Opasraportti

FSci - Degree Programme in Mathematics and Physics (2020 - 2021)

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

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

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

Tutkintorakenteet

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

Tutkintorakenteen tila: published

Lukuvuosi: 2020-21

Lukuvuoden alkamispäivämäärä: 01.08.2020

Information about schedulling the studies

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
- *Alternative Orientation courses*
  - 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: Student tutoring, 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
761115P: Laboratory Exercises in Physics 1, 5 op
Compulsory
761115P-01: Laboratory Exercises in Physics 1, lecture and exam, 0 op
761115P-02: Laboratory Exercises in Physics 1, laboratory exercises, 0 op
761120P: Laboratory Exercises in Physics 2, 5 op
761119P: Electromagnetism 1, 5 op
766101P: Mathematics for physics, 5 op
A325102: Physics, intermediate studies, 35 - 60 op
Compulsory Studies
761312A: Electromagnetism 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
761310A: Wave motion and optics, 5 op
766384A: B.Sc. seminar, 4 op
766385A: B.Sc. thesis, 6 op
761386A: Maturity test, 0 op
Electives
761316A: Being a teacher in mathematical subjects, 5 op
761337A: Practical training, 3 - 6 op
764337A: Practical training, 3 - 9 op
766383A: Climate.Now, 2 - 5 op

Marjor Subject in Mathematics, Compulsory Studies in Physics

761115P: Laboratory Exercises in Physics 1, 5 op
Compulsory
761115P-01: Laboratory Exercises in Physics 1, lecture and exam, 0 op
761115P-02: Laboratory Exercises in Physics 1, laboratory exercises, 0 op
761118P: Mechanics 1, 5 op
761108P: Physical world view, 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

Electives

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

Electives

800146P: Introduction to teaching, 5 op
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
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

800146P: Introduction to teaching, 5 op
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
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 Physics: Orientation Space Physics (25 ECTS credits)

A325705: Space Physics Minor, 25 - 60 op
Mandatory courses
765114P: Fundamentals of astronomy I, 5 op
766355A: Basics of space physics, 5 op
761354A: Introduction to research in space physics, 5 op
805305A: Introduction to Regression and Analysis of Variance, 5 op
805306A: Introduction to Multivariate methods, 5 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

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
Alternative
761309A: Mechanics 2, 5 op
761317A: Numerical Programming, 5 op
766315A: Numerical modelling, 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
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
766355A: Basics of space physics, 5 op
765307A: Research Project of Astronomy I, 5 op
Alternative

765309A: Galaxies, 5 op
765384A: Physics of the solar system I, 5 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
800146P: Introduction to teaching, 5 op
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
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

Minor Subjects

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: Electronic Sensors, 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

Other Minor Studies

Optional courses

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

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

Tutkintorakenteen tila: published

Lukuvuosi: 2020-21

Lukuvuoden alkamispäivämäärä: 01.08.2020

Information about schedulling the studies

General information about scheduling the studies

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
Alternative Orientation courses
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: Student tutoring, 2 op
300003Y: Activities in university and student organizations, 1 - 4 op

Studies in Physics (vähintään 15 op)

Major in Physics, Compulsory Studies in Physics

H325118: Physics basic and intermediate studies for Subject Teacher, 70 op
Compulsory studies
761108P: Physical world view, 5 op
761118P: Mechanics 1, 5 op
761115P: Laboratory Exercises in Physics 1, 5 op
Compulsory
761115P-01: Laboratory Exercises in Physics 1, lecture and exam, 0 op
761115P-02: Laboratory Exercises in Physics 1, laboratory exercises, 0 op
761120P: Laboratory Exercises in Physics 2, 5 op
761119P: Electromagnetism 1, 5 op
761312A: Electromagnetism 2, 5 op
761313A: Atomic physics 1, 5 op
761310A: Wave motion and optics, 5 op
766344A: Nuclear and particle physics, 5 op
761314A: Thermophysics, 5 op
766384A: B.Sc. seminar, 4 op
766385A: B.Sc. thesis, 6 op
761386A: Maturity test, 0 op
Alternative studies
766101P: Mathematics for physics, 5 op
761316A: Being a teacher in mathematical subjects, 5 op
763343A: Solid state physics, 5 op

Marjor 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
761115P: Laboratory Exercises in Physics 1, 5 op
Compulsory
761115P-01: Laboratory Exercises in Physics 1, lecture and exam, 0 op
761115P-02: Laboratory Exercises in Physics 1, laboratory exercises, 0 op
Alternative
761120P: Laboratory Exercises in Physics 2, 5 op
761313A: Atomic physics 1, 5 op
761310A: Wave motion and optics, 5 op
761314A: Thermophysics, 5 op
761119P: Electromagnetism 1, 5 op
761312A: Electromagnetism 2, 5 op
766344A: Nuclear and particle physics, 5 op
If you want to complete 60 ECTS cr in physics. Choose all the courses below
763343A: Solid state physics, 5 op
766101P: Mathematics for physics, 5 op
761316A: Being a teacher in mathematical subjects, 5 op

Studies in Mathematics (vähintään 45 op)

Major 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

800146P: Introduction to teaching, 5 op
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
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 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

Electives

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

Electives

800146P: Introduction to teaching, 5 op
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

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 (60 op)

Minor in Chemistry

Minor in computer science

Other Minor Studies

Optional Studies

This part contains all courses which are not minor studies, such as, single courses in different subjects, extra language courses, etc.

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

806119P: A Second Course in Statistics, 5 op
802159P: Basic method in Analysis for Economic Sciences, 5 op
766382A: Climate communication, 2 op
806118P: Introduction to Statistics, 5 op
802158P: Mathematics for Economic Sciences, 7 op
802160P: Matrices and optimization for Economic Sciences, 5 op
806116P: Statistics for Economic Sciences, 5 op
766381A: Sustainable.now, 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

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

- Chemistry
- Geosciences.

Note:
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 skills in English must have been otherwise acquired. If you need to take English, but lack the background, please get in touch with the Languages and Communication contact teacher to discuss individual solutions.

ECTS Credits:

2 ECTS / 53 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 demonstrate the ability to:
utilize your knowledge of word formation, text structure, and cohesion markers to understand the vocabulary and content of academic texts,
use effective reading strategies and techniques for studying vocabulary, and
summarize texts both orally or in writing.

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:

The course is implemented using blended methods, which may include web-based teaching and face-to-face teaching. The course utilizes the Moodle learning environment.

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.

Target group:

Faculty of Natural Sciences:1st-year students of Biology, Mathematical & Physical Sciences
Faculty of Technology: 1st-year students of Chemistry, Geosciences

Prerequisites and co-requisites:

Post-requisite Students are also required to take English 2 902004Y following completion of this course.

Recommended optional programme components:

None

Recommended or required reading:

Course materials used will be available from the library or online.

Assessment methods and criteria:

Continuous assessment takes into account active and regular participation in classroom sessions and successful completion of all homework tasks, There are three monthly tests on material covered so far. The assessment of the course is based on the learning outcomes listed above.

Grading:

The course utilises a grading scale of Pass/Fail.

Person responsible:

Karen Niskanen

Working life cooperation:

The course does not contain working life cooperation.

Other information:

N.B. Students with grades laudatur or eximia in their A1 English school-leaving examination can be exempted from this course and will be granted the credits by your faculty. Contact the 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

Status:

This course is mandatory for students who choose English as their foreign language in the following B.Sc. degree programs:

Faculty of Natural Sciences:

Biology

Mathematical & Physical Sciences.

Faculty of Technology:

Chemistry

Geoscience.

Required proficiency level:

Students taking this course must have had English as the A1 or A2 language at school or have equivalent skills.

ECTS Credits:

2 ECTS credits / 53 hours of 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 in your own field
prepare and present scientific subjects from your own field of studies to your classmates, using appropriate field-related vocabulary.

Contents:

In the classroom, you will practice the skills of listening, speaking and presenting topics in your own field. The emphasis is on working in pairs and small groups. In addition, you will complete independent homework assignments to support the classroom learning.

Mode of delivery:

The course is implemented using blended methods, which may include distance teaching, classroom instruction and activities in the Moodle learning environment.

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.

Target group:

2nd year students of Biology, Chemistry, Geoscience
1st year students of Mathematical and Physical Sciences

Prerequisites and co-requisites:

Prequisite course: 902002Y English 1, unless exempted

Recommended optional programme components:

-

Recommended or required reading:

Materials will be provided in electronic format or are available from the library.

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.

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

Proficiency level:

B1/B2/C1
This course is only for Finnish speaking students with CEFR-level A2 in Swedish language. We don’t offer Beginners courses in Swedish.

Status:

Required proficiency level:

Contents:

Learning activities and teaching methods:

Recommended optional programme components:

-

Recommended or required reading:

Assessment methods and criteria:

Working life cooperation:

-

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

Proficiency level:

This course is only for Finnish speaking students with CEFR-level A2-B1 in Swedish language. There are no beginner courses in Swedish at the university.

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:

This course is only for Finnish speaking students with CEFR-level A1/A2 in Swedish language. University of Oulu, Languages and Communication unit don’t offer Beginners courses in Swedish.

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.

Alternative Orientation courses

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
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 credit / 27 hours of work

Language of instruction:

Finnish

Timing:

Architecture 3. spring semester, period III;
biochemistry 3. autumn semester;
biology 3. autumn semester, period I;
chemistry 3. autumn semester, period I;
civil engineering 2. spring semester, period IV;
computer science and engineering 2. spring semester, period IV;
electronics and communications engineering 3. spring semester;
geosciences 2. spring semester, period IV;
geography 3. semester, periods I and III;
industrial engineering and management 3. year;
information processing sciences 1. or 3. 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;
Master's degree students in industrial engineering and management 1st year.

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 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.

Recommended optional programme components:

In biochemistry the course is completed as a part of 740376A Bachelor's Thesis.

Recommended or required reading:

Web learning material Tieteellisen tiedonhankinnan opas

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

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:

-

Other information:

The course learning platform is Lovelace (lovelace.oulu.fi)

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: Student tutoring, 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:

1-10 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 and employment opportunities for physicists.

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:

Pauli Väisänen

Working life cooperation:

No work placement period

761118P: Mechanics 1, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Aku Venhola

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 2-14. Also older and newer 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: Two midterm exams or final examination
761118P-02: Two laboratory exercises.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Aku Venhola

Working life cooperation:

No work placement period

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
Opettajat: Lauri Hautala
Opintokohteen kielet: Finnish
Leikkaavuudet:

761121P	Physical Measurements I	3.0 op
761121P-01	Laboratory exercises in physics 1, 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 / 135 hours of work

Language of instruction:

Finnish

Timing:

Spring term, periods 3 and 4

Learning outcomes:

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

Contents:

The skill of measuring is important for physicists. This is an introductory course on how to make physical measurements and how to treat the measured data. Laboratory works are made in groups. Laboratory safety is also an essential part of physical measurements. 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 subsequent laboratory courses Laboratory exercises in physics 2 and 3.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

12 hours of lectures, 16 hours of exercises, 107 hours of self-study.

Target group:

Students in physics degree program. Other students studying in University of Oulu can also participate to the course.

Prerequisites and co-requisites:

No specific prerequisites.

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:

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

Assessment methods and criteria:

The assessment is performed using exercises to be completed during the course. Further instructions will be given at the beginning of the course.

Grading:

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

Person responsible:

Lauri Hautala

Working life cooperation:

The course does not contain working life cooperation.

Other information:

Timetables, further instructions and materials can be found from the course website in Moodle (moodle.oulu.fi).

Compulsory

761115P-01: Laboratory Exercises in Physics 1, lecture and exam, 0 op

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

761121P-01	Laboratory exercises in physics 1, exam	0.0 op
761121P-02	Physical measurements I, lab. exercises	0.0 op
761121P	Physical Measurements I	3.0 op

Ei opintojaksokuvauksia.

761115P-02: Laboratory Exercises in Physics 1, laboratory exercises, 0 op

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

761121P-01	Laboratory exercises in physics 1, exam	0.0 op
761121P-02	Physical measurements I, lab. exercises	0.0 op

761121P Physical Measurements I 3.0 op

Ei opintojaksokuvauksia.

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
Opettajat: Lauri Hautala
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).

