

Opasraportti

Mining Engineering and Mineral Processing (2016 - 2017)

OULU MINING SCHOOL

There are two degree programmes in Oulu Mining School:

- * Mining Technology and Mineral Processing (technical studies)
- * Geosciences

Contact us: study.oms@oulu.fi

THE DEGREE PROGRAMME IN MINING TECHNOLOGY AND MINERAL PROCESSING

You will find more information of degree programme from website "Studies at university of Oulu": <http://www.oulu.fi/education/5-6-year-degree-programmes/mining-technology-and-mineral-processing#content-top>

Student advisor: Saara Luhtaanmäki, 029 448 2371.

Tutkintorakenteet

Mining Technology and Mineral Processing, BSc (Tech)

Tutkintorakenteen tila: archived

Lukuvuosi: 2016-17

Lukuvuoden alkamispäivämäärä: 01.08.2016

Basic Studies (70 op)

A439101: Basic Studies, Mining Technology and Mineral Processing, 70 op

Basic Studies

- 491100P: Orientation to OMS studies, 1 op
- 477011P: Introduction to Process and Environmental Engineering I, 5 op
- 488010P: Introduction to Process and Environmental Engineering II, 5 op
- 031010P: Calculus I, 5 op
- 031075P: Calculus II, 5 op
- 031076P: Differential Equations, 5 op
- 031078P: Matrix Algebra, 5 op
- 031021P: Probability and Mathematical Statistics, 5 op
- 031022P: Numerical Analysis, 5 op
- 761113P: Electricity and magnetism, 5 op
- 461102A: Statics, 5 op
- 780120P: Basic Principles in Chemistry, 5 op
- 780123P: Introductory Laboratory Works in Chemistry, 5 op
- 030005P: Information Skills, 1 op

902011P: Technical English 3, 6 op
 901008P: Second Official Language (Swedish), 2 op

Intermediate Studies (60 op)

A439102: Intermediate Studies, Mining Technology and Mineral Processing, 60 op

Intermediate Studies

488012A: Environmental Legislation, 5 op
 771113P: Introduction to Geology I, 5 op
 774301A: A Basic Course in Geochemistry, 6 op
 771102P: Basic course in mineralogy, 6 op
 477121A: Particle Technology, 5 op
 477122A: Bulk Solids Handling, 5 op
 461103A: Strength of materials I, 5 op
 461106A: Dynamics, 5 op
 492300A: Rock mechanics, 5 op
 477501A: Process dynamics, 5 op
 477502A: Experiment design and analysis, 5 op
 493302A: Chemical phenomena in mineral processes, 5 op

Preparing Studies to Study Options (25 op)

A439125: Supplementary Studies, Mining Technology and Mineral Processing, 25 op

To Study Options

477401A: Thermodynamic Equilibria, 5 op
 477201A: Material and Energy Balances, 5 op
 488102A: Hydrological Processes, 5 op
 477052A: Fluid Mechanics, 5 op
 493300A: Principles of mineral processing, 5 op

Working Life Studies (25 op)

A439124: Working Life Studies, Mining Technology and Mineral Processing, 25 op

Working Life Studies

555225P: Basics of industrial engineering and management, 5 op
 555265P: Occupational Safety and Health Management, 5 op
 491300A: Practical Training, 5 op
 900060A: Technical Communication, 2 op
 491302A: Bachelor's thesis, 8 op
 491303A: Maturity test, 0 op

Master of Science (Tech), Mining Engineering and Mineral Processing

Tutkintorakenteen tila: published

Lukuvuosi: 2016-17

Lukuvuoden alkamispäivämäärä: 01.08.2016

Supplementary Studies, Mining Engineering and Mineral Processing (enintään 60 op)

Choose these supplementary studies if you have not taken Bachelor's degree at the degree programme in Mining Engineering and Mineral Processing, and if so called 'Bridge studies' (max 60 ECTS) have been planned for you. If you are unsure on which courses to choose, contact Student Adviser.

A439126: Bridge studies, Mining Technology and Mineral Processing, 0 - 60 op

Bridge Studies

031010P: Calculus I, 5 op
 031075P: Calculus II, 5 op
 031076P: Differential Equations, 5 op
 031078P: Matrix Algebra, 5 op
 031022P: Numerical Analysis, 5 op
 461102A: Statics, 5 op
 771113P: Introduction to Geology I, 5 op
 774301A: A Basic Course in Geochemistry, 6 op
 771102P: Basic course in mineralogy, 6 op
 477121A: Particle Technology, 5 op
 477122A: Bulk Solids Handling, 5 op
 461103A: Strength of materials I, 5 op
 461106A: Dynamics, 5 op
 492300A: Rock mechanics, 5 op
 493302A: Chemical phenomena in mineral processes, 5 op
 477201A: Material and Energy Balances, 5 op
 488102A: Hydrological Processes, 5 op
 477052A: Fluid Mechanics, 5 op
 493300A: Principles of mineral processing, 5 op

Modules of the Study Options (60 op)

Choose one of the following modules.

The Study Option of Mineral Processing

A439127: Mineral Processing, Module of the Option, 0 - 60 op

Mineral Processing

772694S: Geometallurgy and mineral processing, 5 op
 493606S: Mine Geology, 5 op
 772335A: Introduction to ore mineralogy, 5 op
 477713S: Automation in Mineral Processing, 5 op
 493605S: Ore beneficiation technologies, 5 op
 493602S: Mineral process simulation, 5 op
 493607S: Quality requirements for concentrate, 5 op
 493608S: Development of beneficiation processes, 10 op
 492603S: Mining Project feasibility study, 5 op
 488133A: Environmental Impact Assessment, 5 op
 493609S: Mining, environment and society, 5 op

The Study Option of Mining Engineering

A439128: Mining Engineering, Module of the Option, 0 - 60 op

Mining Engineering

493301A: Mining geophysics, 5 op
 493606S: Mine Geology, 5 op
 772694S: Geometallurgy and mineral processing, 5 op
 492604S: Rock engineering, 5 op
 492600S: Mining Engineering, 10 op
 492606S: Modelling of mining, 5 op
 492602S: Financial and Project valuation of mining, 5 op
 492603S: Mining Project feasibility study, 5 op
 466107S: Design of concrete structures, 6 op
 488133A: Environmental Impact Assessment, 5 op
 493609S: Mining, environment and society, 5 op

Supplementary module (20 - 50 op)

491602S: Professional practical training, 5 op

Master's Thesis (30 op)

491601S: Master's thesis, 30 op

491600S: Maturity test, 0 op

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

493611S: Pilot-scale Mineral Processing, 5 op

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuuluvien opintokohteiden kuvaukset

A439101: Basic Studies, Mining Technology and Mineral Processing, 70 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Study module

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Basic Studies

491100P: Orientation to OMS studies, 1 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

1 ECTS /28 hours of work

Language of instruction:

Finnish

Timing:

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

Learning outcomes:

The aim of the course is to introduce new students to the university, academic studies, the studies of his /her degree programme in the Oulu Mining School.

Contents:

Issues related to the beginning of the studies. Goals, structure and contents of the studies in the Oulu Mining School. Preparing a personal study plan. Study technique and the using the library.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Tutorials, information days organized by the faculty and by the degree programmes, independent studying.

Target group:

All first year students in Degree Programme in Mining Technology and Mineral Processing

Prerequisites and co-requisites:

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Recommended optional programme components:

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Recommended or required reading:

Study guide, Teekkarin työkirja

Assessment methods and criteria:

Participation to the tutorials and information sessions and doing the personal study plan. The student has to participate in orientation and two topic lectures (Ajankäyttö ja suunnitelmallinen opiskelu, Oppiminen on taitolaji).

Grading:

Verbal scale Passed/Failed

Person responsible:

Student advisor Saara Luhtaanmäki

Working life cooperation:

No

Other information:

-

477011P: Introduction to Process and Environmental Engineering I, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Aki Sorsa

Opintokohteen kielet: Finnish

Leikkaavuudet:

470219A Introduction to Process Engineering 3.5 op

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

Finnish

Timing:

Implementation during periods 1-2 on the autumn term

Learning outcomes:

The objective of this course is to give insight to the whole perspective of process and environmental engineering and to familiarise the students with the terminology involved. In addition, the objective is also to outline the connections between process and environmental engineering and other fields closely related to them.

