing the course the student is able to solve optimization convex optimization problems with the basic optimization algorithms. The student is also able to form the necessary and sufficient conditions for the optimality.

Contents:

Linear optimization, Simplex-algorithm, nonlinear optimization, KKT-conditions, duality, conjugate gradient method, penalty and barrier function methods.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 14 h / Self-study 93 h.

Target group:

Students in Wireless Communication Engineering

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses Calculus I and II, Matrix algebra

Recommended optional programme components:

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Recommended or required reading:

P. Ciarlet; Introduction to numerical linear algebra and optimization, M. Bazaraa, H. Sherali, C.M. Shetty; Nonlinear programming

Assessment methods and criteria:

The course can be completed by a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Keijo Ruotsalainen

Working life cooperation:

-

Other information:

-

031080A: Signal Analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kotila, Vesa Iisakki

Opintokohteen kielet: Finnish

Leikkaavuudet:

031050A	Signal Analysis	4.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish.
The course can be completed in English by a final exam or a retake exam.

Timing:

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

Learning outcomes:

Upon completion of the course, the student:
-is able to calculate the energy, the power, the convolution and the frequency spectrum of discrete and analog, periodic and non-periodic deterministic signals
-is able to calculate the spectrum of a sampled signal
-is able to calculate the Hilbert transform and the complex envelope of a signal
-is able to study the stationarity, the mutual dependence and the frequency content of random signals by means of the auto- and cross-correlation functions, and the power- and cross-power spectral densities
-is able to study the effect of an LTI system on a signal

Contents:

Signals, classification, frequency. Fourier analysis, analog and digital signal, fast Fourier transform. LTI system. Hilbert transform. AM- FM- and PM-modulation. Random variable. Covariance matrix. Random signal. Stationarity, autocorrelation. Power spectral density. Random signal in LTI system. Signal estimation.

Mode of delivery:

Blended teaching.

Learning activities and teaching methods:

Lectures 28 h / Exercises 14 h / Self-study privately or in a group 93 h. The independent work includes individual STACK-assignments as online work.

Target group:

-

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses 031078P Matrix Algebra, 031021P Probability and Mathematical Statistics and 031077P Complex Analysis.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes. Additional reading: Proakis, J.G., Manolakis, D.K.: Introduction to Digital Signal Pro-cessing. Shanmugan, K.S., Breipohl, A.M.: Random Signals, Detection, Estimation and Data Analysis.

Assessment methods and criteria:

The course is completed with a final exam or a retake exam. In addition to the final exam, STACK-assignments given during the course are part of the assessment. The assessment of the course is based on the learning outcomes of the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Vesa Kotila

Working life cooperation:

-

Other information:

-

802322A: Basics in mathematical modelling, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Erkki Laitinen

Opintokohteen kielet: Finnish

805305A: Introduction to Regression and Analysis of Variance, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Päkkilä

Opintokohteen kielet: Finnish

Leikkaavuudet:

806112P	Basic Methods of Data Analysis	10.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Autumn term, 2nd period. Recommended to be taken already in the 2nd year for those aiming at specialization in data science.

Learning outcomes:

Upon successful completion of the course the student can describe the basic concepts and main principles of regression and variance analysis with one or several explanatory variables, and is able to apply these methods in analysing a small scale data set as well as to apply the necessary computational tools.

Contents:

Linear regression and analysis of variance models for continuous outcomes; Formulation of the model and interpretation of parameters; Fitting the models, estimation of parameters, and prediction with the method of least squares: Basic methods of model criticism and diagnostics; Use of R environment in modelling.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Lectures 28 h, practicals 14 h, and independent work. The practicals include both homework and computer class exercises.

Target group:

Students of mathematical sciences and other interested. The course belongs to core studies for those with an orientation to data science. It is a prerequisite for those doing M.Sc. in computational mathematics and data science having data science as the specialization profile. The course is useful also for students of the Faculty of Science and the Oulu Business School as well as those of computer science or computational engineering, who have statistics as a minor subject.

Prerequisites and co-requisites:

806113P Introduction to Statistics or 806119P A Second Course in Statistics or corresponding abilities acquired otherwise.

Recommended optional programme components:

Is assumed as preliminary knowledge in the course 805306A Introduction to Multivariate Methods.

Recommended or required reading:

Lecture notes and material distributed during lectures and practicals. Recommended reading:James, G., Witten, D., Hastie, T., Tibshirani, R. (2013). An Introduction to Statistical Learning with Applications in R}. Springer, New York; chapters 1-3. -- freely downloadable from http://www-bcf.usc.edu/~gareth/ISL/

Assessment methods and criteria:

Practical exercises and final exam. Passing the course requires adequate participation in practical sessions and sufficient homework activity.

Grading:

Numeric assessment scale from 1 to 5

Person responsible:

Jari Päkkilä

Working life cooperation:

No

805306A: Introduction to Multivariate methods, 5 op

Voimassaolo: 01.08.2017 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Jari Päkkilä
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Autumn term, 2nd period. Recommended to be taken already in the 2nd year for those aiming at specialization in data science.

Learning outcomes:

Upon successful completion of the course the student can describe the basic concepts and main principles of the logistic regression, principal components analysis, discriminant analysis, classification analysis and clustering analysis, and is able to apply these methods in analysing a small scale data set as well as to apply the necessary computational tools.

Contents:

Logistic regression, principal components analysis, discriminant analysis, classification analysis and clustering analysis; Use of R environment in modelling; Course is an application oriented.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Lectures 28 h, practicals 14 h, and independent work. The practicals include both homework and computer class exercises.

Target group:

Students of mathematical sciences and other interested. The course belongs to core studies for those with an orientation to data science. It is a prerequisite for those doing M.Sc. in computational mathematics and data science having data science as the specialization profile. The course is useful also for students of the Faculty of Science and the Oulu Business School as well as those of computer science or computational engineering, who have statistics as a minor subject.

Prerequisites and co-requisites:

806113P Introduction to Statistics or 806119P A Second Course in Statistics and 805305A Introduction to Regression and Analysis of Variance or corresponding abilities acquired otherwise.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and material distributed during lectures and practicals. Recommended reading:James, G., Witten, D., Hastie, T., Tibshirani, R. (2013). An Introduction to Statistical Learning with Applications in R}. Springer, New York; chapters 4 and 10. -- freely downloadable from http://www-bcf.usc.edu/~gareth/ISL/.

Assessment methods and criteria:

Practical exercises and final exam. Passing the course requires adequate participation in practical sessions and sufficient homework activity.

Grading:

Numeric assessment scale from 1 to 5, Fail

Person responsible:

Jari Päkkilä

Working life cooperation:

No

800324A: Practical training, 5 op

Voimassaolo: 01.08.2017 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Kari Myllylä
Opintokohteen kielet: Finnish
Leikkaavuudet:

802327A	Tutoring	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Person responsible:

Kari Myllylä

A325004: Mathematics Minor, 25 - 120 op

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

ayA325004	Mathematics Minor (OPEN UNI)	25.0 op

Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.

General Studies in Mathematics (min 45 ECTS cr)

802151P: Introduction to mathematical deduction, 5 op

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

ay802151P	Introduction to mathematical deduction (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

First period at the first semester.

Learning outcomes:

After completing the course, student is:
- able to use different methods proving techniquesis
- able to use basic set theoretic concepts and definitionsis
- able to define and apply basic definitions related to functions

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h

Target group:

Major and minor students

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

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

Grading:

Pass/Fail

Person responsible:

Marko Leinonen

Working life cooperation:

-

800119P: Functions and limit, 5 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Salmi

Opintokohteen kielet: Finnish

Leikkaavuudet:

802162P	Continuity and Limit	5.0 op
802155P	Continuity and limit	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1st year, 1st period

Learning outcomes:

Upon completing the course the student is
- able to apply the triangle inequality and make approximations
- able to manipulate elementary functions such as polynomials and trigonometric functions
- able to define the limit of a sequence and the limit of a function as well as apply these definitions
- able to apply different techniques to determine limits.

Contents:

The course concerns real-valued functions of one variable. In particular elementary functions are defined and the monotonicity of functions is studied. The notion of absolute value is reviewed and applied to approximation. Also the triangle inequality is used in approximation. The central concept is the limit of a function, which is introduced via the limit of a sequence. The aim of the course is to improve deductive skills as well as computational skills.

Mode of delivery:

Face-to-face teaching, computer exercises

Learning activities and teaching methods:

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

Target group:

1st year mathematics and physics students as well as students taking mathematics as a minor subject

Prerequisites and co-requisites:

Introduction to mathematical deduction 802151P is recommended to be taken simultaneously (or earlier).

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes, STACK exercises. Additional material: for example the book P. Harjulehto, R. Klén, M. Koskenoja, Analyysiä reaaliluvuilla.

Assessment methods and criteria:

Final exam, exercises

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

No

Other information:

Replaces the course 802162P Continuity and Limit.

800317A: Continuity and derivative, 5 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802163P	Derivative	5.0 op
802156P	Derivative	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1st year, 2nd period

Learning outcomes:

Upon completing the course the student is
- able to define the concept of continuous function and apply this definition in examples and deductions
- able to determine derivatives of functions
- able to apply derivative to study functions
- able to appy the concepts of continuity and derivative in various problems, including deductions

Contents:

The course concerns continuity and derivative of real-valued functions of one variable. The central topics are the intermediate value theorem, the chain rule, the derivative of inverse functions, the mean value theorem and its applications. Differential calculus is also applied to various problems. The aim of the course is to improve mathematical thinking as well as computational skills.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

1st year mathematics and physics students as well as students taking mathematics as a minor subject

Prerequisites and co-requisites:

Functions and limit 800119P, Introduction to mathematical deduction 802151P

Recommended optional programme components:

-

Recommended or required reading:

In addition to the material hand out in the course, for example the book P. Harjulehto, R. Klén, M. Koskenoja, Analyysiä reaaliluvuilla.

Assessment methods and criteria:

Final exam, exercises

Grading:

1-5, fail

Person responsible:

Esa Järvenpää

Working life cooperation:

no

Other information:

Replaces the course 802163P Derivative.

800318A: Integral, 5 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ville Suomala

Opintokohteen kielet: Finnish

Leikkaavuudet:

802164P	Series and Integral	5.0 op
802353A	Series and Integrals	6.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1st year 3rd period

Learning outcomes:

After completing the course, the student
- manages the basics of integration theory
- understands the connection and differences between definite and indefinite integral
- is able to understand the connetcion between the integral and the derivative
- is able to use appropriate integration methods and knows where integration theory is applied

Contents:

Introduction to integration theory. Riemann-integral, The fundamental theorem of Calculus, Eksponent function and logarithm, integration by parts, integration by substitution, improper integral. Applications of integration theory.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h, independent work

Target group:

1st year mathematics and physics students as well as students taking mathematics as a minor subject

Prerequisites and co-requisites:

Functions and limit, Continuity and derivative

Recommended or required reading:

In addition to the material hand out in the course, for example the book P. Harjulehto, R. Klén, M. Koskenoja, Analyysiä reaaliluvuilla.

Assessment methods and criteria:

Final exam

Grading:

1-5

Person responsible:

Ville Suomala

Working life cooperation:

no

Other information:

Replaces the course 802164P Series and integral.

802120P: Introduction to Matrices, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802118P Linear Algebra I 4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

1. year, 4. period

Learning outcomes:

After completing the course the student is able to
- apply arithmetic operations of matrices
- solve system of linear equations by matrix methods
- study linear depence and linear indepence of vectors
- recognize the subspace of R^n and understands the concepts of basis and dimension of a vector space
- analyse matrices by the parameters and the vectors

Contents:

Vectors and matrices, Systems of linear equations, determinant of a matrix, subspaces of R^n, linear depence and linear indepence of vectors, base, dimension, eigenvalues and eigenvectors of a matrix, diagonalization.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, Exercises 14 h

Target group:

Major and minor studies

Prerequisites and co-requisites:

802151P Introduction to Mathematical Deduction

Recommended or required reading:

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

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Marko Leinonen

Working life cooperation:

-

800328A: Calculus of several variables, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802351A Vector Calculus 5.0 op

800322A Multidimensional analysis 8.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd year, 1st period

Learning outcomes:

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

Contents:

The course concerns calculus of severable variables. The central concepts of the course are partial derivative, gradient, divergence, curl and multiple integral. Integral theorems related to functions of several variables are also presented. In addition power series are introduced. The course offers basic tools for applications.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics and physics major and minor students

Prerequisites and co-requisites:

Continuity and derivative 800317A, Integral 800318A, Introduction to matrices 802120P

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Mahmoud Filali

Working life cooperation:

No

Other information:

Replaces the course 802351A Vector calculus

802320A: Linear Algebra, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802119P	Linear Algebra II	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish and English

Timing:

2nd year, 2nd period

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors and minors students

Prerequisites and co-requisites:

802120P Introduction to Matrices

Recommended optional programme components:

-

Recommended or required reading:

http://cc.oulu.fi/~tma/OPETUS.html

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Tapani Matala-aho

Working life cooperation:

No

Other information:

-

806113P: Introduction to Statistics, 5 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Hanna Heikkinen

Opintokohteen oppimateriaali:
Wild, Christopher J. , , 2000
Grönroos, Matti (2) , , 2003

Opintokohteen kielet: Finnish

Leikkaavuudet:

806118P	Introduction to Statistics	5.0 op

806119P A Second Course in Statistics 5.0 op

806116P Statistics for Economic Sciences 5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

4th period. 1st or 2nd year of studies.

Learning outcomes:

Upon completion of the course, student will be
- able to identify and define the main principles of statistical research, collection of the data and analysis
- able to apply basic methods of descriptive statistics and statistical inference in simple quantitative research using a statistical software
- able to critically evaluate results of the statistical research presented in media
- prepared for teaching statistics in secondary school and high school
- prepared for participating in a group.

Contents:

- the nature and the meaning of statistics
- data and the acquisition of them: observations, variables, measuring and designs of a study
- the descriptive statistics of empirical distributions: tables, graphical presentations and descriptive measures of center, variation and dependence
- the most important probability distributions
- the principles and the basic methods of statistical inference: random sample, sample statistics, point estimation, confidence intervals and statistical testing of hypotheses.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 16 h (partly compulsory) / instructed group work (28 h) / independent work 80 h. Group works will be returned. Additional independently implemented learning diary tasks. Independent work contains also preparation for group work and peer assessment.

Target group:

Students of mathematical and physical sciences.

Prerequisites and co-requisites:

The recommended prerequisite prior to enrolling for the course is the completion of the courses: 802151P Introduction to mathematical deduction and 800119P Functions and limit.

Recommended optional programme components:

After the course, student is able to continue other statistics courses.

Recommended or required reading:

Lecture notes.

Assessment methods and criteria:

This course utilizes continuous assessment. Practical works and learning diaries are assessed weekly. In addition web tests and learning tasks. The assessment of the course is based on the learning outcomes of the course. The more detailed assessment criteria is available in the beginning of the course. In addition one compulsory lecture and peer assessment.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Hanna Heikkinen

Working life cooperation:

No

800320A: Differential equations, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Erkki Laitinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

031076P	Differential Equations	5.0 op
031017P	Differential Equations	4.0 op
800345A	Differential Equations I	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

2nd year

Learning outcomes:

Upon completing the course the student
- is able to classify differential equations and is able to apply correct solution methods to them
- knows the conditions that guarantee the unique solvability of an equation
- understands the concept of implicitly defined solution

Contents:

The course is devoted to ordinary differential equations. Central part is formed by first order differential equations (separable, homogeneous, linear, exact equations and certain equations which can be transformed into these). The equations are solved using algebraic, iterative and numerical methods. The second part which is central to applications is formed by linear inhomogeneous differential equations with constant coefficients and linear second order equations with continuous coefficient functions. In addition, systems of differential equations are considered. Certain second order linear differential equatoins (e.g. Legendre's equation) is solved via power series.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h, independent work

Target group:

Major and minor students

Prerequisites and co-requisites:

Continuity and derivative 800317A and Integral 800318A

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

1-5

Working life cooperation:

no

Other information:

Homepage in Noppa portal.

These courses mandatory in Master studies if not included in Bachelor degree

802354A: Basics in Algebra, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Myllylä

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay802354A	Number Theory and Groups (OPEN UNI)	5.0 op
800333A	Algebra I	8.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

1. year, 3. period

Learning outcomes:

After completing the course, student is able to

- derive and proof main results in the course
- use and apply different proof techniques
- recognize algebraic structures and the concepts
- see connections and differences between different algebraic structures

Contents:

The course includes basics in arithmetics and algebraic structures, such as, congruence, residue classes, prime numbres, Euclidean algorithm, the fundamental theorem of arithmetic, Euler-Fermat formula, groups and morphisms. The course gives an understanding of
algebraic terms and concepts used in mathematics and physics.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28 h lectures, 14 h exercises

Target group:

Major and minor students

Prerequisites and co-requisites:

802151P Introduction to mathematical deduction

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

1-5

Person responsible:

Kari Myllylä

Working life cooperation:

-

801195P: Probability Theory, 5 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Tuominen, P., , 1993

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year, 2nd period.

Learning outcomes:

Upon completing the course the student will be able to
- solve simple practical problems associated with probability
- solve simple theoretical problems associated with probability
- derive the basic properties of probability, starting from the axioms

Contents:

The course is an introduction to probability. In the beginning high school level probability is reviewed and after that axiomatic treatment of the theory starts. The central concepts discussed include probability space, conditional probability, independence, and random variable together with its distribution and expected value.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors and minors

Prerequisites and co-requisites:

Integral 800318A

Recommended optional programme components:

-

Recommended or required reading:

Lectures.
Text book: Pekka Tuominen: Todennäköisyyslaskenta I, Limes ry, Helsinki.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Hanna Heikkinen

Working life cooperation:

-

802357A: Euclidean Spaces, 5 op

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

802352A	Euclidean Topology	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

2nd year 2nd period

Learning outcomes:

After passing the course the student
- will be able to define basic topological concepts
- will be able to handle sequences
- will be able to justify basic properties of continuous vector valued functions

Contents:

Sequences, continuity and limit of a vector valued function, basic topological concepts

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

28 hours of lectures, 14 hours of excercises, independent work

Target group:

Major and minor students

Prerequisites and co-requisites:

Functions and limits, Continuity and derivative, Introduction to Matrices, Integral

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Ville Suomala

Working life cooperation:

No

Other information:

-

Electives

H325030: Optional studies in mathematics and statistics, 5 - 60 op

Voimassaolo: 01.08.2018 -
Opiskelumuoto: Optional Studies
Laji: Study module
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Electives

802355A: Algebraic Structures, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Kari Myllylä
Opintokohteen kielet: Finnish
Leikkaavuudet:

800333A	Algebra I	8.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

Second year, 1. period

Learning outcomes:

After completing the course, student is able to

- derive and proof main results in the course
- use and apply different proof techniques
- recognize algebraic structures and the concepts
- see connections and differences between different algebraic structures

Contents:

The course introduces algebraic structures, such as rings, subrings, ideals, integral domains, fields and finite fields. The course gives an understanding of algebraic terms and concepts used in mathematics and physics.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28 h lectures, 14 h exercises

Target group:

Major students

Prerequisites and co-requisites:

802354A Basics in Algebra

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

1-5

Person responsible:

Kari Myllylä

Working life cooperation:

-

800321A: Series and Approximation, 5 op

Voimassaolo: 01.08.2017 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

2nd year

Learning outcomes:

Upon completing the course the student is
- able to manipulate series and investigate their convergence
- able to explain the difference between uniform and pointwise convergence
- able to study the uniform and pointwise convergence of function sequences and series
- able to use power series in approximation

Contents:

The course concerns both number series and function series. The central topics are convergence tests, pointwise and uniform convergence, power series and the Taylor series. The course gives also an introduction to approximation of functions by polynomials for example.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors

Prerequisites and co-requisites:

Continuity and derivative 800317A and Integral 800318A

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Mahmoud Filali

Working life cooperation:

no

802358A: Metric Spaces, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802356A	Metric Topology	5.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year, 4th period

Learning outcomes:

After the course the student is able to
- define metric spaces
- give examples of metric spaces
- define elementary topological concepts (open and closed sets, accumulation point, etc)
- apply the definitions from elementary topology in examples and proofs

Contents:

The goal of the courses is to expand student's knowledge and understanding of continuity and to introduce to other topological concepts in the setting of metric spaces. Course considers basic topology of n-dimensional Euclidean space and introduces also other metric spaces as examples. Central concepts are open and closed sets, compactness and completeness.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors (obligatory for mathematics majors except for subject teacher students)

Prerequisites and co-requisites:

802357A Euclidean spaces OR 802357A Introduction to Real Analysis

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Midterm exams or final exam

Grading:

1-5

Person responsible:

Mahmoud Filali

Working life cooperation:

-

Other information:

-

800320A: Differential equations, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Erkki Laitinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

031076P	Differential Equations	5.0 op
031017P	Differential Equations	4.0 op
800345A	Differential Equations I	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

2nd year

Learning outcomes:

Upon completing the course the student
- is able to classify differential equations and is able to apply correct solution methods to them
- knows the conditions that guarantee the unique solvability of an equation
- understands the concept of implicitly defined solution

Contents:

The course is devoted to ordinary differential equations. Central part is formed by first order differential equations (separable, homogeneous, linear, exact equations and certain equations which can be transformed into these). The equations are solved using algebraic, iterative and numerical methods. The second part which is central to applications is formed by linear inhomogeneous differential equations with constant coefficients and linear second order equations with continuous coefficient functions. In addition, systems of differential equations are considered. Certain second order linear differential equatoins (e.g. Legendre's equation) is solved via power series.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h, independent work

Target group:

Major and minor students

Prerequisites and co-requisites:

Continuity and derivative 800317A and Integral 800318A

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

1-5

Working life cooperation:

no

Other information:

Homepage in Noppa portal.

801396A: Introduction to Probability Theory II, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opintokohteen oppimateriaali:
Tuominen, P., , 1993
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

On successful completion of this course, the student will be able to:
- work with random variables both in theory and applications
- explain the central results in probability theory such that Law of large numbers and the Central limit theorem
- determine generating functions of random variables and apply them for example to calculate moments
- apply various stocastic models
- derive the basic results associated with the new concepts introduced
- use two-dimensional distributions
- work with conditional distributions

Contents:

The central topics are the moments of a distribution, the probability generating function, the Law of Large Numbers, the Central Limit Theorem, two-dimensional distibutions as well as conditional distributions.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics major and minor students. Recommended for students aiming for the profile of computational mathematics and data science.

Prerequisites and co-requisites:

801195P Introduction to probability I, 800328A Calculus of several variables (or Vector Calculus)

Recommended or required reading:

P. Tuominen: Todennäköisyyslaskenta I, Limes 2002 and other books on probability.

Assessment methods and criteria:

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

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

-

800146P: Introduction to teaching, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

801329A	Mathematics in Teaching	3.0 op
802157P	Mathematics in teaching	2.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1st year, 3th period

Learning outcomes:

After the course, the student is able to reflect critically on the learning and teaching of mathematics. The student can discuss and explain the connection between mathematics at school and at university.

Contents:

Learning and teaching mathematics and physics are thought about and discussed.
The course consists of reflective exercises, reading articles and seminar meetings where the exercises are discussed. The student writes a learning journal.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28 h seminar meetings, 105 h independent work and group work

Target group:

1st year mathematics and physics teacher students

Prerequisites and co-requisites:

-

Assessment methods and criteria:

Participating in the meetings, writing a learning diary, group work tasks

Grading:

pass/fail

Person responsible:

Marko Leinonen

Working life cooperation:

No

Other information:

Replaces the course 801329A Mathematics in teaching.

802336A: Introduction to Cryptography, 5 op

Voimassaolo: 01.06.2016 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay802336A	Introduction to Cryptography (OPEN UNI)	5.0 op
801346A	Introduction to Cryptography	4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year or later, every period

Learning outcomes:

After completeing the course, student
- knows the principles of sime traditianl symmetric key methods
- knows how public key methods (RSA, discrete logarithm, knapsack) work
- is familiar with the possibility to use and apply number theory in cryptography

Contents:

The course considers some traditional symmetric key methods (affine system, matrix cryptography) and three public key methods, namely RSA, discrete logarithm and knapsack.

Mode of delivery:

Independent work

Learning activities and teaching methods:

Net course; Lecture slides, exercisis, solutions of exercisis (in Noppa) + stack-exercisis

Target group:

Major and minor students

Prerequisites and co-requisites:

802354A Basics of Algebra, 802120P Introduction to Matrices

Recommended optional programme components:

-

Recommended or required reading:

Lecture slides, exercisis, solutions of exercisis, stack-exercisis

Assessment methods and criteria:

Final exam or Final exam + stack-exercisis

Grading:

1-5, fail

Person responsible:

Marko Leinonen

Working life cooperation:

No

801399A: Geometry, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

801389A	Basic Geometry for University Students	6.0 op

Ei opintojaksokuvauksia.

802359A: Advanced Vector Calculus, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ville Suomala

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year, 4th period

Learning outcomes:

After completing the course the student is able to
- use derivative as a linear mapping
- formulate and apply Inverse function theorem and Implicit function theorem
- define and calculate Riemann integral in higher dimensions

Contents:

The aim of the course is to deepen the understanding of calculus of severable variables. The derivative is treated as a linear mapping. The central results are the Inverse Function Theorem and the Implicit Function Theorem. In the course the Riemann integral is defined in higher dimension and related basic results are proved

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors

Prerequisites and co-requisites:

802351A Vector Calculus
802164P Series and Integral
802163P Derivative

802358A Metric spaces (or 802357A Euklidean spaces)

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Pekka Salmi

Working life cooperation:

No

Other information:

-

802328A: Basics in Number Theory, 5 op

Voimassaolo: 01.06.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapani Matala-aho

Opintokohteen oppimateriaali:
Hardy, G. H., , 1979
Rosen, Kenneth H., , 1993
Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish/English

Timing:

2.-3. year of studies. Timing varies.

Learning outcomes:

As usual in my mathematical studies I shall be able to solve problems arising from the subject and to prove essential theorems starting from the given definitions using the tools applied in the course. More detailed; For example, when I pass the course with the grade 1/5, I shall recognize most definitions and I am able to solve closely related problems. Also I am able to rewrite short proofs with some understanding. When I pass the course with the grade 5/5, then I shall understand well the given definitions with the proofs of the theorems deduced from them. Further, I am able to solve challenging problems which demand independent deductions with several stages and applications of appropriate tools.

Contents:

In our lectures we consider arithmetical properties of the common numbers involved in studing mathematics and in particular number theory. Also the methods will get a special interest. Examples of the numbers under the research will be binomials, continued fractions, sums of powers and some numbers sharing a name with the mathematicians Bernoulli, Euler, Fermat, Fibonacci, Heron, Lucas, Mersenne, Neper, Pythagoras, Stirling, Wilson and Wolstenholme. From the tools we mention congruences of rational numbers and polynomials, difference operators, generating series, irrationality considerations, matrix presentations, recurrences and telescopes.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures and execises

Target group:

Major and minor students

Prerequisites and co-requisites:

802354A Lukuteoria ja ryhmät
802355A Rings, fields and polynomials
802118P Linear algebra I
802119P Linear algebra II
802352A Euclidean topology
802353A Series and integrals

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes,
G.H. Hardy ja E.M. Wright: An Introduction to the Theory of Numbers;
Kenneth H. Rosen: Elementary number theory and its applications.

Assessment methods and criteria:

Mid-term exams or final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Tapani Matala-aho

Working life cooperation:

-

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

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

800346A	Differential Equations II	4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year or later, 2nd period

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h

Target group:

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

Prerequisites and co-requisites:

Differential equations, Complex analysis

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Working life cooperation:

No

Other information:

-

031077P: Complex analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kemppainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish

Timing:

Fall semester, period 1.

Learning outcomes:

After completing the course the student

1. is able to calculate the derivative and the integral of functions of complex variable,
2. understands the concept of analyticity
3. is capable of calculating the contour integrals and using the theory of residues for computing the line integrals, will be able to apply the techniques of complex analysis to simple problems in signal processing.

Contents:

Complex numbers and functions, complex derivative and analyticity, complex series, Cauchy's integral theorem, Laurent and Taylor expansions, theory of residues, applications to signal analysis.

Mode of delivery:

Face-toface teaching, Stack(web-based too) exercises.

Learning activities and teaching methods:

Lectures 28 h/Exercises 14 h/Self study 93 h.

Target group:

The students in the engineering sciences. The other students are welcome, too.

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses Calculus I and II, Differential Equations.

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 lecture notes

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Jukka Kemppainen

Working life cooperation:

-

Other information:

-

802338A: Complex Analysis II, 5 op

Voimassaolo: 01.06.2016 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

ECTS Credits:

5 credits

Contents:

like - terminating, non-terminating, irrationality, periodicity, approximation properties will be s

Person responsible:

Valery Serov

031022P: Numerical Analysis, 5 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Marko Huhtanen
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish. English speaking students should contact the instructor.
The course can be completed in English by intermediate exams or by a final exam.

Timing:

Spring semester, period 3

Learning outcomes:

Knows numerical algorithms for solving basic problems in computing. Knows basics about numerical linear algebra and some of its applications. Knows how nonlinear systems are solved and how they appear in optimization. Knows how differential equations are solved numerically.

Contents:

Numerical linear algebra, numerical methods for systems of equations, unconstrained optimization, basics of the approximation theory, numerical quadratures, numerical methods for ordinary differential equations.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 22 h / Self-study 85 h.

Target group:

-

Prerequisites and co-requisites:

Completion of courses Calculus I and II, a course on Differential Equations and a Course on Linear Algebra.

Recommended optional programme components:

-

Recommended or required reading:

Material posted on the web-page of the course.

Assessment methods and criteria:

Intermediate exams or a final exam.

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

Grading:

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

Person responsible:

Marko Huhtanen

Working life cooperation:

-

Other information:

-

802365A: Introduction to Mathematical Solfware, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Mikko Orispää

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish (also English if needed)

Timing:

2.-3. year

Learning outcomes:

Upon completion of the course, the student knows the basics of the use of the most common mathematical software, is able to use mathematical software in solving mathematical tasks and problems, and is able to independently deepen her knowledge of different mathematical software as necessary.

Contents:

During the course, the student learns the basics of some of commonly used mathematical software which include Matlab and Python (Numpy/Scipy).

Mode of delivery:

The course is arranged in a computer class as a series of lectures and rehearsals. On the lectures, the students have the possibility to use and try the mathematical software during the lectures. In the rehearsals, different given problems and tasks are solved together.

Learning activities and teaching methods:

Lectures 22 h / Rehearsals 22 h / Self-study 60 h. The self-study contains the independent learning of the software and also the preparation of the final assignments.

Target group:

Anybody interested in mathematical software.

Prerequisites and co-requisites:

The required prerequisite is the completion of following courses (or corresponding knowledge of the subject):
- 802120P Matrix calculus
- 802320A Linear algebra

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 required and recommended reading consists mainly on free material (manuals/tutorial) found in the internet. More information will be given at the beginning of the course.

Assessment methods and criteria:

The course is assessed by final assignments. The student who wish to complete the course at A-level will make two separate assignments of given topics using (at least) two different mathematical software. Those who wish to complete the course in S-level will need to discuss with the lecturer about the extra work needed to pass. For example, it could be possible to do assignments of wider topics, making an assignment(s) with a software not covered in the course, or making an assignment that requires particular skills and knowledge.

Grading:

The course utilizes grading scale pass / fail.

Person responsible:

Mikko Orispää

Working life cooperation:

-

Other information:

-

802361A: Numerical Computation, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

On successful completion of this course, the student will be able to solve basic numerical problems using Fortran programming and to exploit the Unix computers and software libraries for solving numerical problems.

Contents:

On the course students train programming of numerical algorithms using Fortran 95 programming language in Unix (Linux) operating system. On the course, DISLIN subroutine library is used for the visualization of the numerical calculation results.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h + exercises+practical work. Self-study has important role.

Target group:

Major and minor students

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 required and recommended reading consists mainly on free material (manuals/tutorial) found in the internet. More information will be given at the beginning of the course.

Assessment methods and criteria:

The assessment of the course is based on the assesment of practical work at the end of course.

Grading:

The course utilizes verbal grading scale pass / fail.

Person responsible:

Erkki Laitinen

Working life cooperation:

No

Other information:

-

031025A: Introduction to Optimization, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English

Timing:

The course is held in the autumn, during period 1.