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Lauri Hautala

Working life cooperation:

No work placement period

Other information:

Moodle

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

766101P: Mathematics for physics, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish, the course can be completed in English

Timing:

First autumn, period 1

Learning outcomes:

The course quickly provides the student the basic mathematical knowledge and skills required in physical sciences. The objective is to learn the basics of differential and integral calculus, methods for solving the most typical first and second order differential equations and the basics of vector differential calculus. After the course the student understands the basic mathematical methods needed in physics and is able to apply them to problems arising in the different physics courses and in research. Another objective is also to understand the geometrical meaning of different mathematical concepts and their connection to physical phenomena.

Contents:

Integral and differential calculus, complex variables and functions, introduction to differential equations, vectors, functions of several variables, differentials and partial derivatives, gradient, divergence, curl, scalar and vector fields, Gauss's and Stokes theorem.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 14 h, exercises 28 h, self-study 90 h

Target group:

Primarily for students who study Physics in the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisities

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and the textbook R. A. Adams, Calculus - A Complete Course.

Assessment methods and criteria:

Continuous evaluation and 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:

moodle.oulu.fi

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
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

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 or individual excercises, webexcercises or final exam.

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 credits / 135 hours of work

Language of instruction:

Language of instruction is Finnish, but the exam and exercises can be done in English if agreed with the lecturer.

Timing:

The course is held in the spring semester during the 4th period. It is recommended to complete the course at the second spring semester.

Learning outcomes:

The student knows structure models 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 is familiar with fission and fusion reactions and how they can be exploited in energy production.
The student knows the standard model classification of elementary 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 structure and properties of nuclei, nuclear forces, nuclear models, radioactivity, nuclear reactions, properties and interactions of elementary particles.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 32 h (of which 4 h can be reserved for 2 mid-term exams), 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 (761313A), Electromagnetism 1 (761119P). Supporting courses Electromagnetism 2 (761312A) and Solid state physics (763343A).

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

Final examination or two intermediate exams.

Grading:

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

Person responsible:

Minna Patanen

Working life cooperation:

The course does not contain working life cooperation.

Other information:

The web page of the course in Moodle

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 credits

Language of instruction:

Finnish

Timing:

2nd spring

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

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

Prerequisites and co-requisites:

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

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 credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Third autumn semester

Learning outcomes:

The student can explain the basic concepts of thermophysics and can show how the following results (see Contents) arise from them at the level they are presented in lectures. In addition, the student can solve such problems that necessitate deep understanding of the content represented in the course.

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

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

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

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, 2016.

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
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

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 credits

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

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 ECTS 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

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 ECTS credits

Language of instruction:

Finnish/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

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

761337A: Practical training, 3 - 6 op

Opiskelumuoto: Intermediate Studies
Laji: Practical training
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opettajat: Lauri Hautala
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

766383A: Climate.Now, 2 - 5 op

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

ay766386A	Climate.Now (OPEN UNI)	2.0 op
766683S	Climate.Now	5.0 op
ay766383A	Climate.Now (OPEN UNI)	2.0 op

ECTS Credits:

2 ECTS credits / 54 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the autumn semester, during periods 1 and 2.

Learning outcomes:

Upon completion of the course, student can:
- look at climate change from many different perspectives and create connections between them as well as look for solutions to the climate challenge in a variety of ways
- reflect her or his own role in climate change and apply what has been learned on the course to her or his field of study
- examine different perspectives, solutions, information sources, and the current debate on climate change critically.

Contents:

Scientific basis of climate change, mitigation of climate, change, effects of climate change and adaptation.

Mode of delivery:

Web-based teaching

Learning activities and teaching methods:

Studying online material and independent study 46 h, learning task 8 h.

Target group:

All students.

Prerequisites and co-requisites:

No prerequisities required.

Recommended optional programme components:

No simultaneous studies.

Recommended or required reading:

Material at DigiCampus, Moodle page of the course.

Assessment methods and criteria:

Course grading is based on the learning task.

Grading:

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

Person responsible:

Jussi Malila

Working life cooperation:

The course does not contain working life cooperation.

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
Opettajat: Lauri Hautala
Opintokohteen kielet: Finnish
Leikkaavuudet:

761121P	Physical Measurements I	3.0 op
761121P-01	Laboratory exercises in physics 1, 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 / 135 hours of work
Language of instruction:
Finnish
Timing:
Spring term, periods 3 and 4
Learning outcomes:
The student can safely make physical measurements, use basic measurement tools, read different scales, handle the data, calculate the error estimations and make a sensible report of the laboratory measurements.
Contents:
The skill of measuring is important for physicists. This is an introductory course on how to make physical measurements and how to treat the measured data. Laboratory works are made in groups. Laboratory safety is also an essential part of physical measurements. 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 subsequent laboratory courses Laboratory exercises in physics 2 and 3.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
12 hours of lectures, 16 hours of exercises, 107 hours of self-study.

Target group:
Students in physics degree program. Other students studying in University of Oulu can also participate to the course.
Prerequisites and co-requisites:
No specific prerequisites.
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:
Study material will be announced at the beginning of the course.
Assessment methods and criteria:
The assessment is performed using exercises to be completed during the course. Further instructions will be given at the beginning of the course.
Grading:
The course utilizes a numerical grading scale 0-5 where zero stands for a fail.
Person responsible:
Lauri Hautala
Working life cooperation:
The course does not contain working life cooperation.
Other information:
Timetables, further instructions and materials can be found from the course website in Moodle (moodle.oulu.fi).

Compulsory

761115P-01: Laboratory Exercises in Physics 1, lecture and exam, 0 op

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

761121P-01	Laboratory exercises in physics 1, exam	0.0 op
761121P-02	Physical measurements I, lab. exercises	0.0 op
761121P	Physical Measurements I	3.0 op

Ei opintojaksokuvauksia.

761115P-02: Laboratory Exercises in Physics 1, laboratory exercises, 0 op

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

761121P-01	Laboratory exercises in physics 1, exam	0.0 op
761121P-02	Physical measurements I, lab. exercises	0.0 op
761121P	Physical Measurements I	3.0 op

Ei opintojaksokuvauksia.

761118P: Mechanics 1, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Aku Venhola

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 2-14. Also older and newer 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: Two midterm exams or final examination
761118P-02: Two laboratory exercises.

Grading:
Numerical grading scale 0 – 5, where 0 = fail

Person responsible:
Aku Venhola

Working life cooperation:
No work placement period

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 and employment opportunities for physicists.
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:
Pauli Väisänen
Working life cooperation:
No work placement period

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 credits

Language of instruction:

Finnish

Timing:

First period at the first semester.

Learning outcomes:

After completing the course, the student:
- is able to understand different proving techniques
- is able to evaluate and justify whether simple statements are true or false
- is able to understand and read text containing mathematical notation
- knows the basic definitions and concepts related to set theory and functions

Contents:

The course in an introduction to mathematical deduction and introduces different types of proof techniques. Special attention is paid to mathematical reading and writing skills and justifying reasoning. 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:

Exercises and final exam.

Grading:

Pass/Fail

Person responsible:

Topi Törmä

Working life cooperation:

No

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, fail

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, LU - factorization of a matrix.

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 credits

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

Opettajat: Pekka Salmi

Opintokohteen kielet: Finnish

Leikkaavuudet:

802119P Linear Algebra II 5.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish and English

Timing:

2nd year, 3rd 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:

-

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

No

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 credits

Language of instruction:

Finnish

Timing:

4th period. Students of mathematics and physics: 1st 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, instructed group work 26-28 h, independent study 89 h. Groups return their group tasks. Additional independently implemented learning tasks. Independent study includes also preparation for group work.

Target group:

Students of mathematical and physical sciences. Students of other degree programmes: 806118P, 806119P

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 tasks (including e.g. learning diaries and web tests) are assessed weekly. The assessment of the course is based on the learning outcomes of the course. The more detailed assessment criteria will be available in the beginning 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:

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, fail

Person responsible:

Erkki Laitinen

Working life cooperation:

no

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 credits

Language of instruction:

Finnish

Timing:

1. year, 3. period

Learning outcomes:

After completing the course, student is able to:

- derive and proof main results 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, fail

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 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:

Mid-term exams and/or final exam. Active participation in 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:

Hanna Heikkinen

Working life cooperation:

-

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

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.

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, fail

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
Opettajat: Mahmoud Filali
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

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, fail

Person responsible:

Mahmoud Filali

Working life cooperation:

-

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, fail

Person responsible:

Erkki Laitinen

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 credits

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

After completion of the course, the student:
- can work with random variables in theory and practice
- can use two-dimensional discrete and continuous distributions in problems
- can recognize two-dimensional normal distribution and work with those
- can work with conditional distributions and conditional expectations
- can explain the fundamental results of probability such as the Law of Large Numbers and the Central Limit Theorem
- can determine moment generating functions of random variables and apply them for example to determine moments.

Contents:

Central topics are two-dimensional discrete and continuous distributions, conditional distribution, conditional expectation, two-dimensional normal distribution, moments, moment generating function, the Law of Large Numbers, the Central Limit Theorem.

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:

-

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:

ay802136P	Introduction to Cryptography	2.0 op
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 and twice in the summer

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 Moodle) + 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

Opettajat: Pekka Salmi

Opintokohteen kielet: Finnish

Leikkaavuudet:

801389A	Basic Geometry for University Students	6.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd to 5th year

Learning outcomes:

After completion of the course, the student can use geometric axioms to justify simple geometric results and apply axioms and known results in geometric problems and deductions.

Contents:

The course is an introduction to axiomatic geometry from a modern viewpoint. Using geometric axioms, we first derive the concept of vector and vectors are used in the study of geometry.
We first study affine geometry and then Euclidean geometry. Some classical results such as Ceva's theorem are derived. Finally, we consider area and volume.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28 hours lectures, 14 hours tutorials, 91 hours independent work

Target group:

Major and minor students in mathematics

Prerequisites and co-requisites:

Linear algebra

Recommended or required reading:

Lecture notes. Literature: John Roe, Elementary Geometry, Oxford University Press, Oxford, 1993.

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

No

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:

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

Target group:

Mathematics majors

Prerequisites and co-requisites:

800328A Calculus of several variables

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Ville Suomala

Working life cooperation:

No

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
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

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 Basics in Algebra
802355A Algebraic Structures

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:

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

Grading:

1-5, fail

Person responsible:

Marko Leinonen

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, 3rd 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

Person responsible:

Valery Serov

Working life cooperation:

No

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:

-

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 ECTS credits / 42 hours of work

Language of instruction:

English

Timing:

The course is held in the autumn semester, during the period 1. It is recommended to complete the course at the first autumn semester.

Learning outcomes:

Upon completition of the course, the student will be able to:
1. Apply the fundamental theorem of integration in complex sense to some concrete functions.
2. Represent functions via power series (for analytic functions) via Laurent expansions (for functions with singularities).
3. Calculate the residues and some classes of integrals using residue theory.
4. Calculate some classes of series by residue theory.
5. Use Laplace transform for solutions of ODEs.

Contents:

1. Fundamental theorem of integration.
2. Harmonic functions and mean value formulae.
3. Liouville’s theorem and fundamental theorem of algebra.
4. Representation of analytic functions via the power series.
5. Laurent expansions.

6. Residues and their calculus.
7. The principle of the argument and Rouche's theorem.
8. Calculations of integrals by residue theory.
9. Calculation of series by residue theory.
10. Laplace transform.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 14 h / Self-study at least 20 h.

Target group:

No specific targets except passing final exam w.r.t. the content and outcomes (see previous parts).

Prerequisites and co-requisites:

Complex Analysis (031077P)
Calculus of several variables including multidimenional integral (Calculus of several variables 800328A)

Recommended or required reading:

Any book in Complex Analysis, in particular Lecture Notes of V.S. Serov "Complex Analysis, Second Edition", Oulu University Press, 2017.

Assessment methods and criteria:

Final Exam

Grading:

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

Person responsible:

Valery Serov

Working life cooperation:

The course does not contain working life cooperation.

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:

Online 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. The exams are remote exams. It is possibility to take exams also at the university.
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:

-

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
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

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:

Erkki Laitinen

Working life cooperation:

-

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 credits

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

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.

The course, Introduction to Optimization, will be lectured remotely through the ZOOM video conferencing tool. The more detailed instructions and access to ZOOM lectures can be found in the Moodle work space of the course. The link is here: https://moodle.oulu.fi/course/view.php?id=5350.