After the course, the student can analyse the process and environmental engineering aspects of an industrial process. He/She can, for example, divide the process into unit processes, analyse the process or a chain of processes based on the material balances, identify and evaluate the significance of essential mechanical, chemical and transport phenomena, analyse the control and process design aspects of a process etc. He/She can also evaluate the significance of different aspects of process and environmental engineering to the overall production system when these aspects are further examined in forthcoming courses.

Contents:

The course is divided into the next eight separate themes: 1. Unit processes and material balances. 2. Environmental impacts and their classification. 3. Mechanical phenomena. 4. Momentum, heat and mass transfer phenomena. 5. Chemical reactions and reactors. 6. The possibilities of biological process engineering. 7. Process dynamics and control. 8. Process measurements and measurability.

Mode of delivery:

Group work and contact lectures supporting those

Learning activities and teaching methods:

Assignments (8 altogether) carried out in small groups and contact lectures supporting them (16 hours)

Target group:

Bachelor's degree students in the study fields of process and environmental engineering

Prerequisites and co-requisites:

None

Recommended optional programme components:

The course serves as an introduction to the studies in process and environmental engineering

Recommended or required reading:

The material is provided during the contact lectures and through the course webpages. It is also expected that the students seek material for completing the assignments independently.

Assessment methods and criteria:

The assignments (altogether 8) covering the course themes carried out in small groups. Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

The course utilises a numerical grading scale 1-5 and fail.

Person responsible:

Dr Aki Sorsa

Working life cooperation:

No

Other information:

The assessment method utilized requires the active attendance to the group work and contact lectures from the beginning of the course

488010P: Introduction to Process and Environmental Engineering II, 5 op

Voimassaolo: 01.08.2013 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Fabritius, Timo Matti Juhani, Jukka Käräjäoja

Opintokohteen kielet: Finnish

Leikkaavuudet:

488011P Introduction to Environmental Engineering 5.0 op

ECTS Credits:

5 cr / 135 hours of work

Language of instruction:

Available only in Finnish

Timing:

The course is given in the spring semester, during periods III and IV. It is recommended to complete the course at the 1st spring semester.

Learning outcomes:

Students can examine industrial processes using the methods and perspectives of process and environmental engineering (e.g. material management, phenomenon-based considerations and automation) and they recognize the role of different areas of the process and environmental engineering, when these areas are considered in the forthcoming courses.

Contents:

1. Materials in industrial processes. 2. Water resources and land use. 3. Rehabilitation methods. 4. Chemical reactions and reactors. 5. Bioprocess engineering. 6. PI diagrams. 7. Control and operation of processes.

Mode of delivery:

Classroom education

Learning activities and teaching methods:

Group exercises and contact-education (14 h) that supports these exercises. Available only in Finnish.

Target group:

Students of process and environmental engineering

Prerequisites and co-requisites:

None

Recommended optional programme components:

This course is an introduction to the other courses of process and environmental engineering

Recommended or required reading:

Material will be distributed during lectures and via course www-site

Assessment methods and criteria:

Group exercises. Please note that the course is not available in English, but only in Finnish. Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

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

Person responsible:

Professor Timo Fabritius

Working life cooperation:

No

Other information:

It is highly recommended that the students are present already in the first lecture, since it is not possible to come along after the course has already begun.

031010P: Calculus I, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Lusikka

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031010P Calculus I (OPEN UNI) 5.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn semester, periods 1-3.

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 55 h / Group work 22 h.

Target group:

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Prerequisites and co-requisites:

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Recommended optional programme components:

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Recommended or required reading:

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

Assessment methods and criteria:

Intermediate exams or a final exam.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Ilkka Lusikka

Working life cooperation:

-

Other information:

-

031075P: Calculus II, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Lusikka

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031075P Calculus II (OPEN UNI) 5.0 op

031011P Calculus II 6.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Spring, period 3

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 28 h.

Target group:

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Prerequisites and co-requisites:

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

Recommended optional programme components:

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Recommended or required reading:

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

Assessment methods and criteria:

Intermediate exams or a final exam.

Grading:

Numerical grading scale 1-5.

Person responsible:

Ilkka Lusikka

Working life cooperation:

-

Other information:

-

031076P: Differential Equations, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031076P Differential Equations (OPEN UNI) 5.0 op

800320A Differential equations 5.0 op

031017P Differential Equations 4.0 op

Ei opintojaksokuvauksia.

031078P: Matrix Algebra, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Matti Peltola

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031078P Matrix Algebra (OPEN UNI) 5.0 op

031019P Matrix Algebra 3.5 op

Ei opintojaksokuvauksia.

031021P: Probability and Mathematical Statistics, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kemppainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031021P Probability and Mathematical Statistics (OPEN UNI) 5.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Spring semester, periods 4-6

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

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Prerequisites and co-requisites:

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

Recommended optional programme components:

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Recommended or required reading:

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

Assessment methods and criteria:

Intermediate exams or a final exam.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Jukka Kemppainen

Working life cooperation:

-

Other information:

-

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

Language of instruction:

Finnish

Timing:

Spring semester, periods 4-5

Learning outcomes:

The student recognizes what numerical solution methods can be used to solve some specific mathematical problems, can perform the required steps in the numerical algorithm and is able to perform the error analysis.

Contents:

Numerical linear algebra. Numerical methods for systems of equations, Basics of the approximation theory. Numerical quadratures. Numerical methods for ordinary and partial differential equations.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 44 h / Group work 22 h.

Target group:

-

Prerequisites and co-requisites:

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

Recommended optional programme components:

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Recommended or required reading:

J. Douglas Faires and Richar L. Burden, Numerical methods; Alfio Quarteroni, Riccardo Sacco, Fausto Saleri, Numerical mathematics

Assessment methods and criteria:

Intermediate exams or a final exam.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Marko Huhtanen

Working life cooperation:

-

Other information:

-

761113P: Electricity and magnetism, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761119P	Electromagnetism 1	5.0 op
761119P-01	Electromagnetism 1, lectures and exam	0.0 op
761119P-02	Electromagnetism 1, lab. exercises	0.0 op
766319A	Electromagnetism	7.0 op
761103P	Electricity and Magnetism	4.0 op

ECTS Credits:

5 credits

Language of instruction:

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

Timing:

Spring

Learning outcomes:

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

Contents:

Electromagnetic interaction is one of the four fundamental interactions in physics and many phenomena like light, radio waves, electric current, magnetism and formation of solid matter are based on electromagnetism. The current technological development is largely based on applications of electromagnetism in energy production and transfer, telecommunications and information technology. *Contents in brief:* Coulomb's law. Electric field and potential. Gauss's law. Capacitors and dielectrics. Electric current, resistors, electromotive force and DC circuits. Magnetic field, motion of a charged particle in electric and magnetic fields, and applications. Ampère's law and Biot-Savart law. Electromagnetic induction and Faraday's law. Inductance and inductors. R-L-C circuits, alternating current and AC circuits.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, 6 exercises (12 h), 2 laboratory exercises (8 h), self-study 83 h

Target group:

For the students of the University of Oulu.

Prerequisites and co-requisites:

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

Recommended optional programme components:

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

Recommended or required reading:

Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 13th edition, 2012, chapters 21-31. Also older editions can be used.

Lecture material: Finnish lecture material will be available on the web page of the course.

Course material availability can be checked [here](#).

Assessment methods and criteria:

Three mini examinations and end examination or final examination

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Anita Aikio

Working life cooperation:

No work placement period

Other information:

<https://wiki oulu.fi/display/761113P/>

461102A: Statics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Lahtinen, Hannu Tapio

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay461102A Statics (OPEN UNI) 5.0 op

461016A-01 Statics, examination 0.0 op

461016A-02 Statics, exercises 0.0 op

461016A Statics 5.0 op

Ei opintojaksokuvauksia.