Learning outcomes:

After completing the course the student is able to solve optimization convex optimization problems with the basic optimization algorithms. The student is also able to form the necessary and sufficient conditions for the optimality.

Contents:

Linear optimization, Simplex-algorithm, nonlinear optimization, KKT-conditions, duality, conjugate gradient method, penalty and barrier function methods.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 14 h / Self-study 93 h.

Target group:

Students in Wireless Communication Engineering

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses Calculus I and II, Matrix algebra

Recommended optional programme components:

-

Recommended or required reading:

P. Ciarlet; Introduction to numerical linear algebra and optimization, M. Bazaraa, H. Sherali, C.M. Shetty; Nonlinear programming

Assessment methods and criteria:

The course can be completed by a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Keijo Ruotsalainen

Working life cooperation:

-

Other information:

-

031080A: Signal Analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kotila, Vesa Iisakki

Opintokohteen kielet: Finnish

Leikkaavuudet:

031050A	Signal Analysis	4.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish.
The course can be completed in English by a final exam or a retake exam.

Timing:

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

Learning outcomes:

Upon completion of the course, the student:
-is able to calculate the energy, the power, the convolution and the frequency spectrum of discrete and analog, periodic and non-periodic deterministic signals
-is able to calculate the spectrum of a sampled signal
-is able to calculate the Hilbert transform and the complex envelope of a signal
-is able to study the stationarity, the mutual dependence and the frequency content of random signals by means of the auto- and cross-correlation functions, and the power- and cross-power spectral densities
-is able to study the effect of an LTI system on a signal

Contents:

Signals, classification, frequency. Fourier analysis, analog and digital signal, fast Fourier transform. LTI system. Hilbert transform. AM- FM- and PM-modulation. Random variable. Covariance matrix. Random signal. Stationarity, autocorrelation. Power spectral density. Random signal in LTI system. Signal estimation.

Mode of delivery:

Blended teaching.

Learning activities and teaching methods:

Lectures 28 h / Exercises 14 h / Self-study privately or in a group 93 h. The independent work includes individual STACK-assignments as online work.

Target group:

-

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses 031078P Matrix Algebra, 031021P Probability and Mathematical Statistics and 031077P Complex Analysis.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes. Additional reading: Proakis, J.G., Manolakis, D.K.: Introduction to Digital Signal Pro-cessing. Shanmugan, K.S., Breipohl, A.M.: Random Signals, Detection, Estimation and Data Analysis.

Assessment methods and criteria:

The course is completed with a final exam or a retake exam. In addition to the final exam, STACK-assignments given during the course are part of the assessment. The assessment of the course is based on the learning outcomes of the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Vesa Kotila

Working life cooperation:

-

Other information:

-

802322A: Basics in mathematical modelling, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Erkki Laitinen

Opintokohteen kielet: Finnish

805305A: Introduction to Regression and Analysis of Variance, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Päkkilä

Opintokohteen kielet: Finnish

Leikkaavuudet:

806112P	Basic Methods of Data Analysis	10.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Autumn term, 2nd period. Recommended to be taken already in the 2nd year for those aiming at specialization in data science.

Learning outcomes:

Upon successful completion of the course the student can describe the basic concepts and main principles of regression and variance analysis with one or several explanatory variables, and is able to apply these methods in analysing a small scale data set as well as to apply the necessary computational tools.

Contents:

Linear regression and analysis of variance models for continuous outcomes; Formulation of the model and interpretation of parameters; Fitting the models, estimation of parameters, and prediction with the method of least squares: Basic methods of model criticism and diagnostics; Use of R environment in modelling.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Lectures 28 h, practicals 14 h, and independent work. The practicals include both homework and computer class exercises.

Target group:

Students of mathematical sciences and other interested. The course belongs to core studies for those with an orientation to data science. It is a prerequisite for those doing M.Sc. in computational mathematics and data science having data science as the specialization profile. The course is useful also for students of the Faculty of Science and the Oulu Business School as well as those of computer science or computational engineering, who have statistics as a minor subject.

Prerequisites and co-requisites:

806113P Introduction to Statistics or 806119P A Second Course in Statistics or corresponding abilities acquired otherwise.

Recommended optional programme components:

Is assumed as preliminary knowledge in the course 805306A Introduction to Multivariate Methods.

Recommended or required reading:

Lecture notes and material distributed during lectures and practicals. Recommended reading:James, G., Witten, D., Hastie, T., Tibshirani, R. (2013). An Introduction to Statistical Learning with Applications in R}. Springer, New York; chapters 1-3. -- freely downloadable from http://www-bcf.usc.edu/~gareth/ISL/

Assessment methods and criteria:

Practical exercises and final exam. Passing the course requires adequate participation in practical sessions and sufficient homework activity.

Grading:

Numeric assessment scale from 1 to 5

Person responsible:

Jari Päkkilä

Working life cooperation:

No

805306A: Introduction to Multivariate methods, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Päkkilä

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Autumn term, 2nd period. Recommended to be taken already in the 2nd year for those aiming at specialization in data science.

Learning outcomes:

Upon successful completion of the course the student can describe the basic concepts and main principles of the logistic regression, principal components analysis, discriminant analysis, classification analysis and clustering analysis, and is able to apply these methods in analysing a small scale data set as well as to apply the necessary computational tools.

Contents:

Logistic regression, principal components analysis, discriminant analysis, classification analysis and clustering analysis; Use of R environment in modelling; Course is an application oriented.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Lectures 28 h, practicals 14 h, and independent work. The practicals include both homework and computer class exercises.

Target group:

Students of mathematical sciences and other interested. The course belongs to core studies for those with an orientation to data science. It is a prerequisite for those doing M.Sc. in computational mathematics and data science having data science as the specialization profile. The course is useful also for students of the Faculty of Science and the Oulu Business School as well as those of computer science or computational engineering, who have statistics as a minor subject.

Prerequisites and co-requisites:

806113P Introduction to Statistics or 806119P A Second Course in Statistics and 805305A Introduction to Regression and Analysis of Variance or corresponding abilities acquired otherwise.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and material distributed during lectures and practicals. Recommended reading:James, G., Witten, D., Hastie, T., Tibshirani, R. (2013). An Introduction to Statistical Learning with Applications in R}. Springer, New York; chapters 4 and 10. -- freely downloadable from http://www-bcf.usc.edu/~gareth/ISL/.

Assessment methods and criteria:

Practical exercises and final exam. Passing the course requires adequate participation in practical sessions and sufficient homework activity.

Grading:

Numeric assessment scale from 1 to 5, Fail

Person responsible:

Jari Päkkilä

Working life cooperation:

No

800324A: Practical training, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Kari Myllylä
Opintokohteen kielet: Finnish
Leikkaavuudet:

802327A	Tutoring	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Person responsible:

Kari Myllylä

A300091: Language and Communication Studies, 0 op

Opiskelumuoto: Language and Communication Studies
Laji: Study module
Vastuuyksikkö: Faculty of Science
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.

Compulsory Studies

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

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

Proficiency level:

B2/C1 on the Common European Framework of Reference scale.

Status:

This course is mandatory for students who choose English as their foreign language in the following B.Sc. degree programmes:
Faculty of Natural Sciences
•Biology
•Mathematical and Physical Sciences

Faculty of Technology
•Department of Chemistry
Oulu Mining School
•Geosciences degree programme

Please consult your faculty’s Study Guide to establish the language requirements for your own degree program.

Required proficiency level:

English must have been the A1 or A2 language at school or equivalent English skills should have been acquired otherwise.

ECTS Credits:

2 ECTS / 54 hours of work

Language of instruction:

English

Timing:

Biology: 1st year spring term (periods 3 and 4)
Mathematical and Physical Sciences: 1st year autumn term (periods 1 and 2)
Chemistry: 1st year autumn term (periods 1 and 2)
Geosciences: 1st year spring term (periods 3 and 4)

Learning outcomes:

By the end of the course, you are expected to

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

Contents:

The course will focus on reading strategies; these include recognising how texts are organised, identifying key points in a text, and understanding words in context. Vocabulary work in the course will focus on: a) academic vocabulary, as used in formal scientific writing, and b) using your knowledge of the meanings of parts of words (affixes) to infer meaning.

Mode of delivery:

Contact teaching and independent study

Learning activities and teaching methods:

The English 1 course is adapted to accommodate many different fields of study, and thus the materials and implementation methods of the course vary. There will be 26 hours of guided teaching events and 28 hours of independent study, either individually or in a group. A more detailed course description and list of homework tasks will be provided by the teacher.

Target group:

Faculty of Natural Sciences: Biology, Mathematical & Physical Sciences
Faculty of Technology: Chemistry
Oulu Mining School: Geosciences

Prerequisites and co-requisites:

-

Recommended optional programme components:

Students are also required to take English 2 902004Y, or English 4 902005Y, AFTER completion of this course.

Recommended or required reading:

Course materials will be provided in electronic form or will be accessible from the university library.

Assessment methods and criteria:

Student work is monitored by continuous assessment, and students are required to participate regularly and actively in all contact teaching provided. During the course, there will be three monthly tests on material covered so far. The assessment of the course is based on the learning outcomes listed above. Read more about assessment criteria at the University of Oulu webpage.

Grading:

Pass/Fail

Person responsible:

Karen Niskanen

Working life cooperation:

-

Other information:

N.B. Students with grades *laudatur* or *eximia* in their A1 English school-leaving examination can be exempted from this course and will be granted the credits. Please contact your own faculty for information.

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

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

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

Proficiency level:

B2/C1 on the Common European Framework of Reference scale.

Status:

This course is mandatory for students who choose English as their foreign language in the following B.Sc. degree programmes:
Faculty of Natural Sciences:
Biology
Mathematical & Physical Sciences

Faculty of Technology:
Chemistry
Oulu Mining School:
Geoscience degree programme

Note: Information Processing Science students who began their studies in autumn 2017 or later will take English 4 instead.
Please consult your faculty's study guide to establish the language requirements of your own degree programme.

Required proficiency level:

Students taking this course must have had English as the A1 or A2 language at school or have equivalent skills. The course English 1 (902002Y) is a pre-requisite, unless exempted.

ECTS Credits:

2 ECTS credits / 54 hours work.

Language of instruction:

English

Timing:

Biology: 2nd year autumn term (periods 1 and 2)
Mathematic and Physical Sciences 1st year spring term (periods 3 and 4)

Chemistry: 2nd year spring term (periods 3 and 4)
Geosciences: 2nd year spring term (periods 3 and 4)

Learning outcomes:

By the end of the course, you are expected to have demonstrated the ability to:

- **use appropriate strategies and techniques for communicating effectively** in English in an academic context
- **prepare and present scientific subjects** to your classmates, using appropriate field-related vocabulary.

Contents:

Skills in listening, speaking, and presenting academic topics are practised in the classroom, where there is an emphasis on working in pairs and small groups. Homework is given to support the classroom learning.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

The English 2 course is tailored to the needs of students in different fields of study, and thus the materials and implementation methods of the course vary between groups. The teacher will provide a more detailed schedule and list of homework tasks. There will be 26 hours of guided teaching events and 28 hours of independent work, including both individual and group work.
Individual learning methods: autonomous learning tasks, practice in lecture listening and written tasks in preparation for classroom lessons
Group work: Preparation of presentations in groups

Target group:

2nd year students of Biology, Chemistry, Geoscience
1st year students of Mathematical and Physical Sciences (new programme)

Prerequisites and co-requisites:

Pre-requisite course: 902002Y Englannin kieli 1

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Continuous assessment is based on regular attendance, active participation in all lessons and the successful completion of all homework tasks.
The assessment of the course is based on the learning outcomes of the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Pass / fail.

Person responsible:

Karen Niskanen

Working life cooperation:

-

Other information:

-

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

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Opintokohteen kielet: Swedish

Leikkaavuudet:

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

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

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Opintokohteen kielet: Swedish

Leikkaavuudet:

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

Optinal language and communication studies

901018Y: Brush-up Course in Swedish, 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:

ay901018Y Brush-up Course in Swedish (OPEN UNI) 2.0 op

Voidaan suorittaa useasti: Kyllä

Proficiency level:

-

Status:

For students whose proxiciency level in Swedish is not sufficient.

Required proficiency level:

See status

ECTS Credits:

2 ECTS credits

Language of instruction:

Swedish and Finnish

Timing:

before the obligatory Swedish course, see Status

Learning outcomes:

See Contents

Contents:

Throughout the course unit the student brushes up on his/her Swedish skills. Various oral and written exercises aim to improve his/her command of essential grammatical structures and vocabulary and his/her ability to understand spoken Swedish.

Mode of delivery:

contact teaching

Learning activities and teaching methods:

Contact teaching and independent study.

Target group:

See Status

Prerequisites and co-requisites:

See Status

Recommended optional programme components:

before the obligatory Swedish course, see Status

Recommended or required reading:

Will be agreed on in the class.

Assessment methods and criteria:

Active participation and a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

pass / fail

Person responsible:

See Contact teachers

Working life cooperation:

-

Other information:

Registration in WebOodi. Registration is binding and cancellation is subject to a charge unless done before the registration closes.
This course is also offered by the Summer University.

A300090: Other Studies, 0 op

Opiskelumuoto: Other Studies

Laji: Study module

Vastuuyksikkö: Faculty of Science

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.

Major subject in mathematics: select the code 800012Y. Major subject in physics: select the code 761010Y

761010Y: Orientation course for new students, 3 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: General Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Seppo Alanko

Opintokohteen kielet: Finnish

Leikkaavuudet:

761011Y	Orientation course for new students	2.0 op
761011Y-01	Orientation course, Small groups	0.0 op
761011Y-02	Orientation course, Research groups	0.0 op

ECTS Credits:

3 ECTS credits / 80 hours of work

Language of instruction:

Finnish

Timing:

1 st autumn

Learning outcomes:

After the course, the student is able to plan her/his studies and find answers to questions regarding teaching and studying.

Contents:

During the course, older students introduce the new students to the studying environment and the university organization, provide information on the subject matters, aims and prospects related to the field of study, and help with the practical issues connected to the beginning of the studies. The course includes an introduction to different profiles in the degree programme, teacher tutor meetings and guidance for making a personal study plan.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Group work 10-15 h, lectures 10 h, teacher tutor meetings

Target group:

Students in mathematical and physical sciences

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

Coincides with 800012Y

Recommended or required reading:

Handouts

Assessment methods and criteria:

Participation to meetings, producing a personal study plan.

Grading:

pass/fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

800012Y: Orientation for New Students, 3 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: General Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

3 ECTS credits / 80 hours of work

Language of instruction:

Finnish

Timing:

1 st autumn

Learning outcomes:

After the course, the student is able to plan her/his studies and find answers to questions regarding teaching and studying.

Contents:

During the course, older students introduce the new students to the studying environment and the university organization, provide information on the subject matters, aims and prospects related to the field of study, and help with the practical issues connected to the beginning of the studies. The course includes an introduction to different profiles in the degree programme, teacher tutor meetings and guidance for making a personal study plan.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Group work 10-15 h, lectures 10 h, teacher tutor meetings

Target group:

Students in mathematical and physical sciences

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

Coincides with 761010Y

Recommended or required reading:

Handouts

Assessment methods and criteria:

Participation to meetings, producing a personal study plan.

Grading:

Pass/fail

Person responsible:

Pekka Salmi

Working life cooperation:

No work placement period

Compulsory Studies

030005P: Information Skills, 1 op

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

030004P	Introduction to Information Retrieval	0.0 op

ECTS Credits:

1 ECTS credits / 27 hours of work

Language of instruction:

Finnish

Timing:

Architecture 3. spring semester, period I; Biochemistry 3. autumn semester; Biology 3. autumn semester, period I; Chemistry 3. autumn semester, period II; Computer Science and Engineering 2. spring semester, period IV; Electronics and Communications Engineering 3. spring semester; Geosciences 2. spring semester, period IV; Geography 1. and 3. spring semester, period III; I ndustrial Engineering and Management 3. year (Master's degree students in Industrial Engineering and Management 1st year.); Information Processing Sciences 1. year; Mathematics and Physics 1. spring semester, period III; Mechanical Engineering 3. year; Mining Engineering and Mineral Processing 3. year; Process and Environmental Engineering 2. year, period II.

Learning outcomes:

Upon completion of the course, the students:
- can search scientific information,
- can use the most important databases of their discipline,
- know how to evaluate search results and information sources,
- can use the reference management tool

Contents:

Scientific information retrieval process, the most important databases and publication channels of the discipline, evaluation of the reliability of information sources and RefWorks reference management tool.

Mode of delivery:

Blended teaching: classroom training, web-based learning material and exercises, a group assignment.

Learning activities and teaching methods:

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

Target group:

Compulsory for all bachelor degree students of Faculty of Information Technology and Electrical Engineering, Faculty of Technology and Faculty of Science. Compulsory also for those Master's degree students in Industrial Engineering and Management who have no earlier studies in the information skills. Optional for the students of biochemistry.

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Web learning material Tieteellisen tiedonhankinnan opas http://libguides.oulu.fi/tieteellinentiedonhankinta (in Finnish)

Assessment methods and criteria:

Passing the course requires participation in the training sessions and successful completion of the course assignments.

Grading:

pass/fail

Person responsible:

Ursula Heinikoski

Working life cooperation:

-

Other information:

-

521141P: Elementary Programming, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Oja

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521141P	Elementary Programming (OPEN UNI)	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 ECTS Cr

Language of instruction:

Lectures and learning material are in Finnish. The course is not available English

Timing:

Fall, periods 1-2.

Learning outcomes:

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

2. Understands the basic concepts of programming

3. Knows the basics of the Python programming language

4. Is able to implement programs independently

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

Contents:

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

Mode of delivery:

Web-based teaching + face-to-face teaching

Learning activities and teaching methods:

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

Target group:

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

Prerequisites and co-requisites:

None.

Recommended optional programme components:

The course provides a basis for subsequent programming courses.

Recommended or required reading:

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

Assessment methods and criteria:

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

Grading:

pass/fail.

Person responsible:

Mika Oja

Working life cooperation:

-

Optional courses

761013Y: Student tutoring, 2 op

Opiskelumuoto: General Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

2 credits

Language of instruction:

Finnish

Timing:

2nd – 5th autumn

Learning outcomes:

The student can guide study groups in matters of studying and the organization of university.

Contents:

A student who has been at the university for a few years, is actively involved and has an interest in new students may serve as a tutor for the course 761011Y Orientation course for new students.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Tutoring 10 – 15 h

Target group:

Optional for the students in physics

Prerequisites and co-requisites:

First year studies

Recommended optional programme components:

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

Recommended or required reading:

Handouts

Assessment methods and criteria:

Tutoring 10-15 h
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Scale pass/fail

Person responsible:

NN

Working life cooperation:

No work placement period

800009Y: Acting as a Student Tutor, 2 op

Opiskelumuoto: General Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

300003Y: Activities in university and student organizations, 1 - 4 op

Voimassaolo: 01.01.2010 -

Opiskelumuoto: General Studies

Laji: Course

Vastuuyksikkö: Faculty of Science

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

1-4 credits

Language of instruction:

Finnish

Timing:

1st-5th year

A325101: Physics, basic studies, 25 - 40 op

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

Ei opintojaksokuvauksia.

Studies in Physics

761108P: Physical world view, 5 op

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

761112P	Physical world view	3.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Autumn

Learning outcomes:

After the course student can see the position of physics in the advancement of scientific world view and technology. The student has a comprehensive view of different learning and studying methods (s)he can use later on.

Contents:

The forming of key concepts in physics, using models and observations in advancing both classical and modern physics. The meaning of applying physics in modern society. Getting to know different areas of physics research.

Mode of delivery:

Multiform teaching

Learning activities and teaching methods:

48 h face-to-face teaching, 85 h independent work including course work and group work

Target group:

Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

Feynman, R. The Character of Physical Law, Penguin Books 1992 (or equivalent, there are several prints). The original Massenger Lectures by Richard Fenyman in 1965 (7x55min) can be found online with search "Richard Feynman messenger lectures".

Assessment methods and criteria:

Passed course work or final exam

Grading:

Numerical grading scale 0-5, where 0 = fail

Person responsible:

Laura Timonen

Working life cooperation:

No work placement period

Other information:

https://wiki.oulu.fi/display/761112P/

761118P: Mechanics 1, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Vaara, Juha Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

766343A	Mechanics	7.0 op
761111P	Basic mechanics	5.0 op
761101P	Basic Mechanics	4.0 op
766323A	Mechanics	6.0 op
761323A	Mechanics	6.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work
- 761118P-01, Lectures and exam (4 cr)
- 761118P-02, Lab. exercises (1 cr)

Language of instruction:

The lectures will be in Finnish. The textbook is in English and exercises are selected from the textbook. For further information, contact the responsible person of the course.

Timing:

Autumn

Learning outcomes:

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

Contents:

We encounter many phenomena related to mechanics in our everyday life. Most engineering sciences are based on mechanics and mechanics forms the basis of many other fields of physics, including modern physics. Contents in brief: Short summary of vector calculus. Kinematics, projectile motion and circular motion. Newton’s laws of motion. Work and different forms of energy. Momentum, impulse and collisions. Rotational motion and moment of inertia. Torque and angular momentum. Rigid body equilibrium problems. Gravitation. Periodic motion. Fluid mechanics.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, 7 exercises (14 h), 2 laboratory exercises (3 hours/exercise), self-study 83 h

Target group:

For the students of the University of Oulu.

Prerequisites and co-requisites:

Knowledge of vector calculus and basics of differential and integral calculus.

Recommended optional programme components:

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

Recommended or required reading:

Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 13th edition, 2012, chapters 1-14. Also older editions can be used. Lecture material: Finnish lecture material will be available on the web page of the course.

Assessment methods and criteria:

Both parts (761118P-01 and 761118P-02) will be graded separately. The final grade of the course is the weighted average of the grades of part 1 (4 cr) and part 2 (1 cr).
761118P-01: Three midterm exams or final examination
761118P-02: Two laboratory exercises
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Juha Vaara

Working life cooperation:

No work placement period

Other information:

https://wiki.oulu.fi/display/761118P

Compulsory

761118P-01: Mechanics 1, lectures and exam, 0 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Basic Studies

Laji: Partial credit

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Vaara, Juha Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

766343A Mechanics 7.0 op

761111P-02 Basic mechanics, lab. exercises 0.0 op

761111P-01 Basic mechanics, lectures and exam 0.0 op

761111P Basic mechanics 5.0 op

761121P Physical Measurements I 3.0 op

761101P Basic Mechanics 4.0 op

761323A Mechanics 6.0 op

766323A Mechanics 6.0 op

Language of instruction:

The lectures will be in Finnish. The textbook is in English and exercises are selected from the textbook. For further information, contact the responsible person of the course.

Timing:

Autumn

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

The whole course: Lectures 30 h, 7 exercises (14 h), 2 laboratory exercises (3 hours/exercise), self-study 83 h

Target group:

For the students of the University of Oulu

Prerequisites and co-requisites:

Knowledge of vector calculus and basics of differential and integral calculus.

Recommended optional programme components:

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

Recommended or required reading:

Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 13th edition, 2012, chapters 1-14. Also older editions can be used. Lecture material: Finnish lecture material will be available on the web page of the course.

Assessment methods and criteria:

761118P-01: Three midterm exams or final examination

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Juha Vaara

Working life cooperation:

No work placement period

Other information:

Course website
Both parts (761118P-01 and 761118P-02) will be graded separately. The final grade of the course is the weighted average of the grades of part 1 (4 cr) and part 2 (1 cr).

761118P-02: Mechanics 1, lab. exercises, 0 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Basic Studies

Laji: Partial credit

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766343A	Mechanics	7.0 op
761111P-01	Basic mechanics, lectures and exam	0.0 op
761111P-02	Basic mechanics, lab. exercises	0.0 op
761111P	Basic mechanics	5.0 op
761101P	Basic Mechanics	4.0 op
761323A	Mechanics	6.0 op
766323A	Mechanics	6.0 op

Timing:

Autumn

Learning outcomes:

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

Contents:

We encounter many phenomena related to mechanics in our everyday life. Most engineering sciences are based on mechanics and mechanics forms the basis of many other fields of physics, including modern physics. Contents in brief: Short summary of vector calculus. Kinematics, projectile motion and circular motion. Newton’s laws of motion. Work and different forms of energy. Momentum, impulse and collisions. Rotational motion and moment of inertia. Torque and angular momentum. Rigid body equilibrium problems. Gravitation. Periodic motion. Fluid mechanics.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

The whole course: Lectures 30 h, 7 exercises (14 h), 2 laboratory exercises (3 hours/exercise), self-study 83 h

Target group:

For the students of the University of Oulu

Prerequisites and co-requisites:

Knowledge of vector calculus and basics of differential and integral calculus.

Recommended optional programme components:

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

Other information:

Course website

761115P: Laboratory Exercises in Physics 1, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761121P	Physical Measurements I	3.0 op
761121P-01	Physical measurements I, exam	0.0 op
761121P-02	Physical measurements I, lab. exercises	0.0 op
800149P	Introduction to LateX	2.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Spring

Learning outcomes:

The student can safely make physical measurements, use different measurement tools, read different scales, handle the data, calculate the error estimations and make a sensible report of his laboratopy measurements.

Contents:

The skill to make laboratory measurements is important for physicists. This is an introductory course how to make physical measurements and how to treat the measured data. Laboratory works are made in groups. The laboratory security is an essential part also in physics. Measurements are made with different instruments. As a result the most probable value is determined as well as its error. The skills obtained during this course can be applied in the other laboratory courses Laboratory exercises in physics 2 and 3.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 10 h, exercises 20 h (5 x 4 h). Five different works will be made during the course in groups. Self-study 103 h.

Target group:

For the students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites.

Recommended optional programme components:

800149P Introduction to LaTex

Recommended or required reading:

Lecture material is in Finnish. Work instructions are available also in English.

Assessment methods and criteria:

Written reports of the experiments and one written examination.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

Other information:

Includes parts:
761115P-01 Laboratory Exercises in Physics 1, lecture and exam
761115P-02 Laboratory Exercises in Physics 1, laboratory exercises
761115P-03 Laboratory Exercises in Physics 1, Introduction to LateX

761120P: Laboratory Exercises in Physics 2, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766106P	Laboratory exercises in physics 2	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1. spring - 3. autumn

Learning outcomes:

After completing the course, the student can rather independently work with the most important measuring instruments used in physics and has experience in planning and conducting different measurements. The student is also able to critically assess her/his own results and report them to a group of peers.

Contents:

The laboratory exercises (0,5 ECTS per exercise) train the student in applying measurements to research into different physical phenomena. The exercises include practising how to plan the measurements, learning how to use the measuring instruments, processing and assessing the results, and drawing up scientific reports. Some of the exercises can be chosen according to the student´s own interest.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Per one exercise, 4 h of measurements in the laboratory and 5-9 h of preparation and drawing up a report independently.

Target group:

No specific target qroup

Prerequisites and co-requisites:

Recommended: 761121P/761115P Laboratory exercises in physics 1.

Recommended optional programme components:

Each exercise is closely related to a basic or intermediate course in physics, because the phenomena connected to the measurements and their theory are discussed in the lectures for the courses.

Recommended or required reading:

The exercise work instructions and guidelines for the work report, which can be found on the website of the course.

Assessment methods and criteria:

Adequate familiarization with the phenomenon under scrutiny and the measurements before the exercise (oral or written questions), successfully completing the guided measurements, reporting on the exercise (the work report will be graded).
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

Other information:

Course webpage

761119P: Electromagnetism 1, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Timo Asikainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

761113P-01	Electricity and magnetism, lectures and exam	0.0 op
761113P-02	Electricity and magnetism, lab. exercises	0.0 op
761113P	Electricity and magnetism	5.0 op
766319A	Electromagnetism	7.0 op
761103P	Electricity and Magnetism	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work
- 761119P-01, Lectures and exam (4 cr)
- 761119P-02, Lab. exercises (1 cr)

Language of instruction:

Finnish

Timing:

Second fall term

Learning outcomes:

The student will be able to understand the basic concepts of electromagnetism and can apply this understanding to solve problems related to electromagnetism.

Contents:

Basic principles of electromagnetic phenomena and their physical and geometric interpretation. More detailed contents will be presented later.

Mode of delivery:

face-to-face teaching

Learning activities and teaching methods:

Lectures 32 h, 7 exercises (14 h), 2 laboratory exercises (3 hours/exercise), self-study 83 h

Target group:

For the students of the University of Oulu.

Prerequisites and co-requisites:

Knowledge of vector calculus and basics of differential and integral calculus.

Recommended optional programme components:

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

Recommended or required reading:

Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 13. ed., chapters 21-31. Also other editions can be used. Lecture material in finnish.

Assessment methods and criteria:

Both parts (761119P-01 and 761119P-02) will be graded separately. The final grade of the course is the weighted average of the grades of part 1 (4 cr) and part 2 (1 cr).
761119P-01: Three small midterm exams or final examination
761119P-02: Two laboratory exercises
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Timo Asikainen

A325102: Physics, intermediate studies, 35 - 60 op

Opiskelumuoto: Intermediate Studies

Laji: Study module

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

Ei opintojaksokuvauksia.

Compulsory Studies

761312A: Electromagnetism 2, 5 op

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

766319A	Electromagnetism	7.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Second spring term

Learning outcomes:

The student will be able to derive the individual results like electric fields produced by charge distributions, magnetic field by current systems and solve problems related to electromagnetic induction. The student can derive the wave equation for electromagnetic waves.

Contents:

The foundations of the electromagnetic field theory. Exact contents to be specified later.

Mode of delivery:

face-to-face teaching

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Anita Aikio

761309A: Mechanics 2, 5 op

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

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Second year fall term

Learning outcomes:

Students can apply the Lagrange's and Hamilton's methods to various problems in classical mechanics, and are aware of their connection to quantum mechanics. They can explain why the theory of relativity is needed, apply the Lorentz-transformation, explain why faster-than-light signals do not exist, and undestand the equivalence between mass and energy.

Contents:

In the first of the course part we discuss the Lagrangian and Hamiltonian formulations of classical mechanics. They are alternative but equivalent ways to formulate the equations of motion that follow from Newtons laws. We will also encounter some new mathematical tools, such as calculus of variations, which can be used to solve various minimization problems. Possible symmetries and conservation laws are emphasized in the Lagrangian and Hamiltonian equations of motion, which often simplify the study of complex dynamical systems. Many important concepts in quantum mechanics have counterparts in the Lagrangian and Hamiltonian formulations of classical mechanics. In the second half of the course we go beyond the realm of Newtonian mechanics and study the principles of the (special) theory of relativity. We will derive the Lorentz-transformation of coordinates by starting from Einstein's basic assumptions, and study motion in flat spacetime. Among other things we will derive the equivalence of mass and energy (E=m*c^2) and discuss various apparent paradoxes.

Mode of delivery:

face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, 7 exercises (14 h), self-study 91 h

Target group:

For the students of the University of Oulu

Prerequisites and co-requisites:

Basics of differential and integral calculus. Mechanics 1.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes in Finnish. Other recommended material will be specified later.

Assessment methods and criteria:

Two written intermediate examinations or one final examination.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Heikki Vanhamäki

Working life cooperation:

No work placement period

Other information:

Lectured for the 1st time during period 1 in autumn 2018.

761313A: Atomic physics 1, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Saana-Maija Aho

Opintokohteen kielet: Finnish

Leikkaavuudet:

766326A Atomic physics 1 6.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

Second autumn term

Learning outcomes:

Student can explain the development of the atomic model. Student is able to describe some interaction mechanisms of electromagnetic radiation and matter. Student can resolve easy quantum mechanical problems. Student can describe the principles used when the wave functions and energies of some simple systems are determined. Student can take advantage of the periodic table of elements in finding the chemical and physical properties of atoms based on its electronic structure.

Contents:

In the beginning of the course, the historical events which led to the development of the quantum mechanics and the modern atomic model in the early 20th century are discussed. In this context, the interaction processes between matter and electromagnetic radiation, like black-body radiation, the photoelectric effect, and scattering, are examined. In quantum mechanics, particles are usually described with the aid of wave functions. De Broglie wavelength, the group and phase velocities of particles, and Heisenberg uncertainty principle serve as an introduction to the wave properties of particles. The Bohr's atomic model, electronic transitions of atoms, and emission spectra of atoms are also discussed. The first touch to the quantum mechanics is the solutions of wave functions and energies for some simple systems, like hydrogen atom, are described. Additionally, many-electron atoms are discussed briefly. Some modern research methods which are used to study the atomic physics are introduced. Applications which exploit the atom physical phenomena in everyday life are also discussed.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, 7 exercises, self-study 90 h

Target group:

No specific target qroup

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

Books: A. Beiser: Concepts of Modern Physics, McGraw-Hill Inc.