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:

The course, Introduction to Optimization, will be lectured remotely through the ZOOM video conferencing tool. The more detailed instructions and access to ZOOM lectures can be found in the Moodle work space of the course. The link is here: https://moodle.oulu.fi/course/view.php?id=5350.

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.

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 study the effect of sampling on the 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:

The lectures and exercise classes will be arranged as distance learning via Zoom. The Zoom-links, directions and other material (in Finnish) will be made available in the Moodle-workspace for the course, which can be found at https://moodle.oulu.fi/course/view.php?id=5361

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 Processing. Shanmugan, K.S., Breipohl, A.M.: Random Signals, Detection, Estimation and Data Analysis.

Assessment methods and criteria:

The course is completed with mid-term exams or a final exam. When completed with mid-term exams, exercise assignments are part of the continuous assessment. The assessment of the course is based on the learning outcomes of the course.

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:

-

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

ECTS Credits:

5 ECTS credits

Person responsible:

Erkki Laitinen

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

Language of instruction:

Finnish

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 credits

Language of instruction:

Finnish

Timing:

First period at the first semester.

Learning outcomes:

After completing the course, the student:
- is able to understand different proving techniques
- is able to evaluate and justify whether simple statements are true or false
- is able to understand and read text containing mathematical notation
- knows the basic definitions and concepts related to set theory and functions

Contents:

The course in an introduction to mathematical deduction and introduces different types of proof techniques. Special attention is paid to mathematical reading and writing skills and justifying reasoning. 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:

Exercises and final exam.

Grading:

Pass/Fail

Person responsible:

Topi Törmä

Working life cooperation:

No

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, LU - factorization of a matrix.

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 credits

Language of instruction:

Finnish

Timing:

4th period. Students of mathematics and physics: 1st 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, instructed group work 26-28 h, independent study 89 h. Groups return their group tasks. Additional independently implemented learning tasks. Independent study includes also preparation for group work.

Target group:

Students of mathematical and physical sciences. Students of other degree programmes: 806118P, 806119P

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 tasks (including e.g. learning diaries and web tests) are assessed weekly. The assessment of the course is based on the learning outcomes of the course. The more detailed assessment criteria will be available in the beginning 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:

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 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:

Mid-term exams and/or final exam. Active participation in 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:

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, fail

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 credits

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
Opettajat: Pekka Salmi
Opintokohteen kielet: Finnish
Leikkaavuudet:

802119P Linear Algebra II 5.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish and English

Timing:

2nd year, 3rd 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:

-

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

No

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 credits

Language of instruction:

Finnish

Timing:

1. year, 3. period

Learning outcomes:

After completing the course, student is able to:

- derive and proof main results 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, fail

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

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 ECTS credits

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

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.

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, fail

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
Opettajat: Mahmoud Filali
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

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, fail

Person responsible:

Mahmoud Filali

Working life cooperation:

-

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, fail

Person responsible:

Erkki Laitinen

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 credits

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

After completion of the course, the student:
- can work with random variables in theory and practice
- can use two-dimensional discrete and continuous distributions in problems
- can recognize two-dimensional normal distribution and work with those
- can work with conditional distributions and conditional expectations
- can explain the fundamental results of probability such as the Law of Large Numbers and the Central Limit Theorem
- can determine moment generating functions of random variables and apply them for example to determine moments.

Contents:

Central topics are two-dimensional discrete and continuous distributions, conditional distribution, conditional expectation, two-dimensional normal distribution, moments, moment generating function, the Law of Large Numbers, the Central Limit Theorem.

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:

-

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:

ay802136P	Introduction to Cryptography	2.0 op
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 and twice in the summer

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 Moodle) + 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

Opettajat: Pekka Salmi

Opintokohteen kielet: Finnish

Leikkaavuudet:

801389A Basic Geometry for University Students 6.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd to 5th year

Learning outcomes:

After completion of the course, the student can use geometric axioms to justify simple geometric results and apply axioms and known results in geometric problems and deductions.

Contents:

The course is an introduction to axiomatic geometry from a modern viewpoint. Using geometric axioms, we first derive the concept of vector and vectors are used in the study of geometry.
We first study affine geometry and then Euclidean geometry. Some classical results such as Ceva's theorem are derived. Finally, we consider area and volume.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28 hours lectures, 14 hours tutorials, 91 hours independent work

Target group:

Major and minor students in mathematics

Prerequisites and co-requisites:

Linear algebra

Recommended or required reading:

Lecture notes. Literature: John Roe, Elementary Geometry, Oxford University Press, Oxford, 1993.

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

No

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:

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

Target group:

Mathematics majors

Prerequisites and co-requisites:

800328A Calculus of several variables

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Ville Suomala

Working life cooperation:

No

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
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

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 Basics in Algebra
802355A Algebraic Structures

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:

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

Grading:

1-5, fail

Person responsible:

Marko Leinonen

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, 3rd 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

Person responsible:

Valery Serov

Working life cooperation:

No

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:

-

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 ECTS credits / 42 hours of work

Language of instruction:

English

Timing:

The course is held in the autumn semester, during the period 1. It is recommended to complete the course at the first autumn semester.

Learning outcomes:

Upon completition of the course, the student will be able to:
1. Apply the fundamental theorem of integration in complex sense to some concrete functions.
2. Represent functions via power series (for analytic functions) via Laurent expansions (for functions with singularities).
3. Calculate the residues and some classes of integrals using residue theory.
4. Calculate some classes of series by residue theory.
5. Use Laplace transform for solutions of ODEs.

Contents:

1. Fundamental theorem of integration.
2. Harmonic functions and mean value formulae.
3. Liouville's theorem and fundamental theorem of algebra.
4. Representation of analytic functions via the power series.
5. Laurent expansions.
6. Residues and their calculus.
7. The principle of the argument and Rouche's theorem.
8. Calculations of integrals by residue theory.
9. Calculation of series by residue theory.
10. Laplace transform.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 14 h / Self-study at least 20 h.

Target group:

No specific targets except passing final exam w.r.t. the content and outcomes (see previous parts).

Prerequisites and co-requisites:

Complex Analysis (031077P)
Calculus of several variables including multidimenional integral (Calculus of several variables 800328A)

Recommended or required reading:

Any book in Complex Analysis, in particular Lecture Notes of V.S. Serov "Complex Analysis, Second Edition", Oulu University Press, 2017.

Assessment methods and criteria:

Final Exam

Grading:

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

Person responsible:

Valery Serov

Working life cooperation:

The course does not contain working life cooperation.

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:

Online 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. The exams are remote exams. It is possibility to take exams also at the university.
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:

-

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

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

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:

Erkki Laitinen

Working life cooperation:

-

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 credits

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

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.
The course, Introduction to Optimization, will be lectured remotely through the ZOOM video conferencing tool. The more detailed instructions and access to ZOOM lectures can be found in the Moodle work space of the course. The link is here: https://moodle.oulu.fi/course/view.php?id=5350.

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:

The course, Introduction to Optimization, will be lectured remotely through the ZOOM video conferencing tool. The more detailed instructions and access to ZOOM lectures can be found in the Moodle work space of the course. The link is here: https://moodle.oulu.fi/course/view.php?id=5350.

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.

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 study the effect of sampling on the 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:

The lectures and exercise classes will be arranged as distance learning via Zoom. The Zoom-links, directions and other material (in Finnish) will be made available in the Moodle-workspace for the course, which can be found at https://moodle.oulu.fi/course/view.php?id=5361

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 Processing. Shanmugan, K.S., Breipohl, A.M.: Random Signals, Detection, Estimation and Data Analysis.

Assessment methods and criteria:

The course is completed with mid-term exams or a final exam. When completed with mid-term exams, exercise assignments are part of the continuous assessment. The assessment of the course is based on the learning outcomes of the course.

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:

-

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

ECTS Credits:

5 ECTS credits

Person responsible:

Erkki Laitinen

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. Recemmended 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

Language of instruction:

Finnish

Person responsible:

Kari Myllylä

A325705: Space Physics Minor, 25 - 60 op

Voimassaolo: 01.01.2019 -
Opiskelumuoto: Basic Studies

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

Ei opintojaksokuvauksia.

Mandatory courses

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 credits

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.)

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

766355A: Basics of space physics, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766345A Basics of space physics 6.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish / English

Timing:

Every year.

Learning outcomes:

The student identifies and is capable of naming the basic concepts and processes of the Sun, solar wind, magnetosphere and ionosphere. She/he can explain the reasons for different phenomena in space physics and apply the theory to solve simple problems.

Contents:

This lecture course gives the basic knowledge of the processes taking place in the near-Earth space. In the interplanetary space, the solar wind is a continuous plasma flow emerging from the Sun. It compresses the magnetic field of the Earth into a region with a cometary shape, called the magnetosphere. The solar radiation and charged particles precipitating from the magnetosphere ionise the upper part of the atmosphere thus creating the ionosphere. Bursts of plasma and high-energy particles from the Sun cause disturbances in the surrounding space. These phenomena create the varying space weather. The space weather may affect e.g. telecommunication links, electrical power networks, operation of satellites and safety of astronauts. Northern lights is one form of space weather. This course deals the phenomena described above.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h (7 pcs), 85 h of self-studies.

Target group:

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

Prerequisites and co-requisites:

Basic knowledge of mechanics and electromagnetism.

Recommended optional programme components:

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

Recommended or required reading:

K. Mursula: Avaruusfysiikan perusteet (Basics of Space physics; in Finnish; distributed on Moodle). Supporting material: H. Koskinen: Johdatus plasmafysiikkaan ja sen avaruussovellutuksiin (Limes ry); A. Brekke: Physics of the upper polar atmosphere (Wiley & Sons).

Assessment methods and criteria:

Final examination, see details on course Moodle page.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Anita Aikio

Working life cooperation:

No work placement period

761354A: Introduction to research in space physics, 5 op

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

ECTS Credits:

5 ECTS credits / 135 h of work

Language of instruction:

Finnish, but can be lectured also in English if needed

Timing:

Spring 3.-4. periods, recommended timing 3rd year spring

Learning outcomes:

Upon completion of the course, the student:
- is familiar with the basics of Matlab programming
- is familiar with various types of datasets commonly used in space physics research
- can operate and analyse space physics data in Matlab
- can apply statistical analysis methods commonly used in space physics research
- can complete small research assignments and write simple reports of them

Contents:

The course first gives an introduction of Matlab programming. We then familiarize with different types of datasets commonly used in space physics research. We learn various statistical analysis methods and how to apply them in Matlab for various space physics research problems.

Mode of delivery:

Face-to-face teaching + web-based teaching

Learning activities and teaching methods:

Course has joint 20 h of lectures/exercises and 115 h of project works.

Target group:

Course is targeted, e.g., to physics students specializing in space physics in their B.Sc. and/or M.Sc. studies. The course is useful also to other physics and mathematics students interested in Matlab data analysis.

Prerequisites and co-requisites:

Recommended prerequisites are 521141P Elementary programming (or something similar), 766355A Basics of space physics. Also 805305A Introduction to Regression and Analysis of Variance, and 806311A Introduction to Multivariate Methods are recommended.

Recommended optional programme components:

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

Assessment methods and criteria:

During the course the students complete a set of project works, which will be assessed separately. The final assessment of the course is based on the average of the project works.

Grading:

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

Person responsible:

Timo Asikainen and Heikki Vanhamäki

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. Recemmended 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. Recemmended 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

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
Opintokohteen kielet: Finnish
Leikkaavuudet:

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

ECTS Credits:

5 ECTS credits

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

764125P: Foundations of cellular biophysics, 5 op

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

764115P	Foundations of cellular biophysics	4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd spring

Learning outcomes:

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

Contents:

In this course cellular function is considered from the point of 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).

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.

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

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761116P	Radiation physics, biology and safety	3.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish

Timing:

Spring term, 3. period

Learning outcomes:

After completing the course, the student:

- can describe the physical origin of different types of radiation and their interaction with matter,
- can explain the essential effects ionizing radiation has on human body and
- knows what rules and regulations govern the use of radiation in Finland.

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 in the industry and research. The biologic effects of radiation and legislation related to radiation safety are also discussed.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

14 hours of lectures, 14 hours of exercises, 107 hours of self-study

Target group:

Students in physics degree program. Other students studying in University of Oulu can also participate to the course.

Prerequisites and co-requisites:

Broad studies in high school physics and basics from high school chemistry and biology.