780120P: Basic Principles in Chemistry, 5 op**Voimassaolo:** 01.08.2016 -**Opiskelumuoto:** Basic Studies**Laji:** Course**Vastuuyksikkö:** Field of Chemistry**Arvostelu:** 1 - 5, pass, fail**Opintokohteen kielet:** Finnish**Leikkaavuudet:**

780117P General and Inorganic Chemistry A 5.0 op

780109P Basic Principles in Chemistry 4.0 op

ECTS Credits:

5 credits/134 hours of work

Language of instruction:

Finnish

Timing:

1st autumn

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

40 hours of lectures and 94 hours of self-study

Target group:

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

Prerequisites and co-requisites:

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

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:Final examination. Read more about [assessment criteria](#) at the University of Oulu webpage.**Grading:**

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

Person responsible:

Lecturer Minna Tiainen

Working life cooperation:

No

Other information:

No

780123P: Introductory Laboratory Works in Chemistry, 5 op**Voimassaolo:** 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Chemistry

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

780127P Principles of Chemistry Labwork 5.0 op

ECTS Credits:

5 credits /134 hours of work

Language of instruction:

Finnish

Timing:

1st autumn or 1st spring

Learning outcomes:

After this course, the student can apply laboratory safety instructions and act accordingly. He/she can communicate by using basic laboratory terminology and work in a group under the guidance. The student identifies basic laboratory equipment and can use them properly. He/she recognizes the importance of the planning of the laboratory work. The student is able to utilize the basic chemistry techniques and determination methods in the given task. Furthermore, the student can also make laboratory notes and write a report on the performed task.

Contents:

Laboratory safety, basic laboratory equipment, basic chemistry techniques and determination methods as well as some of their theoretical background, problems related to the studied determination methods, keeping a laboratory notebook, writing a report.

Mode of delivery:

Supervised laboratory work, independently done preparatory problems.

Learning activities and teaching methods:

Safety in laboratory 2 hours, 40 hours of laboratory work + demonstrations + problems, 92 hours of self-study.

Target group:

Biochemistry, Process Engineering, Environmental engineering, compulsory. In the entity of 25 credits, compulsory. Physical Sciences, Geology, Mathematical Sciences, optional.

Prerequisites and co-requisites:

Basic Principles in Chemistry (780120P, 5cr) or Basic Principles in Chemistry (780109P, 4 cr) or General and Inorganic Chemistry A (780117P, 5 cr). Student is allowed to participate to the course simultaneously when participating the prerequisites. Attendance at the lecture of Safety in laboratory is compulsory.

Recommended optional programme components:

Participation in the courses Basic Principles of Chemistry (780123P, 5 cr), General and Inorganic Chemistry A (780117P, 5 cr) and Introduction to Organic Chemistry (780116P, 5 cr).

Recommended or required reading:

Instruction Book (in Finnish): Kemian perustyöt 780123P

Assessment methods and criteria:

Accomplishment of the course requires accepted preparatory problems, laboratory exercises, problems related to them and final examination. Laboratory exercises and final examination has to be completed within next two terms. Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

The course utilizes verbal grading scale pass/fail.

Person responsible:

Ph.D. Teija Kangas

Working life cooperation:

No

Other information:

Attendance at the lecture of Safety at work is compulsory. The exercises must be done before each laboratory assignment. Deadline of the written report is binding. Failure will lead to the renewal of the work.

030005P: Information Skills, 1 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Faculty of Technology

Arvostelu: 1 - 5, pass, fail

Opettajat: Ursula Heinikoski, Sassali, Jani Henrik

Opintokohteen kielet: Finnish

Leikkaavuudet:

030004P Introduction to Information Retrieval 0.0 op

ECTS Credits:

1 ECTS credit

Language of instruction:

Finnish

Timing:

2nd or 3rd year

Learning outcomes:

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

Contents:

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

Mode of delivery:

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

Learning activities and teaching methods:

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

Target group:

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

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

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

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

pass/fail

Person responsible:

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

Working life cooperation:

-

Other information:

-

902011P: Technical English 3, 6 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Proficiency level:

[CEFR B2 - C1](#)

Status:

This course is compulsory for the students who have chosen English as their foreign language. (See the foreign language requirements for your own degree programme.)

Required proficiency level:

English must have been the A1 or A2 language at school or equivalent English skills acquired otherwise. If you need to take English, but lack this background, please get in touch with the [Languages and Communication contact teacher](#) for your department to discuss individual solutions.

ECTS Credits:

6 ECTS credits (The workload is 160 hours.)

STUDENTS OF ENGINEERING: The course consists of 3 x 2-ECTS modules.

STUDENTS OF ARCHITECTURE: The course consists of 2 x 3-ECTS modules.

Students with the matriculation exam grade *Laudatur* or *Eximia cum laude approbatur* will be exempted from part of the course (2 ECTS credits).

Language of instruction:

English

Timing:

STUDENTS OF ENGINEERING:

PYO, KO, TuTa: *1st & 2nd* years of studies, beginning 1st year autumn.

SO & CSE: 2nd & 3rd years of studies, beginning 2nd year autumn.

STUDENTS OF ARCHITECTURE:

1st & 2nd years of studies, beginning 1st year spring and continuing 2nd year autumn.

Learning outcomes:

By the end of the course, you will be able to

- demonstrate efficient strategies and methods for developing and maintaining your English proficiency
- communicate using the core vocabulary required for professional language use in your field
- apply language skills, intercultural awareness and presentation techniques necessary for working in a multicultural environment
- use language, culture and communication skills at a B2-C1 CEFR level in accordance with your own professional needs.

Contents:

In this course, you will focus on developing oral and written English language skills which enable you to follow developments in your own professional field and manage successfully in an international, intercultural working environment.

STUDENTS OF ENGINEERING:

The course consists of three modules:

1. first, [Professional English for Technology](#) (PET, 2 ECTS credits),
2. then **two modules** (2 ECTS credits each) from a [free-choice module menu, in which each module has its own content](#). These modules allow you to develop further skills in specific core areas. Read the module descriptions with care so that you choose modules which match your own needs, interests and level.

TuTa students, however, take ONE module from the free-choice menu and then, in second year autumn,

the [902143Y, Company Presentations](#) module, which is integrated with a course in their own department

([555226A Operations and production](#)) .

STUDENTS OF ARCHITECTURE:

The course consists of two modules:

See the course description of each module ([902011P-38](#) module A and [902011P-39](#) module B for a detailed explanation of the course content.

Mode of delivery:

STUDENTS OF ENGINEERING: The mode of delivery varies according to the modules you take. See the course descriptions for the individual modules.

STUDENTS OF ARCHITECTURE: face-to-face teaching in the premises of your own department and independent study

Learning activities and teaching methods:

STUDENTS OF ENGINEERING: The teaching methods and learning activities depend on which free-choice modules you choose. See the course descriptions for the individual modules.

STUDENTS OF ARCHITECTURE:

The classroom teaching comprises about 50% of the total student workload for the course and includes mini-lectures, group and teamwork, student presentations. The independent work component comprises online work and independent study in preparation for classroom activities.

Target group:

Students of the Faculty of Technology

- **all Engineering Departments**
- **the Department of Architecture**

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Materials will be provided by the teacher.

Assessment methods and criteria:

Assessment methods vary according to the individual modules taken. The assessment criteria are based on the learning outcomes of the module.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

pass / fail.

Person responsible:

Each department in the Technical Faculty has its own [Languages and Communication contact teacher](#) for questions about English studies.

Working life cooperation:

-

Other information:

[See the Languages and Communication Study Guide, English, TTK.](#)

901008P: Second Official Language (Swedish), 2 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Opintokohteen kielet: Swedish

Leikkaavuudet:

ay901008P Second Official Language (Swedish) (OPEN UNI) 2.0 op

Ei opintojaksokuvauksia.