Assessment methods and criteria:

Group excercises, lectures, webexcercises or two exams.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Saana-Maija Huttula

Working life cooperation:

No work placement period

766344A: Nuclear and particle physics, 5 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766330A-01 Structure of matter, part 1: Solid state physics 0.0 op

766330A-02 Structure of matter, part 2: Nuclear and particle physics 0.0 op

766334A Structure of matter II 2.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd spring

Learning outcomes:

The student knows the structure and key properties of atomic nuclei, the most important ways in which the nuclei undergo radioactive decay, and is familiar with some technological applications based on nuclear properties and radioactivity. The student can explain fission and fusion reactions.
The student knows the key varieties of subatomic particles, their properties and interactions. The student can explain main principles of particle accelerators and detectors, and how they are used in research.

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, 8 exercises (16 h), self-study 87 h

Target group:

Primarily for the students of the degree programme in physics.
Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

Atomic physics 1 (766326A), Electromagnetism (766319A). An important supporting course is Thermophysics (766328A/766348A).

Recommended optional programme components:

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

Recommended or required reading:

Textbooks: H. D. Young and R. A. Freedman: University Physics, 13th edition, Pearson Addison-Wesley, 2012, or earlier editions (in part), R. Eisberg and R. Resnick: Quantum physics of atoms, molecules, solids, nuclei, and particles, John Wiley & Sons (in part). Additional material available from the web pages of the course.
Course material availability can be checked here.

Assessment methods and criteria:

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

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Minna Patanen

Working life cooperation:

No work placement period

Other information:

Course website

763343A: Solid state physics, 5 op

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

766330A	Structure of matter	6.0 op
766330A-02	Structure of matter, part 2: Nuclear and particle physics	0.0 op
766330A-01	Structure of matter, part 1: Solid state physics	0.0 op
763333A	Structure of matter I	4.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd spring

Learning outcomes:

To learn to explain the basics of solid state physics such as lattice structure, binding interactions, lattice vibrations, band structure and its effect on conductivity, conductivity of semiconductors, the interaction between light and matter, magnetism and superconductivity, and to apply these to different materials.

Contents:

The rapid development of technology is largely based on understanding the properties of the solid state. There are many interesting phenomena in solid state physics, which are consequences of very large number of particles and their interactions. The course starts with symmetry of crystal lattices and their experimental determination. Different binding forces of solids are discussed. Lattice vibrations and their contribution to specific heat are studied. Especial emphasis is put on electronic structure, and it is used to explain the electric conduction in metals, insulators and semiconductors. Also experimental methods, magnetism and superconductivity are discussed.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, exercises 16 h, self-study 87 h

Target group:

Primarily for the students of the degree programme in physics.
Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

Atomic physics 1 (766326A), Electromagnetism (766319A). An important supporting course is Thermophysics (766328A/766348A).

Recommended optional programme components:

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

Recommended or required reading:

E. Thuneberg: Kiinteä aineen fysiikka (lecture notes), C. Kittel: Introduction to solid state physics.

Assessment methods and criteria:

Examination

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Matti Alatalo

Working life cooperation:

No work placement period

Other information:

https://noppa.oulu.fi/noppa/kurssi/763343a/

761314A: Thermophysics, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Perttu Lantto

Opintokohteen kielet: Finnish

Leikkaavuudet:

766348A	Thermophysics	7.0 op
766328A	Thermophysics	6.0 op
761328A	Thermophysics	4.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

Third autumn semester

Learning outcomes:

The student knows the structure and key properties of atomic nuclei, the most important ways in which the nuclei undergo radioactive decay, and is familiar with some technological applications based on nuclear properties and radioactivity. The student can explain fission and fusion reactions.
The student knows the key varieties of subatomic particles, their properties and interactions. The student can explain main principles of particle accelerators and detectors, and how they are used in research.

Contents:

The goal of the course is to explain how the macroscopic thermophysical properties of a system (e.g., equation of state) can be derived from its fundamental microscopic properties (e.g., from the behavior of the molecules). For this purpose, the students are given a physically clear understanding of the basic principles of thermophysics, recognizing the fundamental role of its statistical nature. Topics will include: Basic concepts, The first law, Thermal expansion, heat transfer, and diffusion, The second law, The combined law, Heat engines and refrigerators, Thermodynamic potentials, Phases of matter, Classical ideal gas, Classical and open systems, Quantal ideal gas.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 32 h, 9 exercises (18 h), self-study 83 h

Target group:

Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

Textbooks: H. D. Young and R. A. Freedman: University Physics, 13th edition, Pearson Addison-Wesley, 2012, or earlier editions (in part), F. Mandl: Statistical Physics, second edition, John Wiley & Sons Ltd., 1988 (in part).
Lecture notes: Juhani Lounila: 766328A Termofysiikka, Oulun yliopisto, 2015.

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:

Perttu Lantto

Working life cooperation:

No work placement period

766384A: B.Sc. seminar, 4 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:

4 ECTS cr

Language of instruction:

Finnish

Timing:

3rd autumn

Learning outcomes:

The student is familiar with the special requirements of a scientific text and is aware of physics' common practices in scientific writing. The student has the basic knowledge of scientific writing enabling the student to write her/his B.Sc. thesis under a supervision. The student learns important scientific communication skills necessary in scientific research in physics.

Contents:

Both written and oral reporting is essential part of the scientific research. During the course, the students participate in the seminars, act as opponents and present a seminar talk. The course gives basic knowledge of scientific writing so that the student can start to write her/his B. Sc. thesis.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Compulsory for Bachelor of Science in physics. In seminars 80 % obligatory attendance.

Prerequisites and co-requisites:

Introduction to information retrieval (030005P).

Recommended optional programme components:

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

Recommended or required reading:

Material available from the web pages of the course.

Assessment methods and criteria:

Students have to attend the lectures (ca. 80 %) and be an opponent for two seminar talks. Students have to give a seminar talk, which is graded (0-5). Possible homework.

Grading:

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

Person responsible:

Minna Patanen

Working life cooperation:

No work placement period

Other information:

Course website

766385A: B.Sc. thesis, 6 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:

6 credits

Language of instruction:

Finnish or English

Timing:

3rd year

Learning outcomes:

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

Contents:

Both written and oral reporting is essential part of the scientific research. In the course, the students write a candidate thesis. The candidate thesis is about 20 pages. Thesis is written about subject given by and under supervision of a senior researcher.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Self-study 160 h.

Target group:

Compulsory for Bachelor of Science in physics.

Prerequisites and co-requisites:

Introduction to information retrieval (030005P).

Recommended optional programme components:

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

Recommended or required reading:

Material available from the web pages of the course.

Assessment methods and criteria:

B.Sc. thesis

Grading:

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

Person responsible:

Marko Huttula

Working life cooperation:

No work placement period

Other information:

Course website ???

761386A: Maturity test, 0 op

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

ECTS Credits:

0 credits

Language of instruction:

English

Timing:

3rd autumn or spring

Learning outcomes:

The student knows the vocabulary of the research field of his/her thesis and can independently produce text related to the thesis.

Contents:

Written test about a subject of the B.Sc. Thesis. The length of the text is recommended to be one exam paper.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Independent work

Target group:

Compulsory in B.Sc. degree for student of physics.

Prerequisites and co-requisites:

B.Sc. thesis

Recommended optional programme components:

No alternative course units

Recommended or required reading:

No reading

Assessment methods and criteria:

The test event

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

Grading:

Scale pass/fail

Person responsible:

Professors

Working life cooperation:

No work placement period

761310A: Wave motion and optics, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Seppo Alanko

Opintokohteen kielet: Finnish

Leikkaavuudet:

766349A Wave motion and optics 7.0 op

761114P Wave motion and optics 5.0 op

761114P-02 Wave motion and optics, lab. exercises 0.0 op

761114P-01 Wave motion and optics, lectures and exam 0.0 op

766329A Wave motion and optics 6.0 op

761104P Wave Motion 3.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

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

Timing:

First spring

Learning outcomes:

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

Contents:

General principles of wave motion, sound, electromagnetic waves, propagation of light, image formation in mirrors and lenses, optical instruments, interference, Fraunhofer diffraction, diffraction grating.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h, 2 laboratory exercises (3 hours/exercise), self-study 90 h

Target group:

No specific target qroup

Prerequisites and co-requisites:

Basic skills in mathematics.

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

Two written intermediate examinations or one final examination

Grading:

Numerical grading scale 0 – 5, where 0 is fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

Other information:

Includes parts:
761310A-01 Wave motion and optics, lectures and exam
761310A-02 Wave motion and optics, lab. exercises

Compulsory

761310A-01: Wave motion and optics, lectures and exam, 0 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Seppo Alanko

Opintokohteen kielet: Finnish

Leikkaavuudet:

766349A Wave motion and optics 7.0 op

761114P Wave motion and optics 5.0 op

761114P-01 Wave motion and optics, lectures and exam 0.0 op

761114P-02 Wave motion and optics, lab. exercises 0.0 op

766329A Wave motion and optics 6.0 op

761104P Wave Motion 3.0 op

Language of instruction:

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

Timing:

Firts spring

Learning outcomes:

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

Contents:

General principles of wave motion, sound, electromagnetic waves, propagation of light, image formation in mirrors and lenses, optical instruments, interference, Fraunhofer diffraction, diffraction grating.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h, 2 laboratory exercises (3 hours/exercise), self-study 90 h

Target group:

No specific target qroup

Prerequisites and co-requisites:

Basic skills in mathematics

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

Two written intermediate examinations or one final examination

Grading:

Numerical grading scale 0 – 5, where 0 is fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

761310A-02: Wave motion and optics, lab. exercises, 0 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766349A	Wave motion and optics	7.0 op
761114P	Wave motion and optics	5.0 op
761114P-01	Wave motion and optics, lectures and exam	0.0 op
761114P-02	Wave motion and optics, lab. exercises	0.0 op
766329A	Wave motion and optics	6.0 op
761104P	Wave Motion	3.0 op

Ei opintojaksokuvauksia.

Electives

761316A: Being a teacher in mathematical subjects, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Saana-Maija Aho

Opintokohteen kielet: Finnish

Leikkaavuudet:

766339A	Physics for teachers	5.0 op
766338A	Physics for teachers	4.0 op

Ei opintojaksokuvauksia.

761337A: Practical training, 3 - 6 op

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

ECTS Credits:

3 - 6 credits

Language of instruction:

English or Finnish

Timing:

2nd - 5th year

Learning outcomes:

After the practical training, the student is able to participate in scientific research in his/her own field.

Contents:

A job, e.g. a summer job, which supports studies in physics, and could be accepted as a practical training. One month of employment corresponds 1.5 study points. Maximum of 6 credits from practical training can be included in Bachelor and/or Master of Science studies in physics.

Mode of delivery:

A summer job, for example

Learning activities and teaching methods:

Training and a written report

Target group:

Students in physics

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

No specific material

Assessment methods and criteria:

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

Grading:

Scale pass/fail

Person responsible:

Lauri Hautala

Working life cooperation:

Work placement period

764337A: Practical training, 3 - 9 op

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

Opintokohteen kielet: Finnish

ECTS Credits:

3 - 9 credits

Language of instruction:

English or Finnish

Timing:

2nd - 5th year

Learning outcomes:

After practical training the student understands better the actual needs of employment.

Contents:

Have you found a job, e.g. a summer job, which supports your studies in biophysics, and could be accepted as a practical training? One month of employment corresponds 1.5 study points.

Mode of delivery:

A summer job, for example

Learning activities and teaching methods:

Practical training and report

Target group:

Students in biophysics

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

No specific material

Assessment methods and criteria:

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

Grading:

Scale pass/fail

Person responsible:

Kyösti Heimonen

Working life cooperation:

Work placement period

A325104: Physics Minor, 15 op

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

Ei opintojaksokuvauksia.

General Studies in Physics

761108P: Physical world view, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761112P	Physical world view	3.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Autumn

Learning outcomes:

After the course student can see the position of physics in the advancement of scientific world view and technology. The student has a comprehensive view of different learning and studying methods (s)he can use later on.

Contents:

The forming of key concepts in physics, using models and observations in advancing both classical and modern physics. The meaning of applying physics in modern society. Getting to know different areas of physics research.

Mode of delivery:

Multiform teaching

Learning activities and teaching methods:

48 h face-to-face teaching, 85 h independent work including course work and group work

Target group:

Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

Feynman, R. The Character of Physical Law, Penguin Books 1992 (or equivalent, there are several prints). The original Massenger Lectures by Richard Fenyman in 1965 (7x55min) can be found online with search "Richard Feynman messenger lectures".

Assessment methods and criteria:

Passed course work or final exam

Grading:

Numerical grading scale 0-5, where 0 = fail

Person responsible:

Laura Timonen

Working life cooperation:

No work placement period

Other information:

https://wiki.oulu.fi/display/761112P/

761118P: Mechanics 1, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Vaara, Juha Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

766343A	Mechanics	7.0 op
761111P	Basic mechanics	5.0 op
761101P	Basic Mechanics	4.0 op
766323A	Mechanics	6.0 op
761323A	Mechanics	6.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work
- 761118P-01, Lectures and exam (4 cr)
- 761118P-02, Lab. exercises (1 cr)

Language of instruction:

The lectures will be in Finnish. The textbook is in English and exercises are selected from the textbook. For further information, contact the responsible person of the course.

Timing:

Autumn

Learning outcomes:

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

Contents:

We encounter many phenomena related to mechanics in our everyday life. Most engineering sciences are based on mechanics and mechanics forms the basis of many other fields of physics, including modern physics. Contents in brief: Short summary of vector calculus. Kinematics, projectile motion and circular motion. Newton’s laws of motion. Work and different forms of energy. Momentum, impulse and collisions. Rotational motion and moment of inertia. Torque and angular momentum. Rigid body equilibrium problems. Gravitation. Periodic motion. Fluid mechanics.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, 7 exercises (14 h), 2 laboratory exercises (3 hours/exercise), self-study 83 h

Target group:

For the students of the University of Oulu.

Prerequisites and co-requisites:

Knowledge of vector calculus and basics of differential and integral calculus.

Recommended optional programme components:

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

Recommended or required reading:

Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 13th edition, 2012, chapters 1-14. Also older editions can be used. Lecture material: Finnish lecture material will be available on the web page of the course.

Assessment methods and criteria:

Both parts (761118P-01 and 761118P-02) will be graded separately. The final grade of the course is the weighted average of the grades of part 1 (4 cr) and part 2 (1 cr).
761118P-01: Three midterm exams or final examination
761118P-02: Two laboratory exercises

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

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Juha Vaara

Working life cooperation:

No work placement period

Other information:

https://wiki.oulu.fi/display/761118P

Compulsory

761118P-01: Mechanics 1, lectures and exam, 0 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Basic Studies

Laji: Partial credit

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Vaara, Juha Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

766343A	Mechanics	7.0 op
761111P-02	Basic mechanics, lab. exercises	0.0 op
761111P-01	Basic mechanics, lectures and exam	0.0 op
761111P	Basic mechanics	5.0 op
761121P	Physical Measurements I	3.0 op
761101P	Basic Mechanics	4.0 op
761323A	Mechanics	6.0 op
766323A	Mechanics	6.0 op

Language of instruction:

The lectures will be in Finnish. The textbook is in English and exercises are selected from the textbook. For further information, contact the responsible person of the course.

Timing:

Autumn

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

The whole course: Lectures 30 h, 7 exercises (14 h), 2 laboratory exercises (3 hours/exercise), self-study 83 h

Target group:

For the students of the University of Oulu

Prerequisites and co-requisites:

Knowledge of vector calculus and basics of differential and integral calculus.

Recommended optional programme components:

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

Recommended or required reading:

Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 13th edition, 2012, chapters 1-14. Also older editions can be used. Lecture material: Finnish lecture material will be available on the web page of the course.

Assessment methods and criteria:

761118P-01: Three midterm exams or final examination

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Juha Vaara

Working life cooperation:

No work placement period

Other information:

Course website
Both parts (761118P-01 and 761118P-02) will be graded separately. The final grade of the course is the weighted average of the grades of part 1 (4 cr) and part 2 (1 cr).

761118P-02: Mechanics 1, lab. exercises, 0 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Basic Studies

Laji: Partial credit

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766343A	Mechanics	7.0 op
761111P-01	Basic mechanics, lectures and exam	0.0 op
761111P-02	Basic mechanics, lab. exercises	0.0 op
761111P	Basic mechanics	5.0 op
761101P	Basic Mechanics	4.0 op
761323A	Mechanics	6.0 op
766323A	Mechanics	6.0 op

Timing:

Autumn

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

The whole course: Lectures 30 h, 7 exercises (14 h), 2 laboratory exercises (3 hours/exercise), self-study 83 h

Target group:

For the students of the University of Oulu

Prerequisites and co-requisites:

Knowledge of vector calculus and basics of differential and integral calculus.

Recommended optional programme components:

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

Other information:

Course website

761115P: Laboratory Exercises in Physics 1, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761121P	Physical Measurements I	3.0 op
761121P-01	Physical measurements I, exam	0.0 op
761121P-02	Physical measurements I, lab. exercises	0.0 op
800149P	Introduction to LateX	2.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Spring

Learning outcomes:

The student can safely make physical measurements, use different measurement tools, read different scales, handle the data, calculate the error estimations and make a sensible report of his laboratopy measurements.

Contents:

The skill to make laboratory measurements is important for physicists. This is an introductory course how to make physical measurements and how to treat the measured data. Laboratory works are made in groups. The laboratory security is an essential part also in physics. Measurements are made with different instruments. As a result the most probable value is determined as well as its error. The skills obtained during this course can be applied in the other laboratory courses Laboratory exercises in physics 2 and 3.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 10 h, exercises 20 h (5 x 4 h). Five different works will be made during the course in groups. Self-study 103 h.

Target group:

For the students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites.

Recommended optional programme components:

800149P Introduction to LaTex

Recommended or required reading:

Lecture material is in Finnish. Work instructions are available also in English.

Assessment methods and criteria:

Written reports of the experiments and one written examination.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

Other information:

Includes parts:
761115P-01 Laboratory Exercises in Physics 1, lecture and exam
761115P-02 Laboratory Exercises in Physics 1, laboratory exercises
761115P-03 Laboratory Exercises in Physics 1, Introduction to LateX

Optional studies in Physics. When you complete 25 ECTS cr from the physics. Choose the 2 courses below. (60 ECTS cr of minor subject are all selected below)

761119P: Electromagnetism 1, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Timo Asikainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

761113P-01	Electricity and magnetism, lectures and exam	0.0 op
761113P-02	Electricity and magnetism, lab. exercises	0.0 op
761113P	Electricity and magnetism	5.0 op
766319A	Electromagnetism	7.0 op
761103P	Electricity and Magnetism	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work
- 761119P-01, Lectures and exam (4 cr)
- 761119P-02, Lab. exercises (1 cr)

Language of instruction:

Finnish

Timing:

Second fall term

Learning outcomes:

The student will be able to understand the basic concepts of electromagnetism and can apply this understanding to solve problems related to electromagnetism.

Contents:

Basic principles of electromagnetic phenomena and their physical and geometric interpretation. More detailed contents will be presented later.

Mode of delivery:

face-to-face teaching

Learning activities and teaching methods:

Lectures 32 h, 7 exercises (14 h), 2 laboratory exercises (3 hours/exercise), self-study 83 h

Target group:

For the students of the University of Oulu.

Prerequisites and co-requisites:

Knowledge of vector calculus and basics of differential and integral calculus.

Recommended optional programme components:

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

Recommended or required reading:

Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 13. ed., chapters 21-31. Also other editions can be used. Lecture material in finnish.

Assessment methods and criteria:

Both parts (761119P-01 and 761119P-02) will be graded separately. The final grade of the course is the weighted average of the grades of part 1 (4 cr) and part 2 (1 cr).
761119P-01: Three small midterm exams or final examination
761119P-02: Two laboratory exercises
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Timo Asikainen

761313A: Atomic physics 1, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Saana-Maija Aho

Opintokohteen kielet: Finnish

Leikkaavuudet:

766326A	Atomic physics 1	6.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

Second autumn term

Learning outcomes:

Student can explain the development of the atomic model. Student is able to describe some interaction mechanisms of electromagnetic radiation and matter. Student can resolve easy quantum mechanical problems. Student can describe the principles used when the wave functions and energies of some simple systems are determined. Student can take advantage of the periodic table of elements in finding the chemical and physical properties of atoms based on its electronic structure.

Contents:

In the beginning of the course, the historical events which led to the development of the quantum mechanics and the modern atomic model in the early 20th century are discussed. In this context, the interaction processes between matter and electromagnetic radiation, like black-body radiation, the photoelectric effect, and scattering, are examined. In quantum mechanics, particles are usually described with the aid of wave functions. De Broglie wavelength, the group and phase velocities of particles, and Heisenberg uncertainty principle serve as an introduction to the wave properties of particles. The Bohr's atomic model, electronic transitions of atoms, and emission spectra of atoms are also discussed. The first touch to the quantum mechanics is the solutions of wave functions and energies for some simple systems, like hydrogen atom, are described. Additionally, many-electron atoms are discussed briefly. Some modern research methods which are used to study the atomic physics are introduced. Applications which exploit the atom physical phenomena in everyday life are also discussed.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, 7 exercises, self-study 90 h

Target group:

No specific target qroup

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

Books: A. Beiser: Concepts of Modern Physics, McGraw-Hill Inc.

Assessment methods and criteria:

Group excercises, lectures, webexcercises or two exams.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Saana-Maija Huttula

Working life cooperation:

No work placement period

761314A: Thermophysics, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Perttu Lantto

Opintokohteen kielet: Finnish

Leikkaavuudet:

766348A	Thermophysics	7.0 op
766328A	Thermophysics	6.0 op
761328A	Thermophysics	4.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

Third autumn semester

Learning outcomes:

The student knows the structure and key properties of atomic nuclei, the most important ways in which the nuclei undergo radioactive decay, and is familiar with some technological applications based on nuclear properties and radioactivity. The student can explain fission and fusion reactions.
The student knows the key varieties of subatomic particles, their properties and interactions. The student can explain main principles of particle accelerators and detectors, and how they are used in research.

Contents:

The goal of the course is to explain how the macroscopic thermophysical properties of a system (e.g., equation of state) can be derived from its fundamental microscopic properties (e.g., from the behavior of the molecules). For this purpose, the students are given a physically clear understanding of the basic principles of thermophysics, recognizing the fundamental role of its statistical nature. Topics will include: Basic concepts, The first law, Thermal expansion, heat transfer, and diffusion, The second law, The combined law, Heat engines and refrigerators, Thermodynamic potentials, Phases of matter, Classical ideal gas, Classical and open systems, Quantal ideal gas.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 32 h, 9 exercises (18 h), self-study 83 h

Target group:

Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

Textbooks: H. D. Young and R. A. Freedman: University Physics, 13th edition, Pearson Addison-Wesley, 2012, or earlier editions (in part), F. Mandl: Statistical Physics, second edition, John Wiley & Sons Ltd., 1988 (in part).
Lecture notes: Juhani Lounila: 766328A Termofysiikka, Oulun yliopisto, 2015.

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:

Perttu Lantto

Working life cooperation:

No work placement period

761310A: Wave motion and optics, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Seppo Alanko

Opintokohteen kielet: Finnish

Leikkaavuudet:

766349A	Wave motion and optics	7.0 op
761114P	Wave motion and optics	5.0 op
761114P-02	Wave motion and optics, lab. exercises	0.0 op
761114P-01	Wave motion and optics, lectures and exam	0.0 op
766329A	Wave motion and optics	6.0 op
761104P	Wave Motion	3.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

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

Timing:

First spring

Learning outcomes:

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

Contents:

General principles of wave motion, sound, electromagnetic waves, propagation of light, image formation in mirrors and lenses, optical instruments, interference, Fraunhofer diffraction, diffraction grating.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h, 2 laboratory exercises (3 hours/exercise), self-study 90 h

Target group:

No specific target qroup

Prerequisites and co-requisites:

Basic skills in mathematics.

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

Two written intermediate examinations or one final examination

Grading:

Numerical grading scale 0 – 5, where 0 is fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

Other information:

Includes parts:
761310A-01 Wave motion and optics, lectures and exam
761310A-02 Wave motion and optics, lab. exercises

Compulsory

761310A-01: Wave motion and optics, lectures and exam, 0 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Seppo Alanko

Opintokohteen kielet: Finnish

Leikkaavuudet:

766349A Wave motion and optics 7.0 op

761114P Wave motion and optics 5.0 op

761114P-01 Wave motion and optics, lectures and exam 0.0 op

761114P-02 Wave motion and optics, lab. exercises 0.0 op

766329A Wave motion and optics 6.0 op

761104P Wave Motion 3.0 op

Language of instruction:

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

Timing:

Firts spring

Learning outcomes:

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

Contents:

General principles of wave motion, sound, electromagnetic waves, propagation of light, image formation in mirrors and lenses, optical instruments, interference, Fraunhofer diffraction, diffraction grating.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h, 2 laboratory exercises (3 hours/exercise), self-study 90 h

Target group:

No specific target qroup

Prerequisites and co-requisites:

Basic skills in mathematics

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

Two written intermediate examinations or one final examination

Grading:

Numerical grading scale 0 – 5, where 0 is fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

761310A-02: Wave motion and optics, lab. exercises, 0 op

Voimassaolo: 01.08.2017 -
Opiskelumuoto: Intermediate Studies
Laji: Partial credit
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

766349A	Wave motion and optics	7.0 op
761114P	Wave motion and optics	5.0 op
761114P-01	Wave motion and optics, lectures and exam	0.0 op
761114P-02	Wave motion and optics, lab. exercises	0.0 op
766329A	Wave motion and optics	6.0 op
761104P	Wave Motion	3.0 op

Ei opintojaksokuvauksia.

If you want to complete 60 ECTS cr in physics. Choose all the courses below

761309A: Mechanics 2, 5 op

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

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Second year fall term

Learning outcomes:

Students can apply the Lagrange's and Hamilton's methods to various problems in classical mechanics, and are aware of their connection to quantum mechanics. They can explain why the theory of relativity is needed, apply the Lorentz-transformation, explain why faster-than-light signals do not exist, and undestand the equivalence between mass and energy.

Contents:

In the first of the course part we discuss the Lagrangian and Hamiltonian formulations of classical mechanics. They are alternative but equivalent ways to formulate the equations of motion that follow from Newtons laws. We will also encounter some new mathematical tools, such as calculus of variations, which can be used to solve various minimization problems. Possible symmetries and conservation laws are emphasized in the Lagrangian and Hamiltonian equations of motion, which often simplify the study of complex dynamical systems. Many important concepts in quantum mechanics have counterparts in the Lagrangian and Hamiltonian formulations of classical mechanics. In the second half of the course we go beyond the realm of Newtonian mechanics and study the principles of the (special) theory of relativity. We will derive the Lorentz-transformation of coordinates by starting from Einstein's basic assumptions, and study motion in flat spacetime. Among other things we will derive the equivalence of mass and energy (E=m*c^2) and discuss various apparent paradoxes.

Mode of delivery:

face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, 7 exercises (14 h), self-study 91 h

Target group:

For the students of the University of Oulu

Prerequisites and co-requisites:

Basics of differential and integral calculus. Mechanics 1.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes in Finnish. Other recommended material will be specified later.

Assessment methods and criteria:

Two written intermediate examinations or one final examination.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Heikki Vanhamäki

Working life cooperation:

No work placement period

Other information:

Lectured for the 1st time during period 1 in autumn 2018.

761120P: Laboratory Exercises in Physics 2, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766106P	Laboratory exercises in physics 2	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1. spring - 3. autumn

Learning outcomes:

After completing the course, the student can rather independently work with the most important measuring instruments used in physics and has experience in planning and conducting different measurements. The student is also able to critically assess her/his own results and report them to a group of peers.

Contents:

The laboratory exercises (0,5 ECTS per exercise) train the student in applying measurements to research into different physical phenomena. The exercises include practising how to plan the measurements, learning how to use the measuring instruments, processing and assessing the results, and drawing up scientific reports. Some of the exercises can be chosen according to the student´s own interest.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Per one exercise, 4 h of measurements in the laboratory and 5-9 h of preparation and drawing up a report independently.

Target group:

No specific target qroup

Prerequisites and co-requisites:

Recommended: 761121P/761115P Laboratory exercises in physics 1.

Recommended optional programme components:

Each exercise is closely related to a basic or intermediate course in physics, because the phenomena connected to the measurements and their theory are discussed in the lectures for the courses.

Recommended or required reading:

The exercise work instructions and guidelines for the work report, which can be found on the website of the course.

Assessment methods and criteria:

Adequate familiarization with the phenomenon under scrutiny and the measurements before the exercise (oral or written questions), successfully completing the guided measurements, reporting on the exercise (the work report will be graded).
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

Other information:

Course webpage

761312A: Electromagnetism 2, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Anita Aikio

Opintokohteen kielet: Finnish

Leikkaavuudet:

766319A	Electromagnetism	7.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Second spring term

Learning outcomes:

The student will be able to derive the individual results like electric fields produced by charge distributions, magnetic field by current systems and solve problems related to electromagnetic induction. The student can derive the wave equation for electromagnetic waves.

Contents:

The foundations of the electromagnetic field theory. Exact contents to be specified later.

Mode of delivery:

face-to-face teaching

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Anita Aikio

766344A: Nuclear and particle physics, 5 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766330A-01	Structure of matter, part 1: Solid state physics	0.0 op
766330A-02	Structure of matter, part 2: Nuclear and particle physics	0.0 op
766334A	Structure of matter II	2.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd spring

Learning outcomes:

The student knows the structure and key properties of atomic nuclei, the most important ways in which the nuclei undergo radioactive decay, and is familiar with some technological applications based on nuclear properties and radioactivity. The student can explain fission and fusion reactions.
The student knows the key varieties of subatomic particles, their properties and interactions. The student can explain main principles of particle accelerators and detectors, and how they are used in research.

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, 8 exercises (16 h), self-study 87 h

Target group:

Primarily for the students of the degree programme in physics.
Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

Atomic physics 1 (766326A), Electromagnetism (766319A). An important supporting course is Thermophysics (766328A/766348A).

Recommended optional programme components:

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

Recommended or required reading:

Textbooks: H. D. Young and R. A. Freedman: University Physics, 13th edition, Pearson Addison-Wesley, 2012, or earlier editions (in part), R. Eisberg and R. Resnick: Quantum physics of atoms, molecules, solids, nuclei, and particles, John Wiley & Sons (in part). Additional material available from the web pages of the course.
Course material availability can be checked here.

Assessment methods and criteria:

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

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Minna Patanen

Working life cooperation:

No work placement period

Other information:

Course website

763343A: Solid state physics, 5 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766330A	Structure of matter	6.0 op
766330A-02	Structure of matter, part 2: Nuclear and particle physics	0.0 op
766330A-01	Structure of matter, part 1: Solid state physics	0.0 op
763333A	Structure of matter I	4.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd spring

Learning outcomes:

To learn to explain the basics of solid state physics such as lattice structure, binding interactions, lattice vibrations, band structure and its effect on conductivity, conductivity of semiconductors, the interaction between light and matter, magnetism and superconductivity, and to apply these to different materials.

Contents:

The rapid development of technology is largely based on understanding the properties of the solid state. There are many interesting phenomena in solid state physics, which are consequences of very large number of particles and their interactions. The course starts with symmetry of crystal lattices and their experimental determination. Different binding forces of solids are discussed. Lattice vibrations and their contribution to specific heat are studied. Especial emphasis is put on electronic structure, and it is used to explain the electric conduction in metals, insulators and semiconductors. Also experimental methods, magnetism and superconductivity are discussed.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, exercises 16 h, self-study 87 h

Target group:

Primarily for the students of the degree programme in physics.
Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

Atomic physics 1 (766326A), Electromagnetism (766319A). An important supporting course is Thermophysics (766328A/766348A).