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 material (in Finnish), ”säteily- ja ydinturvallisuus” book series produced by säteilyturvakeskus and other material provided during the course.

Assessment methods and criteria:

Exercise problems. Further instructions will be given at the beginning of the course.

Grading:

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

Person responsible:

Juho Keskinen

Working life cooperation:

The course does not contain working life cooperation.

Other information:

Timetables, further instructions and materials can be found from the course website in Moodle (moodle.oulu.fi).

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 ECTS 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, Seppo Alanko, Lauri Hautala

Working life cooperation:

No work placement period

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 credits

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:

Kyösti Heimonen

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 credits

Language of instruction:

Finnish / English depending on the audience

Timing:

3rd autumn

Learning outcomes:

The most important goal of the course is the development of a quantum mechanical frame-of-mind. After the course, the student knows the postulates of quantum mechanics and can solve the Schrödinger equation in such one- and three-dimensional problems that have important applications in condensed matter physics and in atomic, nuclear and molecular physics. The student will also learn to derive the uncertainty principle and use it to interpret what happens in a quantum mechanical measurement.

Contents:

Quantum mechanics, together with the general theory of relativity, lays the foundation for the modern scientific understanding of the nature. Recent developments in nanotechnology has also brought quantum-based applications into our everyday lives. However, the greatest influence quantum mechanics brings is on how we understand and interpret the behavior of the basic building blocks of nature. One of the interesting results of quantum mechanics is the uncertainty principle which means, for example, that a particle does not possess well defined position and velocity at a given time. This has far-reaching consequences in our understanding of the structure of matter, and even of the present amount and distribution of galaxies in the known universe. The inherent indeterminacy in the classical state of the particles implies that the microscopic particles have to be described with the so-called wave function, which determines the probability density of finding the particle at an arbitrary location. The course begins with the introduction of the basic principles and postulates of quantum mechanics. As an example, several one-dimensional problems for the time-evolution of the wave function are solved. The uncertainty principle is derived in its general form, and applied to the simultaneous measurement of position and velocity. In three-dimensional problems, spherical symmetry is connected with the angular momentum. The corresponding operators and quantum numbers are derived. As an example, the quantized energy states of hydrogen atom are solved. The general formulation of quantum mechanics in terms of abstract Hilbert space and its linear transformations is presented, and shown to be equivalent with the wave function formalism. The properties of the general theory are illustrated in terms of the two quantum paradigms: the two-level system and the
harmonic oscillator.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 50 h, 12 exercises (á 3 h), self-study and examination 184 h

Target group:

Compulsory for theoretical physicists and physicists. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

Atomic physics (766326A) and knowledge of linear algebra and differential equations.

Recommended optional programme components:

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

Recommended or required reading:

J. Tuorila: Kvanttimekaniikka I (2013, in Finnish). D. Griffiths: Introduction to Quantum Mechanics (2005).

Assessment methods and criteria:

Two written intermediate examinations or one final examination.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Matti Alatalo

Working life cooperation:

No work placement period

763313A: Quantum mechanics II, 10 op

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

Opintokohteen kielet: Finnish

Leikkaavuudet:

763613S Quantum mechanics II 10.0 op

ECTS Credits:

10 ECTS credits

Language of instruction:

English (or Finnish, depending on the participants)

Timing:

3rd spring

Learning outcomes:

Course continues the development of the quantum mechanical frame-of-mind. After the course, the student can solve different physical eigenvalue problems by using matrices, can calculate the quantum numbers of the system, and can estimate the effect of a perturbation. The student can also solve problems that arise in low-energy scattering.

Contents:

Quantum mechanics of two and many particle systems is discussed in the context of, e.g.the periodic table of elements and the band structure of solids. For atomic, molecular and nuclear physics, the essential quantity in classifying states is the angular momentum, which we study in detail including the particle spin. Effects of weak perturbations are studied in terms of time-independent and time-dependent perturbation theory. As an example, we calculate fine-structure corrections to hydrogen atom, Zeeman effect, and the bound states of ionic Hydrogen molecule and He-atom. We derive the Fermi golden rule to calculate radiation induced transition rates between eigenstates. Finally we study interactions between particles using scattering theory. Concepts such as cross section, phase shift, scattering amplitude and Green's function are introduced.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 50 h, 12 exercises, self-study and examination 184 h

Target group:

For all interested in modern, quantum phenomena, compulsory for theoretical physicists. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

Quantum Mechanics I (763312A).

Recommended optional programme components:

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

Recommended or required reading:

J. Tuorila: Kvanttimekaniikka II (2014, in Finnish). D. Griffiths: Introduction to Quantum Mechanics (2005).

Assessment methods and criteria:

Two written intermediate examinations or one final examination.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Matti Silveri

Working life cooperation:

No work placement period

Alternative

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

Leikkaavuudet:

763310A Analytical mechanics 6.0 op

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 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 half of the course we go momentarily 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. In the latter part of the course we discuss the Lagrangian formulation of classical mechanics. It is an alternative but equivalent way 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 equations of motion, which often simplify the study of complex dynamical systems. Many important concepts in quantum mechanics have counterparts in the Lagrangian formulation of classical mechanics.

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:

Mechanics 1. Basics of vectors and differential and integral calculus. Course "Calculus of several variables" should be taken at the same time as Mechanics 2 (at the latest). Introduction to matrices and/or linear algebra may be usefull as well.

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

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 credits

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, 11 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.

Grading:

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

Person responsible:

Jussi Malila

766315A: Numerical modelling, 5 op

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

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish

Timing:

The course is held during the autumn semester, during periods 1 and 2.

Learning outcomes:

The aim of the course is that student:

- knows and recognises most important numerical methods used in physical sciences.
- can solve common numerical problems in physics using a software package for symbolical calulations.

Contents:

Course introduces to Mathematic, which is used to obtain analytical or numerical solutions for various scientific problems. Examples include problems in mechanics, radioactivity, RLC-circuits and heat transfer.

Mode of delivery:

Course is delivered using web-based teaching, but contains an introductory face-to-face session.

Learning activities and teaching methods:

Lectures 2 h / independent work with web-based material, practices 127 h / guidance sessions (in web platform) 6 h

Target group:

Course is aimed for students in physics, esp. theoretical physics.

Prerequisites and co-requisites:

Knowledge of basic studies in physics and mathematics is required.

Recommended optional programme components:

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

Recommended or required reading:

Learning material in Moodle.

Assessment methods and criteria:

Course assessment is based on practice questions.

Grading:

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

Person responsible:

Jussi Malila

Working life cooperation:

The course does not contain 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
Opintokohteen kielet: Finnish
Leikkaavuudet:

761116P Radiation physics, biology and safety 3.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish

Timing:

Spring term, 3. period

Learning outcomes:

After completing the course, the student:
- can describe the physical origin of different types of radiation and their interaction with matter,
- can explain the essential effects ionizing radiation has on human body and
- knows what rules and regulations govern the use of radiation in Finland.

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 in the industry and research. The biologic effects of radiation and legislation related to radiation safety are also discussed.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

14 hours of lectures, 14 hours of exercises, 107 hours of self-study

Target group:

Students in physics degree program. Other students studying in University of Oulu can also participate to the course.

Prerequisites and co-requisites:

Broad studies in high school physics and basics from high school chemistry and biology.

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 material (in Finnish), ”säteily- ja ydinturvallisuus” book series produced by säteilyturvakeskus and other material provided during the course.

Assessment methods and criteria:

Exercise problems. Further instructions will be given at the beginning of the course.

Grading:

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

Person responsible:

Juho Keskinen

Working life cooperation:

The course does not contain working life cooperation.

Other information:

Timetables, further instructions and materials can be found from the course website in Moodle (moodle.oulu.fi).

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

Opettajat: Lauri Hautala

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 / 135 hours of work

Language of instruction:

Finnish

Timing:

The course is continuously on-going. The course can be started by signing to a laboratory exercise session at “Fysiikan opetuslaboratorio” in Moodle. The recommended time of completion is after Laboratory exercises in physics 1 and 2 courses.

Learning outcomes:

After the course, a student is capable of planning, performing, handling the data and reporting results from physical measurements. Student is 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 a wide range of physics phenomena in laboratory circumstances. Exercises already included in the course "Laboratory exercises in physics 2" may not be selected. It is also possible to include a research related exercise to the course (worth 1 ECTS credit /exercise, max. 1 exercise/research group) where students are included in the daily research of a research group. Research related exercises are to be agreed with a supervising researcher and the course responsible.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Laboratory exercises performed independently

Target group:

Physics degree program students

Prerequisites and co-requisites:

761115P Laboratory exercises in physics 1 and 761120P Laboratory exercises in physics 2.

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:

Laboratory exercise instructions and possible other material.

Assessment methods and criteria:

The course consists of laboratory exercises which the student performs as many as is required by the number of overall course credits. Each exercise is worth 0.5-1 ECTS credits depending on the exercise.

Grading:

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

Person responsible:

Lauri Hautala

Working life cooperation:

The course does not contain working life cooperation.

Other information:

Sign-up for the laboratory exercises is done through “Fysiikan opetuslaboratorio” named workspace in Moodle (moodle.oulu.fi).

763312A: Quantum mechanics I, 10 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763612S	Quantum mechanics I	10.0 op

ECTS Credits:

10 ECTS credits

Language of instruction:

Finnish / English depending on the audience

Timing:

3rd autumn

Learning outcomes:

The most important goal of the course is the development of a quantum mechanical frame-of-mind. After the course, the student knows the postulates of quantum mechanics and can solve the Schrödinger equation in such one- and three-dimensional problems that have important applications in condensed matter physics and in atomic, nuclear and molecular physics. The student will also learn to derive the uncertainty principle and use it to interpret what happens in a quantum mechanical measurement.

Contents:

Quantum mechanics, together with the general theory of relativity, lays the foundation for the modern scientific understanding of the nature. Recent developments in nanotechnology has also brought quantum-based applications into our everyday lives. However, the greatest influence quantum mechanics brings is on how we understand and interpret the behavior of the basic building blocks of nature. One of the interesting results of quantum mechanics is the uncertainty principle which means, for example, that a particle does not possess well defined position and velocity at a given time. This has far-reaching consequences in our understanding of the structure of matter, and even of the present amount and distribution of galaxies in the known universe. The inherent indeterminacy in the classical state of the particles implies that the microscopic particles have to be described with the so-called wave function, which determines the probability density of finding the particle at an arbitrary location. The course begins with the introduction of the basic principles and postulates of quantum mechanics. As an example, several one-dimensional problems for the time-evolution of the wave function are solved. The uncertainty principle is derived in its general form, and applied to the simultaneous measurement of position and velocity. In three-dimensional problems, spherical symmetry is connected with the angular momentum. The corresponding operators and quantum numbers are derived. As an example, the quantized energy states of hydrogen atom are solved. The general formulation of quantum mechanics in terms of abstract Hilbert space and its

linear transformations is presented, and shown to be equivalent with the wave function formalism. The properties of the general theory are illustrated in terms of the two quantum paradigms: the two-level system and the
harmonic oscillator.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 50 h, 12 exercises (á 3 h), self-study and examination 184 h

Target group:

Compulsory for theoretical physicists and physicists. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

Atomic physics (766326A) and knowledge of linear algebra and differential equations.

Recommended optional programme components:

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

Recommended or required reading:

J. Tuorila: Kvanttimekaniikka I (2013, in Finnish). D. Griffiths: Introduction to Quantum Mechanics (2005).

Assessment methods and criteria:

Two written intermediate examinations or one final examination.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Matti Alatalo

Working life cooperation:

No work placement period

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 ECTS 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, Seppo Alanko, Lauri Hautala

Working life cooperation:

No work placement period

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 credits

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.)

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

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 credits

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.

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

766355A: Basics of space physics, 5 op

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

766345A	Basics of space physics	6.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish / English

Timing:

Every year.

Learning outcomes:

The student identifies and is capable of naming the basic concepts and processes of the Sun, solar wind, magnetosphere and ionosphere. She/he can explain the reasons for different phenomena in space physics and apply the theory to solve simple problems.