A439102: Intermediate Studies, Mining Technology and Mineral Processing, 60 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Study module

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Intermediate Studies

488012A: Environmental Legislation, 5 op

Voimassaolo: 01.01.2011 - 31.07.2017

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Leikkaavuudet:

488101A Environmental Legislation 5.0 op

ECTS Credits:

5 ECTS / 135 hours of work

Language of instruction:

Finnish

Timing:

The course unit is given in the autumn semester, during period 2

Learning outcomes:

Upon completion of the course, the student will be able to explain the main component of Finnish environmental legislation and knows the structure of environmental administration in governmental and municipal level; authorities, jurisdiction and duties. The student will be able to understand differences between EIA and environmental permits. Having completed the course, the student knows what permits and acts must be considered in different cases relating to mining, water and energy initiatives.

Contents:

Environmental Legislation of Finland

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 12 h, seminar 8 h and self-study 113 h. Totally 133 h.

Target group:

Students in bachelor program of environmental engineering and Mining Engineering and Mineral Processing

Prerequisites and co-requisites:

None

Recommended optional programme components:

-

Recommended or required reading:

Ympäristöoikeuden pääpiirteet (Ekroos, Kumpula 2010, ISBN: 9789510361283), lecture notes

Assessment methods and criteria:

Group work (50% of the final grade of the course) and seminar (50%). Seminar includes presentation, report and discussion.

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:

University Lecturer Anna-Kaisa Ronkanen

Working life cooperation:

No

Other information:

-

771113P: Introduction to Geology I, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay771113P Introduction to Geology I (OPEN UNI) 5.0 op

ECTS Credits:

5 credits

Language of instruction:

Finnish

Timing:

1st year autumn

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face to face

Learning activities and teaching methods:

36 h lectures, 6 h exercises

Target group:

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

Prerequisites and co-requisites:

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

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

Written examination and identification test of rock types.

Grading:

5-1/fail

Person responsible:

Eero Hanski

Working life cooperation:

No

774301A: A Basic Course in Geochemistry, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opettajat: Eero Hanski

Opintokohteen kielet: Finnish

ECTS Credits:

6 credits

Language of instruction:

Finnish

Timing:

1st spring

Learning outcomes:

Upon completion of this course, students will have a broad overview of the different fields of geochemistry and be able to relate the behavior of elements to different physico-chemical processes in nature. They will be able to convert geochemical data from one form to another (wt%, molar and cation proportions, milliequivalents), plot these data on different diagrams, and carry out simple mineral dissolution /precipitation and mass balance calculations.

Contents:

Geochemistry as a field of science; history of geochemistry; tasks and fields of geochemistry; origin and electron configuration of chemical elements; origins and structure of the Earth; meteorites; the geochemical classification of the elements; composition of earth's different spheres; geochemical differentiation; composition of magmas; dissolution and precipitation of minerals; pH-Eh-diagrams; introduction to isotope geochemistry.

Mode of delivery:

Face to face

Learning activities and teaching methods:

32 h lectures, 12 h exercises

Target group:

All students conducting basic courses in geosciences.

Prerequisites and co-requisites:

A basic course in chemistry.

Recommended optional programme components:

It is recommended that a basic course in chemistry (e.g. 780117P) has been taken during the previous fall semester.

Recommended or required reading:

Gill, Robin, Chemical Fundamentals of Geology, Chapman & Hall, London, 1996, 298 p. And Mason, B. & Moore, C.B.: Principles of Geochemistry, 4th Student Edition, J. Wiley, New York, 1982, p. 187-209. The availability of the literature can be checked from [this link](#).

Assessment methods and criteria:

Examination in both theory and calculations.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

5-1/fail

Person responsible:

Eero Hanski

Working life cooperation:

No

771102P: Basic course in mineralogy, 6 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Tuisku

Opintokohteen kielet: Finnish

ECTS Credits:

6 credits

Language of instruction:

Finnish

Timing:

1st year autumn

Learning outcomes:

Students obtain a basic knowledge on mineralogy.

Contents:

Crystal, crystal systems, mineral, rocks. Formation of minerals in geological processes, chemical and physical properties of minerals, occurrence and utilization.

Mode of delivery:

Face to face

Learning activities and teaching methods:

20 h lectures, 16 h exercises. Exercises are compulsory.

Target group:

1st year geosciences students.

Prerequisites and co-requisites:

No

Recommended optional programme components:

-

Recommended or required reading:

Risto Piispanen ja Pekka Tuisku (2005) Mineralogian perusteet. <http://cc.oulu.fi/~petuisku/Mineralogia/MinPer.htm>

Assessment methods and criteria:

Examination, compulsory exercises

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

1-5/fail

Person responsible:

Pekka Tuisku, Jukka Pekka Ranta

Working life cooperation:

No

Other information:

-

477121A: Particle Technology, 5 op

Voimassaolo: 01.08.2015 - 31.07.2022

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Maria Salmela-Karhu

Opintokohteen kielet: Finnish

Leikkaavuudet:

477120A Fluid and Particle Engineering 5.0 op

477101A Fluid and Particle Engineering I 3.0 op

ECTS Credits:

5 ECTS / 133 h of work

Language of instruction:

Finnish

Timing:

Implementation in spring term, period 4

Learning outcomes:

Upon completion of the course, a student should be able to identify the mainline mechanical processes in process industry enhancing the degree of upgrading, as well as recovery operations related to those mechanical main processes. The student is able to identify the equipments related to the mechanical processes and can explain their purpose of use and their operational principles.

Contents:

Granular material and sampling, particle size and particle size distribution, specific surface area, basics in grinding, crushing, sieving and mineral concentration, froth flotation, mineral concentration methods based on density difference, magnetic concentration and other concentration methods, granulation, separation from suspensions

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

The implementation methods of the course are varying. Lectures and exercises max. 48 h. A part of teaching can be replaced by home or group works.

Target group:

: Bachelor students in process and environmental engineering

Prerequisites and co-requisites:

Introduction to process and environmental engineering I (477011P)

Recommended optional programme components:

-

Recommended or required reading:

Lecture materials and other materials that will be announced at the lectures

Assessment methods and criteria:

This course utilizes continuous assessment including lecture diaries and three intermediate exams. Alternatively, the course can also be completed by taking the end exam.

Grading:

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

Person responsible:

Ari Ämmälä

Working life cooperation:

No

Other information:

-

477122A: Bulk Solids Handling, 5 op

Voimassaolo: 01.08.2015 - 31.07.2023

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

477120A Fluid and Particle Engineering 5.0 op

477102A Bulk Solids Handling 4.0 op

ECTS Credits:

5 ECTS / 133 h of work

Language of instruction:

Finnish

Timing:

Implementation in period 2 (autumn term)

Learning outcomes:

Upon completion of the course, a student should be able to identify auxiliary mechanical unit processes as well as equipments and phenomena related to them. In addition, the student can explain application of unit processes and can describe their operational principles.

Contents:

Liquid and suspensions: fluid mechanics, pumping and hydraulic transport, mixing. Gases and aerodispersions: gas dynamics, compression, pneumatic transport. Granular bulk material: properties, storage, mechanical transportation, fluidization.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

The implementation methods of the course vary. Lectures and exercises max. 48 h. A part of teaching can be replaced by home or group works.

Target group:

Bachelor students in process or environmental engineering

Prerequisites and co-requisites:

477101A Particle Technology

Recommended optional programme components:

-

Recommended or required reading:

Lecture materials and other materials that will be announced at the lectures

Assessment methods and criteria:

This course utilizes continuous assessment including lecture diaries and three intermediate exams. Alternatively, the course can also be completed by taking the end exam.

Grading:

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

Person responsible:

Ari Ämmälä

Working life cooperation:

No

Other information:

-

461103A: Strength of materials I, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Lahtinen, Hannu Tapio

Opintokohteen kielet: Finnish

Leikkaavuudet:

461010A-01 Strength of Materials I, examination 0.0 op

461010A-02 Strength of Materials I, exercises 0.0 op

461010A Strength of Materials I 7.0 op

Ei opintojaksokuvauksia.