Recommended optional programme components:

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

Recommended or required reading:

E. Thuneberg: Kiinteä aineen fysiikka (lecture notes), C. Kittel: Introduction to solid state physics.

Assessment methods and criteria:

Examination

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Matti Alatalo

Working life cooperation:

No work placement period

Other information:

https://noppa.oulu.fi/noppa/kurssi/763343a/

Obligatory for subject teacher

761316A: Being a teacher in mathematical subjects, 5 op

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

766339A	Physics for teachers	5.0 op
766338A	Physics for teachers	4.0 op

Ei opintojaksokuvauksia.

A325004: Mathematics Minor, 25 - 120 op

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

Leikkaavuudet:

ayA325004 Mathematics Minor (OPEN UNI) 25.0 op

Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.

General Studies in Mathematics (min 45 ECTS cr)

802151P: Introduction to mathematical deduction, 5 op

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

ay802151P Introduction to mathematical deduction (OPEN UNI) 5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

First period at the first semester.

Learning outcomes:

After completing the course, student is:
- able to use different methods proving techniquesis
- able to use basic set theoretic concepts and definitionsis
- able to define and apply basic definitions related to functions

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h

Target group:

Major and minor students

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

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

Grading:

Pass/Fail

Person responsible:

Marko Leinonen

Working life cooperation:

-

800119P: Functions and limit, 5 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Salmi

Opintokohteen kielet: Finnish

Leikkaavuudet:

802162P	Continuity and Limit	5.0 op
802155P	Continuity and limit	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1st year, 1st period

Learning outcomes:

Upon completing the course the student is
- able to apply the triangle inequality and make approximations
- able to manipulate elementary functions such as polynomials and trigonometric functions
- able to define the limit of a sequence and the limit of a function as well as apply these definitions
- able to apply different techniques to determine limits.

Contents:

The course concerns real-valued functions of one variable. In particular elementary functions are defined and the monotonicity of functions is studied. The notion of absolute value is reviewed and applied to approximation. Also the triangle inequality is used in approximation. The central concept is the limit of a function, which is introduced via the limit of a sequence. The aim of the course is to improve deductive skills as well as computational skills.

Mode of delivery:

Face-to-face teaching, computer exercises

Learning activities and teaching methods:

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

Target group:

1st year mathematics and physics students as well as students taking mathematics as a minor subject

Prerequisites and co-requisites:

Introduction to mathematical deduction 802151P is recommended to be taken simultaneously (or earlier).

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes, STACK exercises. Additional material: for example the book P. Harjulehto, R. Klén, M. Koskenoja, Analyysiä reaaliluvuilla.

Assessment methods and criteria:

Final exam, exercises

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

No

Other information:

Replaces the course 802162P Continuity and Limit.

800317A: Continuity and derivative, 5 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802163P	Derivative	5.0 op
802156P	Derivative	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1st year, 2nd period

Learning outcomes:

Upon completing the course the student is
- able to define the concept of continuous function and apply this definition in examples and deductions
- able to determine derivatives of functions
- able to apply derivative to study functions
- able to appy the concepts of continuity and derivative in various problems, including deductions

Contents:

The course concerns continuity and derivative of real-valued functions of one variable. The central topics are the intermediate value theorem, the chain rule, the derivative of inverse functions, the mean value theorem and its applications. Differential calculus is also applied to various problems. The aim of the course is to improve mathematical thinking as well as computational skills.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

1st year mathematics and physics students as well as students taking mathematics as a minor subject

Prerequisites and co-requisites:

Functions and limit 800119P, Introduction to mathematical deduction 802151P

Recommended optional programme components:

-

Recommended or required reading:

In addition to the material hand out in the course, for example the book P. Harjulehto, R. Klén, M. Koskenoja, Analyysiä reaaliluvuilla.

Assessment methods and criteria:

Final exam, exercises

Grading:

1-5, fail

Person responsible:

Esa Järvenpää

Working life cooperation:

no

Other information:

Replaces the course 802163P Derivative.

800318A: Integral, 5 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ville Suomala

Opintokohteen kielet: Finnish

Leikkaavuudet:

802164P	Series and Integral	5.0 op
802353A	Series and Integrals	6.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1st year 3rd period

Learning outcomes:

After completing the course, the student
- manages the basics of integration theory
- understands the connection and differences between definite and indefinite integral
- is able to understand the connetcion between the integral and the derivative
- is able to use appropriate integration methods and knows where integration theory is applied

Contents:

Introduction to integration theory. Riemann-integral, The fundamental theorem of Calculus, Eksponent function and logarithm, integration by parts, integration by substitution, improper integral. Applications of integration theory.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h, independent work

Target group:

1st year mathematics and physics students as well as students taking mathematics as a minor subject

Prerequisites and co-requisites:

Functions and limit, Continuity and derivative

Recommended or required reading:

In addition to the material hand out in the course, for example the book P. Harjulehto, R. Klén, M. Koskenoja, Analyysiä reaaliluvuilla.

Assessment methods and criteria:

Final exam

Grading:

1-5

Person responsible:

Ville Suomala

Working life cooperation:

no

Other information:

Replaces the course 802164P Series and integral.

802120P: Introduction to Matrices, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802118P	Linear Algebra I	4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

1. year, 4. period

Learning outcomes:

After completing the course the student is able to
- apply arithmetic operations of matrices
- solve system of linear equations by matrix methods
- study linear depence and linear indepence of vectors
- recognize the subspace of R^n and understands the concepts of basis and dimension of a vector space
- analyse matrices by the parameters and the vectors

Contents:

Vectors and matrices, Systems of linear equations, determinant of a matrix, subspaces of R^n, linear depence and linear indepence of vectors, base, dimension, eigenvalues and eigenvectors of a matrix, diagonalization.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, Exercises 14 h

Target group:

Major and minor studies

Prerequisites and co-requisites:

802151P Introduction to Mathematical Deduction

Recommended or required reading:

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

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Marko Leinonen

Working life cooperation:

-

800328A: Calculus of several variables, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802351A	Vector Calculus	5.0 op
800322A	Multidimensional analysis	8.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd year, 1st period

Learning outcomes:

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

Contents:

The course concerns calculus of severable variables. The central concepts of the course are partial derivative, gradient, divergence, curl and multiple integral. Integral theorems related to functions of several variables are also presented. In addition power series are introduced. The course offers basic tools for applications.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics and physics major and minor students

Prerequisites and co-requisites:

Continuity and derivative 800317A, Integral 800318A, Introduction to matrices 802120P

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Mahmoud Filali

Working life cooperation:

No

Other information:

Replaces the course 802351A Vector calculus

802320A: Linear Algebra, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802119P	Linear Algebra II	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish and English

Timing:

2nd year, 2nd period

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors and minors students

Prerequisites and co-requisites:

802120P Introduction to Matrices

Recommended optional programme components:

-

Recommended or required reading:

http://cc.oulu.fi/~tma/OPETUS.html

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Tapani Matala-aho

Working life cooperation:

No

Other information:

-

806113P: Introduction to Statistics, 5 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Hanna Heikkinen

Opintokohteen oppimateriaali:
Wild, Christopher J. , , 2000
Grönroos, Matti (2) , , 2003

Opintokohteen kielet: Finnish

Leikkaavuudet:

806118P	Introduction to Statistics	5.0 op
806119P	A Second Course in Statistics	5.0 op
806116P	Statistics for Economic Sciences	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

4th period. 1st or 2nd year of studies.

Learning outcomes:

Upon completion of the course, student will be
- able to identify and define the main principles of statistical research, collection of the data and analysis
- able to apply basic methods of descriptive statistics and statistical inference in simple quantitative research using a statistical software
- able to critically evaluate results of the statistical research presented in media
- prepared for teaching statistics in secondary school and high school
- prepared for participating in a group.

Contents:

- the nature and the meaning of statistics
- data and the acquisition of them: observations, variables, measuring and designs of a study
- the descriptive statistics of empirical distributions: tables, graphical presentations and descriptive measures of center, variation and dependence
- the most important probability distributions
- the principles and the basic methods of statistical inference: random sample, sample statistics, point estimation, confidence intervals and statistical testing of hypotheses.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 16 h (partly compulsory) / instructed group work (28 h) / independent work 80 h. Group works will be returned. Additional independently implemented learning diary tasks. Independent work contains also preparation for group work and peer assessment.

Target group:

Students of mathematical and physical sciences.

Prerequisites and co-requisites:

The recommended prerequisite prior to enrolling for the course is the completion of the courses: 802151P Introduction to mathematical deduction and 800119P Functions and limit.

Recommended optional programme components:

After the course, student is able to continue other statistics courses.

Recommended or required reading:

Lecture notes.

Assessment methods and criteria:

This course utilizes continuous assessment. Practical works and learning diaries are assessed weekly. In addition web tests and learning tasks. The assessment of the course is based on the learning outcomes of the course. The more detailed assessment criteria is available in the beginning of the course. In addition one compulsory lecture and peer assessment.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Hanna Heikkinen

Working life cooperation:

No

800320A: Differential equations, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Erkki Laitinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

031076P	Differential Equations	5.0 op
031017P	Differential Equations	4.0 op
800345A	Differential Equations I	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

2nd year

Learning outcomes:

Upon completing the course the student
- is able to classify differential equations and is able to apply correct solution methods to them
- knows the conditions that guarantee the unique solvability of an equation
- understands the concept of implicitly defined solution

Contents:

The course is devoted to ordinary differential equations. Central part is formed by first order differential equations (separable, homogeneous, linear, exact equations and certain equations which can be transformed into these). The equations are solved using algebraic, iterative and numerical methods. The second part which is central to applications is formed by linear inhomogeneous differential equations with constant coefficients and linear second order equations with continuous coefficient functions. In addition, systems of differential equations are considered. Certain second order linear differential equatoins (e.g. Legendre's equation) is solved via power series.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h, independent work

Target group:

Major and minor students

Prerequisites and co-requisites:

Continuity and derivative 800317A and Integral 800318A

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

1-5

Working life cooperation:

no

Other information:

Homepage in Noppa portal.

These courses mandatory in Master studies if not included in Bachelor degree

802354A: Basics in Algebra, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Myllylä

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay802354A Number Theory and Groups (OPEN UNI) 5.0 op

800333A Algebra I 8.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

1. year, 3. period

Learning outcomes:

After completing the course, student is able to

- derive and proof main results in the course
- use and apply different proof techniques
- recognize algebraic structures and the concepts
- see connections and differences between different algebraic structures

Contents:

The course includes basics in arithmetics and algebraic structures, such as, congruence, residue classes, prime numbres, Euclidean algorithm, the fundamental theorem of arithmetic, Euler-Fermat formula, groups and morphisms. The course gives an understanding of
algebraic terms and concepts used in mathematics and physics.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28 h lectures, 14 h exercises

Target group:

Major and minor students

Prerequisites and co-requisites:

802151P Introduction to mathematical deduction

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

1-5

Person responsible:

Kari Myllylä

Working life cooperation:

-

801195P: Probability Theory, 5 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:
Tuominen, P., , 1993
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year, 2nd period.

Learning outcomes:

Upon completing the course the student will be able to
- solve simple practical problems associated with probability
- solve simple theoretical problems associated with probability
- derive the basic properties of probability, starting from the axioms

Contents:

The course is an introduction to probability. In the beginning high school level probability is reviewed and after that axiomatic treatment of the theory starts. The central concepts discussed include probability space, conditional probability, independence, and random variable together with its distribution and expected value.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors and minors

Prerequisites and co-requisites:

Integral 800318A

Recommended optional programme components:

-

Recommended or required reading:

Lectures.
Text book: Pekka Tuominen: Todennäköisyyslaskenta I, Limes ry, Helsinki.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Hanna Heikkinen

Working life cooperation:

-

802357A: Euclidean Spaces, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ville Suomala

Opintokohteen kielet: Finnish

Leikkaavuudet:

802352A	Euclidean Topology	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

2nd year 2nd period

Learning outcomes:

After passing the course the student
- will be able to define basic topological concepts
- will be able to handle sequences
- will be able to justify basic properties of continuous vector valued functions

Contents:

Sequences, continuity and limit of a vector valued function, basic topological concepts

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

28 hours of lectures, 14 hours of excercises, independent work

Target group:

Major and minor students

Prerequisites and co-requisites:

Functions and limits, Continuity and derivative, Introduction to Matrices, Integral

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Ville Suomala

Working life cooperation:

No

Other information:

-

Electives

H325030: Optional studies in mathematics and statistics, 5 - 60 op

Voimassaolo: 01.08.2018 -
Opiskelumuoto: Optional Studies
Laji: Study module
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Electives

802355A: Algebraic Structures, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Kari Myllylä
Opintokohteen kielet: Finnish
Leikkaavuudet:

800333A	Algebra I	8.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

Second year, 1. period

Learning outcomes:

After completing the course, student is able to

- derive and proof main results in the course
- use and apply different proof techniques
- recognize algebraic structures and the concepts
- see connections and differences between different algebraic structures

Contents:

The course introduces algebraic structures, such as rings, subrings, ideals, integral domains, fields and finite fields. The course gives an understanding of algebraic terms and concepts used in mathematics and physics.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28 h lectures, 14 h exercises

Target group:

Major students

Prerequisites and co-requisites:

802354A Basics in Algebra

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

1-5

Person responsible:

Kari Myllylä

Working life cooperation:

-

800321A: Series and Approximation, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

2nd year

Learning outcomes:

Upon completing the course the student is
- able to manipulate series and investigate their convergence
- able to explain the difference between uniform and pointwise convergence
- able to study the uniform and pointwise convergence of function sequences and series
- able to use power series in approximation

Contents:

The course concerns both number series and function series. The central topics are convergence tests, pointwise and uniform convergence, power series and the Taylor series. The course gives also an introduction to approximation of functions by polynomials for example.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors

Prerequisites and co-requisites:

Continuity and derivative 800317A and Integral 800318A

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Mahmoud Filali

Working life cooperation:

no

802358A: Metric Spaces, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802356A	Metric Topology	5.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year, 4th period

Learning outcomes:

After the course the student is able to
- define metric spaces
- give examples of metric spaces

- define elementary topological concepts (open and closed sets, accumulation point, etc)
- apply the definitions from elementary topology in examples and proofs

Contents:

The goal of the courses is to expand student's knowledge and understanding of continuity and to introduce to other topological concepts in the setting of metric spaces. Course considers basic topology of n-dimensional Euclidean space and introduces also other metric spaces as examples. Central concepts are open and closed sets, compactness and completeness.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors (obligatory for mathematics majors except for subject teacher students)

Prerequisites and co-requisites:

802357A Euclidean spaces OR 802357A Introduction to Real Analysis

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Midterm exams or final exam

Grading:

1-5

Person responsible:

Mahmoud Filali

Working life cooperation:

-

Other information:

-

800320A: Differential equations, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Erkki Laitinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

031076P	Differential Equations	5.0 op
031017P	Differential Equations	4.0 op
800345A	Differential Equations I	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

2nd year

Learning outcomes:

Upon completing the course the student
- is able to classify differential equations and is able to apply correct solution methods to them
- knows the conditions that guarantee the unique solvability of an equation
- understands the concept of implicitly defined solution

Contents:

The course is devoted to ordinary differential equations. Central part is formed by first order differential equations (separable, homogeneous, linear, exact equations and certain equations which can be transformed into these). The equations are solved using algebraic, iterative and numerical methods. The second part which is central to applications is formed by linear inhomogeneous differential equations with constant coefficients and linear second order equations with continuous coefficient functions. In addition, systems of differential equations are considered. Certain second order linear differential equatoins (e.g. Legendre's equation) is solved via power series.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h, independent work

Target group:

Major and minor students

Prerequisites and co-requisites:

Continuity and derivative 800317A and Integral 800318A

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

1-5

Working life cooperation:

no

Other information:

Homepage in Noppa portal.

801396A: Introduction to Probability Theory II, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:
Tuominen, P., , 1993
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

On successful completion of this course, the student will be able to:
- work with random variables both in theory and applications
- explain the central results in probability theory such that Law of large numbers and the Central limit theorem
- determine generating functions of random variables and apply them for example to calculate moments
- apply various stocastic models
- derive the basic results associated with the new concepts introduced
- use two-dimensional distributions
- work with conditional distributions

Contents:

The central topics are the moments of a distribution, the probability generating function, the Law of Large Numbers, the Central Limit Theorem, two-dimensional distibutions as well as conditional distributions.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics major and minor students. Recommended for students aiming for the profile of computational mathematics and data science.

Prerequisites and co-requisites:

801195P Introduction to probability I, 800328A Calculus of several variables (or Vector Calculus)

Recommended or required reading:

P. Tuominen: Todennäköisyyslaskenta I, Limes 2002 and other books on probability.

Assessment methods and criteria:

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

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

-

800146P: Introduction to teaching, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

801329A	Mathematics in Teaching	3.0 op
802157P	Mathematics in teaching	2.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1st year, 3th period

Learning outcomes:

After the course, the student is able to reflect critically on the learning and teaching of mathematics. The student can discuss and explain the connection between mathematics at school and at university.

Contents:

Learning and teaching mathematics and physics are thought about and discussed.
The course consists of reflective exercises, reading articles and seminar meetings where the exercises are discussed. The student writes a learning journal.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28 h seminar meetings, 105 h independent work and group work

Target group:

1st year mathematics and physics teacher students

Prerequisites and co-requisites:

-

Assessment methods and criteria:

Participating in the meetings, writing a learning diary, group work tasks

Grading:

pass/fail

Person responsible:

Marko Leinonen

Working life cooperation:

No

Other information:

Replaces the course 801329A Mathematics in teaching.

802336A: Introduction to Cryptography, 5 op

Voimassaolo: 01.06.2016 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay802336A	Introduction to Cryptography (OPEN UNI)	5.0 op
801346A	Introduction to Cryptography	4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year or later, every period

Learning outcomes:

After completeing the course, student
- knows the principles of sime traditianl symmetric key methods
- knows how public key methods (RSA, discrete logarithm, knapsack) work
- is familiar with the possibility to use and apply number theory in cryptography

Contents:

The course considers some traditional symmetric key methods (affine system, matrix cryptography) and three public key methods, namely RSA, discrete logarithm and knapsack.

Mode of delivery:

Independent work

Learning activities and teaching methods:

Net course; Lecture slides, exercisis, solutions of exercisis (in Noppa) + stack-exercisis

Target group:

Major and minor students

Prerequisites and co-requisites:

802354A Basics of Algebra, 802120P Introduction to Matrices

Recommended optional programme components:

-

Recommended or required reading:

Lecture slides, exercisis, solutions of exercisis, stack-exercisis

Assessment methods and criteria:

Final exam or Final exam + stack-exercisis

Grading:

1-5, fail

Person responsible:

Marko Leinonen

Working life cooperation:

No

801399A: Geometry, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

801389A	Basic Geometry for University Students	6.0 op

Ei opintojaksokuvauksia.

802359A: Advanced Vector Calculus, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ville Suomala

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year, 4th period

Learning outcomes:

After completing the course the student is able to
- use derivative as a linear mapping
- formulate and apply Inverse function theorem and Implicit function theorem
- define and calculate Riemann integral in higher dimensions

Contents:

The aim of the course is to deepen the understanding of calculus of severable variables. The derivative is treated as a linear mapping. The central results are the Inverse Function Theorem and the Implicit Function Theorem. In the course the Riemann integral is defined in higher dimension and related basic results are proved

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors

Prerequisites and co-requisites:

802351A Vector Calculus
802164P Series and Integral
802163P Derivative
802358A Metric spaces (or 802357A Euklidean spaces)

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Pekka Salmi

Working life cooperation:

No

Other information:

-

802328A: Basics in Number Theory, 5 op

Voimassaolo: 01.06.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapani Matala-aho

Opintokohteen oppimateriaali:
Hardy, G. H., , 1979
Rosen, Kenneth H., , 1993
Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish/English

Timing:

2.-3. year of studies. Timing varies.

Learning outcomes:

As usual in my mathematical studies I shall be able to solve problems arising from the subject and to prove essential theorems starting from the given definitions using the tools applied in the course. More detailed; For example, when I pass the course with the grade 1/5, I shall recognize most definitions and I am able to solve closely related problems. Also I am able to rewrite short proofs with some understanding. When I pass the course with the grade 5/5, then I shall understand well the given definitions with the proofs of the theorems deduced from them. Further, I am able to solve challenging problems which demand independent deductions with several stages and applications of appropriate tools.

Contents:

In our lectures we consider arithmetical properties of the common numbers involved in studing mathematics and in particular number theory. Also the methods will get a special interest. Examples of the numbers under the research will be binomials, continued fractions, sums of powers and some numbers sharing a name with the mathematicians Bernoulli, Euler, Fermat, Fibonacci, Heron, Lucas, Mersenne, Neper, Pythagoras, Stirling, Wilson and Wolstenholme. From the tools we mention congruences of rational numbers and polynomials, difference operators, generating series, irrationality considerations, matrix presentations, recurrences and telescopes.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures and execises

Target group:

Major and minor students

Prerequisites and co-requisites:

802354A Lukuteoria ja ryhmät
802355A Rings, fields and polynomials
802118P Linear algebra I
802119P Linear algebra II
802352A Euclidean topology
802353A Series and integrals

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes,
G.H. Hardy ja E.M. Wright: An Introduction to the Theory of Numbers;
Kenneth H. Rosen: Elementary number theory and its applications.

Assessment methods and criteria:

Mid-term exams or final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Tapani Matala-aho

Working life cooperation:

-

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

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

800346A	Differential Equations II	4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year or later, 2nd period

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h

Target group:

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

Prerequisites and co-requisites:

Differential equations, Complex analysis

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Working life cooperation:

No

Other information:

-

031077P: Complex analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kemppainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish

Timing:

Fall semester, period 1.

Learning outcomes:

After completing the course the student

1. is able to calculate the derivative and the integral of functions of complex variable,
2. understands the concept of analyticity
3. is capable of calculating the contour integrals and using the theory of residues for computing the line integrals, will be able to apply the techniques of complex analysis to simple problems in signal processing.

Contents:

Complex numbers and functions, complex derivative and analyticity, complex series, Cauchy's integral theorem, Laurent and Taylor expansions, theory of residues, applications to signal analysis.

Mode of delivery:

Face-toface teaching, Stack(web-based too) exercises.

Learning activities and teaching methods:

Lectures 28 h/Exercises 14 h/Self study 93 h.

Target group:

The students in the engineering sciences. The other students are welcome, too.

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses Calculus I and II, Differential Equations.

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 lecture notes

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Jukka Kemppainen

Working life cooperation:

-

Other information:

-

802338A: Complex Analysis II, 5 op

Voimassaolo: 01.06.2016 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5 credits

Contents:

like - terminating, non-terminating, irrationality, periodicity, approximation properties will be s

Person responsible:

Valery Serov

031022P: Numerical Analysis, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Marko Huhtanen

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish. English speaking students should contact the instructor.
The course can be completed in English by intermediate exams or by a final exam.

Timing:

Spring semester, period 3

Learning outcomes:

Knows numerical algorithms for solving basic problems in computing. Knows basics about numerical linear algebra and some of its applications. Knows how nonlinear systems are solved and how they appear in optimization. Knows how differential equations are solved numerically.

Contents:

Numerical linear algebra, numerical methods for systems of equations, unconstrained optimization, basics of the approximation theory, numerical quadratures, numerical methods for ordinary differential equations.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 22 h / Self-study 85 h.

Target group:

-

Prerequisites and co-requisites:

Completion of courses Calculus I and II, a course on Differential Equations and a Course on Linear Algebra.

Recommended optional programme components:

-

Recommended or required reading:

Material posted on the web-page of the course.

Assessment methods and criteria:

Intermediate exams or a final exam.

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

Grading:

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

Person responsible:

Marko Huhtanen

Working life cooperation:

-

Other information:

-

802365A: Introduction to Mathematical Solfware, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Mikko Orispää

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish (also English if needed)

Timing:

2.-3. year

Learning outcomes:

Upon completion of the course, the student knows the basics of the use of the most common mathematical software, is able to use mathematical software in solving mathematical tasks and problems, and is able to independently deepen her knowledge of different mathematical software as necessary.

Contents:

During the course, the student learns the basics of some of commonly used mathematical software which include Matlab and Python (Numpy/Scipy).

Mode of delivery:

The course is arranged in a computer class as a series of lectures and rehearsals. On the lectures, the students have the possibility to use and try the mathematical software during the lectures. In the rehearsals, different given problems and tasks are solved together.

Learning activities and teaching methods:

Lectures 22 h / Rehearsals 22 h / Self-study 60 h. The self-study contains the independent learning of the software and also the preparation of the final assignments.

Target group:

Anybody interested in mathematical software.

Prerequisites and co-requisites:

The required prerequisite is the completion of following courses (or corresponding knowledge of the subject):
- 802120P Matrix calculus
- 802320A Linear algebra

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 required and recommended reading consists mainly on free material (manuals/tutorial) found in the internet. More information will be given at the beginning of the course.

Assessment methods and criteria:

The course is assessed by final assignments. The student who wish to complete the course at A-level will make two separate assignments of given topics using (at least) two different mathematical software. Those who wish to complete the course in S-level will need to discuss with the lecturer about the extra work needed to pass. For example, it could be possible to do assignments of wider topics, making an assignment(s) with a software not covered in the course, or making an assignment that requires particular skills and knowledge.

Grading:

The course utilizes grading scale pass / fail.

Person responsible:

Mikko Orispää

Working life cooperation:

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Other information:

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802361A: Numerical Computation, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

On successful completion of this course, the student will be able to solve basic numerical problems using Fortran programming and to exploit the Unix computers and software libraries for solving numerical problems.

Contents:

On the course students train programming of numerical algorithms using Fortran 95 programming language in Unix (Linux) operating system. On the course, DISLIN subroutine library is used for the visualization of the numerical calculation results.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h + exercises+practical work. Self-study has important role.

Target group:

Major and minor students

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 required and recommended reading consists mainly on free material (manuals/tutorial) found in the internet. More information will be given at the beginning of the course.

Assessment methods and criteria:

The assessment of the course is based on the assesment of practical work at the end of course.

Grading:

The course utilizes verbal grading scale pass / fail.

Person responsible:

Erkki Laitinen

Working life cooperation:

No

Other information:

-

031025A: Introduction to Optimization, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English

Timing:

The course is held in the autumn, during period 1.

Learning outcomes:

After completing the course the student is able to solve optimization convex optimization problems with the basic optimization algorithms. The student is also able to form the necessary and sufficient conditions for the optimality.

Contents:

Linear optimization, Simplex-algorithm, nonlinear optimization, KKT-conditions, duality, conjugate gradient method, penalty and barrier function methods.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 14 h / Self-study 93 h.

Target group:

Students in Wireless Communication Engineering

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses Calculus I and II, Matrix algebra

Recommended optional programme components:

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Recommended or required reading:

P. Ciarlet; Introduction to numerical linear algebra and optimization, M. Bazaraa, H. Sherali, C.M. Shetty; Nonlinear programming

Assessment methods and criteria:

The course can be completed by a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Keijo Ruotsalainen

Working life cooperation:

-

Other information:

-

031080A: Signal Analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kotila, Vesa Iisakki

Opintokohteen kielet: Finnish

Leikkaavuudet:

031050A	Signal Analysis	4.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish.

The course can be completed in English by a final exam or a retake exam.

Timing:

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

Learning outcomes:

Upon completion of the course, the student:
-is able to calculate the energy, the power, the convolution and the frequency spectrum of discrete and analog, periodic and non-periodic deterministic signals
-is able to calculate the spectrum of a sampled signal
-is able to calculate the Hilbert transform and the complex envelope of a signal
-is able to study the stationarity, the mutual dependence and the frequency content of random signals by means of the auto- and cross-correlation functions, and the power- and cross-power spectral densities
-is able to study the effect of an LTI system on a signal

Contents:

Signals, classification, frequency. Fourier analysis, analog and digital signal, fast Fourier transform. LTI system. Hilbert transform. AM- FM- and PM-modulation. Random variable. Covariance matrix. Random signal. Stationarity, autocorrelation. Power spectral density. Random signal in LTI system. Signal estimation.

Mode of delivery:

Blended teaching.

Learning activities and teaching methods:

Lectures 28 h / Exercises 14 h / Self-study privately or in a group 93 h. The independent work includes individual STACK-assignments as online work.

Target group:

-

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses 031078P Matrix Algebra, 031021P Probability and Mathematical Statistics and 031077P Complex Analysis.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes. Additional reading: Proakis, J.G., Manolakis, D.K.: Introduction to Digital Signal Pro-cessing. Shanmugan, K.S., Breipohl, A.M.: Random Signals, Detection, Estimation and Data Analysis.

Assessment methods and criteria:

The course is completed with a final exam or a retake exam. In addition to the final exam, STACK-assignments given during the course are part of the assessment. The assessment of the course is based on the learning outcomes of the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Vesa Kotila

Working life cooperation:

-

Other information:

-

802322A: Basics in mathematical modelling, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Erkki Laitinen

Opintokohteen kielet: Finnish

805305A: Introduction to Regression and Analysis of Variance, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Päkkilä

Opintokohteen kielet: Finnish

Leikkaavuudet:

806112P	Basic Methods of Data Analysis	10.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Autumn term, 2nd period. Recommended to be taken already in the 2nd year for those aiming at specialization in data science.

Learning outcomes:

Upon successful completion of the course the student can describe the basic concepts and main principles of regression and variance analysis with one or several explanatory variables, and is able to apply these methods in analysing a small scale data set as well as to apply the necessary computational tools.

Contents:

Linear regression and analysis of variance models for continuous outcomes; Formulation of the model and interpretation of parameters; Fitting the models, estimation of parameters, and prediction with the method of least squares: Basic methods of model criticism and diagnostics; Use of R environment in modelling.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Lectures 28 h, practicals 14 h, and independent work. The practicals include both homework and computer class exercises.

Target group:

Students of mathematical sciences and other interested. The course belongs to core studies for those with an orientation to data science. It is a prerequisite for those doing M.Sc. in computational mathematics and data science having data science as the specialization profile. The course is useful also for students of the Faculty of Science and the Oulu Business School as well as those of computer science or computational engineering, who have statistics as a minor subject.

Prerequisites and co-requisites:

806113P Introduction to Statistics or 806119P A Second Course in Statistics or corresponding abilities acquired otherwise.

Recommended optional programme components:

Is assumed as preliminary knowledge in the course 805306A Introduction to Multivariate Methods.

Recommended or required reading:

Lecture notes and material distributed during lectures and practicals. Recommended reading:James, G., Witten, D., Hastie, T., Tibshirani, R. (2013). An Introduction to Statistical Learning with

Applications in R}. Springer, New York; chapters 1-3. -- freely downloadable from http://www-bcf.usc.edu/~gareth/ISL/

Assessment methods and criteria:

Practical exercises and final exam. Passing the course requires adequate participation in practical sessions and sufficient homework activity.

Grading:

Numeric assessment scale from 1 to 5

Person responsible:

Jari Päkkilä

Working life cooperation:

No

805306A: Introduction to Multivariate methods, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Päkkilä

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Autumn term, 2nd period. Recommended to be taken already in the 2nd year for those aiming at specialization in data science.

Learning outcomes:

Upon successful completion of the course the student can describe the basic concepts and main principles of the logistic regression, principal components analysis, discriminant analysis, classification analysis and clustering analysis, and is able to apply these methods in analysing a small scale data set as well as to apply the necessary computational tools.

Contents:

Logistic regression, principal components analysis, discriminant analysis, classification analysis and clustering analysis; Use of R environment in modelling; Course is an application oriented.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Lectures 28 h, practicals 14 h, and independent work. The practicals include both homework and computer class exercises.

Target group:

Students of mathematical sciences and other interested. The course belongs to core studies for those with an orientation to data science. It is a prerequisite for those doing M.Sc. in computational mathematics and data science having data science as the specialization profile. The course is useful also for students of the Faculty of Science and the Oulu Business School as well as those of computer science or computational engineering, who have statistics as a minor subject.

Prerequisites and co-requisites:

806113P Introduction to Statistics or 806119P A Second Course in Statistics and 805305A Introduction to Regression and Analysis of Variance or corresponding abilities acquired otherwise.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and material distributed during lectures and practicals. Recommended reading:James, G., Witten, D., Hastie, T., Tibshirani, R. (2013). An Introduction to Statistical Learning with Applications in R}. Springer, New York; chapters 4 and 10. -- freely downloadable from http://www-bcf.usc.edu/~gareth/ISL/.

Assessment methods and criteria:

Practical exercises and final exam. Passing the course requires adequate participation in practical sessions and sufficient homework activity.