Contents:

This lecture course gives the basic knowledge of the processes taking place in the near-Earth space. In the interplanetary space, the solar wind is a continuous plasma flow emerging from the Sun. It compresses the magnetic field of the Earth into a region with a cometary shape, called the magnetosphere. The solar radiation and charged particles precipitating from the magnetosphere ionise the upper part of the atmosphere thus creating the ionosphere. Bursts of plasma and high-energy particles from the Sun cause disturbances in the surrounding space. These phenomena create the varying space weather. The space weather may affect e.g. telecommunication links, electrical power networks, operation of satellites and safety of astronauts. Northern lights is one form of space weather. This course deals the phenomena described above.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h (7 pcs), 85 h of self-studies.

Target group:

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

Prerequisites and co-requisites:

Basic knowledge of mechanics and electromagnetism.

Recommended optional programme components:

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

Recommended or required reading:

K. Mursula: Avaruusfysiikan perusteet (Basics of Space physics; in Finnish; distributed on Moodle). Supporting material: H. Koskinen: Johdatus plasmafysiikkaan ja sen avaruussovellutuksiin (Limes ry); A. Brekke: Physics of the upper polar atmosphere (Wiley & Sons).

Assessment methods and criteria:

Final examination, see details on course Moodle page.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Anita Aikio

Working life cooperation:

No work placement period

765307A: Research Project of Astronomy I, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikki Salo

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish or English

Timing:

3rd-4th period, 2nd Spring

Learning outcomes:

Student is able to use computer in processing and visualizing astronomical data.

Mode of delivery:

Face-to-face teaching, independent study

Learning activities and teaching methods:

Lectures 21 h and study project, self-study 115 h

Target group:

Students in astronomy

Prerequisites and co-requisites:

No

Recommended optional programme components:

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

Recommended or required reading:

Lecture material

Assessment methods and criteria:

Quality of the project report

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Heikki Salo, Vitaly Neustroev, Sebastien Comeron, Jürgen Schmidt, Aaron Watkins, Joachim Janz, Xiaodong Liu

Working life cooperation:

No

Alternative

765309A: Galaxies, 5 op

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

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

ECTS Credits:

5 ECTS credits / 133 hour of work

Language of instruction:

English

Timing:

2nd - 4th year, period 2.

Learning outcomes:

Student recognizes the main components of galaxies and can apply them to classify galaxies. Student can describe the theories of formation of galactic structures. Student can solve mathematical problems related to the course and recognizes the terminology well enough to be able to read scientific publications.

Contents:

We begin with the classification of galaxies, which introduces many of the concepts needed in the course. Most of the large galaxies are either spiral galaxies or elliptical galaxies. We study the structure and kinematics in both these galaxy types, including the theories of spiral formation. Especial emphasis is placed on our own galaxy, the Milky Way. We also examine the structure in larger scale: groups and clusters of galaxies.

Mode of delivery:

Face-to-face-teaching

Learning activities and teaching methods:

Lectures 36 h, exercises, self-study 107 h

Target group:

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

Prerequisites and co-requisites:

Fundamentals of astronomy (recommended).

Recommended optional programme components:

No alternative course units of course units that should be completed simultaneuously.

Recommended or required reading:

Sparke, L., Gallagher, J.: Galaxies in the Universe, Cambridge, 2nd ed., 2007.

Assessment methods and criteria:

One written examination.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Aku Venhola, Joachim Janz

Working life cooperation:

No work placement period

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

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, fail
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

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.

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, fail

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
Opettajat: Mahmoud Filali
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

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, fail

Person responsible:

Mahmoud Filali

Working life cooperation:

-

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, fail

Person responsible:

Erkki Laitinen

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 credits

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

After completion of the course, the student:
- can work with random variables in theory and practice
- can use two-dimensional discrete and continuous distributions in problems
- can recognize two-dimensional normal distribution and work with those
- can work with conditional distributions and conditional expectations
- can explain the fundamental results of probability such as the Law of Large Numbers and the Central Limit Theorem
- can determine moment generating functions of random variables and apply them for example to determine moments.

Contents:

Central topics are two-dimensional discrete and continuous distributions, conditional distribution, conditional expectation, two-dimensional normal distribution, moments, moment generating function, the Law of Large Numbers, the Central Limit Theorem.

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:

-

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:

ay802136P	Introduction to Cryptography	2.0 op
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 and twice in the summer

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 Moodle) + 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

Opettajat: Pekka Salmi

Opintokohteen kielet: Finnish

Leikkaavuudet:

801389A	Basic Geometry for University Students	6.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd to 5th year

Learning outcomes:

After completion of the course, the student can use geometric axioms to justify simple geometric results and apply axioms and known results in geometric problems and deductions.

Contents:

The course is an introduction to axiomatic geometry from a modern viewpoint. Using geometric axioms, we first derive the concept of vector and vectors are used in the study of geometry.
We first study affine geometry and then Euclidean geometry. Some classical results such as Ceva's theorem are derived. Finally, we consider area and volume.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28 hours lectures, 14 hours tutorials, 91 hours independent work

Target group:

Major and minor students in mathematics

Prerequisites and co-requisites:

Linear algebra

Recommended or required reading:

Lecture notes. Literature: John Roe, Elementary Geometry, Oxford University Press, Oxford, 1993.

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

No

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:

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

Target group:

Mathematics majors

Prerequisites and co-requisites:

800328A Calculus of several variables

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Ville Suomala

Working life cooperation:

No

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
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

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 Basics in Algebra
802355A Algebraic Structures

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:

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

Grading:

1-5, fail

Person responsible:

Marko Leinonen

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, 3rd 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

Person responsible:

Valery Serov

Working life cooperation:

No

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:

-

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 ECTS credits / 42 hours of work

Language of instruction:

English

Timing:

The course is held in the autumn semester, during the period 1. It is recommended to complete the course at the first autumn semester.

Learning outcomes:

Upon completition of the course, the student will be able to:
1. Apply the fundamental theorem of integration in complex sense to some concrete functions.
2. Represent functions via power series (for analytic functions) via Laurent expansions (for functions with singularities).
3. Calculate the residues and some classes of integrals using residue theory.
4. Calculate some classes of series by residue theory.
5. Use Laplace transform for solutions of ODEs.

Contents:

1. Fundamental theorem of integration.
2. Harmonic functions and mean value formulae.
3. Liouville’s theorem and fundamental theorem of algebra.
4. Representation of analytic functions via the power series.
5. Laurent expansions.
6. Residues and their calculus.
7. The principle of the argument and Rouche’s theorem.
8. Calculations of integrals by residue theory.
9. Calculation of series by residue theory.
10. Laplace transform.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 14 h / Self-study at least 20 h.

Target group:

No specific targets except passing final exam w.r.t. the content and outcomes (see previous parts).

Prerequisites and co-requisites:

Complex Analysis (031077P)
Calculus of several variables including multidimenional integral (Calculus of several variables 800328A)

Recommended or required reading:

Any book in Complex Analysis, in particular Lecture Notes of V.S. Serov ”Complex Analysis, Second Edition”, Oulu University Press, 2017.

Assessment methods and criteria:

Final Exam

Grading:

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

Person responsible:

Valery Serov

Working life cooperation:

The course does not contain working life cooperation.

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:

Online 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. The exams are remote exams. It is possibility to take exams also at the university.
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:

-

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
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

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:

Erkki Laitinen

Working life cooperation:

-

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 credits

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

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.
The course, Introduction to Optimization, will be lectured remotely through the ZOOM video conferencing tool. The more detailed instructions and access to ZOOM lectures can be found in the Moodle work space of the course. The link is here: https://moodle.oulu.fi/course/view.php?id=5350.

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:

The course, Introduction to Optimization, will be lectured remotely through the ZOOM video conferencing tool. The more detailed instructions and access to ZOOM lectures can be found in the Moodle work space of the course. The link is here: https://moodle.oulu.fi/course/view.php?id=5350.

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.

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 study the effect of sampling on the 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:

The lectures and exercise classes will be arranged as distance learning via Zoom. The Zoom-links, directions and other material (in Finnish) will be made available in the Moodle-workspace for the course, which can be found at https://moodle.oulu.fi/course/view.php?id=5361

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 Processing. Shanmugan, K.S., Breipohl, A.M.: Random Signals, Detection, Estimation and Data Analysis.

Assessment methods and criteria:

The course is completed with mid-term exams or a final exam. When completed with mid-term exams, exercise assignments are part of the continuous assessment. The assessment of the course is based on the learning outcomes of the course.

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:

-

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

ECTS Credits:

5 ECTS credits

Person responsible:

Erkki Laitinen

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. Recemmended 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
Language of instruction:
Finnish
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
Opettajat: Mahmoud Filali
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. Recemmended 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. Recemmended 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 Regression and Analysis of Variance, Probability Theory

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

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:

Introduction to Regression and Analysis of Variance, Probability Theory, Likelihood and Bayesian Inference, Introduction to Probability Theory II

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

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:

Agresti, A. (2015). Foundations of Linear and Generalized Linear Models. Wiley, Hoboken; chapters 1-3 and 12.
James, G., Witten, D., Hastie, T., Tibshirani, R. (2013). An Introduction to Statistical Learning with Applications in R}. Springer, New York; luvut 1-3 ja 6-7. -- vapaasti imuroitavissa osoitteesta http://www-bcf.usc.edu/~gareth/ISL/

Assessment methods and criteria:

Active participation in practicals and final exam.

Grading:

Fail, 1-5

Person responsible:

Esa Läärä

Working life cooperation:

No

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:

806113P Introduction to Statistics or 806119P A Second Course in Statistics

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 credits

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

After completion of the course, the student:
- can work with random variables in theory and practice
- can use two-dimensional discrete and continuous distributions in problems
- can recognize two-dimensional normal distribution and work with those
- can work with conditional distributions and conditional expectations
- can explain the fundamental results of probability such as the Law of Large Numbers and the Central Limit Theorem
- can determine moment generating functions of random variables and apply them for example to determine moments.

Contents:

Central topics are two-dimensional discrete and continuous distributions, conditional distribution, conditional expectation, two-dimensional normal distribution, moments, moment generating function, the Law of Large Numbers, the Central Limit Theorem.

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:

-

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:

Online 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. The exams are remote exams. It is possibility to take exams also at the university.
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:

-

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:

-

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
Opintokohteen kielet: English

Proficiency level:

-

Status:

-

Required proficiency level:

-

ECTS Credits:

5 ECTS, 135 hours of work

Language of instruction:

English

Timing:

Master studies, autumn term 1st period – THE COURSE WILL BE ORGANIZED NEXT TIME IN AUTUMN 2021

Learning outcomes:

-

Contents:

-

Mode of delivery:

-

Learning activities and teaching methods:

-

Target group:

-

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

-

Grading:

-

Person responsible:

University lecturer Mikko Finnilä

Working life cooperation:

-

Other information:

THE DESCRIPTION WILL BE UPDATED FOR STUDY GUIDE 2021-2022

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

Proficiency level:

-

Status:

-

Required proficiency level:

-

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 important in biomedical engineering and physics

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 12 h, project work 65 h, self-study 58 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:

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. The course can also be completed as a part of advanced studies with the course code 764327S.

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:

-

Other information:

-

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

Proficiency level:

-

Status:

-

Required proficiency level:

-

ECTS Credits:

5 ECTS, 135 hours of work

Language of instruction:

Finnish

Timing:

Bachelor or Master studies, autumn term, 1st and 2nd periods

Learning outcomes:

The student can identify technologies in different fields of clinical medicine, can describe operating 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 methods and development needs are presented.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Initial exam. Lectures, demonstrations, course assignment and self-study. Final exam which is based on lectures and all given materials.

Target group:

Students of medical and wellness technology, information technology, electrical engineering, mechanical engineering, industrial engineering and management, physics or of other related degree programmes interested in biomedical engineering and medical technologies.

Prerequisites and co-requisites:

-

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.

Other information:

-

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.

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 study the effect of sampling on the 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:

The lectures and exercise classes will be arranged as distance learning via Zoom. The Zoom-links, directions and other material (in Finnish) will be made available in the Moodle-workspace for the course, which can be found at https://moodle.oulu.fi/course/view.php?id=5361

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 Processing. Shanmugan, K.S., Breipohl, A.M.: Random Signals, Detection, Estimation and Data Analysis.

Assessment methods and criteria:

The course is completed with mid-term exams or a final exam. When completed with mid-term exams, exercise assignments are part of the continuous assessment. The assessment of the course is based on the learning outcomes of the course.