461106A: Dynamics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Koivurova Hannu

Opintokohteen kielet: Finnish

Leikkaavuudet:

461018A-01 Dynamics, examination 0.0 op

461018A-02 Dynamics, exercises 0.0 op

461018A Dynamics 4.0 op

Ei opintojaksokuvauksia.

492300A: Rock mechanics, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

English

Timing:

3rd year 3rd period

Learning outcomes:

Upon completion of the course students should: (1) know the basic properties of rock; (2) be able to make stress or strain analysis to a rock sample and a rock structure; (3) be able to analyse rock failure under compression, shear and tension loads; (4) know which factors influence rock failure or fracture and know how those affect rock fracture; (5) know the basic principles and methods in rock support; (6) be able to do rock support design; (7) be able to apply rock mechanics theory to tunnelling, mining planning, rock drilling, rock excavation, slope engineering, and other rock-related engineering.

Contents:

The course will: (1) introduce basic properties and characteristics of rock and rock mass; (2) introduce stress analysis method; (3) present basic theory on rock failure or fracture; (4) introduce basic methods for measuring rock strengths (compressive, shear and tensile) in laboratory; (5) present methods for measuring in-situ stresses; (6) introduce methods for rock support; (7) give knowledge on how to apply rock mechanics to mining engineering and other types of rock engineering.

Mode of delivery:

Face to face teaching

Learning activities and teaching methods:

Lectures, seminars, written reports, and assignments (mine visit if available).

Target group:

Students from mining and mineral processing, geophysics and geology

Recommended or required reading:

Brady BHG and Brown ET. Rock Mechanics for underground mining, third edition. New York: Kluwer Academic Publishers, 2004.

Goodman RE. Introduction to rock mechanics, second edition. New York: John Wiley & Sons, 1989.

Zhang ZX. Rock fracture and blasting: theory and applications. Oxford: Elsevier, 2016 (Chapters 1, 3-7, 10, 17-19, 21-24).

Assessment methods and criteria:

Assessment methods include oral presentations, written reports, seminars, assignments and written examination. The total points gained from the above determine the final grade of the course, and it is given on the scale Fail-1-5.

- For grade 1, the student must be able to know and understand the basic knowledge in this course.
- For grade 2, the student must know how to make stress analysis and rock failure analysis.
- For grade 3 the student must be able to make a plan for rock support.
- For grade 4, the student must be able to make a plan for rock support and evaluate such a plan.
- For grade 5, the student must be able to apply the acquired knowledge to make a very good plan for mining and rock engineering operation by using rock mechanics. He or she must do an outstanding design

in at least one aspect, e.g. he/she can find a problem related rock mechanics or rock fracture and know how to solve the problem or how to make improvement.

Grading:

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

Person responsible:

Zongxian Zhang

Working life cooperation:

No

Other information:

-

477501A: Process dynamics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Leiviskä, Kauko Johannes, Aki Sorsa

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay477501A Process Control Engineering I 5.0 op

470431A Process Control Engineering I 5.0 op

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

Finnish/English. The main lecturing language is Finnish, but the course can also be taken in English with some special arrangements. Contact the responsible person.

Timing:

Negotiable (for the English version)

Learning outcomes:

After the course, the student understands the basic principles of dynamical behaviour of different processes, can write dynamic mass and energy balances for unit processes, and can solve these with the help of the transfer function approach. He knows also the connection between process control and process dynamics.

Contents:

Basics of process models and dynamics. Dynamic models. Lumped and distributed parameter models. Practical examples of different unit processes such as chemical reactors, distillation columns and heat exchangers. Modelling of large-scale processes.

Mode of delivery:

Negotiable (the course can be taken in English with some special arrangements - contact the responsible person)

Learning activities and teaching methods:

Solving exercise problems; textbook

Target group:

Exchange and other international students (for the English version)

Prerequisites and co-requisites:

Courses Material and Energy Balances, Heat Transfer, Mass Transfer and Control System Analysis recommended beforehand

Recommended optional programme components:

The course forms a basis to the advanced courses in the field of control engineering

Recommended or required reading:

Parts of the textbook used: Luyben, W.L.: Process Modeling, Simulation and Control for Chemical Engineers. McGraw Kogakusha Ltd., Tokyo 1973, 558 pp.

Assessment methods and criteria:

Homework and written/oral test

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail. Read more about [assessment criteria](#) at the University of Oulu webpage.

Person responsible:

Professor Kauko Leiviskä

Working life cooperation:

No

Other information:

-

477502A: Experiment design and analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Aki Sorsa

Opintokohteen kielet: Finnish

Leikkaavuudet:

470432A Process Control Engineering II 5.0 op

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

Finnish

Timing:

Implementation in the 4th period on the spring term

Learning outcomes:

After the course, the student knows different experimental design methods and their applicability for different problems. He can also design experiments for multi-variable processes and analyze the results. He can also use some basic means to visualize the results got from experimental data and choose proper tools for experiment design problems.

Contents:

Systematic design of process experiments with matrix techniques (Hadamard, Central Composite Design, Taguchi). Graphical and statistical analysis of experimental data. Correlation, regression and variance analysis. Dynamic data based modelling.

Mode of delivery:

Lectures and extensive exercise work

Learning activities and teaching methods:

Lectures during one period

Target group:

Bachelor's students in process and environmental engineering

Prerequisites and co-requisites:

Course Process Dynamics is recommended beforehand

Recommended optional programme components:

The course forms a basis to the advanced courses in the field of control engineering

Recommended or required reading:

Reading materials. *Additional literature*. Diamond W.J.: Practical Experiment Designs. Lifetime Learning Publications. Belmont, California, 1981. 348 pp.

Assessment methods and criteria:

Examination. It is recommended to take the course also according to the principle of continuous evaluation.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail. Read more about [assessment criteria](#) at the University of Oulu webpage.

Person responsible:

Professor Kauko Leiviskä

Working life cooperation:

No

Other information:

For exchange/international students also the course 477041S Experimental Design is recommended

493302A: Chemical phenomena in mineral processes, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opettajat: Saija Luukkanen

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS / 133 hours of work

Language of instruction:

Finnish, course material in English

Timing:

The course is held in the spring semester, during period 3. It is recommended to complete the course at the 3rd spring semester

Learning outcomes:

Upon successful completion student can explain physical-chemical phenomena (especially surface and electro chemical) affecting various unit operations in mineral processing. Student can also describe general phases in mineral processing and unit operation from standpoint of physical chemistry.

Contents:

Basic equations in thermodynamics; chemical interactions especially in interfaces; electrochemical interactions.

Mode of delivery:

Face to face teaching

Learning activities and teaching methods:

32 h lectures and practicals

Target group:

Major students in Mining engineering and mineral processing, minor subject students in Geosciences and Process engineering.

Prerequisites and co-requisites:

493300A Principles of Mineral Processing

Recommended optional programme components:

-

Recommended or required reading:

Lecture and electronic material

Assessment methods and criteria:

Final exam, practicals, activity

Grading:

1-5/fail

Person responsible:

Saija Luukkanen

Working life cooperation:

No

Other information:

-

A439125: Supplementary Studies, Mining Technology and Mineral Processing, 25 op**Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Intermediate Studies**Laji:** Study module**Vastuuyksikkö:** Oulu Mining School**Arvostelu:** 1 - 5, pass, fail**Opintokohteen kielet:** Finnish**Voidaan suorittaa useasti:** Kyllä

Ei opintojaksokuvauksia.

*To Study Options***477401A: Thermodynamic Equilibria, 5 op****Voimassaolo:** 01.08.2005 -**Opiskelumuoto:** Intermediate Studies**Laji:** Course**Vastuuyksikkö:** Field of Process and Environmental Engineering**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Eetu-Pekka Heikkinen**Opintokohteen kielet:** Finnish**Leikkaavuudet:**

470611A Metallurgy Processes 7.0 op

ECTS Credits:

5 cr / 135 hours of work

Language of instruction:

Available only in Finnish

Timing:

The course is given in the autumn semester, during period II. It is recommended to complete the course at the 2nd year of Bachelor's studies.