Grading:

Numeric assessment scale from 1 to 5, Fail

Person responsible:

Jari Päkkilä

Working life cooperation:

No

800324A: Practical training, 5 op

Voimassaolo: 01.08.2017 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Kari Myllylä
Opintokohteen kielet: Finnish
Leikkaavuudet:

802327A	Tutoring	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Person responsible:

Kari Myllylä

A325001: Mathematics, basic studies, 25 op

Opiskelumuoto: Basic Studies
Laji: Study module
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Kari Myllylä
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory Studies

802151P: Introduction to mathematical deduction, 5 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay802151P	Introduction to mathematical deduction (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

First period at the first semester.

Learning outcomes:

After completing the course, student is:
- able to use different methods proving techniquesis
- able to use basic set theoretic concepts and definitionsis
- able to define and apply basic definitions related to functions

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h

Target group:

Major and minor students

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

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

Grading:

Pass/Fail

Person responsible:

Marko Leinonen

Working life cooperation:

-

800119P: Functions and limit, 5 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Salmi

Opintokohteen kielet: Finnish

Leikkaavuudet:

802162P	Continuity and Limit	5.0 op
802155P	Continuity and limit	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1st year, 1st period

Learning outcomes:

Upon completing the course the student is
- able to apply the triangle inequality and make approximations
- able to manipulate elementary functions such as polynomials and trigonometric functions
- able to define the limit of a sequence and the limit of a function as well as apply these definitions
- able to apply different techniques to determine limits.

Contents:

The course concerns real-valued functions of one variable. In particular elementary functions are defined and the monotonicity of functions is studied. The notion of absolute value is reviewed and applied to approximation. Also the triangle inequality is used in approximation. The central concept is the limit of a function, which is introduced via the limit of a sequence. The aim of the course is to improve deductive skills as well as computational skills.

Mode of delivery:

Face-to-face teaching, computer exercises

Learning activities and teaching methods:

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

Target group:

1st year mathematics and physics students as well as students taking mathematics as a minor subject

Prerequisites and co-requisites:

Introduction to mathematical deduction 802151P is recommended to be taken simultaneously (or earlier).

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes, STACK exercises. Additional material: for example the book P. Harjulehto, R. Klén, M. Koskenoja, Analyysiä reaaliluvuilla.

Assessment methods and criteria:

Final exam, exercises

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

No

Other information:

Replaces the course 802162P Continuity and Limit.

802120P: Introduction to Matrices, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802118P	Linear Algebra I	4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

1. year, 4. period

Learning outcomes:

After completing the course the student is able to
- apply arithmetic operations of matrices
- solve system of linear equations by matrix methods
- study linear depence and linear indepence of vectors
- recognize the subspace of R^n and understands the concepts of basis and dimension of a vector space
- analyse matrices by the parameters and the vectors

Contents:

Vectors and matrices, Systems of linear equations, determinant of a matrix, subspaces of R^n, linear depence and linear indepence of vectors, base, dimension, eigenvalues and eigenvectors of a matrix, diagonalization.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, Exercises 14 h

Target group:

Major and minor studies

Prerequisites and co-requisites:

802151P Introduction to Mathematical Deduction

Recommended or required reading:

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

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Marko Leinonen

Working life cooperation:

-

806113P: Introduction to Statistics, 5 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Hanna Heikkinen

Opintokohteen oppimateriaali:

Wild, Christopher J. , , 2000
Grönroos, Matti (2) , , 2003

Opintokohteen kielet: Finnish

Leikkaavuudet:

806118P	Introduction to Statistics	5.0 op
806119P	A Second Course in Statistics	5.0 op
806116P	Statistics for Economic Sciences	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

4th period. 1st or 2nd year of studies.

Learning outcomes:

Upon completion of the course, student will be
- able to identify and define the main principles of statistical research, collection of the data and analysis
- able to apply basic methods of descriptive statistics and statistical inference in simple quantitative research using a statistical software
- able to critically evaluate results of the statistical research presented in media
- prepared for teaching statistics in secondary school and high school
- prepared for participating in a group.

Contents:

- the nature and the meaning of statistics
- data and the acquisition of them: observations, variables, measuring and designs of a study
- the descriptive statistics of empirical distributions: tables, graphical presentations and descriptive measures of center, variation and dependence
- the most important probability distributions
- the principles and the basic methods of statistical inference: random sample, sample statistics, point estimation, confidence intervals and statistical testing of hypotheses.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 16 h (partly compulsory) / instructed group work (28 h) / independent work 80 h. Group works will be returned. Additional independently implemented learning diary tasks. Independent work contains also preparation for group work and peer assessment.

Target group:

Students of mathematical and physical sciences.

Prerequisites and co-requisites:

The recommended prerequisite prior to enrolling for the course is the completion of the courses: 802151P Introduction to mathematical deduction and 800119P Functions and limit.

Recommended optional programme components:

After the course, student is able to continue other statistics courses.

Recommended or required reading:

Lecture notes.

Assessment methods and criteria:

This course utilizes continuous assessment. Practical works and learning diaries are assessed weekly. In addition web tests and learning tasks. The assessment of the course is based on the learning outcomes of the course. The more detailed assessment criteria is available in the beginning of the course. In addition one compulsory lecture and peer assessment.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Hanna Heikkinen

Working life cooperation:

No

801195P: Probability Theory, 5 op

Voimassaolo: 01.01.2011 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opintokohteen oppimateriaali:
Tuominen, P., , 1993
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year, 2nd period.

Learning outcomes:

Upon completing the course the student will be able to
- solve simple practical problems associated with probability
- solve simple theoretical problems associated with probability
- derive the basic properties of probability, starting from the axioms

Contents:

The course is an introduction to probability. In the beginning high school level probability is reviewed and after that axiomatic treatment of the theory starts. The central concepts discussed include probability space, conditional probability, independence, and random variable together with its distribution and expected value.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors and minors

Prerequisites and co-requisites:

Integral 800318A

Recommended optional programme components:

-

Recommended or required reading:

Lectures.
Text book: Pekka Tuominen: Todennäköisyyslaskenta I, Limes ry, Helsinki.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Hanna Heikkinen

Working life cooperation:

-

A325002: Mathematics, intermediate studies, 35 op

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

Ei opintojaksokuvauksia.

Compulsory Studies

800317A: Continuity and derivative, 5 op

Voimassaolo: 01.01.2017 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

802163P	Derivative	5.0 op
802156P	Derivative	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1st year, 2nd period

Learning outcomes:

Upon completing the course the student is
- able to define the concept of continuous function and apply this definition in examples and deductions
- able to determine derivatives of functions
- able to apply derivative to study functions
- able to appy the concepts of continuity and derivative in various problems, including deductions

Contents:

The course concerns continuity and derivative of real-valued functions of one variable. The central topics are the intermediate value theorem, the chain rule, the derivative of inverse functions, the mean value theorem and its applications. Differential calculus is also applied to various problems. The aim of the course is to improve mathematical thinking as well as computational skills.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

1st year mathematics and physics students as well as students taking mathematics as a minor subject

Prerequisites and co-requisites:

Functions and limit 800119P, Introduction to mathematical deduction 802151P

Recommended optional programme components:

-

Recommended or required reading:

In addition to the material hand out in the course, for example the book P. Harjulehto, R. Klén, M. Koskenoja, Analyysiä reaaliluvuilla.

Assessment methods and criteria:

Final exam, exercises

Grading:

1-5, fail

Person responsible:

Esa Järvenpää

Working life cooperation:

no

Other information:

Replaces the course 802163P Derivative.

800318A: Integral, 5 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ville Suomala

Opintokohteen kielet: Finnish

Leikkaavuudet:

802164P	Series and Integral	5.0 op
802353A	Series and Integrals	6.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1st year 3rd period

Learning outcomes:

After completing the course, the student
- manages the basics of integration theory
- understands the connection and differences between definite and indefinite integral
- is able to understand the connetcion between the integral and the derivative
- is able to use appropriate integration methods and knows where integration theory is applied

Contents:

Introduction to integration theory. Riemann-integral, The fundamental theorem of Calculus, Eksponent function and logarithm, integration by parts, integration by substitution, improper integral. Applications of integration theory.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h, independent work

Target group:

1st year mathematics and physics students as well as students taking mathematics as a minor subject

Prerequisites and co-requisites:

Functions and limit, Continuity and derivative

Recommended or required reading:

In addition to the material hand out in the course, for example the book P. Harjulehto, R. Klén, M. Koskenoja, Analyysiä reaaliluvuilla.

Assessment methods and criteria:

Final exam

Grading:

1-5

Person responsible:

Ville Suomala

Working life cooperation:

no

Other information:

Replaces the course 802164P Series and integral.

800328A: Calculus of several variables, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802351A	Vector Calculus	5.0 op
800322A	Multidimensional analysis	8.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd year, 1st period

Learning outcomes:

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

Contents:

The course concerns calculus of severable variables. The central concepts of the course are partial derivative, gradient, divergence, curl and multiple integral. Integral theorems related to functions of several variables are also presented. In addition power series are introduced. The course offers basic tools for applications.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics and physics major and minor students

Prerequisites and co-requisites:

Continuity and derivative 800317A, Integral 800318A, Introduction to matrices 802120P

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Mahmoud Filali

Working life cooperation:

No

Other information:

Replaces the course 802351A Vector calculus

802320A: Linear Algebra, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802119P	Linear Algebra II	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish and English

Timing:

2nd year, 2nd period

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors and minors students

Prerequisites and co-requisites:

802120P Introduction to Matrices

Recommended optional programme components:

-

Recommended or required reading:

http://cc.oulu.fi/~tma/OPETUS.html

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Tapani Matala-aho

Working life cooperation:

No

Other information:

-

802354A: Basics in Algebra, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Myllylä

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay802354A	Number Theory and Groups (OPEN UNI)	5.0 op
800333A	Algebra I	8.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

1. year, 3. period

Learning outcomes:

After completing the course, student is able to

- derive and proof main results in the course
- use and apply different proof techniques
- recognize algebraic structures and the concepts
- see connections and differences between different algebraic structures

Contents:

The course includes basics in arithmetics and algebraic structures, such as, congruence, residue classes, prime numbres, Euclidean algorithm, the fundamental theorem of arithmetic, Euler-Fermat formula, groups and morphisms. The course gives an understanding of algebraic terms and concepts used in mathematics and physics.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28 h lectures, 14 h exercises

Target group:

Major and minor students

Prerequisites and co-requisites:

802151P Introduction to mathematical deduction

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

1-5

Person responsible:

Kari Myllylä

Working life cooperation:

-

802357A: Euclidean Spaces, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ville Suomala

Opintokohteen kielet: Finnish

Leikkaavuudet:

802352A	Euclidean Topology	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

2nd year 2nd period

Learning outcomes:

After passing the course the student
- will be able to define basic topological concepts
- will be able to handle sequences
- will be able to justify basic properties of continuous vector valued functions

Contents:

Sequences, continuity and limit of a vector valued function, basic topological concepts

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

28 hours of lectures, 14 hours of excercises, independent work

Target group:

Major and minor students

Prerequisites and co-requisites:

Functions and limits, Continuity and derivative, Introduction to Matrices, Integral

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Ville Suomala

Working life cooperation:

No

Other information:

-

800331A: Proseminar, 10 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Myllylä

Opintokohteen kielet: Finnish

Leikkaavuudet:

801323A	Seminar	6.0 op

ECTS Credits:

10 ECTS credits / 266 hours of work

Language of instruction:

Finnish

Timing:

2nd and 3rd year

Learning outcomes:

After completing the Bachelor's thesis:
1) student is able to form a clear and logical
2) student is able to concentrate to important and essential details in the subject of thesis
3) student gain experience presenting mathematical concept and research studies

Contents:

Proseminar (Bachelor's thesis) is a small mathematical study based on literature. Student is familiarized to write mathematical texts and obtain information using literature. Thesis includes a oral presentation from the subject of the thesis.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Seminars and own work

Target group:

Major students

Prerequisites and co-requisites:

Compulsory basic and intermediate studies

Recommended optional programme components:

Maturity test is written from the topic of Bachelor's thesis

Assessment methods and criteria:

Bachelor's thesis

Grading:

Pass/Fail

Person responsible:

Kari Myllylä

800300A: Maturity test, 0 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

0 cr

Language of instruction:

Finnish/Swedish

Timing:

Third year

Learning outcomes:

Maturity test

Contents:

Students must take a written maturity test to demonstrate their language skills and how well they know the topic of their thesis. The maturity test is taken in the language in which the student has received his or her education in Finland. If the student has received his or her education in a language other than Finnish or Swedish, the degree programme determines the language of the maturity test. In such cases only the contents of the maturity test is evaluated, not the language.

Mode of delivery:

Maturity test written in examination room.

Learning activities and teaching methods:

Maturity test

Target group:

Major students

Prerequisites and co-requisites:

Bachelor's degree (or similar)

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

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

Grading:

Pass/Fail

Person responsible:

Supervisor of thesis

Working life cooperation:

-

H325030: Optional studies in mathematics and statistics, 5 - 60 op

Voimassaolo: 01.08.2018 -
Opiskelumuoto: Optional Studies
Laji: Study module
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Electives

802355A: Algebraic Structures, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Kari Myllylä
Opintokohteen kielet: Finnish
Leikkaavuudet:

800333A	Algebra I	8.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

Second year, 1. period

Learning outcomes:

After completing the course, student is able to

- derive and proof main results in the course
- use and apply different proof techniques
- recognize algebraic structures and the concepts
- see connections and differences between different algebraic structures

Contents:

The course introduces algebraic structures, such as rings, subrings, ideals, integral domains, fields and finite fields. The course gives an understanding of algebraic terms and concepts used in mathematics and physics.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28 h lectures, 14 h exercises

Target group:

Major students

Prerequisites and co-requisites:

802354A Basics in Algebra

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

1-5

Person responsible:

Kari Myllylä

Working life cooperation:

-

800321A: Series and Approximation, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

2nd year

Learning outcomes:

Upon completing the course the student is
- able to manipulate series and investigate their convergence
- able to explain the difference between uniform and pointwise convergence
- able to study the uniform and pointwise convergence of function sequences and series
- able to use power series in approximation

Contents:

The course concerns both number series and function series. The central topics are convergence tests, pointwise and uniform convergence, power series and the Taylor series. The course gives also an introduction to approximation of functions by polynomials for example.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors

Prerequisites and co-requisites:

Continuity and derivative 800317A and Integral 800318A

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Mahmoud Filali

Working life cooperation:

no

802358A: Metric Spaces, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802356A	Metric Topology	5.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year, 4th period

Learning outcomes:

After the course the student is able to
- define metric spaces
- give examples of metric spaces
- define elementary topological concepts (open and closed sets, accumulation point, etc)
- apply the definitions from elementary topology in examples and proofs

Contents:

The goal of the courses is to expand student's knowledge and understanding of continuity and to introduce to other topological concepts in the setting of metric spaces. Course considers basic topology of n-dimensional Euclidean space and introduces also other metric spaces as examples. Central concepts are open and closed sets, compactness and completeness.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors (obligatory for mathematics majors except for subject teacher students)

Prerequisites and co-requisites:

802357A Euclidean spaces OR 802357A Introduction to Real Analysis

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Midterm exams or final exam

Grading:

1-5

Person responsible:

Mahmoud Filali

Working life cooperation:

-

Other information:

-

800320A: Differential equations, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Erkki Laitinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

031076P	Differential Equations	5.0 op
031017P	Differential Equations	4.0 op
800345A	Differential Equations I	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

2nd year

Learning outcomes:

Upon completing the course the student
- is able to classify differential equations and is able to apply correct solution methods to them
- knows the conditions that guarantee the unique solvability of an equation
- understands the concept of implicitly defined solution

Contents:

The course is devoted to ordinary differential equations. Central part is formed by first order differential equations (separable, homogeneous, linear, exact equations and certain equations which can be transformed into these). The equations are solved using algebraic, iterative and numerical methods. The second part which is central to applications is formed by linear inhomogeneous differential equations with constant coefficients and linear second order equations with continuous coefficient functions. In addition, systems of differential equations are considered. Certain second order linear differential equatoins (e.g. Legendre's equation) is solved via power series.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h, independent work

Target group:

Major and minor students

Prerequisites and co-requisites:

Continuity and derivative 800317A and Integral 800318A

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

1-5

Working life cooperation:

no

Other information:

Homepage in Noppa portal.

801396A: Introduction to Probability Theory II, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opintokohteen oppimateriaali:
Tuominen, P., , 1993
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

On successful completion of this course, the student will be able to:
- work with random variables both in theory and applications
- explain the central results in probability theory such that Law of large numbers and the Central limit theorem
- determine generating functions of random variables and apply them for example to calculate moments
- apply various stocastic models
- derive the basic results associated with the new concepts introduced
- use two-dimensional distributions
- work with conditional distributions

Contents:

The central topics are the moments of a distribution, the probability generating function, the Law of Large Numbers, the Central Limit Theorem, two-dimensional distibutions as well as conditional distributions.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics major and minor students. Recommended for students aiming for the profile of computational mathematics and data science.

Prerequisites and co-requisites:

801195P Introduction to probability I, 800328A Calculus of several variables (or Vector Calculus)

Recommended or required reading:

P. Tuominen: Todennäköisyyslaskenta I, Limes 2002 and other books on probability.

Assessment methods and criteria:

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

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

-

800146P: Introduction to teaching, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

801329A	Mathematics in Teaching	3.0 op
802157P	Mathematics in teaching	2.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1st year, 3th period

Learning outcomes:

After the course, the student is able to reflect critically on the learning and teaching of mathematics. The student can discuss and explain the connection between mathematics at school and at university.

Contents:

Learning and teaching mathematics and physics are thought about and discussed.
The course consists of reflective exercises, reading articles and seminar meetings where the exercises are discussed. The student writes a learning journal.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28 h seminar meetings, 105 h independent work and group work

Target group:

1st year mathematics and physics teacher students

Prerequisites and co-requisites:

-

Assessment methods and criteria:

Participating in the meetings, writing a learning diary, group work tasks

Grading:

pass/fail

Person responsible:

Marko Leinonen

Working life cooperation:

No

Other information:

Replaces the course 801329A Mathematics in teaching.

802336A: Introduction to Cryptography, 5 op

Voimassaolo: 01.06.2016 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay802336A	Introduction to Cryptography (OPEN UNI)	5.0 op
801346A	Introduction to Cryptography	4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year or later, every period

Learning outcomes:

After completeing the course, student
- knows the principles of sime traditianl symmetric key methods
- knows how public key methods (RSA, discrete logarithm, knapsack) work
- is familiar with the possibility to use and apply number theory in cryptography

Contents:

The course considers some traditional symmetric key methods (affine system, matrix cryptography) and three public key methods, namely RSA, discrete logarithm and knapsack.

Mode of delivery:

Independent work

Learning activities and teaching methods:

Net course; Lecture slides, exercisis, solutions of exercisis (in Noppa) + stack-exercisis

Target group:

Major and minor students

Prerequisites and co-requisites:

802354A Basics of Algebra, 802120P Introduction to Matrices

Recommended optional programme components:

-

Recommended or required reading:

Lecture slides, exercisis, solutions of exercisis, stack-exercisis

Assessment methods and criteria:

Final exam or Final exam + stack-exercisis

Grading:

1-5, fail

Person responsible:

Marko Leinonen

Working life cooperation:

No

801399A: Geometry, 5 op

Voimassaolo: 01.08.2019 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

801389A	Basic Geometry for University Students	6.0 op

Ei opintojaksokuvauksia.

802359A: Advanced Vector Calculus, 5 op

Voimassaolo: 01.06.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Ville Suomala
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year, 4th period

Learning outcomes:

After completing the course the student is able to
- use derivative as a linear mapping
- formulate and apply Inverse function theorem and Implicit function theorem
- define and calculate Riemann integral in higher dimensions

Contents:

The aim of the course is to deepen the understanding of calculus of severable variables. The derivative is treated as a linear mapping. The central results are the Inverse Function Theorem and the Implicit Function Theorem. In the course the Riemann integral is defined in higher dimension and related basic results are proved

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors

Prerequisites and co-requisites:

802351A Vector Calculus
802164P Series and Integral
802163P Derivative

802358A Metric spaces (or 802357A Euklidean spaces)

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Pekka Salmi

Working life cooperation:

No

Other information:

-

802328A: Basics in Number Theory, 5 op

Voimassaolo: 01.06.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapani Matala-aho

Opintokohteen oppimateriaali:
Hardy, G. H., , 1979
Rosen, Kenneth H., , 1993

Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish/English

Timing:

2.-3. year of studies. Timing varies.

Learning outcomes:

As usual in my mathematical studies I shall be able to solve problems arising from the subject and to prove essential theorems starting from the given definitions using the tools applied in the course. More detailed; For example, when I pass the course with the grade 1/5, I shall recognize most definitions and I am able to solve closely related problems. Also I am able to rewrite short proofs with some understanding. When I pass the course with the grade 5/5, then I shall understand well the given definitions with the proofs of the theorems deduced from them. Further, I am able to solve challenging problems which demand independent deductions with several stages and applications of appropriate tools.

Contents:

In our lectures we consider arithmetical properties of the common numbers involved in studing mathematics and in particular number theory. Also the methods will get a special interest. Examples of the numbers under the research will be binomials, continued fractions, sums of powers and some numbers sharing a name with the mathematicians Bernoulli, Euler, Fermat, Fibonacci, Heron, Lucas, Mersenne, Neper, Pythagoras, Stirling, Wilson and Wolstenholme. From the tools we mention congruences of rational numbers and polynomials, difference operators, generating series, irrationality considerations, matrix presentations, recurrences and telescopes.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures and execises

Target group:

Major and minor students

Prerequisites and co-requisites:

802354A Lukuteoria ja ryhmät
802355A Rings, fields and polynomials
802118P Linear algebra I
802119P Linear algebra II
802352A Euclidean topology
802353A Series and integrals

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes,
G.H. Hardy ja E.M. Wright: An Introduction to the Theory of Numbers;
Kenneth H. Rosen: Elementary number theory and its applications.

Assessment methods and criteria:

Mid-term exams or final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Tapani Matala-aho

Working life cooperation:

-

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

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

800346A	Differential Equations II	4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year or later, 2nd period

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h

Target group:

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

Prerequisites and co-requisites:

Differential equations, Complex analysis

Recommended optional programme components:

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Recommended or required reading:

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

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Working life cooperation:

No

Other information:

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031077P: Complex analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kemppainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031077P	Complex analysis (OPEN UNI)	5.0 op

031018P Complex Analysis 4.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish

Timing:

Fall semester, period 1.

Learning outcomes:

After completing the course the student

1. is able to calculate the derivative and the integral of functions of complex variable,
2. understands the concept of analyticity
3. is capable of calculating the contour integrals and using the theory of residues for computing the line integrals, will be able to apply the techniques of complex analysis to simple problems in signal processing.

Contents:

Complex numbers and functions, complex derivative and analyticity, complex series, Cauchy's integral theorem, Laurent and Taylor expansions, theory of residues, applications to signal analysis.

Mode of delivery:

Face-toface teaching, Stack(web-based too) exercises.

Learning activities and teaching methods:

Lectures 28 h/Exercises 14 h/Self study 93 h.

Target group:

The students in the engineering sciences. The other students are welcome, too.

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses Calculus I and II, Differential Equations.

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 lecture notes

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Jukka Kemppainen

Working life cooperation:

-

Other information:

-

802338A: Complex Analysis II, 5 op

Voimassaolo: 01.06.2016 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5 credits

Contents:

like - terminating, non-terminating, irrationality, periodicity, approximation properties will be studied

Person responsible:

Valery Serov

031022P: Numerical Analysis, 5 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Marko Huhtanen
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish. English speaking students should contact the instructor.
The course can be completed in English by intermediate exams or by a final exam.

Timing:

Spring semester, period 3

Learning outcomes:

Knows numerical algorithms for solving basic problems in computing. Knows basics about numerical linear algebra and some of its applications. Knows how nonlinear systems are solved and how they appear in optimization. Knows how differential equations are solved numerically.

Contents:

Numerical linear algebra, numerical methods for systems of equations, unconstrained optimization, basics of the approximation theory, numerical quadratures, numerical methods for ordinary differential equations.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 22 h / Self-study 85 h.

Target group:

-

Prerequisites and co-requisites:

Completion of courses Calculus I and II, a course on Differential Equations and a Course on Linear Algebra.

Recommended optional programme components:

-

Recommended or required reading:

Material posted on the web-page of the course.

Assessment methods and criteria:

Intermediate exams or a final exam.

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

Grading:

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

Person responsible:

Marko Huhtanen

Working life cooperation:

-

Other information:

-

802365A: Introduction to Mathematical Solfware, 5 op

Voimassaolo: 01.06.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Mikko Orispää
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish (also English if needed)

Timing:

2.-3. year

Learning outcomes:

Upon completion of the course, the student knows the basics of the use of the most common mathematical software, is able to use mathematical software in solving mathematical tasks and problems, and is able to independently deepen her knowledge of different mathematical software as necessary.

Contents:

During the course, the student learns the basics of some of commonly used mathematical software which include Matlab and Python (Numpy/Scipy).

Mode of delivery:

The course is arranged in a computer class as a series of lectures and rehearsals. On the lectures, the students have the possibility to use and try the mathematical software during the lectures. In the rehearsals, different given problems and tasks are solved together.

Learning activities and teaching methods:

Lectures 22 h / Rehearsals 22 h / Self-study 60 h. The self-study contains the independent learning of the software and also the preparation of the final assignments.

Target group:

Anybody interested in mathematical software.

Prerequisites and co-requisites:

The required prerequisite is the completion of following courses (or corresponding knowledge of the subject):
- 802120P Matrix calculus
- 802320A Linear algebra

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 required and recommended reading consists mainly on free material (manuals/tutorial) found in the internet. More information will be given at the beginning of the course.

Assessment methods and criteria:

The course is assessed by final assignments. The student who wish to complete the course at A-level will make two separate assignments of given topics using (at least) two different mathematical software. Those who wish to complete the course in S-level will need to discuss with the lecturer about the extra work needed to pass. For example, it could be possible to do assignments of wider topics, making an assignment (s) with a software not covered in the course, or making an assignment that requires particular skills and knowledge.

Grading:

The course utilizes grading scale pass / fail.

Person responsible:

Mikko Orispää

Working life cooperation:

-

Other information:

-

802361A: Numerical Computation, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

On successful completion of this course, the student will be able to solve basic numerical problems using Fortran programming and to exploit the Unix computers and software libraries for solving numerical problems.

Contents:

On the course students train programming of numerical algorithms using Fortran 95 programming language in Unix (Linux) operating system. On the course, DISLIN subroutine library is used for the visualization of the numerical calculation results.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h + exercises+practical work. Self-study has important role.

Target group:

Major and minor students

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 required and recommended reading consists mainly on free material (manuals/tutorial) found in the internet. More information will be given at the beginning of the course.

Assessment methods and criteria:

The assessment of the course is based on the assesment of practical work at the end of course.

Grading:

The course utilizes verbal grading scale pass / fail.

Person responsible:

Erkki Laitinen

Working life cooperation:

No

Other information:

-

031025A: Introduction to Optimization, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English

Timing:

The course is held in the autumn, during period 1.

Learning outcomes:

After completing the course the student is able to solve optimization convex optimization problems with the basic optimization algorithms. The student is also able to form the necessary and sufficient conditions for the optimality.

Contents:

Linear optimization, Simplex-algorithm, nonlinear optimization, KKT-conditions, duality, conjugate gradient method, penalty and barrier function methods.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 14 h / Self-study 93 h.

Target group:

Students in Wireless Communication Engineering

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses Calculus I and II, Matrix algebra

Recommended optional programme components:

-

Recommended or required reading:

P. Ciarlet; Introduction to numerical linear algebra and optimization, M. Bazaraa, H. Sherali, C.M. Shetty; Nonlinear programming

Assessment methods and criteria:

The course can be completed by a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Keijo Ruotsalainen

Working life cooperation:

-

Other information:

-

031080A: Signal Analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kotila, Vesa Iisakki

Opintokohteen kielet: Finnish

Leikkaavuudet:

031050A	Signal Analysis	4.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish.
The course can be completed in English by a final exam or a retake exam.

Timing:

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

Learning outcomes:

Upon completion of the course, the student:
-is able to calculate the energy, the power, the convolution and the frequency spectrum of discrete and analog, periodic and non-periodic deterministic signals
-is able to calculate the spectrum of a sampled signal
-is able to calculate the Hilbert transform and the complex envelope of a signal
-is able to study the stationarity, the mutual dependence and the frequency content of random signals by means of the auto- and cross-correlation functions, and the power- and cross-power spectral densities
-is able to study the effect of an LTI system on a signal

Contents:

Signals, classification, frequency. Fourier analysis, analog and digital signal, fast Fourier transform. LTI system. Hilbert transform. AM- FM- and PM-modulation. Random variable. Covariance matrix. Random signal. Stationarity, autocorrelation. Power spectral density. Random signal in LTI system. Signal estimation.

Mode of delivery:

Blended teaching.

Learning activities and teaching methods:

Lectures 28 h / Exercises 14 h / Self-study privately or in a group 93 h. The independent work includes individual STACK-assignments as online work.

Target group:

-

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses 031078P Matrix Algebra, 031021P Probability and Mathematical Statistics and 031077P Complex Analysis.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes. Additional reading: Proakis, J.G., Manolakis, D.K.: Introduction to Digital Signal Pro-cessing. Shanmugan, K.S., Breipohl, A.M.: Random Signals, Detection, Estimation and Data Analysis.

Assessment methods and criteria:

The course is completed with a final exam or a retake exam. In addition to the final exam, STACK-assignments given during the course are part of the assessment. The assessment of the course is based on the learning outcomes of the course.

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

Grading:

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

Person responsible:

Vesa Kotila

Working life cooperation:

-

Other information:

-

802322A: Basics in mathematical modelling, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Erkki Laitinen

Opintokohteen kielet: Finnish

805305A: Introduction to Regression and Analysis of Variance, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Päkkilä

Opintokohteen kielet: Finnish

Leikkaavuudet:

806112P	Basic Methods of Data Analysis	10.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Autumn term, 2nd period. Recommended to be taken already in the 2nd year for those aiming at specialization in data science.

Learning outcomes:

Upon successful completion of the course the student can describe the basic concepts and main principles of regression and variance analysis with one or several explanatory variables, and is able to apply these methods in analysing a small scale data set as well as to apply the necessary computational tools.

Contents:

Linear regression and analysis of variance models for continuous outcomes; Formulation of the model and interpretation of parameters; Fitting the models, estimation of parameters, and prediction with the method of least squares: Basic methods of model criticism and diagnostics; Use of R environment in modelling.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Lectures 28 h, practicals 14 h, and independent work. The practicals include both homework and computer class exercises.

Target group:

Students of mathematical sciences and other interested. The course belongs to core studies for those with an orientation to data science. It is a prerequisite for those doing M.Sc. in computational mathematics and data science having data science as the specialization profile. The course is useful also for students of the Faculty of Science and the Oulu Business School as well as those of computer science or computational engineering, who have statistics as a minor subject.

Prerequisites and co-requisites:

806113P Introduction to Statistics or 806119P A Second Course in Statistics or corresponding abilities acquired otherwise.

Recommended optional programme components:

Is assumed as preliminary knowledge in the course 805306A Introduction to Multivariate Methods.

Recommended or required reading:

Lecture notes and material distributed during lectures and practicals. Recommended reading:James, G., Witten, D., Hastie, T., Tibshirani, R. (2013). An Introduction to Statistical Learning with Applications in R}. Springer, New York; chapters 1-3. -- freely downloadable from http://www-bcf.usc.edu/~gareth/ISL/

Assessment methods and criteria:

Practical exercises and final exam. Passing the course requires adequate participation in practical sessions and sufficient homework activity.

Grading:

Numeric assessment scale from 1 to 5

Person responsible:

Jari Päkkilä

Working life cooperation:

No

805306A: Introduction to Multivariate methods, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Päkkilä

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Autumn term, 2nd period. Recommended to be taken already in the 2nd year for those aiming at specialization in data science.

Learning outcomes:

Upon successful completion of the course the student can describe the basic concepts and main principles of the logistic regression, principal components analysis, discriminant analysis, classification analysis and clustering analysis, and is able to apply these methods in analysing a small scale data set as well as to apply the necessary computational tools.