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:

-

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

Proficiency level:

-

Status:

-

Required proficiency level:

-

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:

Number of ECTS cr of the course and the methods of implementation vary. The course includes lectures 19h, demonstrations 8h and final exam 3 h. Number of hours left for independent study depends on the number of the ECTS cr the student wishes to complete and is from 8 to 51 hours.

Target group:

All Bachelor´s, Master´s and postgraduate students interested in methods of biomedical imaging.

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Handouts and literature given in the lectures

Assessment methods and criteria:

In this field, write with which method the teacher will monitor/
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

Working life cooperation:

-

Other information:

-

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: Zalan Rajna, Tapio Seppänen
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits.

Language of instruction:

English.

Timing:

The course unit is held in the autumn semester, during period 2. It is recommended to complete the course at the master’s degree level.

Learning outcomes:

After completing the course, student:

1. knows about special characteristics of the biosignals and typical signal processing methods
2. can solve small-scale problems related to biosignal analysis
3. implement small-scale MATLAB 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. The laboratory work can alternatively be performed on an online system (MathWorks Grader). Student can do the lab works remotely or in the lab using the same online system.

Learning activities and teaching methods:

Lectures 12h, Laboratory work 24h, Self-study for laboratory working and examination 99 h.

Target group:

Students interested in digital signal processing applications in biomedical engineering, at their master's level studies.

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:

Face-to-face lectures. Students solve the programming problems in the laboratory work independently, supervised by assistants. The MathWorks Grader online system is used for programming tasks and it also verifies the completed tasks. Written examination.
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:

Online teaching / Moodle

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:

-

Other information:

Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.

521093S: Biomedical Instrumentation, 5 op

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

521107S	Biomedical Instrumentation	6.0 op

ECTS Credits:

5

Language of instruction:

English.

Timing:

Period 4.

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 signals commonly measured 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). Introduction to medical imaging and monitoring methods and instruments and physical therapy devices. Electrical safety aspects.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures/exercises 30 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:

Teemu Myllylä

Working life cooperation:

No.

521124S: Electronic Sensors, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Aliaksandr Bykau, Alexey Popov
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.
The information about the course 521124S - Anturit ja mittausmenetelmät/Electronic Sensors has been added to the Moodle page:
https://moodle.oulu.fi/course/view.php?id=5357

Course description: "The course is aimed at students willing to be capable of explaining the operating principles of different sensors and selecting the right sensor for each measuring target. We will focus on how to quantify the requirements that affect sensor selection as well as recognize and evaluate the uncertainty of a measurement. In addition, we will go into questions on how to plan and design sensor signal conditioning circuits."

The lectures and seminars will be organized remotely via Zoom environment. The corresponding link will be published on the page of the course in Moodle prior to the lecture.

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:

Aliaksandr Bykau ja Alexey Popov

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: Aliaksandr Bykau, Alexey Popov

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:

Online teaching.
The information about the remote teaching of the course: 521240S Biophotonics and Biomedical Optics has been added to the course workspace in moodle https://moodle.oulu.fi/course/view.php?id=2436&section=0
Shortly, the lectures and seminars will be organized remotely via the zoom environment.
The corresponding link will be published on the moodle page prior to the lecture.
The exam/test will performed online through the moodle or google forms at the estimated day.

Learning activities and teaching methods:

Lectures/exercises 38 h and self-study 100 h.
The information about the remote teaching of the course: 521240S Biophotonics and Biomedical Optics has been added to the course workspace in moodle https://moodle.oulu.fi/course/view.php?id=2436&section=0
Shortly, the lectures and seminars will be organized remotely via the zoom environment.
The corresponding link will be published on the moodle page prior to the lecture.
The exam/test will performed online through the moodle or google forms at the estimated day.

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:

Aliaksandr Bykau and Alexey Popov

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
Opintokohteen kielet: English

Proficiency level:

-

Status:

-

Required proficiency level:

-

ECTS Credits:

5 ECTS, 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 and cells as well as failure mechanisms of tissues.
Student understands relationship between biomechanical properties and tissue composition and structure.
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. Cell biomechanics. Biomechanical modeling of tissues.

Mode of delivery:

Blended teaching.

Learning activities and teaching methods:

Lectures 20h, Calculation assignment 10h, interactive lecture and group work 4 h, assignment 8h and preparing report 18h and self-study 75h.

Target group:

Master students of Biomedical Engineering. The course is also suitable for other interested degree and postgraduate students with adequate prerequisites.

Prerequisites and co-requisites:

It is recommended that the student has basic knowledge of 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:

Mandatory parts of the course: accepted assignment with written report 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. Course grade is based on score of the final exam.

Possibility to earn additional points from mathematical exercises.

Person responsible:

University lecturer Mikko Finnilä

Working life cooperation:

-

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

Proficiency level:

-

Status:

-

Required proficiency level:

-

ECTS Credits:

5 ECTS, 135 hours of work

Language of instruction:

English

Timing:

Master´s studies, spring term 4th period

Learning outcomes:

The student can describe the main challenges of movement biomechanics and principles for motion analysis.
The student understands 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:

Master´s students of biomedical engineering, medical and wellness technology, information technology and other related degree programs. Master´s students of physics (biomedical physics). Other interested master's and postgraduate students.

Prerequisites and co-requisites:

The student needs to have basic knowledge on statistical analysis, sensors and measurement techniques and signal processing. It is also recommended to have basic knowledge of anatomy and physiology.

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 lab 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

Other information:

-

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

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

- Chemistry
- Geosciences.

Note:
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 skills in English must have been otherwise acquired. If you need to take English, but lack the background, please get in touch with the Languages and Communication contact teacher to discuss individual solutions.

ECTS Credits:

2 ECTS / 53 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 demonstrate the ability to:
utilize your knowledge of word formation, text structure, and cohesion markers to understand the vocabulary and content of academic texts,
use effective reading strategies and techniques for studying vocabulary, and
summarize texts both orally or in writing.

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:

The course is implemented using blended methods, which may include web-based teaching and face-to-face teaching. The course utilizes the Moodle learning environment.

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.

Target group:

Faculty of Natural Sciences:1st-year students of Biology, Mathematical & Physical Sciences
Faculty of Technology: 1st-year students of Chemistry, Geosciences

Prerequisites and co-requisites:

Post-requisite Students are also required to take English 2 902004Y following completion of this course.

Recommended optional programme components:

None

Recommended or required reading:

Course materials used will be available from the library or online.

Assessment methods and criteria:

Continuous assessment takes into account active and regular participation in classroom sessions and successful completion of all homework tasks, There are three monthly tests on material covered so far. The assessment of the course is based on the learning outcomes listed above.

Grading:

The course utilises a grading scale of Pass/Fail.

Person responsible:

Karen Niskanen

Working life cooperation:

The course does not contain working life cooperation.

Other information:

N.B. Students with grades laudatur or eximia in their A1 English school-leaving examination can be exempted from this course and will be granted the credits by your faculty. Contact the 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

Status:

This course is mandatory for students who choose English as their foreign language in the following B.Sc. degree programs:

Faculty of Natural Sciences:

Biology
Mathematical & Physical Sciences.

Faculty of Technology:

Chemistry
Geoscience.

Required proficiency level:

Students taking this course must have had English as the A1 or A2 language at school or have equivalent skills.

ECTS Credits:

2 ECTS credits / 53 hours of 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 in your own field
prepare and present scientific subjects from your own field of studies to your classmates, using appropriate field-related vocabulary.

Contents:

In the classroom, you will practice the skills of listening, speaking and presenting topics in your own field. The emphasis is on working in pairs and small groups. In addition, you will complete independent homework assignments to support the classroom learning.

Mode of delivery:

The course is implemented using blended methods, which may include distance teaching, classroom instruction and activities in the Moodle learning environment.

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.

Target group:

2nd year students of Biology, Chemistry, Geoscience
1st year students of Mathematical and Physical Sciences

Prerequisites and co-requisites:

Prequisite course: 902002Y English 1, unless exempted

Recommended optional programme components:

-

Recommended or required reading:

Materials will be provided in electronic format or are available from the library.

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.

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

Proficiency level:

B1/B2/C1
This course is only for Finnish speaking students with CEFR-level A2 in Swedish language. We don’t offer Beginners courses in Swedish.

Status:

Required proficiency level:

Contents:

Learning activities and teaching methods:

Recommended optional programme components:

-

Recommended or required reading:

Assessment methods and criteria:

Working life cooperation:

-

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

Proficiency level:

This course is only for Finnish speaking students with CEFR-level A2-B1 in Swedish language. There are no beginner courses in Swedish at the university.

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:

This course is only for Finnish speaking students with CEFR-level A1/A2 in Swedish language. University of Oulu, Languages and Communication unit don’t offer Beginners courses in Swedish.

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.

Alternative Orientation courses

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

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 credit / 27 hours of work

Language of instruction:

Finnish

Timing:

Architecture 3. spring semester, period III;
biochemistry 3. autumn semester;
biology 3. autumn semester, period I;
chemistry 3. autumn semester, period I;
civil engineering 2. spring semester, period IV;
computer science and engineering 2. spring semester, period IV;
electronics and communications engineering 3. spring semester;
geosciences 2. spring semester, period IV;
geography 3. semester, periods I and III;
industrial engineering and management 3. year;
information processing sciences 1. or 3. 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;
Master's degree students in industrial engineering and management 1st year.

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 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.

Recommended optional programme components:

In biochemistry the course is completed as a part of 740376A Bachelor’s Thesis.

Recommended or required reading:

Web learning material Tieteellisen tiedonhankinnan opas

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

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:

-

Other information:

The course learning platform is Lovelace (lovelace.oulu.fi)

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: Student tutoring, 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:
1-10 credits
Language of instruction:
Finnish
Timing:
1st-5th year

H325118: Physics basic and intermediate studies for Subject Teacher, 70 op

Voimassaolo: 01.08.2020 -
Opiskelumuoto: Intermediate Studies
Laji: Study module
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory studies

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 and employment opportunities for physicists.

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:

Pauli Väisänen

Working life cooperation:

No work placement period

761118P: Mechanics 1, 5 op

Voimassaolo: 01.08.2017 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opettajat: Aku Venhola
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 2-14. Also older and newer 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: Two midterm exams or final examination
761118P-02: Two laboratory exercises.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Aku Venhola

Working life cooperation:

No work placement period

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

Opettajat: Lauri Hautala

Opintokohteen kielet: Finnish

Leikkaavuudet:

761121P	Physical Measurements I	3.0 op
761121P-01	Laboratory exercises in physics 1, 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 / 135 hours of work

Language of instruction:

Finnish

Timing:

Spring term, periods 3 and 4

Learning outcomes:

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

Contents:

The skill of measuring is important for physicists. This is an introductory course on how to make physical measurements and how to treat the measured data. Laboratory works are made in groups. Laboratory safety is also an essential part of physical measurements. 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 subsequent laboratory courses Laboratory exercises in physics 2 and 3.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

12 hours of lectures, 16 hours of exercises, 107 hours of self-study.

Target group:

Students in physics degree program. Other students studying in University of Oulu can also participate to the course.

Prerequisites and co-requisites:

No specific prerequisites.

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:

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

Assessment methods and criteria:

The assessment is performed using exercises to be completed during the course. Further instructions will be given at the beginning of the course.

Grading:

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

Person responsible:

Lauri Hautala

Working life cooperation:

The course does not contain working life cooperation.

Other information:

Timetables, further instructions and materials can be found from the course website in Moodle (moodle.oulu.fi).

Compulsory

761115P-01: Laboratory Exercises in Physics 1, lecture and exam, 0 op

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

761121P-01	Laboratory exercises in physics 1, exam	0.0 op
761121P-02	Physical measurements I, lab. exercises	0.0 op
761121P	Physical Measurements I	3.0 op

Ei opintojaksokuvauksia.

761115P-02: Laboratory Exercises in Physics 1, laboratory exercises, 0 op

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

761121P-01	Laboratory exercises in physics 1, exam	0.0 op
761121P-02	Physical measurements I, lab. exercises	0.0 op
761121P	Physical Measurements I	3.0 op

Ei opintojaksokuvauksia.

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
Opettajat: Lauri Hautala
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).

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Lauri Hautala

Working life cooperation:

No work placement period

Other information:

Moodle

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

761312A: Electromagnetism 2, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

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

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 or individual excercises, webexcercises or final exam.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Saana-Maija Huttula

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
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

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 credits / 135 hours of work

Language of instruction:

Language of instruction is Finnish, but the exam and exercises can be done in English if agreed with the lecturer.