Learning outcomes:

Student is capable of defining chemical equilibria of the systems that are related to industrial processes and understands the relevance of equilibria (and their computational determination) as a part of process analysis, planning and control. Additionally, (s)he can define a meaningful system to be considered in computation thermodynamics; i.e. (s)he can create a computationally solvable problem based on technical problem that in itself is not solvable computationally.

Contents:

Concepts of enthalpy (H), entropy (S) and Gibbs free energy (G). The effect of temperature and pressure on H, S and G. Chemical and phase equilibria. Activity and activity coefficient. Calculation of thermodynamic equilibria using equilibrium constant as well as Gibbs free energy minimisation.

Mode of delivery:

Classroom education

Learning activities and teaching methods:

Lectures, software exercise as well as other exercises. Available only in Finnish.

Target group:

Students of process and environmental engineering

Prerequisites and co-requisites:

'Basic Principles in Chemistry' and 'Material and Energy Balances' as prerequisites

Recommended optional programme components:

This is one of the courses in which physical chemistry is used in the applications of process and environmental engineering. It is part of a education that aims at skills needed in the phenomenon-based modelling and planning of industrial processes.

Recommended or required reading:

Material will be distributed during lectures and exercises.

Assessment methods and criteria:

Students are required to make a portfolio consisting of a learning diary and exercises. Please note that the course is organised only in Finnish.

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:

University Lecturer Eetu-Pekka Heikkinen

Working life cooperation:

No

Other information:

It is highly recommended that the students are present already in the first lecture, since it is not possible to come along after the course has already begun. Course webpage (in Finnish): <http://www.oulu.fi/pyomet/477401a>.

477201A: Material and Energy Balances, 5 op

Voimassaolo: 01.08.2005 - 31.12.2019

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Tiina Leiviskä

Opintokohteen kielet: Finnish

Leikkaavuudet:

477221A Material and Energy Balances 5.0 op

470220A Fundamentals of Chemical Process Engineering 5.0 op

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

Finnish. The course can be completed in English as a book examination.

Timing:

Autumn period 1

Learning outcomes:

The student is able to formulate material and energy balances for a process by taking into account the restrictions set by reaction stoichiometry. The student knows how the created mathematical formulation can be exploited in process consideration.

Contents:

Formulation of material and energy balances by taking into account the effects of chemical reactions.

Mode of delivery:

Lectures and group exercise

Learning activities and teaching methods:

Lectures 40h, group work 10h and self-study 80h

Target group:

Bachelor students in of Process or Environmental Engineering

Prerequisites and co-requisites:

Basics from the course Introduction to Process Engineering

Recommended optional programme components:

-

Recommended or required reading:

Reklaitis, G.V.: Introduction to Material and Energy Balances. John Wiley & Sons, 1983. ISBN 0-471-04131-9.

Assessment methods and criteria:

During the course, there are two intermediate exams and both of them must be passed. Alternatively student can participate in final exam after the course. In addition to this, the students will be making a group exercise, which will be evaluated.

Read more about the course assessment and grading systems of the University of Oulu at www.oulu.fi/english/studying/assessment

Grading:

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

Person responsible:

Dr Tiina Leiviskä

Working life cooperation:

No

Other information:

-

488102A: Hydrological Processes, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay488102A Hydrological Processes (OPEN UNI) 5.0 op

480207A Hydraulics and Hydrology 5.0 op

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

Finnish, course can also be completed in English as a self-study/book exam

Timing:

The course unit is given in the autumn semester during period 1. Also the English version of the course is only available in the autumn semester.

Learning outcomes:

After the course, the student understands and can describe the main hydrological processes, water movements and hydraulics phenomenon quantitatively through mathematical methods. The student also understands and quantifies the relation between state and flow with relation to snowmelt, evaporation, infiltration and groundwater flow. After course student have knowledge also to design pipe and open channel projects.

Contents:

Hydrological cycle, physical properties of water, distribution of water resources, water balance, precipitation, evapotranspiration, soil and ground water, infiltration, runoff, snow hydrology, hydrometry, water quality of rivers and lakes, open channel flow, flow in pipe systems.

Mode of delivery:

Face-face teaching in Finnish, self-study package in English

Learning activities and teaching methods:

For the English self-study package, 4 tutor sessions are arranged during the autumn semester

Target group:

Students in international programs of environmental engineering

Prerequisites and co-requisites:

No

Recommended optional programme components:

The course is a prerequisite for Master level studies

Recommended or required reading:

Physical Hydrology (Dingman SL, 2002, 2nd Edition, ISBN 978-1-57766-561-8), Fluid Mechanics and Hydraulics (Giles, Evett and Liu, 3rd Edition, ISBN 0-07-020509-4)

Assessment methods and criteria:

Both hydrology and hydraulics assignments must be returned and passed with threshold of 50% in order to get final examination. The final grade of the course is weighted average of assignments (80%) and examination (20%)

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail. Read more about [assessment criteria](#) at the University of Oulu webpage.

Person responsible:

University Lecturer Anna-Kaisa Ronkanen

Working life cooperation:

No

Other information:

-

477052A: Fluid Mechanics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

477301A Momentum Transfer 3.0 op

ECTS Credits:

5 ECTS / 133 hours of work.

Language of instruction:

Finnish, can be completed in English as a book examination.

Timing:

Implementation in spring semester during 3rd period. It is recommended to complete the course at the second (Bachelor's) spring semester.

Learning outcomes:

After the course the student is able to determine the viscosity of pure substances and mixtures and to estimate the effect of temperature and pressure on viscosity. The student is able to recognise the interactions between a solid body and flowing fluid and to distinguish the forces, their directions and to calculate their magnitudes. The student is able to formulate momentum balance equations and to solve these in order to calculate velocity distribution, flow rate and pressure drop. The student is able to distinguish laminar and turbulent flow regimes from others and is able to use the correct equations according to flow regime. After the course the student is able to design pipelines and other simple flow mechanical process equipment.

Contents:

Viscosity. Mechanism of momentum transfer. Creating and solving differential momentum balances. Friction factor. Macroscopic balances. Flow in pipes and open-channels.

Mode of delivery:

Face-to-face teaching in Finnish. Book examination in English.

Learning activities and teaching methods:

Lectures 45 h, homework 15 h and self-study 73 h. For foreign students written examination based on given literature.

Target group:

Bachelor's degree students of process and environmental engineering.

Prerequisites and co-requisites:

Knowledge of solving differential equations.

Recommended optional programme components:

The course is part of a stream that aims at skills needed in the phenomenon-based modelling and planning of industrial processes.

Recommended or required reading:

Munson, B.R., Young, D.F. & Okiishi, T.H. Fundamentals of Fluid Mechanics.

Assessment methods and criteria:

This course utilizes continuous assessment. During the course there are 5 intermediate exams. The course can also be completed by final examination. Read more about the course assessment and grading systems of the University of Oulu at www oulu.fi/english/studying/assessment.

Grading:

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

Person responsible:

University teacher Kaisu Ainassaari

Working life cooperation:

No

Other information:

-

493300A: Principles of mineral processing, 5 op**Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Intermediate Studies**Laji:** Course**Vastuuyksikkö:** Oulu Mining School**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Saija Luukkanen**Opintokohteen kielet:** English, Finnish**Leikkaavuudet:**

ay493300A Principles of mineral processing (OPEN UNI) 5.0 op

ECTS Credits:

5 ECTS / 133 hours of work

Language of instruction:

Finnish; material mainly in English

Timing:2nd period in the autumn. Recommended for the 3rd year students.**Learning outcomes:**

Upon completion the course the student can explain the main unit process used in ore beneficiation and understands the main chemical and mineralogical factors playing the key role in process development. The student is able to calculate the most relevant process related calculations, such as mass balances, concentrate recoveries and grindability. The student is aware of the environmental as well as H&S aspects of mineral processing.

Contents:

The main unit processes used in mineral processing. Understanding how the mineralogy and chemistry of the ore influences in the process development.