Contents:

Logistic regression, principal components analysis, discriminant analysis, classification analysis and clustering analysis; Use of R environment in modelling; Course is an application oriented.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Lectures 28 h, practicals 14 h, and independent work. The practicals include both homework and computer class exercises.

Target group:

Students of mathematical sciences and other interested. The course belongs to core studies for those with an orientation to data science. It is a prerequisite for those doing M.Sc. in computational mathematics and data science having data science as the specialization profile. The course is useful also for students of the Faculty of Science and the Oulu Business School as well as those of computer science or computational engineering, who have statistics as a minor subject.

Prerequisites and co-requisites:

806113P Introduction to Statistics or 806119P A Second Course in Statistics and 805305A Introduction to Regression and Analysis of Variance or corresponding abilities acquired otherwise.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and material distributed during lectures and practicals. Recommended reading:James, G., Witten, D., Hastie, T., Tibshirani, R. (2013). An Introduction to Statistical Learning with Applications in R}. Springer, New York; chapters 4 and 10. -- freely downloadable from http://www-bcf.usc.edu/~gareth/ISL/.

Assessment methods and criteria:

Practical exercises and final exam. Passing the course requires adequate participation in practical sessions and sufficient homework activity.

Grading:

Numeric assessment scale from 1 to 5, Fail

Person responsible:

Jari Päkkilä

Working life cooperation:

No

800324A: Practical training, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Myllylä

Opintokohteen kielet: Finnish

Leikkaavuudet:

802327A	Tutoring	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Person responsible:

Kari Myllylä

802355A: Algebraic Structures, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Myllylä

Opintokohteen kielet: Finnish

Leikkaavuudet:

800333A	Algebra I	8.0 op

ECTS Credits:
5 ECTS credits
Language of instruction:
Finnish
Timing:
Second year, 1. period
Learning outcomes:
After completing the course, student is able to

- derive and proof main results in the course
- use and apply different proof techniques
- recognize algebraic structures and the concepts
- see connections and differences between different algebraic structures

Contents:
The course introduces algebraic structures, such as rings, subrings, ideals, integral domains, fields and finite fields. The course gives an understanding of algebraic terms and concepts used in mathematics and physics.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
28 h lectures, 14 h exercises
Target group:
Major students
Prerequisites and co-requisites:
802354A Basics in Algebra
Recommended optional programme components:
-
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Final exam
Grading:
1-5
Person responsible:
Kari Myllylä
Working life cooperation:
-

H325030: Optional studies in mathematics and statistics, 5 - 60 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Optional Studies

Laji: Study module

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Electives

802355A: Algebraic Structures, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Kari Myllylä
Opintokohteen kielet: Finnish
Leikkaavuudet:

800333A	Algebra I	8.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

Second year, 1. period

Learning outcomes:

After completing the course, student is able to

- derive and proof main results in the course
- use and apply different proof techniques
- recognize algebraic structures and the concepts
- see connections and differences between different algebraic structures

Contents:

The course introduces algebraic structures, such as rings, subrings, ideals, integral domains, fields and finite fields. The course gives an understanding of algebraic terms and concepts used in mathematics and physics.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28 h lectures, 14 h exercises

Target group:

Major students

Prerequisites and co-requisites:

802354A Basics in Algebra

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

1-5

Person responsible:

Kari Myllylä

Working life cooperation:

-

800321A: Series and Approximation, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

2nd year

Learning outcomes:

Upon completing the course the student is
- able to manipulate series and investigate their convergence
- able to explain the difference between uniform and pointwise convergence
- able to study the uniform and pointwise convergence of function sequences and series
- able to use power series in approximation

Contents:

The course concerns both number series and function series. The central topics are convergence tests, pointwise and uniform convergence, power series and the Taylor series. The course gives also an introduction to approximation of functions by polynomials for example.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors

Prerequisites and co-requisites:

Continuity and derivative 800317A and Integral 800318A

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Mahmoud Filali

Working life cooperation:

no

802358A: Metric Spaces, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802356A	Metric Topology	5.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year, 4th period

Learning outcomes:

After the course the student is able to
- define metric spaces
- give examples of metric spaces
- define elementary topological concepts (open and closed sets, accumulation point, etc)
- apply the definitions from elementary topology in examples and proofs

Contents:

The goal of the courses is to expand student's knowledge and understanding of continuity and to introduce to other topological concepts in the setting of metric spaces. Course considers basic topology of n-dimensional Euclidean space and introduces also other metric spaces as examples. Central concepts are open and closed sets, compactness and completeness.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors (obligatory for mathematics majors except for subject teacher students)

Prerequisites and co-requisites:

802357A Euclidean spaces OR 802357A Introduction to Real Analysis

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Midterm exams or final exam

Grading:

1-5

Person responsible:

Mahmoud Filali

Working life cooperation:

-

Other information:

-

800320A: Differential equations, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Erkki Laitinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

031076P	Differential Equations	5.0 op
031017P	Differential Equations	4.0 op
800345A	Differential Equations I	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

2nd year

Learning outcomes:

Upon completing the course the student
- is able to classify differential equations and is able to apply correct solution methods to them
- knows the conditions that guarantee the unique solvability of an equation
- understands the concept of implicitly defined solution

Contents:

The course is devoted to ordinary differential equations. Central part is formed by first order differential equations (separable, homogeneous, linear, exact equations and certain equations which can be transformed into these). The equations are solved using algebraic, iterative and numerical methods. The second part which is central to applications is formed by linear inhomogeneous differential equations with constant coefficients and linear second order equations with continuous coefficient functions. In addition, systems of differential equations are considered. Certain second order linear differential equatoins (e.g. Legendre's equation) is solved via power series.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h, independent work

Target group:

Major and minor students

Prerequisites and co-requisites:

Continuity and derivative 800317A and Integral 800318A

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Final exam

Grading:

1-5

Working life cooperation:

no

Other information:

Homepage in Noppa portal.

801396A: Introduction to Probability Theory II, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opintokohteen oppimateriaali:
Tuominen, P., , 1993
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

On successful completion of this course, the student will be able to:
- work with random variables both in theory and applications
- explain the central results in probability theory such that Law of large numbers and the Central limit theorem
- determine generating functions of random variables and apply them for example to calculate moments
- apply various stocastic models
- derive the basic results associated with the new concepts introduced
- use two-dimensional distributions
- work with conditional distributions

Contents:

The central topics are the moments of a distribution, the probability generating function, the Law of Large Numbers, the Central Limit Theorem, two-dimensional distibutions as well as conditional distributions.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics major and minor students. Recommended for students aiming for the profile of computational mathematics and data science.

Prerequisites and co-requisites:

801195P Introduction to probability I, 800328A Calculus of several variables (or Vector Calculus)

Recommended or required reading:

P. Tuominen: Todennäköisyyslaskenta I, Limes 2002 and other books on probability.

Assessment methods and criteria:

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

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

-

800146P: Introduction to teaching, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

801329A	Mathematics in Teaching	3.0 op
802157P	Mathematics in teaching	2.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1st year, 3th period

Learning outcomes:

After the course, the student is able to reflect critically on the learning and teaching of mathematics. The student can discuss and explain the connection between mathematics at school and at university.

Contents:

Learning and teaching mathematics and physics are thought about and discussed.
The course consists of reflective exercises, reading articles and seminar meetings where the exercises are discussed. The student writes a learning journal.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28 h seminar meetings, 105 h independent work and group work

Target group:

1st year mathematics and physics teacher students

Prerequisites and co-requisites:

-

Assessment methods and criteria:

Participating in the meetings, writing a learning diary, group work tasks

Grading:

pass/fail

Person responsible:

Marko Leinonen

Working life cooperation:

No

Other information:

Replaces the course 801329A Mathematics in teaching.

802336A: Introduction to Cryptography, 5 op

Voimassaolo: 01.06.2016 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay802336A Introduction to Cryptography (OPEN UNI) 5.0 op
801346A Introduction to Cryptography 4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year or later, every period

Learning outcomes:

After completeing the course, student
- knows the principles of sime traditianl symmetric key methods
- knows how public key methods (RSA, discrete logarithm, knapsack) work
- is familiar with the possibility to use and apply number theory in cryptography

Contents:

The course considers some traditional symmetric key methods (affine system, matrix cryptography) and three public key methods, namely RSA, discrete logarithm and knapsack.

Mode of delivery:

Independent work

Learning activities and teaching methods:

Net course; Lecture slides, exercisis, solutions of exercisis (in Noppa) + stack-exercisis

Target group:

Major and minor students

Prerequisites and co-requisites:

802354A Basics of Algebra, 802120P Introduction to Matrices

Recommended optional programme components:

-

Recommended or required reading:

Lecture slides, exercisis, solutions of exercisis, stack-exercisis

Assessment methods and criteria:

Final exam or Final exam + stack-exercisis

Grading:

1-5, fail

Person responsible:

Marko Leinonen

Working life cooperation:

No

801399A: Geometry, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

801389A Basic Geometry for University Students 6.0 op

Ei opintojaksokuvauksia.

802359A: Advanced Vector Calculus, 5 op

Voimassaolo: 01.06.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Ville Suomala
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year, 4th period

Learning outcomes:

After completing the course the student is able to
- use derivative as a linear mapping
- formulate and apply Inverse function theorem and Implicit function theorem
- define and calculate Riemann integral in higher dimensions

Contents:

The aim of the course is to deepen the understanding of calculus of severable variables. The derivative is treated as a linear mapping. The central results are the Inverse Function Theorem and the Implicit Function Theorem. In the course the Riemann integral is defined in higher dimension and related basic results are proved

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors

Prerequisites and co-requisites:

802351A Vector Calculus
802164P Series and Integral
802163P Derivative
802358A Metric spaces (or 802357A Euklidean spaces)

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Pekka Salmi

Working life cooperation:

No

Other information:

-

802328A: Basics in Number Theory, 5 op

Voimassaolo: 01.06.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapani Matala-aho

Opintokohteen oppimateriaali:
Hardy, G. H., , 1979
Rosen, Kenneth H., , 1993
Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish/English

Timing:

2.-3. year of studies. Timing varies.

Learning outcomes:

As usual in my mathematical studies I shall be able to solve problems arising from the subject and to prove essential theorems starting from the given definitions using the tools applied in the course. More detailed; For example, when I pass the course with the grade 1/5, I shall recognize most definitions and I am able to solve closely related problems. Also I am able to rewrite short proofs with some understanding. When I pass the course with the grade 5/5, then I shall understand well the given definitions with the proofs of the theorems deduced from them. Further, I am able to solve challenging problems which demand independent deductions with several stages and applications of appropriate tools.

Contents:

In our lectures we consider arithmetical properties of the common numbers involved in studing mathematics and in particular number theory. Also the methods will get a special interest. Examples of the numbers under the research will be binomials, continued fractions, sums of powers and some numbers sharing a name with the mathematicians Bernoulli, Euler, Fermat, Fibonacci, Heron, Lucas, Mersenne, Neper, Pythagoras, Stirling, Wilson and Wolstenholme. From the tools we mention congruences of rational numbers and polynomials, difference operators, generating series, irrationality considerations, matrix presentations, recurrences and telescopes.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures and execises

Target group:

Major and minor students

Prerequisites and co-requisites:

802354A Lukuteoria ja ryhmät
802355A Rings, fields and polynomials
802118P Linear algebra I
802119P Linear algebra II
802352A Euclidean topology
802353A Series and integrals

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes,
G.H. Hardy ja E.M. Wright: An Introduction to the Theory of Numbers;
Kenneth H. Rosen: Elementary number theory and its applications.

Assessment methods and criteria:

Mid-term exams or final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Tapani Matala-aho

Working life cooperation:

-

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

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

800346A	Differential Equations II	4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year or later, 2nd period

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h

Target group:

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

Prerequisites and co-requisites:

Differential equations, Complex analysis

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Working life cooperation:

No

Other information:

-

031077P: Complex analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kemppainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish

Timing:

Fall semester, period 1.

Learning outcomes:

After completing the course the student

1. is able to calculate the derivative and the integral of functions of complex variable,
2. understands the concept of analyticity
3. is capable of calculating the contour integrals and using the theory of residues for computing the line integrals, will be able to apply the techniques of complex analysis to simple problems in signal processing.

Contents:

Complex numbers and functions, complex derivative and analyticity, complex series, Cauchy's integral theorem, Laurent and Taylor expansions, theory of residues, applications to signal analysis.

Mode of delivery:

Face-toface teaching, Stack(web-based too) exercises.

Learning activities and teaching methods:

Lectures 28 h/Exercises 14 h/Self study 93 h.

Target group:

The students in the engineering sciences. The other students are welcome, too.

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses Calculus I and II, Differential Equations.

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 lecture notes

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Jukka Kemppainen

Working life cooperation:

-

Other information:

-

802338A: Complex Analysis II, 5 op

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

ECTS Credits:

5 credits

Contents:

like - terminating, non-terminating, irrationality, periodicity, approximation properties will be studied

Person responsible:

Valery Serov

031022P: Numerical Analysis, 5 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Marko Huhtanen
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish. English speaking students should contact the instructor.
The course can be completed in English by intermediate exams or by a final exam.

Timing:

Spring semester, period 3

Learning outcomes:

Knows numerical algorithms for solving basic problems in computing. Knows basics about numerical linear algebra and some of its applications. Knows how nonlinear systems are solved and how they appear in optimization. Knows how differential equations are solved numerically.

Contents:

Numerical linear algebra, numerical methods for systems of equations, unconstrained optimization, basics of the approximation theory, numerical quadratures, numerical methods for ordinary differential equations.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 22 h / Self-study 85 h.

Target group:

-

Prerequisites and co-requisites:

Completion of courses Calculus I and II, a course on Differential Equations and a Course on Linear Algebra.

Recommended optional programme components:

-

Recommended or required reading:

Material posted on the web-page of the course.

Assessment methods and criteria:

Intermediate exams or a final exam.

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

Grading:

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

Person responsible:

Marko Huhtanen

Working life cooperation:

-

Other information:

-

802365A: Introduction to Mathematical Solfware, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Mikko Orispää

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish (also English if needed)

Timing:

2.-3. year

Learning outcomes:

Upon completion of the course, the student knows the basics of the use of the most common mathematical software, is able to use mathematical software in solving mathematical tasks and problems, and is able to independently deepen her knowledge of different mathematical software as necessary.

Contents:

During the course, the student learns the basics of some of commonly used mathematical software which include Matlab and Python (Numpy/Scipy).

Mode of delivery:

The course is arranged in a computer class as a series of lectures and rehearsals. On the lectures, the students have the possibility to use and try the mathematical software during the lectures. In the rehearsals, different given problems and tasks are solved together.

Learning activities and teaching methods:

Lectures 22 h / Rehearsals 22 h / Self-study 60 h. The self-study contains the independent learning of the software and also the preparation of the final assignments.

Target group:

Anybody interested in mathematical software.

Prerequisites and co-requisites:

The required prerequisite is the completion of following courses (or corresponding knowledge of the subject):
- 802120P Matrix calculus
- 802320A Linear algebra

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 required and recommended reading consists mainly on free material (manuals/tutorial) found in the internet. More information will be given at the beginning of the course.

Assessment methods and criteria:

The course is assessed by final assignments. The student who wish to complete the course at A-level will make two separate assignments of given topics using (at least) two different mathematical software. Those who wish to complete the course in S-level will need to discuss with the lecturer about the extra work needed to pass. For example, it could be possible to do assignments of wider topics, making an assignment (s) with a software not covered in the course, or making an assignment that requires particular skills and knowledge.

Grading:

The course utilizes grading scale pass / fail.

Person responsible:

Mikko Orispää

Working life cooperation:

-

Other information:

-

802361A: Numerical Computation, 5 op

Voimassaolo: 01.06.2015 -

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

ECTS Credits:
5 ECTS cr
Language of instruction:
Finnish
Timing:
2nd or 3rd year
Learning outcomes:
On successful completion of this course, the student will be able to solve basic numerical problems using Fortran programming and to exploit the Unix computers and software libraries for solving numerical problems.
Contents:
On the course students train programming of numerical algorithms using Fortran 95 programming language in Unix (Linux) operating system. On the course, DISLIN subroutine library is used for the visualization of the numerical calculation results.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 28 h + exercises+practical work. Self-study has important role.
Target group:
Major and minor students
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 required and recommended reading consists mainly on free material (manuals/tutorial) found in the internet. More information will be given at the beginning of the course.
Assessment methods and criteria:
The assessment of the course is based on the assesment of practical work at the end of course.
Grading:
The course utilizes verbal grading scale pass / fail.
Person responsible:
Erkki Laitinen
Working life cooperation:
No
Other information:
-

031025A: Introduction to Optimization, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Ruotsalainen Keijo
Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English

Timing:

The course is held in the autumn, during period 1.

Learning outcomes:

After completing the course the student is able to solve optimization convex optimization problems with the basic optimization algorithms. The student is also able to form the necessary and sufficient conditions for the optimality.

Contents:

Linear optimization, Simplex-algorithm, nonlinear optimization, KKT-conditions, duality, conjugate gradient method, penalty and barrier function methods.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 14 h / Self-study 93 h.

Target group:

Students in Wireless Communication Engineering

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses Calculus I and II, Matrix algebra

Recommended optional programme components:

-

Recommended or required reading:

P. Ciarlet; Introduction to numerical linear algebra and optimization, M. Bazaraa, H. Sherali, C.M. Shetty; Nonlinear programming

Assessment methods and criteria:

The course can be completed by a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Keijo Ruotsalainen

Working life cooperation:

-

Other information:

-

031080A: Signal Analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kotila, Vesa Iisakki

Opintokohteen kielet: Finnish

Leikkaavuudet:

031050A	Signal Analysis	4.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish.
The course can be completed in English by a final exam or a retake exam.

Timing:

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

Learning outcomes:

Upon completion of the course, the student:
-is able to calculate the energy, the power, the convolution and the frequency spectrum of discrete and analog, periodic and non-periodic deterministic signals
-is able to calculate the spectrum of a sampled signal
-is able to calculate the Hilbert transform and the complex envelope of a signal
-is able to study the stationarity, the mutual dependence and the frequency content of random signals by means of the auto- and cross-correlation functions, and the power- and cross-power spectral densities
-is able to study the effect of an LTI system on a signal

Contents:

Signals, classification, frequency. Fourier analysis, analog and digital signal, fast Fourier transform. LTI system. Hilbert transform. AM- FM- and PM-modulation. Random variable. Covariance matrix. Random signal. Stationarity, autocorrelation. Power spectral density. Random signal in LTI system. Signal estimation.

Mode of delivery:

Blended teaching.

Learning activities and teaching methods:

Lectures 28 h / Exercises 14 h / Self-study privately or in a group 93 h. The independent work includes individual STACK-assignments as online work.

Target group:

-

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses 031078P Matrix Algebra, 031021P Probability and Mathematical Statistics and 031077P Complex Analysis.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes. Additional reading: Proakis, J.G., Manolakis, D.K.: Introduction to Digital Signal Pro-cessing. Shanmugan, K.S., Breipohl, A.M.: Random Signals, Detection, Estimation and Data Analysis.

Assessment methods and criteria:

The course is completed with a final exam or a retake exam. In addition to the final exam, STACK-assignments given during the course are part of the assessment. The assessment of the course is based on the learning outcomes of the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Vesa Kotila

Working life cooperation:

-

Other information:

-

802322A: Basics in mathematical modelling, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Erkki Laitinen
Opintokohteen kielet: Finnish

805305A: Introduction to Regression and Analysis of Variance, 5 op

Voimassaolo: 01.08.2017 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Jari Päkkilä
Opintokohteen kielet: Finnish
Leikkaavuudet:

806112P	Basic Methods of Data Analysis	10.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Autumn term, 2nd period. Recommended to be taken already in the 2nd year for those aiming at specialization in data science.

Learning outcomes:

Upon successful completion of the course the student can describe the basic concepts and main principles of regression and variance analysis with one or several explanatory variables, and is able to apply these methods in analysing a small scale data set as well as to apply the necessary computational tools.

Contents:

Linear regression and analysis of variance models for continuous outcomes; Formulation of the model and interpretation of parameters; Fitting the models, estimation of parameters, and prediction with the method of least squares: Basic methods of model criticism and diagnostics; Use of R environment in modelling.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Lectures 28 h, practicals 14 h, and independent work. The practicals include both homework and computer class exercises.

Target group:

Students of mathematical sciences and other interested. The course belongs to core studies for those with an orientation to data science. It is a prerequisite for those doing M.Sc. in computational mathematics and data science having data science as the specialization profile. The course is useful also for students of the Faculty of Science and the Oulu Business School as well as those of computer science or computational engineering, who have statistics as a minor subject.

Prerequisites and co-requisites:

806113P Introduction to Statistics or 806119P A Second Course in Statistics or corresponding abilities acquired otherwise.

Recommended optional programme components:

Is assumed as preliminary knowledge in the course 805306A Introduction to Multivariate Methods.

Recommended or required reading:

Lecture notes and material distributed during lectures and practicals. Recommended reading:James, G., Witten, D., Hastie, T., Tibshirani, R. (2013). An Introduction to Statistical Learning with Applications in R}. Springer, New York; chapters 1-3. -- freely downloadable from http://www-bcf.usc.edu/~gareth/ISL/

Assessment methods and criteria:

Practical exercises and final exam. Passing the course requires adequate participation in practical sessions and sufficient homework activity.

Grading:

Numeric assessment scale from 1 to 5

Person responsible:

Jari Päkkilä

Working life cooperation:

No

805306A: Introduction to Multivariate methods, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Päkkilä

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Autumn term, 2nd period. Recommended to be taken already in the 2nd year for those aiming at specialization in data science.

Learning outcomes:

Upon successful completion of the course the student can describe the basic concepts and main principles of the logistic regression, principal components analysis, discriminant analysis, classification analysis and clustering analysis, and is able to apply these methods in analysing a small scale data set as well as to apply the necessary computational tools.

Contents:

Logistic regression, principal components analysis, discriminant analysis, classification analysis and clustering analysis; Use of R environment in modelling; Course is an application oriented.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Lectures 28 h, practicals 14 h, and independent work. The practicals include both homework and computer class exercises.

Target group:

Students of mathematical sciences and other interested. The course belongs to core studies for those with an orientation to data science. It is a prerequisite for those doing M.Sc. in computational mathematics and data science having data science as the specialization profile. The course is useful also for students of the Faculty of Science and the Oulu Business School as well as those of computer science or computational engineering, who have statistics as a minor subject.

Prerequisites and co-requisites:

806113P Introduction to Statistics or 806119P A Second Course in Statistics and 805305A Introduction to Regression and Analysis of Variance or corresponding abilities acquired otherwise.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and material distributed during lectures and practicals. Recommended reading:James, G., Witten, D., Hastie, T., Tibshirani, R. (2013). An Introduction to Statistical Learning with Applications in R}. Springer, New York; chapters 4 and 10. -- freely downloadable from http://www-bcf.usc.edu/~gareth/ISL/.

Assessment methods and criteria:

Practical exercises and final exam. Passing the course requires adequate participation in practical sessions and sufficient homework activity.

Grading:

Numeric assessment scale from 1 to 5, Fail

Person responsible:

Jari Päkkilä

Working life cooperation:

No

800324A: Practical training, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Myllylä

Opintokohteen kielet: Finnish

Leikkaavuudet:

802327A	Tutoring	4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Person responsible:

Kari Myllylä

800321A: Series and Approximation, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits / 133 hours of work
Language of instruction:
Finnish
Timing:
2nd year
Learning outcomes:
Upon completing the course the student is
- able to manipulate series and investigate their convergence

- able to explain the difference between uniform and pointwise convergence
- able to study the uniform and pointwise convergence of function sequences and series
- able to use power series in approximation

Contents:

The course concerns both number series and function series. The central topics are convergence tests, pointwise and uniform convergence, power series and the Taylor series. The course gives also an introduction to approximation of functions by polynomials for example.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics majors

Prerequisites and co-requisites:

Continuity and derivative 800317A and Integral 800318A

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Mahmoud Filali

Working life cooperation:

no

A326602: Statistics, intermediate studies, 35 op

Opiskelumuoto: Intermediate Studies

Laji: Study module

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory Studies

805305A: Introduction to Regression and Analysis of Variance, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Päkkilä

Opintokohteen kielet: Finnish

Leikkaavuudet:

806112P	Basic Methods of Data Analysis	10.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Autumn term, 2nd period. Recommended to be taken already in the 2nd year for those aiming at specialization in data science.

Learning outcomes:

Upon successful completion of the course the student can describe the basic concepts and main principles of regression and variance analysis with one or several explanatory variables, and is able to apply these methods in analysing a small scale data set as well as to apply the necessary computational tools.

Contents:

Linear regression and analysis of variance models for continuous outcomes; Formulation of the model and interpretation of parameters; Fitting the models, estimation of parameters, and prediction with the method of least squares: Basic methods of model criticism and diagnostics; Use of R environment in modelling.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Lectures 28 h, practicals 14 h, and independent work. The practicals include both homework and computer class exercises.

Target group:

Students of mathematical sciences and other interested. The course belongs to core studies for those with an orientation to data science. It is a prerequisite for those doing M.Sc. in computational mathematics and data science having data science as the specialization profile. The course is useful also for students of the Faculty of Science and the Oulu Business School as well as those of computer science or computational engineering, who have statistics as a minor subject.

Prerequisites and co-requisites:

806113P Introduction to Statistics or 806119P A Second Course in Statistics or corresponding abilities acquired otherwise.

Recommended optional programme components:

Is assumed as preliminary knowledge in the course 805306A Introduction to Multivariate Methods.

Recommended or required reading:

Lecture notes and material distributed during lectures and practicals. Recommended reading:James, G., Witten, D., Hastie, T., Tibshirani, R. (2013). An Introduction to Statistical Learning with Applications in R}. Springer, New York; chapters 1-3. -- freely downloadable from http://www-bcf.usc.edu/~gareth/ISL/

Assessment methods and criteria:

Practical exercises and final exam. Passing the course requires adequate participation in practical sessions and sufficient homework activity.

Grading:

Numeric assessment scale from 1 to 5

Person responsible:

Jari Päkkilä

Working life cooperation:

No

805306A: Introduction to Multivariate methods, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Päkkilä

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Autumn term, 2nd period. Recommended to be taken already in the 2nd year for those aiming at specialization in data science.

Learning outcomes:

Upon successful completion of the course the student can describe the basic concepts and main principles of the logistic regression, principal components analysis, discriminant analysis, classification analysis and clustering analysis, and is able to apply these methods in analysing a small scale data set as well as to apply the necessary computational tools.

Contents:

Logistic regression, principal components analysis, discriminant analysis, classification analysis and clustering analysis; Use of R environment in modelling; Course is an application oriented.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Lectures 28 h, practicals 14 h, and independent work. The practicals include both homework and computer class exercises.

Target group:

Students of mathematical sciences and other interested. The course belongs to core studies for those with an orientation to data science. It is a prerequisite for those doing M.Sc. in computational mathematics and data science having data science as the specialization profile. The course is useful also for students of the Faculty of Science and the Oulu Business School as well as those of computer science or computational engineering, who have statistics as a minor subject.

Prerequisites and co-requisites:

806113P Introduction to Statistics or 806119P A Second Course in Statistics and 805305A Introduction to Regression and Analysis of Variance or corresponding abilities acquired otherwise.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and material distributed during lectures and practicals. Recommended reading:James, G., Witten, D., Hastie, T., Tibshirani, R. (2013). An Introduction to Statistical Learning with Applications in R}. Springer, New York; chapters 4 and 10. -- freely downloadable from http://www-bcf.usc.edu/~gareth/ISL/.

Assessment methods and criteria:

Practical exercises and final exam. Passing the course requires adequate participation in practical sessions and sufficient homework activity.

Grading:

Numeric assessment scale from 1 to 5, Fail

Person responsible:

Jari Päkkilä

Working life cooperation:

No

Choose from the following 15 ECTS cr

805349A: Likelihood and Bayesian Inference, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Läärä Esa

Opintokohteen kielet: Finnish

Leikkaavuudet:

805310A Statistical Inference I 10.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd or 3rd year of B.Sc. studies, spring term

Learning outcomes:

After successful completion of the course the student can describe the basic principles of likelihood inference, derive likelihood functions of models with few parameters, compute likelihood quantities basen on them, and interpret results such obtained.

Contents:

Statistical model and observation data; likelihood function, log-likelihood, score, information; maximum likelihood estimation, relative likelihood, likelihood interval and likelihood region, profile likelihood; normal approximation of log-likelihood; use of R environment in inferential problems.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures (28 h), practicals and computer classes (14 h), and independent work

Target group:

Students having statistics as the major or a minor subject

Prerequisites and co-requisites:

Introduction to Probability Theory I, Basic Methods of Data Analysis

Recommended optional programme components:

Is needed in nearly all intermediate and advanced courses in statistics

Recommended or required reading:

Migon, H.S., Gamerman, D., Louzada, F. Statistical Inference: An Integrated Approach, Second Edition. Chapman and Hall/CRC, 2014; Pawitan, Y: In All Likelihood: Statistical Modelling and Inference Using Likelihood, Oxford, 2001; Sprott, D. A.: Statistical Inference in Science, Springer, 2000; Kalbfleisch, J.G.: Probability and Statistical Inference, volume 2: Statistical Inference, Second Edition, Springer, 1985.

Assessment methods and criteria:

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

Grading:

Fail, 1-5

Person responsible:

Esa Läärä

Working life cooperation:

No

Other information:

-

805350A: Estimation and Test Theory, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Läärä Esa

Opintokohteen kielet: Finnish

Leikkaavuudet:

805310A	Statistical Inference I	10.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd or 3rd year during B.Sc. studies

Learning outcomes:

After successful completion of the course the student can describe the basic principles of frequentist and bayesian statistical inference, compute point and interval estimates, test statistics and P-values based on likelihood function of models with few parameters, and interpret results thus obtained.

Contents:

Statistical model and observational data; construction and properties of point estimators and confidence intervals; likelihood ratio, score and Wald test statistics and their asymptotic sampling distribution; jackknife and bootstrap methods; elements of bayesian inference; use of R environment in inferential problems.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures (28 h), practicals and computer classes (14 h), and independent work

Target group:

Students having statistics as the major or a minor subject

Prerequisites and co-requisites:

Likelihood inference, Introduction to probability theory I, Basic Methods of Data Analysis

Recommended optional programme components:

Needed in nearly all intermediate and advanced courses of statistics

Recommended or required reading:

Migon, H.S., Gamerman, D., Louzada, F. Statistical Inference: An Integrated Approach, Second Edition. Chapman & Hall/CRC, 2014; Pawitan, Y: In All Likelihood: Statistical Modelling and Inference Using Likelihood, Oxford, 2001; Sprott, D. A.: Statistical Inference in Science, Springer, 2000; Kalbfleisch, J.G.: Probability and Statistical Inference, volume 2: Statistical Inference, Second Edition, Springer, 1985.

Assessment methods and criteria:

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

Grading:

Fail, 1-5

Person responsible:

Esa Läärä

Working life cooperation:

No

Other information:

-

805351A: Linear Regression, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Läärä Esa

Opintokohteen kielet: Finnish

Leikkaavuudet:

806359A	Regression modelling	10.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd or 3rd year during B.Sc. studies

Learning outcomes:

After successful completion of the course the student can describe basic concepts and assumptions in linear models for continuous outcome variables as well as main principles of regression modelling, and can also apply these methods in analysis of experimental and non-experimental observation data.

Contents:

Linear regression models for a continuous outcome variable; formulation of the model, selection of variables and interpretation of parameters; fitting the models, estimation of parameters and prediction using method of least squares; model criticism and diagnostics; use of R environment and SAS software in modelling.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures (28 h), practicals and computer classes (14 h) and independent work.

Target group:

Students having statistics as the major or a minor subject.

Prerequisites and co-requisites:

Basic Methods of Data Analysis; Core courses in the B.Sc curriculum of mathematical sciences.

Recommended optional programme components:

Prerequisite to the course Generalized Linear Models

Recommended or required reading:

Weisberg, S. (2014). Applied Linear Regression, fourth edition, Hoboken NJ: John Wiley.

Assessment methods and criteria:

Active participation in practicals and final exam. Read more about assessment criteria at the University of Oulu webpage

Grading:

Fail, 1-5

Person responsible:

Esa Läärä

Working life cooperation:

No

Other information:

-

805353A: Statistical Software, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

805340A	Statistical Software	4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

3. year studies. Fall semester. Timing varies.