Timing:

The course is held in the spring semester during the 4th period. It is recommended to complete the course at the second spring semester.

Learning outcomes:

The student knows structure models 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 is familiar with fission and fusion reactions and how they can be exploited in energy production.
The student knows the standard model classification of elementary 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 structure and properties of nuclei, nuclear forces, nuclear models, radioactivity, nuclear reactions, properties and interactions of elementary particles.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 32 h (of which 4 h can be reserved for 2 mid-term exams), 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 (761313A), Electromagnetism 1 (761119P). Supporting courses Electromagnetism 2 (761312A) and Solid state physics (763343A).

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

Final examination or two intermediate exams.

Grading:

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

Person responsible:

Minna Patanen

Working life cooperation:

The course does not contain working life cooperation.

Other information:

The web page of the course in Moodle

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 credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Third autumn semester

Learning outcomes:

The student can explain the basic concepts of thermophysics and can show how the following results (see Contents) arise from them at the level they are presented in lectures. In addition, the student can solve such problems that necessitate deep understanding of the content represented in the course.

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

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

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

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, 2016.

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 credits

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

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 ECTS 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

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 ECTS credits

Language of instruction:

Finnish/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

Alternative studies

766101P: Mathematics for physics, 5 op

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

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

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish, the course can be completed in English

Timing:

First autumn, period 1

Learning outcomes:

The course quickly provides the student the basic mathematical knowledge and skills required in physical sciences. The objective is to learn the basics of differential and integral calculus, methods for solving the most typical first and second order differential equations and the basics of vector differential calculus. After the course the student understands the basic mathematical methods needed in physics and is able to apply them to problems arising in the different physics courses and in research. Another objective is also to understand the geometrical meaning of different mathematical concepts and their connection to physical phenomena.

Contents:

Integral and differential calculus, complex variables and functions, introduction to differential equations, vectors, functions of several variables, differentials and partial derivatives, gradient, divergence, curl, scalar and vector fields, Gauss's and Stokes theorem.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 14 h, exercises 28 h, self-study 90 h

Target group:

Primarily for students who study Physics in the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisities

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and the textbook R. A. Adams, Calculus - A Complete Course.

Assessment methods and criteria:

Continuous evaluation and 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:

moodle.oulu.fi

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

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 credits

Language of instruction:

Finnish

Timing:

2nd spring

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

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

Prerequisites and co-requisites:

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

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 and employment opportunities for physicists.

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:

Pauli Väisänen

Working life cooperation:

No work placement period

761118P: Mechanics 1, 5 op

Voimassaolo: 01.08.2017 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opettajat: Aku Venhola
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 2-14. Also older and newer 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: Two midterm exams or final examination
761118P-02: Two laboratory exercises.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Aku Venhola

Working life cooperation:

No work placement period

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
Opettajat: Lauri Hautala
Opintokohteen kielet: Finnish
Leikkaavuudet:

761121P	Physical Measurements I	3.0 op
761121P-01	Laboratory exercises in physics 1, 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 / 135 hours of work

Language of instruction:

Finnish

Timing:

Spring term, periods 3 and 4

Learning outcomes:

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

Contents:

The skill of measuring is important for physicists. This is an introductory course on how to make physical measurements and how to treat the measured data. Laboratory works are made in groups. Laboratory safety is also an essential part of physical measurements. 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 subsequent laboratory courses Laboratory exercises in physics 2 and 3.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

12 hours of lectures, 16 hours of exercises, 107 hours of self-study.

Target group:

Students in physics degree program. Other students studying in University of Oulu can also participate to the course.

Prerequisites and co-requisites:

No specific prerequisites.

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:

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

Assessment methods and criteria:

The assessment is performed using exercises to be completed during the course. Further instructions will be given at the beginning of the course.

Grading:

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

Person responsible:

Lauri Hautala

Working life cooperation:

The course does not contain working life cooperation.

Other information:

Timetables, further instructions and materials can be found from the course website in Moodle (moodle.oulu.fi).

Compulsory

761115P-01: Laboratory Exercises in Physics 1, lecture and exam, 0 op

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

761121P-01	Laboratory exercises in physics 1, exam	0.0 op
761121P-02	Physical measurements I, lab. exercises	0.0 op
761121P	Physical Measurements I	3.0 op

Ei opintojaksokuvauksia.

761115P-02: Laboratory Exercises in Physics 1, laboratory exercises, 0 op

Voimassaolo: 01.01.2017 -
Opiskelumuoto: Basic Studies

Laji: Partial credit
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opettajat: Lauri Hautala
Opintokohteen kielet: Finnish
Leikkaavuudet:

761121P-01	Laboratory exercises in physics 1, exam	0.0 op
761121P-02	Physical measurements I, lab. exercises	0.0 op
761121P	Physical Measurements I	3.0 op

Ei opintojaksokuvauksia.

Alternative

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
Opettajat: Lauri Hautala
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).

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Lauri Hautala

Working life cooperation:

No work placement period

Other information:

Moodle

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 or individual excercises, webexcercises or final exam.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Saana-Maija Huttula

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

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

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 credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Third autumn semester

Learning outcomes:

The student can explain the basic concepts of thermophysics and can show how the following results (see Contents) arise from them at the level they are presented in lectures. In addition, the student can solve such problems that necessitate deep understanding of the content represented in the course.

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

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

Prerequisites and co-requisites:

No specific prerequisites

Recommended optional programme components:

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

Recommended or required reading:

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, 2016.

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

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

761312A: Electromagnetism 2, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

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 credits / 135 hours of work

Language of instruction:

Language of instruction is Finnish, but the exam and exercises can be done in English if agreed with the lecturer.

Timing:

The course is held in the spring semester during the 4th period. It is recommended to complete the course at the second spring semester.

Learning outcomes:

The student knows structure models 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 is familiar with fission and fusion reactions and how they can be exploited in energy production.
The student knows the standard model classification of elementary 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 structure and properties of nuclei, nuclear forces, nuclear models, radioactivity, nuclear reactions, properties and interactions of elementary particles.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 32 h (of which 4 h can be reserved for 2 mid-term exams), 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 (761313A), Electromagnetism 1 (761119P). Supporting courses Electromagnetism 2 (761312A) and Solid state physics (763343A).

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

Final examination or two intermediate exams.

Grading:

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

Person responsible:

Minna Patanen

Working life cooperation:

The course does not contain working life cooperation.

Other information:

The web page of the course in Moodle

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

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 credits

Language of instruction:

Finnish

Timing:

2nd spring

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

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

Prerequisites and co-requisites:

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

766101P: Mathematics for physics, 5 op

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

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

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish, the course can be completed in English

Timing:

First autumn, period 1

Learning outcomes:

The course quickly provides the student the basic mathematical knowledge and skills required in physical sciences. The objective is to learn the basics of differential and integral calculus, methods for solving the most typical first and second order differential equations and the basics of vector differential calculus. After the course the student understands the basic mathematical methods needed in physics and is able to apply them to problems arising in the different physics courses and in research. Another objective is also to understand the geometrical meaning of different mathematical concepts and their connection to physical phenomena.

Contents:

Integral and differential calculus, complex variables and functions, introduction to differential equations, vectors, functions of several variables, differentials and partial derivatives, gradient, divergence, curl, scalar and vector fields, Gauss's and Stokes theorem.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 14 h, exercises 28 h, self-study 90 h

Target group:

Primarily for students who study Physics in the University of Oulu.

Prerequisites and co-requisites:

No specific prerequisities

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and the textbook R. A. Adams, Calculus - A Complete Course.

Assessment methods and criteria:

Continuous evaluation and 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:

moodle.oulu.fi

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

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 credits

Language of instruction:

Finnish

Timing:

First period at the first semester.

Learning outcomes:

After completing the course, the student:
- is able to understand different proving techniques
- is able to evaluate and justify whether simple statements are true or false
- is able to understand and read text containing mathematical notation
- knows the basic definitions and concepts related to set theory and functions

Contents:

The course in an introduction to mathematical deduction and introduces different types of proof techniques. Special attention is paid to mathematical reading and writing skills and justifying reasoning. 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:

Exercises and final exam.

Grading:

Pass/Fail

Person responsible:

Topi Törmä

Working life cooperation:

No

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, LU - factorization of a matrix.

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 credits

Language of instruction:

Finnish

Timing:

4th period. Students of mathematics and physics: 1st 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, instructed group work 26-28 h, independent study 89 h. Groups return their group tasks. Additional independently implemented learning tasks. Independent study includes also preparation for group work.

Target group:

Students of mathematical and physical sciences. Students of other degree programmes: 806118P, 806119P

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 tasks (including e.g. learning diaries and web tests) are assessed weekly. The assessment of the course is based on the learning outcomes of the course. The more detailed assessment criteria will be available in the beginning 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:

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 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:

Mid-term exams and/or final exam. Active participation in 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:

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, fail

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 credits

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
Opettajat: Pekka Salmi
Opintokohteen kielet: Finnish
Leikkaavuudet:

802119P	Linear Algebra II	5.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish and English

Timing:

2nd year, 3rd 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:

-

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

No

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 credits

Language of instruction:

Finnish

Timing:

1. year, 3. period

Learning outcomes:

After completing the course, student is able to:

- derive and proof main results 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, fail

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

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 ECTS credits

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

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.

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, fail

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
Opettajat: Mahmoud Filali
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

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, fail

Person responsible:

Mahmoud Filali

Working life cooperation:

-

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, fail

Person responsible:

Erkki Laitinen

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 credits

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

After completion of the course, the student:
- can work with random variables in theory and practice
- can use two-dimensional discrete and continuous distributions in problems
- can recognize two-dimensional normal distribution and work with those
- can work with conditional distributions and conditional expectations
- can explain the fundamental results of probability such as the Law of Large Numbers and the Central Limit Theorem
- can determine moment generating functions of random variables and apply them for example to determine moments.

Contents:

Central topics are two-dimensional discrete and continuous distributions, conditional distribution, conditional expectation, two-dimensional normal distribution, moments, moment generating function, the Law of Large Numbers, the Central Limit Theorem.

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:

-

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:

ay802136P	Introduction to Cryptography	2.0 op
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 and twice in the summer

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 Moodle) + 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

Opettajat: Pekka Salmi

Opintokohteen kielet: Finnish

Leikkaavuudet:

801389A	Basic Geometry for University Students	6.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd to 5th year

Learning outcomes:

After completion of the course, the student can use geometric axioms to justify simple geometric results and apply axioms and known results in geometric problems and deductions.

Contents:

The course is an introduction to axiomatic geometry from a modern viewpoint. Using geometric axioms, we first derive the concept of vector and vectors are used in the study of geometry.
We first study affine geometry and then Euclidean geometry. Some classical results such as Ceva's theorem are derived. Finally, we consider area and volume.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28 hours lectures, 14 hours tutorials, 91 hours independent work

Target group:

Major and minor students in mathematics

Prerequisites and co-requisites:

Linear algebra

Recommended or required reading:

Lecture notes. Literature: John Roe, Elementary Geometry, Oxford University Press, Oxford, 1993.

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

No

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:

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

Target group:

Mathematics majors

Prerequisites and co-requisites:

800328A Calculus of several variables

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Ville Suomala

Working life cooperation:

No

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
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

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 Basics in Algebra
802355A Algebraic Structures

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:

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

Grading:

1-5, fail

Person responsible:

Marko Leinonen

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, 3rd 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

Person responsible:

Valery Serov

Working life cooperation:

No

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:

-

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 ECTS credits / 42 hours of work

Language of instruction:

English

Timing:

The course is held in the autumn semester, during the period 1. It is recommended to complete the course at the first autumn semester.

Learning outcomes:

Upon completition of the course, the student will be able to:
1. Apply the fundamental theorem of integration in complex sense to some concrete functions.
2. Represent functions via power series (for analytic functions) via Laurent expansions (for functions with singularities).
3. Calculate the residues and some classes of integrals using residue theory.
4. Calculate some classes of series by residue theory.
5. Use Laplace transform for solutions of ODEs.