Mode of delivery:

Mainly face-to-face teaching

Learning activities and teaching methods:

Lectures, demonstrations, assignments

Target group:

Student with mineral processing as major; students of mining engineering, geosciences and process engineering

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

The material provided during the course. B.A. Wills: Mineral processing technology

Assessment methods and criteria:

Final exam, home works and practicals, energy

Grading:

1-5/fail

Person responsible:

Saija Luukkanen

Working life cooperation:

No

Other information:

-

A439124: Working Life Studies, Mining Technology and Mineral Processing, 25 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Study module

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Working Life Studies

555225P: Basics of industrial engineering and management, 5 op

Voimassaolo: 01.01.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Industrial Engineering and Management

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Majava

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay555225P	Basics of industrial engineering and management (OPEN UNI)	5.0 op
555221P	Introduction to Production	2.0 op
555220P	Basic Course in Industrial Engineering and Management	3.0 op

Language of instruction:

Finnish. English material is also used.

Timing:

Periods 1-2.

Learning outcomes:

Upon completion of the course the student should be able to describe what operations management means. The student can explain the core concepts of business operations and utilize these concepts in describing and analyzing organizational operations. In addition, he/she can explain in general terms the factors that affect economic performance of organizations. The student is able to utilize the terminology used in operations management, describe the financial processes of companies and based on this describe the use of cost accounting in organizational decision-making. The student can also calculate unit costs in various simplified settings, calculate various alternatives, as well as perform planning and goal oriented calculations based on given data, and draw conclusions based on the calculation results.

Contents:

Operations and productivity, operations strategy, forecasting, cost accounting, investments, sustainability, capacity management, location decisions, layout strategies, human resources management, supply chain management, subcontracting, inventory management, production planning, MRP & ERP, production scheduling, Just-in-Time & Lean operations, maintenance.

Mode of delivery:

The tuition will be implemented as blended teaching (web-based teaching and face-to-face teaching).

Learning activities and teaching methods:

Web-based lectures 20 h / exercises 18 h / self-study 96 h.

Target group:

: Industrial Engineering and Management students and other students taking Industrial Engineering and Management as minor.

Prerequisites and co-requisites:

No prerequisites exist.

Recommended optional programme components:

This course is part of the 25 ECTS module of Industrial engineering and management that also includes 555285A Project management, 555242A Product development, 555264P Managing well-being and quality of working life, and 555286A Process and quality management.

Recommended or required reading:

Lecture and exercise materials. Heizer, J. & Render, B. (2014) Operations management: sustainability and supply chain management, 11th ed. Pearson.

Assessment methods and criteria:

This course utilizes continuous assessment. During the course, there are nine mandatory weekly assignments. At least half of the assignments must be passed.

Grading:

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

Person responsible:

D.Sc. Jukka Majava.

Working life cooperation:

No.

Other information:

Substitutes courses 555220P Basic Course in Industrial Engineering and Management 3 ECTS cr and 555221P Introduction to Production 2 ECTS cr.

555265P: Occupational Safety and Health Management, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Industrial Engineering and Management

Arvostelu: 1 - 5, pass, fail

Opettajat: Henri Jounila

Opintokohteen kielet: Finnish

Leikkaavuudet:

555263A Technology, Society and Work 2.0 op

555260P Basic Course in Occupational Safety and Wellbeing at Work 3.0 op

Required proficiency level:

ECTS Credits:

5,0 ECTS credits.

Language of instruction:

Finnish. English material is also used.

Timing:

Periods 3-4.

Learning outcomes:

After the course the student is capable of explaining basic terms of occupational safety and health. He/she is able to assess the importance of occupational safety, health and well-being at work. In addition, he/she is able to assess the significance of occupational safety in the improving of productivity and quality. He/she can apply different safety analysis. Upon completion of the course the student is familiar with the core issues of occupational safety and health management.

Contents:

Occupational safety and health, safety management, safety culture, laws and standards, hazards and risks, occupational diseases and work accidents, safety analysis, occupational safety at shared industrial work sites, occupational safety card, HSEQ-assessment procedure, other current issues.

Mode of delivery:

The tuition will be implemented as face-to-face teaching.

Learning activities and teaching methods:

Lectures and assignments 26 h / group work 40 h / self-study 68 h.

Target group:

Industrial Engineering and Management, Mechanical Engineering, Process Engineering and Environmental Engineering students.

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Lecture materials. Other materials will be defined during the course.

Assessment methods and criteria:

The grading is based on the exam (50 % of the grade) and exercises (50 % of the grade).

Grading:

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

Person responsible:

Henri Jounila

Working life cooperation:

No.

Other information:

Substitutes courses 555260P Basic Course in Occupational Safety and Wellbeing at Work + 555263A Technology, Society and Work.

491300A: Practical Training, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS, 2 months working full-time

Language of instruction:

Finnish or English

Timing:

Student usually works in summer time.

Learning outcomes:

During the practical training the student is exposed to his/her working environment from the point of view of his/her studies and becomes acquainted with one of a possible future job. The student can identify the problems associated with the working environment and can propose improvements to them. The student will experience points of contact between working life and studies.

Contents:

Suitable areas for practical training are, for example, the mining and metallurgical industry and mining projects.

Mode of delivery:

Working as employee

Learning activities and teaching methods:

-

Target group:

Bachelor's students in Mining Technology and Mineral Processing

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Student has to show original references and leave the application and report to student advisor. In reference must be training time period and duties.

Grading:

Verbal scale Passed/Failed

Person responsible:

Student advisor Saara Luhtaanmäki

Working life cooperation:

Yes

Other information:

The objective is to give an overview of the industrial area where the student may possibly work after graduation. Practical training nurtures theoretical study. In addition the training should give the student a general idea about the company and its technical and organizational operations, financial management and supervision. Student training positions often place students in employee-type positions so that the student becomes familiar with practical work, work safety, as well as with the social nature of the working environment. Students will land the jobs themselves.

900060A: Technical Communication, 2 op

Voimassaolo: 01.08.2005 - 31.07.2021

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay900060A Technical Communication (OPEN UNI) 2.0 op

470218P Written and Oral Communication 3.0 op

Proficiency level:

-

Status:

This course unit is compulsory for students of Electrical Engineering, Computer Science, Communications Technologies and Engineering Mechanical Engineering, Process and Environmental Engineering.

Required proficiency level:

-

ECTS Credits:

2 credits

Language of instruction:

Finnish

Timing:

1st year: Process and Environmental Engineering

3rd year: Mechanical Engineering; Electrical Engineering, Computer Science and Engineering and Communications Technologies

Mode of delivery:

Multimodal teaching

Learning activities and teaching methods:

Contact hours ca. 20 h and independent group work or self-study ca. 34 h.

Target group:

Bachelors students of Electrical Engineering, Computer Science, Communications Technologies and Engineering Mechanical Engineering, Process and Environmental Engineering.

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Kauppinen, Anneli & Nummi, Jyrki & Savola, Tea: Tekniikan viestintä: kirjoittamisen ja puhumisen käsikirja (EDITA); Nykänen, Olli: Toimivaa tekstiä: Opas tekniikasta kirjoittaville (TEK) and material in Optima study environment.

Assessment methods and criteria:

Active participation in contact teaching, independent study and completion of given assignments. Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Pass / fail

Person responsible:

Kaija Oikarainen

Toropainen, Outi

Working life cooperation:

-

Other information:

All students are required to attend the first meeting of the course unit so the work groups can be formed and work started in a timely and efficient manner. When signing up for the course unit, you should keep in mind that completing it requires a responsible attitude and a strong commitment to the work because the teamwork-based exercises rely heavily on the participation and activity of the students.

If the student is involved in the University's student associations or functions in a position of trust in university government, student union administration or Oulun Teekkariyhdistys ry (or in its subordinate guilds), he/she may be relieved of some of the group communication exercises. These compensatory actions must always be agreed upon separately with the course unit's teacher. The student must present an official statement from a person in charge of the governing body or association, which details the student's tasks and involvement with that body or association. Participation that took place over five years ago does not entitle the student to any compensation.