Learning outcomes:

After successful completion of the course the student can use independently major statistical software needed in data analysis.

Contents:

The course covers R, SAS and IBM SPSS, and their most important tools for data management, statistical computation, graphics and programming will be introduced and proficiency for their fluent use is acquired.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

42 h lectures, exercises and tutoring. 88 h learning tasks and self-study.

Target group:

Major and minor students

Prerequisites and co-requisites:

806112P Basic methods of data-analysis

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Home works and/or exam

Grading:

Numerical grading 1-5 (or fail)

Person responsible:

Hanna Heikkinen

Working life cooperation:

No

801396A: Introduction to Probability Theory II, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Tuominen, P., , 1993

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

On successful completion of this course, the student will be able to:
- work with random variables both in theory and applications
- explain the central results in probability theory such that Law of large numbers and the Central limit theorem
- determine generating functions of random variables and apply them for example to calculate moments
- apply various stocastic models
- derive the basic results associated with the new concepts introduced
- use two-dimensional distributions
- work with conditional distributions

Contents:

The central topics are the moments of a distribution, the probability generating function, the Law of Large Numbers, the Central Limit Theorem, two-dimensional distibutions as well as conditional distributions.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

Mathematics major and minor students. Recommended for students aiming for the profile of computational mathematics and data science.

Prerequisites and co-requisites:

801195P Introduction to probability I, 800328A Calculus of several variables (or Vector Calculus)

Recommended or required reading:

P. Tuominen: Todennäköisyyslaskenta I, Limes 2002 and other books on probability.

Assessment methods and criteria:

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

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

-

H325104: General Physics, 25 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Basic Studies

Laji: Study module

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Basic and intermediate studies in general physics

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

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Seppo Alanko

Opintokohteen kielet: Finnish

Leikkaavuudet:

761116P	Radiation physics, biology and safety	3.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

Spring

Learning outcomes:

The student knows the origin of ionising radiation and the principles of its interaction with matter. He/she can explain the essential effects of ionising radiation on human tissue and remembers the principles of radiation safety and laws and regulations (in Finland) concerning this.

Contents:

The topics of the course include the origin of ionizing radiation e.g. as a result of radioactive decay and in nuclear reactions, the interaction between radiation and matter, the detection and measurements of radiation, physical quantities and measuring units related to radiation, radiation in the environment, and examples of utilizing radiation. The biologic effects of radiation and the legislation on radiation safety are also discussed.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, 7 problem solving exercises (14 h) and 2 laboratory exercises (8 h). Self-study 90 h.

Target group:

For the students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

740368A Radiation and safety

Recommended or required reading:

Lecture material (in Finnish), Laws and regulations concerning radiation safety

Assessment methods and criteria:

Final examination

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

761315A: Laboratory Exercises in Physics 3, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761615S	Laboratory exercises in physics 3	5.0 op
766308A	Laboratory exercises in physics 3	2.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

2. spring - 3. spring

Learning outcomes:

After the course students are capable for planning, performing, data handling and results reporting on physical measurements. Students are able to evaluate the validity of observations and to estimate the errorlimits and the possible sources of errors.

Contents:

The course is a follow up for the Laboratory exercises in physics 1 and 2 courses where the methods learned will be used to familiarize oneself with the wide range of physics phenomena in laboratory circumstances. The laboratory exercises may be chosen from a variety of works from at the physics exercise laboratory or from the works given at the research group laboratories (1/2 op / exercise). Exercises already included in the course "Laboratory exercises in physics 2" may not be selected. Possibility is also to choose special research related exercises (1op / exercise, max. 1 exercise/research group) where students are included in the daily topics of research supervised by the researchers at research groups of the department. Research related exercises are to be agreed with a supervising researcher and the correspondent of the course.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Laboratory exercises in small groups

Target group:

No specific target qroup

Prerequisites and co-requisites:

Courses 761115P Laboratory exercises in physics 1 and 761120P Laboratory exercises in physics 2.

Recommended optional programme components:

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

Recommended or required reading:

Laboratory exercise instructions

Assessment methods and criteria:

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

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

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 cr

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).

Course material availability can be checked here.

Assessment methods and criteria:

Two written intermediate examinations or one final examination.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Matti Alatalo

Working life cooperation:

No work placement period

Other information:

Course website

At least one of the courses listed below must be chosen

766355A: Basics of space physics, 5 op

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

766345A	Basics of space physics	6.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

In most years

Learning outcomes:

The student identifies and is capable of naming the basic concepts and processes of solar activity, solar wind, magnetosphere and ionosphere. He can explain the reasons for different phenomena in space physics and apply the theory to simple problems.

Contents:

This lecture course gives the basic view on the near space around the Earth. The solar wind is a continuous plasma flow emerging from the Sun. It compresses the magnetic field of the Earth into a region with a cometary shape, called the magnetosphere. The solar radiation and charged particles precipitating from the magnetosphere ionise the upper part of the atmosphere thus creating the ionosphere. The lecture course contains the physics of the Sun, the solar wind, the magnetosphere and the ionosphere, as well as the effects of the the Sun and the solar wind on the magnetosphere and the ionosphere. There are plasma bursts in the Sun causing disturbances in the surrounding space. These phenomena create the varying space weather. The space weather may affect e.g. telecommunication links, electrical power networks and operation of satellites. It may also cause health hazards for astronauts. Since the near space contains ionised gas in magnetic field, plasma physics is used in explaining the phenomena.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 36 h, exercises 18 h, self-study 100 h

Target group:

Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

K. Mursula: Avaruusfysiikan perusteet (Basics of Space physics; in Finnish; distributed in the web page of the Department). Supporting material for instance: H. Koskinen: Johdatus plasmafysiikkaan ja sen avaruussovellutuksiin (Limes ry); A. Brekke: Physics of the upper polar atmosphere (Wiley & Sons). Course material availability can be checked here.

Assessment methods and criteria:

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

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Kalevi Mursula

Working life cooperation:

No work placement period

Other information:

https://wiki.oulu.fi/display/766355A
Passing the course helps in getting drafted in various project works of the space physics group.

761359A: Spectroscopic methods, 5 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766359A	Spectroscopic methods	7.0 op

ECTS Credits:

5 credits

Language of instruction:

Finnish

Timing:

Every second year (odd year), spring term

Learning outcomes:

After completion, student knows the principles of various spectroscopic methods and what kind of physical /biophysical phenomena can be studied and what kind of information can be obtained with these methods.

Contents:

Basic principles of infrared, mass and NMR spectroscopy and X-ray analytics are introduced

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 46 h, exercises 24 h, self-study 63 h

Target group:

Compulsory for students in biophysics. Recommended for students directing at some of the lines in atomic, molecular and materials physics. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

Partly distributed through net, and partly as paper copies during the course.

Assessment methods and criteria:

Two written examinations or one final examination.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Ville-Veikko Telkki

Working life cooperation:

No work placement period

Other information:

https://wiki.oulu.fi/display/761359A/

A325704: Astronomy Minor, 25 - 40 op

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

Ei opintojaksokuvauksia.

Compulsory

765114P: Fundamentals of astronomy I, 5 op

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

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

1st Spring, Period 3

Learning outcomes:

Student can describe the basic physical processes behind astronomical phenomena and can solve mathematical problems related to the course.

Contents:

A more detailed basic astronomy course (part one), that contains e.g. the fundamentals of electromagnetic radiation, astronomical instruments, celestial mechanics and the physical environment of the planets.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 26 h, exercises 12 h, self-study 95 h

Target group:

First or second year students in e.g. astronomy, physics, geophysics or geology. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

H. Karttunen, K.-J. Donner, P. Kröger, H. Oja and M. Poutanen (eds.): Fundamental astronomy, Springer, 2007, chapters 1-7, Carroll, B.W., Ostlie, D.A., An Introduction to Modern Astrophysics, Pearson 2007. (4. edition or newer.)
Course material availability can be checked here.

Assessment methods and criteria:

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

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Pertti Rautiainen

Working life cooperation:

No work placement period

Other information:

https://noppa.oulu.fi/noppa/kurssi/765114p/etusivu

765115P: Fundamentals of astronomy II, 5 op

Voimassaolo: 01.03.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS cr

Timing:

1st Spring, Period 4

Learning outcomes:

Student can describe the basic physical processes behind astronomical phenomena and can solve mathematical problems related to the course.

Contents:

A more detailed basic astronomy course (part two), that contains e.g. stellar structure and evolution, the structure of the Milky Way and principles of cosmology.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 24 h, exercises 12 h, self-study 97 h

Target group:

First or second year students in e.g. astronomy, physics, geophysics or geology. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

H. Karttunen, K.-J. Donner, P. Kröger, H. Oja and M. Poutanen (eds.): Fundamental astronomy, Springer, 2007, chapters 8-20, Carroll, B.W., Ostlie, D.A., An Introduction to Modern Astrophysics, Pearson 2007. Course material availability can be checked here.

Assessment methods and criteria:

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

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Pertti Rautiainen

Working life cooperation:

No work placement period

Other information:

https://noppa.oulu.fi/noppa/kurssi/765115p/etusivu

765309A: Galaxies, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Sébastien Comerón Limbourg

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, Autumn 2018, 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 Most of the large galaxies are either spiral galaxies or elliptical galaxies. We study the structure an kinematics in both these galaxy types, including the theories of spiral formation. Especial emphasis on our own galaxy, the Milky Way. We also examine the structure in larger scale: groups and clust 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. Course material availability can be checked here.

Assessment methods and criteria:

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

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Sébastien Comerón

Working life cooperation:

No work placement period

Other information:

The course is lectured next time autumn 2018, periods 1-2

765384A: Physics of the solar system I, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jürgen Schmidt

Opintokohteen kielet: English

Leikkaavuudet:

767304A	Solar System Physics	5.0 op
767604S	Solar System Physics	5.0 op
765684S	Physics of the Solar System I	5.0 op
765359A	Physics of the Solar System I	7.0 op
765659S	Physics of the Solar System I	7.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

Not lectured every year, Period 2

Learning outcomes:

The student learns basic concepts and methods of solar system science and their application to current problems in the field.

Contents:

The course describes and discusses observations of planets and their satellite systems, asteroids and meteoroids, comets and dwarf planets. Fundamental modern research methods and their application to up to date problems and phenomena in the solar system are introduced. Topics of planetary formation as well as extrasolar planets will be briefly discussed.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

26 hours lecture, 26 hours exercises, 135 hours self-study

Target group:

Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu. The course can be taken at an intermediate and at an advanced level.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

`Planetary Sciences', I. de Pater, J.J. Lissauer (Cambridge University Press), `Physics of the Solar System', B. Bertotti, P. Farinella, D. Vokrouhlicky (Kluwer Academic Publishers). Course material availability can be checked here.

Assessment methods and criteria:

One written examination and points from worked exercise problems Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 - 5, where 0 = fail

Person responsible:

Jürgen Schmidt

Working life cooperation:

No work placement period

Other information:

https://noppa.oulu.fi/noppa/kurssi/765359a/etusivu https://noppa.oulu.fi/noppa/kurssi/765659s/etusivu

Choose another: Major Students of Astronomy take 765307A Research project of astronomy and Minor Students of Astronomy take 765308A History of astronomy.

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:

2 nd Spring

Learning outcomes:

Student is able to use computer in processing and visualizing astronomical data.

Contents:

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 Lanz, Xiaodong Liu

765308A: History of astronomy, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay765308A History of astronomy (OPEN UNI) 5.0 op

765107P Astronomical world view 5.0 op

765107P-02 Astronomical world view (part 2): History of astronomy 0.0 op
765106P History of astronomy 3.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

1st - 3rd year

Learning outcomes:

Student has a general concept of the history of astronomy and the development of physical world view.

Contents:

Astronomy is the oldest exact science. On the other hand, it uses space telescopes and computer simulations. The stellar sky has been observed already in prehistory. Explaining planetary motions celestial phenomena has been in central role in the development of physical theories, and the reve the cosmic scale has deeply shaped our world view. The history of astronomy has an important rol discussions on the history and philosophy of science. Art and popular culture have also been inspi astronomical phenomena.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 32 h, self-study 107 h

Target group:

All students

Prerequisites and co-requisites:

None

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

One written exam.

Grading:

Numerical grading scale 0-5, where 0=fail

Person responsible:

Pertti Rautiainen

Working life cooperation:

No work placement period

Electives

765304A: Celestial mechanics I, 5 - 8 op

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

ECTS Credits:

5-8 credits

Language of instruction:

English (or Finnish)

Timing:

Not lectured every year

Learning outcomes:

The student is able to describe the basic principles of orbital dynamics, and to apply them to solution of simple perturbation problems via numerical integration methods.

Contents:

The course deals with orbital motion of planets, containing several IDL-exercises. The topics include calculation of position from orbital elements, determination of elements from observations. Hyperbolic orbits. Applications of vectorial perturbation theory. General N-body problem.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises and computer demonstrations 24 h, two independent home assessments, self-study 81 h

Target group:

Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

IDL manual + exercise material.
Fitzpatrick, R.: An Introduction to Celestial Mechanics.
Course material availability can be checked here.

Assessment methods and criteria:

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

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Heikki Salo

Working life cooperation:

No work placement period

Other information:

https://wiki.oulu.fi/display/765304A/

765386A: Interstellar Matter, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Sébastien Comerón Limbourg

Opintokohteen kielet: English, Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

2nd, 3rd, or 4th year of study (intermediate course), master (advanced course).

Learning outcomes:

In this course we will study some of the most important processes that take place in the interstellar medium.

Contents:

The interstellar medium is a vacuum that is more perfect than any vacuum that could be created on Earth. And yet, it is a complex multiphase medium. The interstellar medium is the home of many astronomical phænomena. For example, this almost vacuum space integrated along long lines of sight is sufficient to cause the absorption of the light from distant objects. Parts of the interstellar medium are ionized and the galactic magnetic field is frozen within it. When the gas is perturbed by supernova explosions the magnetic field accelerates charged particles which are in turn detected on Earth as cosmic rays. Hidden in the core of the densest molecular gas clouds, new stars are being born.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

32 hours of lectures and exercises, 101 hours of self-study.

Target group:

Astronomy and physics students

Prerequisites and co-requisites:

Basic knowledge in physics and mathematics

Recommended optional programme components:

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

Recommended or required reading:

`Physics of the Interstellar and Intergalactic Medium', B. Draine, Princeton University PressThe Physics of the Interstellar Medium, Second Edition '

Assessment methods and criteria:

Final examination (intermediate and advanced). For the advanced course students, 20% of the mark will come from an extra assignment. Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 - 5, where 0 = fail

Person responsible:

Sébastien Comerón

Working life cooperation:

No work placement period

765358A: Cosmology, 5 op

Voimassaolo: 29.10.2013 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Leikkaavuudet:

765658S	Cosmology	5.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

English

Timing:

2nd, 3rd, or 4th year of study (intermediate course), master (advanced course).

Learning outcomes:

The student will learn to derive the basic properties of an isotropic and homogeneous Universe from the Friedmann equations. The consequences of these equations will be compared to the observed Universe in order to study the properties of the different components of the Universe (baryonic matter, non-baryonic dark matter, dark energy...)

Contents:

The course will introduce the Friedmann-Lemaître-Robertson-Metric and the Friedmann equations and will introduce some predictions. Then, observed properties of the Universe will be presented. Fitting the parameters of the theoretical model with observed data leads to the Standard Model which is the present-day paradigm to explain the Universe.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

32 hours of lectures and exercises, 101 hours of self-study.

Target group:

Astronomy and physics students

Prerequisites and co-requisites:

Basic knowledge in physics and mathematics

Recommended optional programme components:

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

Recommended or required reading:

Introduction to Cosmology by Barbara Ryden. Addusson-Wesley, 1st edition, 2002. The lecturer will provide some notes with essential points.
Course material availability can be checked here.

Assessment methods and criteria:

Final examination (intermediate and advanced). For the advanced course students, 20% of the mark will come from an extra assignment.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grades from 0 to 5, where 0=fail

Person responsible:

Sébastien Comerón

Working life cooperation:

No work placement period

765301A: Introduction to Nonlinear Dynamics, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jürgen Schmidt

Opintokohteen kielet: English, Finnish

Leikkaavuudet:

765601S	Introduction to Nonlinear Dynamics	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

English

Timing:

Not lectured every year

Learning outcomes:

After the course the student is able to apply basic concepts and methods of Nonlinear Dynamics to modeling approaches in physics, astronomy, biology, and chemistry.

Contents:

The course introduces the methods of the Nonlinear Dynamics approach to the analysis of dynamical systems, such as the concepts of fixed points, stability, bifurcations, as well as synchronization and chaos. Applications to various scientific problems are outlined as worked out examples and in the exercises.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 24 h and exercises (10-12 times), self-study 128 h

Target group:

Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu. The course can be taken at an intermediate and at an advanced level.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

`Nonlinear Dynamics And Chaos' by Steven Strogatz

Assessment methods and criteria:

One written examination and points from worked exercise problems Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 - 5, where 0 = fail

Person responsible:

Jürgen Schmidt

Working life cooperation:

No work placement period

Other information:

https://noppa.oulu.fi/noppa/kurssi/765354a/etusivu

767303A: Observational Astronomy I, 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: English

ECTS Credits:

5 ECTS credits /133 hours of work

Language of instruction:

English

Timing:

Not lectured every year

Learning outcomes:

After the finished course the student is expected to understand the role of observations in the formation of astronomical knowledge and to know the main observing techniques and instruments.

Contents:

The course gives an introduction to the modern ground- and space-based telescopes and detec
observational methods. The primary detector in the visual wavelengths, the CCD camera, and b
image reduction techniques are introduced. Observational methods such as direct imaging, astr
photometry, spectroscopy, polarimetry and interferometry are described. Finally, the instruments
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 - http://observatory.ou.edu/wrccd22oct06.pdf Birney, D. S., Gonzalez, G. & Oesper, D.: Observational Astronomy (2nd Edition - 2006) Course material availability can be checked here

Assessment methods and criteria:

One written examination Lue lisää opintosuoritusten arvostelusta yliopiston verkkosivulta.

Grading:

Numerical grading scale 0 – 5, where 0 = fai

Person responsible:

Vitaly Neustroev

Working life cooperation:

No work placement period.

767302A: Physics of the solar system II, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jürgen Schmidt

Opintokohteen kielet: English, Finnish

Leikkaavuudet:

767602S	Physics of the solar system II	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

English

Timing:

Not lectured every year

Learning outcomes:

The student learns concepts and methods of solar system science and their application to current problems in the field.

Contents:

In extension of Physics of the Solar System I, this course addresses in greater depth special topics like planeta magnetospheres, tidal interaction, planetary interiors, and the origin and evolution of the Solar System.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

26 hours lecture, 26 hours exercises, 135 hours self-study

Target group:

Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu. The course can be taken at an intermediate and at an advanced level.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

`Planetary Sciences', I. de Pater, J.J. Lissauer (Cambridge University Press), `Physics of the Solar System', B. Bertotti, P. Farinella, D. Vokrouhlicky (Kluwer Academic Publishers), `Solar System Dynamics', C.D. Murray, S.F. Dermott (Cambridge University Press) Course material availability can be checked here.

Assessment methods and criteria:

One written examination and points from worked exercise problems Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where
0 = fail

Person responsible:

Jürgen Schmidt

Working life cooperation:

Nowork placement period

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

Other information:

https://wiki.oulu.fi/display/765368A/

767300A: Observational astronomy II, 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: English, Finnish

Leikkaavuudet:

767600S	Observational astronomy II	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Learning outcomes:

This is a follow up course to 767303A/767603S, designed to give additional practice utilizing the skills learned in Part I. Students must have taken Part I of the series prior to enrolling in this class.

Contents:

A more detailed and practical course (part two) which covers the theory and practice of obtaining meaningful as data. Topics covered include different detector/telescope configurations, the atmosphere and its effects on obs observational experiments, calibrations and data reductions, both on a theoretical level and experimentally with data. It also introduces some analysis tools and statistical techniques (signal detection, signal-to-noise estimate fitting, and goodness-of-fit estimation, etc.) that are commonly used in astronomical research.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 12 h, exercises 24 h, self-study 97 h

Target group:

Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

Observational astronomy Part I (767303A /767603S)

Recommended optional programme components:

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

Recommended or required reading:

Recommended reading: Kitchin, C.R.: Astrophysical Techniques. Romanishin, W.: An Introduction to Astronomical Photometry Using CCDs - http://observatory.ou.edu/wrccd22oct06.pdf Birney, D. S., Gonzalez, G. & Oesper, D.: Observational Astronomy (2nd Edition - 2006) Course material availability can be checked here

Assessment methods and criteria:

One written examination Lue lisää opintosuoritusten arvostelusta yliopiston verkkosivulta.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Vitaly Neustroev

Working life cooperation:

No work placement period.

A325304: Theoretical Physics Minor, 25 op

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

Ei opintojaksokuvauksia.

Intermediate studies in theoretical physics

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 cr

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).
Course material availability can be checked here.

Assessment methods and criteria:

Two written intermediate examinations or one final examination.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Matti Alatalo

Working life cooperation:

No work placement period

Other information:

Course website

763313A: Quantum mechanics II, 10 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763613S	Quantum mechanics II	10.0 op

ECTS Credits:

10 ECTS cr

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). Course material availability can be checked here.

Assessment methods and criteria:

Two written intermediate examinations or one final examination.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Matti Alatalo

Working life cooperation:

No work placement period

Other information:

Course website

A326010: Biomedical Physics Minor, 25 op

Opiskelumuoto: Basic Studies

Laji: Study module

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory Studies (25 ECTS cr)

764163P: Introduction to Biomedical Physics, 5 op

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

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

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

1st spring

Learning outcomes:

Student can describe and explain some basics and concepts of certain areas of biomedical physics and knows central research targets and methods of biomedical physics.

Contents:

The course provides an introdution to biomedical physics from the point of views of biosciences and medical physics, and introduces basics of research and recording methods of the field, biophysical models, biosystems analysis, cellular and biomolecular physics, physics of fluids and their flow, and some other special issues. The course includes also a short introduction to some fields of physics that are of particular and occupational interest to medical physicists.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 36 h, self-study 96 h, final exam

Target group:

Mainly students in Physics B.Sc. program.
Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

Lectures and lecture notes

Assessment methods and criteria:

Exam

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Kyösti Heimonen

Working life cooperation:

No work placement period

Other information:

Course page

764125P: Foundations of cellular biophysics, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kyösti Heimonen

Opintokohteen kielet: Finnish

Leikkaavuudet:

764115P	Foundations of cellular biophysics	4.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish

Timing:

2nd spring

Learning outcomes:

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

Contents:

In this course cellular function is considered from the point of views of biophysics and medical physics. The course concentrates on the subjects of energy metabolism, information transfer, and the cellular structures and features that are of interest in biophysics or medical physics. The course contains, for instance, introduction to physical chemistry of cells, structure and evolution of cells and cell membranes, cellular homeostasis, kinetics of enzyme reactions, basics of cell membrane function and transportation phenomena, introduction to electrical phenomena of cell membranes, cellular energy sources and metabolism, and the basics of cellular signalling and information processing.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 9 h, self-study 96 h, home exam and final exam

Target group:

Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

Introduction to biomedical physics (764163P) is recommended to be done before this course.

Recommended optional programme components:

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

Recommended or required reading:

Lectures, lecture notes, P.J. Antikainen, Biotieteiden fysikaalista kemiaa, WSOY, Helsinki 1981 (partly); J. Heino and M. Vuento, Solubiologia, WSOY, Porvoo 2002 or newer edition (partly). Course material availability can be checked here.

Assessment methods and criteria:

Home exam, final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Kyösti Heimonen

Working life cooperation:

No work placement period

Other information:

Course website

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

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

761116P	Radiation physics, biology and safety	3.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

Spring

Learning outcomes:

The student knows the origin of ionising radiation and the principles of its interaction with matter. He/she can explain the essential effects of ionising radiation on human tissue and remembers the principles of radiation safety and laws and regulations (in Finland) concerning this.

Contents:

The topics of the course include the origin of ionizing radiation e.g. as a result of radioactive decay and in nuclear reactions, the interaction between radiation and matter, the detection and measurements of radiation, physical quantities and measuring units related to radiation, radiation in the environment, and examples of utilizing radiation. The biologic effects of radiation and the legislation on radiation safety are also discussed.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, 7 problem solving exercises (14 h) and 2 laboratory exercises (8 h). Self-study 90 h.

Target group:

For the students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

740368A Radiation and safety

Recommended or required reading:

Lecture material (in Finnish), Laws and regulations concerning radiation safety

Assessment methods and criteria:

Final examination

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

761359A: Spectroscopic methods, 5 op

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

766359A	Spectroscopic methods	7.0 op

ECTS Credits:

5 credits

Language of instruction:

Finnish

Timing:

Every second year (odd year), spring term

Learning outcomes:

After completion, student knows the principles of various spectroscopic methods and what kind of physical /biophysical phenomena can be studied and what kind of information can be obtained with these methods.

Contents:

Basic principles of infrared, mass and NMR spectroscopy and X-ray analytics are introduced

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 46 h, exercises 24 h, self-study 63 h

Target group:

Compulsory for students in biophysics. Recommended for students directing at some of the lines in atomic, molecular and materials physics. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

Partly distributed through net, and partly as paper copies during the course.

Assessment methods and criteria:

Two written examinations or one final examination.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Ville-Veikko Telkki

Working life cooperation:

No work placement period

Other information:

https://wiki.oulu.fi/display/761359A/

764338A: Basic Neuroscience, 5 op

Voimassaolo: 01.01.2009 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764638S	Basic Neuroscience	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish (Exam can be done in English on the basis of the course book)

Timing:

3th - 5th spring (depending on whether included in BSc or MSc degree)

Learning outcomes:

Student will be able to explain basic oganization and functions of the nervous system.

Contents:

General organization and function of the peripheral and central nervous system are introduced based on a course book. Objective of the course is to provide students with a broad view of the basic principles of nervous system function based on recent knowledge.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, self-study 105 h

Target group:

Primarily the students of the degree programme in physics, especially the biomedical physics students. Also 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:

Lectures and the course book Dale Purves et al.: Neuroscience, 4th edition or newer, Sinauer Associates Inc., MA, USA, 2008.

Assessment methods and criteria:

Final exam

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:

Course website

Recommended Optional Studies

080925A: Anatomy and Physiology for Biomedical Engineering, 5 op

Voimassaolo: 01.08.2017 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Health Sciences
Arvostelu: 1 - 5, pass, fail
Opettajat: Miika Nieminen, Kyösti Heimonen
Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English

Timing:

Master studies, Spring 2019, 4th period

Learning outcomes:

The student is able to define human anatomy and describe the physiological functions, and can explain how these can be investigated using different imaging methods and measurement systems

Contents:

The course acquaints the student to human physiology and anatomy. Areas covered include
Cells and tissues,
Skin, blood, blood circulation and the fluids of the body
Musculoskeletal organs
Defense reactions of the body
Respiration
Digestion
Urine secretion
Metabolic regulation, heat regulation
Reproduction
Sensory functions
Nervous system

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28h, demonstrations 6h. Independent studying 101h. Final examination

Target group:

Biomedical engineering and physics students

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time. Imaging methods are more closely studies in the course Diagnostic Imaging.

Recommended or required reading:

The students will be informed about the supplementary reading in the beginning of the course.

Assessment methods and criteria:

Taking part in the lectures and demonstrations. Final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1- 5. In the numerical scale zero stands for a fail. Course grade is based on score of the final exam.

Person responsible:

Professor Miika Nieminen

Working life cooperation:

Course demonstrations will be held in hospital environment and are related to diagnostics.

Other information:

Maximum number of participants is 40 students.

764322A: Cell membrane biophysics, 10 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kyösti Heimonen

Opintokohteen kielet: Finnish

Leikkaavuudet:

764622S	Cell membrane biophysics	10.0 op

ECTS Credits:

10 ECTS cr

Language of instruction:

English

Timing:

3rd-5th autumn (depending on whether included in BSc or MSc degree). Lectured every second year (during odd years).

Learning outcomes:

After finishing the course the student is able to describe the basics of cell membrane structure and function, to present the basic biophysical models describing the electrical function of the cell membrane, and to solve problems and calculations concerning these models. In addition, the student will be able make and present a short review and a talk on the basis of scientific literature or articles of this field.

Contents:

During the course the students will become acquainted with the central biophysical phenomena of the cell membrane, for example: the physical structure and properties of the cell membrane, lipids and proteins in the membrane, permeation and selectivity, ion channels and their kinetics. In addition they will learn to know the basics about the theory of the different cell membrane recording methods, the models describing the electrical function of the cell membrane and the analysis of cell membrane signals.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 34 h, calculation exercises 20 h, seminar 4 h, seminar presentation, weekly assignments, self-study 206 h

Target group:

Students of Biomedical physics (voluntary in BSc minor, mandatory in MSc). Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

Introduction to biomedical physics (764163P) and Foundations of cellular biophysics (764115P) are recommended to be done before this course.

Recommended optional programme components:

764680 Neural information processing is recommended to be done after this course.

Recommended or required reading:

Lectures, lecture handouts; 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).
Course material availability can be checked here.

Assessment methods and criteria:

Home exam, final exam, seminar presentation

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Kyösti Heimonen

Working life cooperation:

No work placement period

Other information:

Course website

761317A: Numerical Programming, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish, English

ECTS Credits:

5 ECTS

Language of instruction:

English

Timing:

Not lectured every year

Learning outcomes:

Numerical algorithms for differentiation, special functions, integration, derivation, interpolation and Fourier transform. Ordinary differential equations and differential equations with eigenvalues are solved. Algorithms for linear equations and matrix equations with eigenvalues are given. The programming language can be chosen freely. Examples are given in Fortran and Mathematica languages.

Contents:

Numerical algorithms for differentiation, special functions, integration, derivation, interpolation and Fourier transform. Ordinary differential equations and differential equations with eigenvalues are solved. Algorithms for linear equations and matrix equations with eigenvalues are given. The programming language can be chosen freely. Examples are given in Fortran and Mathematica languages.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 26 h, 12 excercises, 3 project works

Target group:

Primarily for the students of the degree programme in physics

Prerequisites and co-requisites:

Recommended: mathematics for physicists, differential equations, linear algebra. Basic knowledge of programming, at least 763114P Introduction to programming

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes, W. H. Press, B. P. Flannery, S. A. Teukolsky and W. T. Vetterling: Numerical Recipes. The Art of Scientific Computing.

Assessment methods and criteria:

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

Grading:

Numerical grading scale 0 – 5, where 0=fail

Person responsible:

Kari Jänkälä

A300006: Medical Engineering Minor, 15 - 25 op

Opiskelumuoto: Intermediate Studies

Laji: Study module

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.

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

031022P: Numerical Analysis, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Marko Huhtanen

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish. English speaking students should contact the instructor.
The course can be completed in English by intermediate exams or by a final exam.

Timing:

Spring semester, period 3

Learning outcomes:

Knows numerical algorithms for solving basic problems in computing. Knows basics about numerical linear algebra and some of its applications. Knows how nonlinear systems are solved and how they appear in optimization. Knows how differential equations are solved numerically.

Contents:

Numerical linear algebra, numerical methods for systems of equations, unconstrained optimization, basics of the approximation theory, numerical quadratures, numerical methods for ordinary differential equations.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 22 h / Self-study 85 h.

Target group:

-

Prerequisites and co-requisites:

Completion of courses Calculus I and II, a course on Differential Equations and a Course on Linear Algebra.

Recommended optional programme components:

-

Recommended or required reading:

Material posted on the web-page of the course.

Assessment methods and criteria:

Intermediate exams or a final exam.

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

Grading:

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

Person responsible:

Marko Huhtanen

Working life cooperation:

-

Other information:

-

031077P: Complex analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kemppainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish

Timing:

Fall semester, period 1.

Learning outcomes:

After completing the course the student

1. is able to calculate the derivative and the integral of functions of complex variable,
2. understands the concept of analyticity
3. is capable of calculating the contour integrals and using the theory of residues for computing the line integrals, will be able to apply the techniques of complex analysis to simple problems in signal processing.

Contents:

Complex numbers and functions, complex derivative and analyticity, complex series, Cauchy's integral theorem, Laurent and Taylor expansions, theory of residues, applications to signal analysis.

Mode of delivery:

Face-toface teaching, Stack(web-based too) exercises.