Contents:

1. Fundamental theorem of integration.
2. Harmonic functions and mean value formulae.
3. Liouville’s theorem and fundamental theorem of algebra.
4. Representation of analytic functions via the power series.
5. Laurent expansions.
6. Residues and their calculus.
7. The principle of the argument and Rouche’s theorem.
8. Calculations of integrals by residue theory.
9. Calculation of series by residue theory.
10. Laplace transform.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 14 h / Self-study at least 20 h.

Target group:

No specific targets except passing final exam w.r.t. the content and outcomes (see previous parts).

Prerequisites and co-requisites:

Complex Analysis (031077P)
Calculus of several variables including multidimenional integral (Calculus of several variables 800328A)

Recommended or required reading:

Any book in Complex Analysis, in particular Lecture Notes of V.S. Serov ”Complex Analysis, Second Edition”, Oulu University Press, 2017.

Assessment methods and criteria:

Final Exam

Grading:

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

Person responsible:

Valery Serov

Working life cooperation:

The course does not contain working life cooperation.

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:

Online 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. The exams are remote exams. It is possibility to take exams also at the university.
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:

-

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
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

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:

Erkki Laitinen

Working life cooperation:

-

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 credits

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

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.
The course, Introduction to Optimization, will be lectured remotely through the ZOOM video conferencing tool. The more detailed instructions and access to ZOOM lectures can be found in the Moodle work space of the course. The link is here: https://moodle.oulu.fi/course/view.php?id=5350.

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:

The course, Introduction to Optimization, will be lectured remotely through the ZOOM video conferencing tool. The more detailed instructions and access to ZOOM lectures can be found in the Moodle work space of the course. The link is here: https://moodle.oulu.fi/course/view.php?id=5350.

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.

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 study the effect of sampling on the 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:

The lectures and exercise classes will be arranged as distance learning via Zoom. The Zoom-links, directions and other material (in Finnish) will be made available in the Moodle-workspace for the course, which can be found at https://moodle.oulu.fi/course/view.php?id=5361

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 Processing. Shanmugan, K.S., Breipohl, A.M.: Random Signals, Detection, Estimation and Data Analysis.

Assessment methods and criteria:

The course is completed with mid-term exams or a final exam. When completed with mid-term exams, exercise assignments are part of the continuous assessment. The assessment of the course is based on the learning outcomes of the course.

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:

-

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

ECTS Credits:

5 ECTS credits

Person responsible:

Erkki Laitinen

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
Language of instruction:
Finnish
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 credits
Language of instruction:
Finnish
Timing:
First period at the first semester.
Learning outcomes:
After completing the course, the student:
- is able to understand different proving techniques
- is able to evaluate and justify whether simple statements are true or false
- is able to understand and read text containing mathematical notation
- knows the basic definitions and concepts related to set theory and functions

Contents:

The course in an introduction to mathematical deduction and introduces different types of proof techniques. Special attention is paid to mathematical reading and writing skills and justifying reasoning. 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:

Exercises and final exam.

Grading:

Pass/Fail

Person responsible:

Topi Törmä

Working life cooperation:

No

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, fail

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, LU - factorization of a matrix.

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 credits

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
Opettajat: Pekka Salmi
Opintokohteen kielet: Finnish
Leikkaavuudet:

802119P	Linear Algebra II	5.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish and English

Timing:

2nd year, 3rd 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:

-

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

No

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 credits

Language of instruction:

Finnish

Timing:

4th period. Students of mathematics and physics: 1st 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, instructed group work 26-28 h, independent study 89 h. Groups return their group tasks. Additional independently implemented learning tasks. Independent study includes also preparation for group work.

Target group:

Students of mathematical and physical sciences. Students of other degree programmes: 806118P, 806119P

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 tasks (including e.g. learning diaries and web tests) are assessed weekly. The assessment of the course is based on the learning outcomes of the course. The more detailed assessment criteria will be available in the beginning 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:

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, fail

Person responsible:

Erkki Laitinen

Working life cooperation:

no

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 credits

Language of instruction:

Finnish

Timing:

1. year, 3. period

Learning outcomes:

After completing the course, student is able to:

- derive and proof main results 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, fail

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 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:

Mid-term exams and/or final exam. Active participation in 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:

Hanna Heikkinen

Working life cooperation:

-

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

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.

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, fail

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

Opettajat: Mahmoud Filali

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

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, fail

Person responsible:

Mahmoud Filali

Working life cooperation:

-

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, fail

Person responsible:

Erkki Laitinen

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 credits

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

After completion of the course, the student:
- can work with random variables in theory and practice
- can use two-dimensional discrete and continuous distributions in problems
- can recognize two-dimensional normal distribution and work with those
- can work with conditional distributions and conditional expectations
- can explain the fundamental results of probability such as the Law of Large Numbers and the Central Limit Theorem
- can determine moment generating functions of random variables and apply them for example to determine moments.

Contents:

Central topics are two-dimensional discrete and continuous distributions, conditional distribution, conditional expectation, two-dimensional normal distribution, moments, moment generating function, the Law of Large Numbers, the Central Limit Theorem.

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:

-

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:

ay802136P Introduction to Cryptography 2.0 op
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 and twice in the summer

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 Moodle) + 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
Opettajat: Pekka Salmi
Opintokohteen kielet: Finnish
Leikkaavuudet:

801389A Basic Geometry for University Students 6.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd to 5th year

Learning outcomes:

After completion of the course, the student can use geometric axioms to justify simple geometric results and apply axioms and known results in geometric problems and deductions.

Contents:

The course is an introduction to axiomatic geometry from a modern viewpoint. Using geometric axioms, we first derive the concept of vector and vectors are used in the study of geometry.
We first study affine geometry and then Euclidean geometry. Some classical results such as Ceva's theorem are derived. Finally, we consider area and volume.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28 hours lectures, 14 hours tutorials, 91 hours independent work

Target group:

Major and minor students in mathematics

Prerequisites and co-requisites:

Linear algebra

Recommended or required reading:

Lecture notes. Literature: John Roe, Elementary Geometry, Oxford University Press, Oxford, 1993.

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

No

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:

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

Target group:

Mathematics majors

Prerequisites and co-requisites:

800328A Calculus of several variables

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Ville Suomala

Working life cooperation:

No

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
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

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 Basics in Algebra
802355A Algebraic Structures

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:

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

Grading:

1-5, fail

Person responsible:

Marko Leinonen

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, 3rd 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

Person responsible:

Valery Serov

Working life cooperation:

No

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:

-

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 ECTS credits / 42 hours of work

Language of instruction:

English

Timing:

The course is held in the autumn semester, during the period 1. It is recommended to complete the course at the first autumn semester.

Learning outcomes:

Upon completition of the course, the student will be able to:
1. Apply the fundamental theorem of integration in complex sense to some concrete functions.
2. Represent functions via power series (for analytic functions) via Laurent expansions (for functions with singularities).
3. Calculate the residues and some classes of integrals using residue theory.
4. Calculate some classes of series by residue theory.
5. Use Laplace transform for solutions of ODEs.

Contents:

1. Fundamental theorem of integration.
2. Harmonic functions and mean value formulae.
3. Liouville's theorem and fundamental theorem of algebra.
4. Representation of analytic functions via the power series.
5. Laurent expansions.
6. Residues and their calculus.
7. The principle of the argument and Rouche's theorem.
8. Calculations of integrals by residue theory.
9. Calculation of series by residue theory.
10. Laplace transform.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 14 h / Self-study at least 20 h.

Target group:

No specific targets except passing final exam w.r.t. the content and outcomes (see previous parts).

Prerequisites and co-requisites:

Complex Analysis (031077P)
Calculus of several variables including multidimenional integral (Calculus of several variables 800328A)

Recommended or required reading:

Any book in Complex Analysis, in particular Lecture Notes of V.S. Serov "Complex Analysis, Second Edition", Oulu University Press, 2017.

Assessment methods and criteria:

Final Exam

Grading:

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

Person responsible:

Valery Serov

Working life cooperation:

The course does not contain working life cooperation.

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:

Online 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. The exams are remote exams. It is possibility to take exams also at the university.
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:

-

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

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

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:

Erkki Laitinen

Working life cooperation:

-

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 credits

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

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.
The course, Introduction to Optimization, will be lectured remotely through the ZOOM video conferencing tool. The more detailed instructions and access to ZOOM lectures can be found in the Moodle work space of the course. The link is here: https://moodle.oulu.fi/course/view.php?id=5350.

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:

The course, Introduction to Optimization, will be lectured remotely through the ZOOM video conferencing tool. The more detailed instructions and access to ZOOM lectures can be found in the Moodle work space of the course. The link is here: https://moodle.oulu.fi/course/view.php?id=5350.

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.

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 study the effect of sampling on the 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:

The lectures and exercise classes will be arranged as distance learning via Zoom. The Zoom-links, directions and other material (in Finnish) will be made available in the Moodle-workspace for the course, which can be found at https://moodle.oulu.fi/course/view.php?id=5361

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 Processing. Shanmugan, K.S., Breipohl, A.M.: Random Signals, Detection, Estimation and Data Analysis.

Assessment methods and criteria:

The course is completed with mid-term exams or a final exam. When completed with mid-term exams, exercise assignments are part of the continuous assessment. The assessment of the course is based on the learning outcomes of the course.

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:

-

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

ECTS Credits:

5 ECTS credits

Person responsible:

Erkki Laitinen

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
Language of instruction:
Finnish
Person responsible:
Kari Myllylä

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	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

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 credits
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:
The course does not require additional studies carried out at the same time. 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:
-

766382A: Climate communication, 2 op

Voimassaolo: 01.01.2020 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish, English

ECTS Credits:
2 ECTS credits / 54 h of work
Language of instruction:
Finnish
Timing:
period 3
Learning outcomes:
Upon completion of the course, the student will be able to:

- understand what are the different forms of climate change communication.
- identify and discuss things that make climate communication
  a) important, b) challenging
- understand what affects the recipients and messengers of climate change information
- critically analyse climate change messages.

Contents:
Getting to understand the different forms of climate communication, factors affecting it, the challenges and keys to impactful communication about climate change.
Mode of delivery:
Web-based teaching, possibly blended
Learning activities and teaching methods:
Studying the course material independently 20 h, assignments 10 h, peer communication and review 10 h, project work 8 h, contact teaching 6 h
Target group:
To anyone interested in the theme.
Prerequisites and co-requisites:
No prerequisites, but it is recommended to do / have done the Climate.now course.
Recommended or required reading:
The course material has been created under DigiCampus.
Assessment methods and criteria:
The assignments in the DigiCampus material are controlled with peer review. The project work has to be completed so that the determined criteria are met.
Grading:
Pass / Fail
Person responsible:
Mira Hulkkonen
Working life cooperation:
No working life cooperation.

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	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

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 credits
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:
The course does not require additional studies carried out at the same time.

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 credits

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:
The course does not require additional studies carried out at the same time. 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:
-

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	5.0 op
806109P	Basic Methods in Statistics I	9.0 op

ECTS Credits:
5 ECTS credits

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

766381A: Sustainable.now, 5 op

Voimassaolo: 01.01.2020 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jussi Malila

Opintokohteen kielet: Finnish, English

ECTS Credits:
5 ECTS credits / 135 hours of work
Language of instruction:
Course will be given in Finnish and English
Timing:
The course is held during the 2nd period.
Learning outcomes:
1) The student understands the intersectional, partly contradictory, goals and interdimensionality of the climate challenge and the challenges of sustainable development.
2) After completing the course, students will be familiar with the multidisciplinary links between climate change and different goals of sustainable development, and will identify different tools for solving problems.
3) The student understands the importance of positivity and solution orientation both through the global responsibility of individuals and through the transformation of existing structures.
Mode of delivery:
Course will be delivered using blended teaching; it is possible to participate the course completely through web-based teaching.
Learning activities and teaching methods:

Course implementation is based on e-learning material available in DigiCampus-platform. Forms of teaching: contact teaching/alternative tasks 12 h / studying of electronic material 86 h / learning diary 14 h / group work 23 h.
Target group:
Course is open for all students.
Prerequisites and co-requisites:
No required prerequisite
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Learning material in DigiCampus.
Assessment methods and criteria:
Course assessment is based on the summary of the learning diary and group work.
Grading:
The course utilizes a numerical grading scale 0-5. In the numerical scale 0 stands for a fail.
Person responsible:
Jussi Malila
Working life cooperation:
Sustainability challenges processed during the group work can also come from working life.
Other information:
Please contact Person responsible for more information and registration for online course,