Learning activities and teaching methods:

Lectures 28 h/Exercises 14 h/Self study 93 h.

Target group:

The students in the engineering sciences. The other students are welcome, too.

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses Calculus I and II, Differential Equations.

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 lecture notes

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Jukka Kemppainen

Working life cooperation:

-

Other information:

-

080925A: Anatomy and Physiology for Biomedical Engineering, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Miika Nieminen, Kyösti Heimonen

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English

Timing:

Master studies, Spring 2019, 4th period

Learning outcomes:

The student is able to define human anatomy and describe the physiological functions, and can explain how these can be investigated using different imaging methods and measurement systems

Contents:

The course acquaints the student to human physiology and anatomy. Areas covered include
Cells and tissues,
Skin, blood, blood circulation and the fluids of the body
Musculoskeletal organs
Defense reactions of the body
Respiration
Digestion
Urine secretion
Metabolic regulation, heat regulation
Reproduction
Sensory functions
Nervous system

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28h, demonstrations 6h. Independent studying 101h. Final examination

Target group:

Biomedical engineering and physics students

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time. Imaging methods are more closely studies in the course Diagnostic Imaging.

Recommended or required reading:

The students will be informed about the supplementary reading in the beginning of the course.

Assessment methods and criteria:

Taking part in the lectures and demonstrations. Final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1- 5. In the numerical scale zero stands for a fail. Course grade is based on score of the final exam.

Person responsible:

Professor Miika Nieminen

Working life cooperation:

Course demonstrations will be held in hospital environment and are related to diagnostics.

Other information:

Maximum number of participants is 40 students.

764327A: Virtual measurement environments, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: Finnish

Leikkaavuudet:

764627S	Virtual measurement environments	5.0 op

ECTS Credits:

5 ECTS, 135 hours of work

Language of instruction:

Finnish or English

Timing:

Bachelor studies, autumn term, 2nd period

Learning outcomes:

The student will learn how to construct software environments for measurements and data analysis.

Contents:

The course gives basic skills to use measuring and analyzing programmes applied not only in academic research but also in R&D of the companies, and their programming environments (Matlab, LabView)

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 15 h, project work 65 h, self-study 55 h

Target group:

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

Prerequisites and co-requisites:

The basics / basic skills in programming.

Recommended optional programme components:

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

Recommended or required reading:

Lecture and exercise notes, other given material

Assessment methods and criteria:

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

Grading:

The course utilizes a numerical grading scale 1-5 or fail. In the numerical grading scale zero stands for a fail. Grading is made based on the projects.

Person responsible:

Professor Timo Jämsä

Working life cooperation:

None

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

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish

Timing:

Autumn term 1st and 2nd periods

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

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

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

Initial exam with multiple-choice questions. Taking part in the lectures and demos. Learning assignment. Final exam, which includes essays. Before participation in the final exam, the student must complete and pass the initial exam and learning assignment.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Professor Timo Jämsä

Working life cooperation:

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

521242A: Introduction to Biomedical Engineering, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Myllylä

Opintokohteen kielet: English

ECTS Credits:

5 ECTS cr

Language of instruction:

English

Timing:

Period 1

Learning outcomes:

After completing the course, the student has a basic knowledge of the biomedical engineering discipline and the applications of engineering science to biomedical problems.

Contents:

Biomedical engineering is a multidisciplinary field of study that ranges from theory to applications at the interface between engineering, medicine and biology. This course will introduce the subdisciplines within biomedical engineering, including such as systems physiology, bioinstrumentation, bioimaging, biophotonics and biomedical signal analysis. General issues of the subdisciplines will be presented together with selected examples and clinical applications. A number of lectures will be given by professionals working in health tech companies, University of Oulu and Oulu University Hospital, presenting different fields of the biomedical engineering. In addition, course offerings of biomedical engineering at the University of Oulu are introduced.

Mode of delivery:

Face-to-face teaching. Under some circumstances distance learning using online material is possible (please, ask the teacher).

Learning activities and teaching methods:

The course includes online material, lectures and a group project. Lectures 28h and laboratory exercises 4 h and self-study 100h

Target group:

-

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Participation in lectures or using the online material and writing a work report.

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

Grading:

1 - 5, pass, fail

Person responsible:

Teemu Myllylä

Working life cooperation:

Guest lecturers

Other information:

-

031080A: Signal Analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kotila, Vesa Iisakki

Opintokohteen kielet: Finnish

Leikkaavuudet:

031050A	Signal Analysis	4.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish.
The course can be completed in English by a final exam or a retake exam.

Timing:

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

Learning outcomes:

Upon completion of the course, the student:
-is able to calculate the energy, the power, the convolution and the frequency spectrum of discrete and analog, periodic and non-periodic deterministic signals
-is able to calculate the spectrum of a sampled signal
-is able to calculate the Hilbert transform and the complex envelope of a signal
-is able to study the stationarity, the mutual dependence and the frequency content of random signals by means of the auto- and cross-correlation functions, and the power- and cross-power spectral densities
-is able to study the effect of an LTI system on a signal

Contents:

Signals, classification, frequency. Fourier analysis, analog and digital signal, fast Fourier transform. LTI system. Hilbert transform. AM- FM- and PM-modulation. Random variable. Covariance matrix. Random signal. Stationarity, autocorrelation. Power spectral density. Random signal in LTI system. Signal estimation.

Mode of delivery:

Blended teaching.

Learning activities and teaching methods:

Lectures 28 h / Exercises 14 h / Self-study privately or in a group 93 h. The independent work includes individual STACK-assignments as online work.

Target group:

-

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses 031078P Matrix Algebra, 031021P Probability and Mathematical Statistics and 031077P Complex Analysis.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes. Additional reading: Proakis, J.G., Manolakis, D.K.: Introduction to Digital Signal Pro-cessing. Shanmugan, K.S., Breipohl, A.M.: Random Signals, Detection, Estimation and Data Analysis.

Assessment methods and criteria:

The course is completed with a final exam or a retake exam. In addition to the final exam, STACK-assignments given during the course are part of the assessment. The assessment of the course is based on the learning outcomes of the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Vesa Kotila

Working life cooperation:

-

Other information:

-

080926A: Introduction to Biomedical Imaging Methods, 1 - 3 op

Voimassaolo: 01.08.2017 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Health Sciences
Arvostelu: 1 - 5, pass, fail
Opettajat: Lassi Rieppo
Opintokohteen kielet: English

ECTS Credits:

1-3 ECTS credit points / 27-81 hours of work.

Language of instruction:

English

Timing:

Master studies, spring term 4th period.

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching. Compulsory participation in lectures.

Learning activities and teaching methods:

Scope of the course and the methods of implementation vary. The course includes lectures 18h and demonstrations 8h. Independent study is determined by the extent of the course to 8-54 hours. The course includes a final exam.

Target group:

All Bachelor, Master and postgraduate students interested in methods of biomedical imaging.

Recommended or required reading:

Handouts and literature given in the lectures.

Assessment methods and criteria:

Participation in the lectures and demonstrations. Exam. The course can be completed with 1, 2 or 3 ECTS cr.
1 ECTS # compulsory participation in lectures
2 ECTS # compulsory participation in lectures and demonstrations
3 ECTS # compulsory participation in lectures, demonstrations and final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Dr Lassi Rieppo

Electives

521273S: Biosignal Processing I, 5 op

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

ECTS Credits:

5 ECTS credits / 50 hours of work

Language of instruction:

English. Examination can be taken in English or Finnish.

Timing:

The course unit is held in the autumn semester, during period 2. It is recommended to complete the course at the end of studies.

Learning outcomes:

After completing the course, student
1. knows special characteristics of the biosignals and typical signal processing methods
2. can solve small-scale problems related to biosignal analysis
3. implement small-scale software for signal processing algorithms

Contents:

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

Mode of delivery:

Face-to-face teaching and guided laboratory work.

Learning activities and teaching methods:

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

Target group:

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

Prerequisites and co-requisites:

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

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Tapio Seppänen

Working life cooperation:

No.

521282S: Biosignal Processing II, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Jukka Kortelainen
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 ECTS cr

Language of instruction:

Lectures and laboratory works are given in English. The examination can be taken in Finnish or English.

Timing:

Period 4

Learning outcomes:

After completing the course, student
1. knows the special characteristics of neural signals and the typical signal processing methods related to them

2. can solve advanced problems related to the neural signal analysis

Contents:

Introduction to neural signals, artifact removal, anesthesia and natural sleep, topographic analysis and source localization, epilepsy, evoked potentials.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures (8 h) and laboratory work (20 h), written exam.

Target group:

Engineering students, medical and wellness technology students, and other students interested in biomedical engineering. Students of the University of Oulu.

Prerequisites and co-requisites:

The basic engineering math courses, digital filtering, programming skills, Biosignal Processing I.

Recommended optional programme components:

-

Recommended or required reading:

The course is based on selected parts from books "EEG Signal Processing", S. Sanei and J. A. Chambers, "Bioelectrical Signal Processing in Cardiac and Neurological Applications", L. Sörnmo and P. Laguna, and "Neural Engineering", B. He (ed.) as well as lecture slides and task assignment specific material.

Assessment methods and criteria:

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

Grading:

Numerical grading of the accepted exam is in the range 1-5.

Person responsible:

Jukka Kortelainen

Working life cooperation:

-

521093S: Biomedical Instrumentation, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Igor Meglinski

Opintokohteen kielet: Finnish

Leikkaavuudet:

521107S	Biomedical Instrumentation	6.0 op

ECTS Credits:

5

Language of instruction:

English.

Timing:

Period 3.

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

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

Target group:

Students interested in biomedical measurements.

Prerequisites and co-requisites:

None

Recommended optional programme components:

Course replaces earlier courses Biomedical measurements and Biomedical instrumentation.

Recommended or required reading:

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

Assessment methods and criteria:

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

Grading:

1 - 5.

Person responsible:

Igor Meglinski

Working life cooperation:

No.

521124S: Sensors and Measuring Techniques, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Igor Meglinski, Teemu Myllylä
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English.

Timing:

Period 2.

Learning outcomes:

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

Contents:

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

Mode of delivery:

Pure face-to-face teaching.

Learning activities and teaching methods:

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

Target group:

4 year students.

Prerequisites and co-requisites:

No.

Recommended optional programme components:

No.

Recommended or required reading:

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

Assessment methods and criteria:

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

Grading:

1-5

Person responsible:

Igor Meglinski

Working life cooperation:

No.

521240S: Biophotonics and Biomedical Optics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Igor Meglinski

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English

Timing:

Period 2

Learning outcomes:

On successful completion of the course, students will be able to categorize the basic principles of modern optical and laser-based diagnostic modalities and instruments used in advanced biomedical research and clinical medicine. They will be able to demonstrate detailed understanding and evaluate the key biophotonics techniques underlying day-to-day clinical diagnostic and therapies and industrial applications in pharmacy, health care and cosmetic products. They can operate with the selected techniques of their choice.

Contents:

The course includes in-depth coverage of state-of-the-art optical imaging and spectroscopy systems for advanced biomedical research and clinical diagnosis, fundamental properties of light such as coherence, polarization, angular momentum, details of light interaction with tissue, and modern imaging system. Coherent Optical Tomography (OCT), Laser Doppler Flowmetry, Laser Speckle Imaging (LSI), Photo-Acoustic Tomography (PAT), Tissue polarimetry; Optical and Near-Infra-Red Spectroscopy (NIRS), Confocal and Fluorescence Microscopies; Tissue Optics: Light/matter interactions, index of refraction, reflection, optical clearing, absorption, Mie scattering, Rayleigh scattering, Monte Carlo modelling.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

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

Target group:

Students interested in biomedical measurements.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

A new course

Recommended or required reading:

V.V Tuchin: Handbook of Optical Biomedical Diagnostics, SPIE Press, 2002; V.V Tuchin: Handbook of Coherent Domain Optical Methods, Springer, 2nd edition, 2013. D.A Boas, C. Pitris, N. Ramanujam, Handbook of Biomedical Optics, CRC Press, 2011.

Assessment methods and criteria:

The course is passed by the final exam and with the assignments.

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

Grading:

1 - 5

Person responsible:

Igor Meglinski

Working life cooperation:

No.

080915S: Tissue Biomechanics, 5 op

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

ECTS Credits:

5 ECTS credit points /135 hours of work.

Language of instruction:

English

Timing:

The course is held in the autumn semester, during period 2. It is recommended to complete the course during Master studies.

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 20h / mathematical exercises 10h / Interactive lecture and group work 4 h / Assignment 8h / Self-study 93h. Final exam.

Target group:

Master students of Biomedical Engineering (all specializations). The course is also suitable for other interested students with adequate prerequisites.

Prerequisites and co-requisites:

It is recommended that the student has basic knowledge on cell biology, anatomy and physiology, mechanics, differential equations, and matrix algebra.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time. Motion biomechanics will be studied in the course 080916S Biomechanics of Human Movement.

Recommended or required reading:

Material and reading given during the course.

Assessment methods and criteria:

Accepted assignment and written final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Professor Simo Saarakkala

Other information:

080916S: Biomechanics of Human Movement, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credit points / 135 hours of work.

Language of instruction:

English

Timing:

Master studies, spring term, 4th period

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

MSc students of Biomedical Engineerin, medical technology, information technology and other related degree programs. Physics MSc students (biomedical physics). Other interested master's degree and postgraduate students.

Prerequisites and co-requisites:

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

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time. Tissue biomechanics will be studied in the course 080915S.

Recommended or required reading:

Material given during lectures.

Assessment methods and criteria:

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

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail. Grading is made based on the exercise report and exam.

Person responsible:

Professor Timo Jämsä

Working life cooperation:

None

Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

806119P: A Second Course in Statistics, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Päkkilä

Opintokohteen kielet: Finnish

Leikkaavuudet:

806113P	Introduction to Statistics A	5.0 op
806109P	Basic Methods in Statistics I	9.0 op

ECTS Credits:
5 ECTS credits
Language of instruction:
Finnish
Timing:
4th period
Learning outcomes:
Upon completion of the course, student will be able to
- analyze continuous and categorical response in the most common experimental and observational studies
- critically evaluate scientific articles
- implement and interpret analyses of a statistical software concerning issues of the course.

Contents:
- Skills for performing statistical analyses and inferences on the basis of data obtained in common experimental and observational studies are expanded and deepened
- statistical literacy of scientific articles with quantitative methods

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Total 50 h face-to-face teaching including lectures and exercise (partly computer exercises). Independent work 83 h.
Target group:
Minor students
Prerequisites and co-requisites:
The recommended prerequisite prior to enrolling for the course is the completion of the course: 806118P Introduction to Statistics or 806116P Statistics for Economic Sciences.
Recommended optional programme components:
After the course, student is able to continue other statistics courses.
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Mid-term exams and/or final exam and possible homework.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Jari Päkkilä
Working life cooperation:
No
Other information:
-

763314A: Analytical mechanics, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Erkki Thuneberg

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

801389A: Basic Geometry, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

801399A	Geometry	5.0 op

ECTS Credits:
6 cr
Language of instruction:
Finnish
Timing:
After the second year at the earliest

Learning outcomes:
After completing the course, a student
- understands the fundamental concepts and results of Euclidean geometry
- can construct basic geometric proofs
- can perform compass-and-straightedge constructions
- can solve basic geometric problems related to applications

Contents:
The course focuses on basic geometric concepts and results familiar from school from an axiomatic angle. We construct geometric theory starting from a set of basic axioms systematically with theorems and their proofs. Most results in the course are familiar to students from junior high and high school, but the course offers a deeper understanding to the founding mathematics behind geometry curriculum in schools, and the birth of axiomatic mathematics.
The majority of the course is dedicated to planar geometry. We also learn to perform classical compass-and-straightedge constructions. Towards the end of the course we extend our examination to three dimensions. In solid geometry we focus on the relations between lines and planes in space and properties of three-dimensional solids. At the end of the course we briefly look into non-Euclidean geometries.

Learning activities and teaching methods:
Summer course
36 hours of face-to-face teaching
Independent studying in groups
In addition an optional research project

Prerequisites and co-requisites:
Mandatory first year courses.

Recommended or required reading:
Lecture notes of Matti Lehtinen and extra material.

Assessment methods and criteria:
Final exam and an optional research project.
If a student only attends (and passes) the final exam, the course is completed as a 6 ECTS A-course (intermediate). Students can also choose to do an additional research project. After passing the final exam and writing a short research project about some topic in geometry, the course is completed as a 6 ECTS S-course (advanced). If the student already has the course completed, it is possible to write the research project as a separate 3 ECTS S-course (advanced).
Read more about assessment criteria at the University of Oulu webpage.

Grading:
1-5, fail

Person responsible:
Emma Leppälä

Other information:
Course website in Noppa.

802339A: Basic course in inverse problems, 5 op

Voimassaolo: 01.06.2016 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Sari Lasanen

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

802159P: Basic method in Analysis for Economic Sciences, 5 op

Voimassaolo: 01.06.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802153P	Basic Mathematics for Economics 1 b	4.0 op
800118P	Basic Mathematics for Economics II	7.0 op

ECTS Credits:
5 ECTS cr
Language of instruction:
Finnish
Timing:
3. period. It is recommended to complete the course at the 1-2th spring semester.
Learning outcomes:
After completing the course, student is able to
- handle functions of several variable
- recognizes the usefullness of partial derivative and is able to apply it in practice
- define and use integral and calculate, for instance, different surface areas
- calculate with complex numbers

Contents:
Course aims to build a solid background to mathematics in later economics courses. One of the main concept in the courses is partial derivative of a function and its applications. Another important concept is intergrals and their applications.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 28 h, exercises 14 h.
Target group:
Students in Oulu Business School.
Prerequisites and co-requisites:
The course 802158P Mathematics for Economic Sciences.
Recommended optional programme components:
After the course, student is able to continue other mathematics courses directed to the students in Oulu Business School.
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Final exam
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Kari Myllylä
Working life cooperation:
-

805352A: Generalized Linear Models, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Mikko Sillanpää

Opintokohteen kielet: Finnish

Leikkaavuudet:

805630S	Generalized Linear Models	5.0 op
806359A	Regression modelling	10.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work
Language of instruction:
Finnish
Timing:
Period 4
Learning outcomes:
After completion of the course, student can define the generalized linear model for most common discrete outcomes like binary outcome (logit, probit) /binomial model, model for count data (poisson model), models with more than two outcome classes with and without ordering in their classes, analysis of frequency data using log-linear models.
Contents:
Interpretation of parameters and predictive inference in models for binary outcome (logit, probit), interpretation of poisson model, overdispersion, interpretation of ordered and unordered multi-class models, connection of chi-square statistics and parameters of log-linear models.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures (28 h) and compulsory exercise (14 h)
Target group:
Master´s students of statistics, applied mathematics and mathematics
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
Agresti, A., Foundations of linear and generalized linear models. John Wiley & Sons, 2015.
Assessment methods and criteria:
Final exam
Grading:
Fail, 1-5
Person responsible:
Mikko Sillanpää
Working life cooperation:
No

800149P: Introduction to LateX, 2 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761115P	Laboratory Exercises in Physics 1	5.0 op
761115P-03	Laboratory Exercises in Physics 1, Introduction to LateX	0.0 op

ECTS Credits:
2 ECTS cr
Language of instruction:
Finnish (in english if needed)
Timing:
2-3 year of studies, before making the Bachelor's thesis.
Learning outcomes:
After completing the course, student

- is able to describe the principles of LaTeX document preparation system
- can form basic template of LaTeX document and modify it to his/her needs
- knows basic commands when writing mathematical text
- is able to use different environments (e.g. enumertions, equations)
- can recognize and fix errors in LaTeX code
- is able to write Bachelor's and Master's thesis using LaTeX

Contents:
Bachelor's and Master's thesis are written using LaTeX document preparation system. This course introduces basics in LaTeX by giving basic knowledge of the principles of LaTeX.
Mode of delivery:
Lectures / exercises (computer class)
Learning activities and teaching methods:
Face-to-face teaching
Target group:
Major students
Prerequisites and co-requisites:
First year math studies
Recommended optional programme components:
Must be completed before Bachelor's thesis.
Recommended or required reading:
Lecture notes
Tobias Oetiker Hubert Partl, Irene Hyna and Elisabeth Schlegl, *The Not So Short Introduction to LATEX2#* (http://tobi.oetiker.ch/lshort/lshort.pdf)
Kopka, H. and Daly, P. W., *Guide to LaTeX (4th Edition)*, Addison-Wesley Professional, 2003

Assessment methods and criteria:
Participation in lectures/exercises and home work.
Grading:
Pass/Fail
Person responsible:
Markus Harju
Working life cooperation:
-

806354A: Introduction to Sampling Methods, 4 op

Voimassaolo: 01.01.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Läärä Esa

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS cr

806118P: Introduction to Statistics, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Päkkilä

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay806118P	Introduction to Statistics (OPEN UNI)	5.0 op
806113P	Introduction to Statistics A	5.0 op

ECTS Credits:
5 ECTS credits

Language of instruction:
Finnish
Timing:
3rd period
Learning outcomes:
After completing the course, student will be able to
- consider issues influencing to data collection
- describe data by appropriate methods (tables, statistics and graphical presentations)
- evaluate the effect size of the sample to the margin of error for instance in Gallup polls and in different market researches
- interpret output of a statistical software.

Contents:
- collecting data, e.g. sampling
- variables and measuring
- descriptive statistical methods and their selection
- margin of error of estimator for population mean and proportion
- statistical literacy
- basic analysis of data using statistical software

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Total 50 h face-to-face teaching including lectures and exercise (partly computer exercises). Independent work 83 h.
Target group:
Minor students
Recommended optional programme components:
After the course, student is able to continue to A Second Course in Statistics.
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Mid-term exams and/or final exam and possible homework.
Grading:
Fail, 1-5
Person responsible:
Hanna Heikkinen and Jari Päkkilä
Working life cooperation:
No
Other information:
-

802158P: Mathematics for Economic Sciences, 7 op

Voimassaolo: 01.06.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Myllylä

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay802158P	Mathematics for Economic Sciences (OPEN UNI)	7.0 op

ECTS Credits:
7 ECTS cr
Language of instruction:
Finnish
Timing:
1. period. It is recommended to complete the course at the 1st autumn semester.
Learning outcomes:

After completing the course, student is able to
- define and apply basic mathematical concept such as rationals, absolute value, power and root function
- handle different types of functions and knows their special properties
- solve different equations and inequalities
- define the concepts of limit and continuity of a function
- calculate limits in case of different functions
- calculate and apply derivative, and knows the relevance of the concept
- use all mathematical concepts covered by the course in different problems related to economics (interest, investments, optimization and indeces)

Contents:
Course aims to build a solid background to mathematics in later economics courses. Course begins with a revision of concepts familiar from high school such as sequences, rationals, absolute value and powers. After that we focus on different types of functions such as polynomials, rational fuctions, exponential functions and logarithm. Different types of equations and inequalities, containing the functions mentioned above, are solved. Main concepts in the course are also limit of a function, continuity and derivative and their applications. Nämä käsitteet tullaan esittelemään kaikille kurssilla käsiteltäville
funktiotyypeille.
After the more mathematical part, the focus is turned on economical applications (such as interests, optimization, investments, indeces).
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 40 h, exercises 20 h.
Target group:
Students in Oulu Business School
Prerequisites and co-requisites:
None
Recommended optional programme components:
After the course, student is able to continue other mathematics courses directed to the students in Oulu Business School.
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Mid-term exams and/or final exam
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Kari Myllylä / Erkki Laitinen
Working life cooperation:
-

802160P: Matrices and optimization for Economic Sciences, 5 op

Voimassaolo: 01.06.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Myllylä

Opintokohteen kielet: Finnish

Leikkaavuudet:

800118P	Basic Mathematics for Economics II	7.0 op

ECTS Credits:
5 ECTS cr
Language of instruction:
Finnish
Timing:
4. period. It is recommended to complete the course at the 1-2 spring semester.
Learning outcomes:

After completing the course the student
- masters the basic operations and properties of matrices
- knows how to utilize matrices with solving simultaneous equations, optimization and constructing different models
- knows the basics of linear optimization
- is prepared to utilize the aforementioned items with his/her subsequent courses.

Contents:
The aim of the course is to create a base for mathematics used in economics. The essential item of the course are the basic operations of matrices and their utilization in mathematical exercises. The course starts on basics and proceeds to solve simultaneous equations with multiple variables and demanding optimization problems with constraints. Those problems that are more difficult than the ones presented in the course 802158P Mathematics for Economic Science, are now solved with matrices. The student will also familiarize herself with Input-Output-Analysis. Some linear optimization is also presented.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 28 h, exercises 14 h.
Target group:
Students in Oulu Business School
Prerequisites and co-requisites:
The courses 802158P Mathematics for Economic Sciences and 802159P Basic method in Analysis for Economic Sciences.
Recommended optional programme components:
After the course, student is able to continue other mathematics courses directed to the students in Oulu Business School.
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Final exam
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Kari Myllylä
Working life cooperation:
-

802333A: Permutations, Fields and Galois Theory, 10 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

800323A	Field extensions	5.0 op
800343A	Permutations, Fields and Galois' Theory	8.0 op

ECTS Credits:
10 ECTS credits
Language of instruction:
Finnish
Timing:
2. year or later. Timing varies.
Learning outcomes:
After having finished the course, the student knows how to compute with permutations and how to construct permutation groups and field extensions. In addition, the student can solve equations of degree three and four and has some understanding about why solving the equation of degree five is not that simple.
Contents:
First we shall have a look at permutations and related group structures such as symmetric and alternating groups. After this we get to know some properties of finite fields and polynomials and proceed to the theory and practice

of field extensions. At the end of the course, we see how to solve equations of degree three and four. The elements of Galois theory are given in order to see that there is no general formula for the solution of equations of degree five.

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures (56h) and exercises (28h)
Target group:
Major and minor studies
Prerequisites and co-requisites:
Compulsory mathematics studies
Recommended optional programme components:
-
Recommended or required reading:
Lecture notes and I.N.Herstein: Abstract Algebra , Prentice Hall, 1996.
Assessment methods and criteria:
Final exam
Grading:
1-5
Person responsible:
Markku Niemenmaa

805331A: Project seminar I, 6 op

Voimassaolo: 23.04.2007 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 ECTS cr
Language of instruction:
Finnish
Timing:
3. year of studies (fall or spring)
Learning outcomes:
After successful completion of the project seminar the student is able to conduct a small scale statistical investigation and report it both in written form and orally.
Contents:
Under supervision of the leader of the seminar each student conducts a small-scale statistical investigation on a given empirical topic and material, makes a written report from it and presents it orally in seminar sessions. The written report is the B.Sc. thesis, when statistics is the major subject of the student.
Mode of delivery:
Seminars
Learning activities and teaching methods:
Seminar sessions (20 h) and independent work.
Target group:
Major and minor students
Prerequisites and co-requisites:
Basic methods of data-analysis
Recommended optional programme components:
Maturity test is written of the subject of proseminar.
Recommended or required reading:
-
Assessment methods and criteria:
Seminar (written) and presentation
Grading:
Pass/Fail
Person responsible:

Jari Päkkilä
Working life cooperation:
-

801323A: Seminar, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

800331A	Proseminar	10.0 op

ECTS Credits:
6 ECTS cr
Language of instruction:
Finnish
Timing:
2nd and 3rd year
Learning outcomes:
After completing the Bachelor's thesis:
1) student is able to form a clear and logical
2) student is able to concentrate to important and essential details in the subject of thesis
3) student gain experience presenting mathematical concept and research studies
Contents:
Proseminar (Bachelor's thesis) is a small mathematical study based on literature. Student is familiarized to write mathematical texts and obtain information using literature. Thesis includes a oral presentation from the subject of the thesis.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Seminars and own work
Target group:
Major students
Prerequisites and co-requisites:
Compulsory basic and intermediate studies.
Recommended optional programme components:
Maturity test is written from the topic of Bachelor's thesis.
Assessment methods and criteria:
Bachelor's thesis
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/Fail
Person responsible:
Kari Myllylä
Working life cooperation:
-

806361A: Statistical analysis with missing data, 5 op

Voimassaolo: 01.01.2013 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 credits
Contents:
simple and modern methods, chain equations, multiple imputation, assumptions of missing data mechanisms,R-packages for handling of missing data

Mode of delivery:
Lectures+exercises
Target group:
Anyone interested in methods for handling of missing data

Prerequisites and co-requisites:
Linear regression
Assessment methods and criteria:
Exam and practical work
Person responsible:
Mikko Sillanpää

805309A: Statistical methods in epidemiology, 9 op

Voimassaolo: 01.06.2009 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Läärä Esa

Opintokohteen oppimateriaali:
Santos Silva, Isabel dos , , 1999
Clayton, David , , 1993
Rothman, Kenneth J. , , 1998
Opintokohteen kielet: Finnish

Assessment methods and criteria:
Read more about assessment criteria at the University of Oulu webpage.

806116P: Statistics for Economic Sciences, 5 op

Voimassaolo: 01.06.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Hanna Heikkinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay806116P	Statistics for Economic Sciences (OPEN UNI)	5.0 op
806113P	Introduction to Statistics A	5.0 op
806109P	Basic Methods in Statistics I	9.0 op

ECTS Credits:
5 ECTS cr
Language of instruction:
Finnish
Timing:
1st period.

Learning outcomes:
After completing the course, student will be able to
- consider issues influencing to data collection
- describe data by appropriate methods: tables, statistics and graphical presentations
- evaluate the effect size of the sample to the margin of error for instance in Gallup polls and in different market researches
- analyze continuous and categorical response in the simple experimental and observational studies
- interpret output of a statistical software.

Contents:
- collecting data, e.g. sampling
- variables and measuring
- descriptive statistical methods and their selection
- the most important probability distributions
- margin of error of estimator for population mean and proportion
- statistical inference of the population proportion and the mean of a continuous variable
- statistical literacy
- basic analysis of data using statistical software

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Total 53 h face-to-face teaching including lectures and exercise (partly computer exercises). Independent work 80 h.
Target group:
Students in Oulu Business School.
Prerequisites and co-requisites:
-
Recommended optional programme components:
After the course, student is able to continue to A Second Course in Statistics.
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Mid-term exams and/or final exam and compulsory participation in computer exercises.
Grading:
Fail, 1-5
Person responsible:
Hanna Heikkinen
Working life cooperation:
No

805324A: Time series analysis, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jussi Klemelä

Opintokohteen oppimateriaali:
Harvey, Andrew C. , , 1993
Lütkepohl, Helmut , , 1991
Hamilton, James D. , , 1994
Opintokohteen kielet: Finnish

ECTS Credits:
5 cr
Language of instruction:
Finnish
Learning outcomes:
After finishing the course, a student can apply linear, nonlinear and nonparametric modeling of time series. A student learns how to choose between alternative time series models and can apply statistical software to fit time series models.
Contents:

1. The course covers basic concepts of time series analysis: stationarity, autocorrelation, spectral distribution and periodogram.
2. Linear time series analysis includes explanation, prediction, parameter estimation and model diagnostics in ARMA models.
3. Nonlinear time series analysis includes threshold models and heteroskedastic time series models (ARCH and GARCH).
4. Furthermore, nonlinear nonparametric smoothing is covered (time space smoothing and state space smoothing) and nonparametric estimation of spectral densities. Nonparametric function estimation includes kernel estimation, local polynomial regression and additive modeling.

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Besides lectures, there are voluntary exercises.
There are 14 times 2 hour lectures and 7 times 2 hour exercises.
Target group:
Students of mathematical sciences, econometrics and finance students.
Prerequisites and co-requisites:
Basic probability theory.
Recommended optional programme components:
-
Recommended or required reading:
Fan, J. ja Yao, Q. (2005). Nonlinear Time Series, Springer. Recommended reading: P. J. Brockwell and R. A. Davis: Time Series: Theory and Methods, Springer, 1991. H. Lutkepohl: Introduction to Multiple Time Series Analysis, Springer. J. Hamilton: Time Series, Princeton University Press The MIT Press, 1994.

Assessment methods and criteria:
Examination

Grading:
1 - 5, Fail
Person responsible:
Sari Lasanen
Working life cooperation:
-
Other information:
Home page of the course is http://cc.oulu.fi/~jklemela/timeseries/
Recommended reading:
P. J. Brockwell and R. A. Davis: Time Series: Theory and Methods, Springer, 1991.
H. Lutkepohl: Introduction to Multiple Time Series Analysis, Springer.
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