491302A: Bachelor's thesis, 8 op**Voimassaolo:** 01.08.2016 -**Opiskelumuoto:** Intermediate Studies**Laji:** Course**Vastuuyksikkö:** Oulu Mining School**Arvostelu:** 1 - 5, pass, fail**Opintokohteen kielet:** Finnish, English**ECTS Credits:**

8 ECTS /213 hours of work

Language of instruction:

Finnish or English

Timing:Spring term of the 3rd academic year**Learning outcomes:**

Students show that they have basic knowledge of the essential methods of their research field and they are able to use the scientific literature.

Contents:

A thesis based on individual research of literature, field work or laboratory work. Before starting the thesis, students must agree upon the details of the thesis with their professor.

Mode of delivery:

Independent work and personal supervision

Learning activities and teaching methods:

Literature study or small own research project

Target group:

All students of the Bachelor level

Prerequisites and co-requisites:

Studies of at least two years

Recommended optional programme components:

-

Recommended or required reading:

Chosen separately in each case

Assessment methods and criteria:

20- to 30-page-long essay, which may contain a practical component in addition to a literature study

Grading:

Pass/fail

Person responsible:

Professors, lecturers

Working life cooperation:

May be

Other information:

-

491303A: Maturity test, 0 op**Voimassaolo:** 01.08.2016 -**Opiskelumuoto:** Intermediate Studies

Laji: Course
Vastuuyksikkö: Oulu Mining School
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

A439126: Bridge studies, Mining Technology and Mineral Processing, 0 - 60 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Supplementary Module

Laji: Study module

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Bridge Studies

031010P: Calculus I, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Lusikka

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031010P Calculus I (OPEN UNI) 5.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn semester, periods 1-3.

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 55 h / Group work 22 h.

Target group:

-

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

Intermediate exams or a final exam.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Ilkka Lusikka

Working life cooperation:

-

Other information:

-

031075P: Calculus II, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Lusikka

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031075P Calculus II (OPEN UNI) 5.0 op

031011P Calculus II 6.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Spring, period 3

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 28 h.

Target group:

-

Prerequisites and co-requisites:

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

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

Intermediate exams or a final exam.

Grading:

Numerical grading scale 1-5.

Person responsible:

Ilkka Lusikka

Working life cooperation:

-

Other information:

-

031076P: Differential Equations, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

Ei opintojaksokuvauksia.

031078P: Matrix Algebra, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Matti Peltola

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

Ei opintojaksokuvauksia.

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

Language of instruction:

Finnish

Timing:

Spring semester, periods 4-5

Learning outcomes:

The student recognizes what numerical solution methods can be used to solve some specific mathematical problems, can perform the required steps in the numerical algorithm and is able to perform the error analysis.

Contents:

Numerical linear algebra. Numerical methods for systems of equations, Basics of the approximation theory. Numerical quadratures. Numerical methods for ordinary and partial differential equations.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 44 h / Group work 22 h.

Target group:

-

Prerequisites and co-requisites:

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

Recommended optional programme components:

-

Recommended or required reading:

J. Douglas Faires and Richar L. Burden, Numerical methods; Alfio Quarteroni, Riccardo Sacco, Fausto Saleri, Numerical mathematics

Assessment methods and criteria:

Intermediate exams or a final exam.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Marko Huhtanen

Working life cooperation:

-

Other information:

-

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Lahtinen, Hannu Tapio

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay461102A	Statics (OPEN UNI)	5.0 op
461016A-01	Statics, examination	0.0 op
461016A-02	Statics, exercises	0.0 op
461016A	Statics	5.0 op

Ei opintojaksokuvauksia.

771113P: Introduction to Geology I, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay771113P	Introduction to Geology I (OPEN UNI)	5.0 op
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ECTS Credits:

5 credits

Language of instruction:

Finnish

Timing:

1st year autumn

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face to face

Learning activities and teaching methods:

36 h lectures, 6 h exercises

Target group:

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

Prerequisites and co-requisites:

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

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

Written examination and identification test of rock types.

Grading:

5-1/fail

Person responsible:

Eero Hanski

Working life cooperation:

No

774301A: A Basic Course in Geochemistry, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opettajat: Eero Hanski

Opintokohteen kielet: Finnish

ECTS Credits:

6 credits

Language of instruction:

Finnish

Timing:

1st spring

Learning outcomes:

Upon completion of this course, students will have a broad overview of the different fields of geochemistry and be able to relate the behavior of elements to different physico-chemical processes in nature. They will be able to convert geochemical data from one form to another (wt%, molar and cation proportions, milliequivalents), plot these data on different diagrams, and carry out simple mineral dissolution /precipitation and mass balance calculations.

Contents:

Geochemistry as a field of science; history of geochemistry; tasks and fields of geochemistry; origin and electron configuration of chemical elements; origins and structure of the Earth; meteorites; the geochemical classification of the elements; composition of earth's different spheres; geochemical differentiation; composition of magmas; dissolution and precipitation of minerals; pH-Eh-diagrams; introduction to isotope geochemistry.

Mode of delivery:

Face to face

Learning activities and teaching methods:

32 h lectures, 12 h exercises

Target group:

All students conducting basic courses in geosciences.

Prerequisites and co-requisites:

A basic course in chemistry.

Recommended optional programme components:

It is recommended that a basic course in chemistry (e.g. 780117P) has been taken during the previous fall semester.

Recommended or required reading:

Gill, Robin, Chemical Fundamentals of Geology, Chapman & Hall, London, 1996, 298 p. And Mason, B. & Moore, C.B.: Principles of Geochemistry, 4th Student Edition, J. Wiley, New York, 1982, p. 187-209.

The availability of the literature can be checked from [this link](#).

Assessment methods and criteria:

Examination in both theory and calculations.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

5-1/fail

Person responsible:

Eero Hanski

Working life cooperation:

No

771102P: Basic course in mineralogy, 6 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Tuisku

Opintokohteen kielet: Finnish

ECTS Credits:

6 credits

Language of instruction:

Finnish

Timing:

1st year autumn

Learning outcomes:

Students obtain a basic knowledge on mineralogy.

Contents:

Crystal, crystal systems, mineral, rocks. Formation of minerals in geological processes, chemical and physical properties of minerals, occurrence and utilization.

Mode of delivery:

Face to face

Learning activities and teaching methods:

20 h lectures, 16 h exercises. Exercises are compulsory.

Target group:

1st year geosciences students.

Prerequisites and co-requisites:

No

Recommended optional programme components:

-

Recommended or required reading:

Risto Piispanen ja Pekka Tuisku (2005) Mineralogian perusteet. <http://cc.oulu.fi/~petuisku/Mineralogia/MinPer.htm>

Assessment methods and criteria:

Examination, compulsory exercises

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

1-5/fail

Person responsible:

Pekka Tuisku, Jukka Pekka Ranta

Working life cooperation:

No

Other information:

-

477121A: Particle Technology, 5 op

Voimassaolo: 01.08.2015 - 31.07.2022

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Maria Salmela-Karhu

Opintokohteen kielet: Finnish

Leikkaavuudet:

477120A Fluid and Particle Engineering 5.0 op

477101A Fluid and Particle Engineering I 3.0 op

ECTS Credits:

5 ECTS / 133 h of work

Language of instruction:

Finnish

Timing:

Implementation in spring term, period 4

Learning outcomes:

Upon completion of the course, a student should be able to identify the mainline mechanical processes in process industry enhancing the degree of upgrading, as well as recovery operations related to those mechanical main processes. The student is able to identify the equipments related to the mechanical processes and can explain their purpose of use and their operational principles.

Contents:

Granular material and sampling, particle size and particle size distribution, specific surface area, basics in grinding, crushing, sieving and mineral concentration, froth flotation, mineral concentration methods based on density difference, magnetic concentration and other concentration methods, granulation, separation from suspensions

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

The implementation methods of the course are varying. Lectures and exercises max. 48 h. A part of teaching can be replaced by home or group works.

Target group:

: Bachelor students in process and environmental engineering

Prerequisites and co-requisites:

Introduction to process and environmental engineering I (477011P)

Recommended optional programme components:

-

Recommended or required reading:

Lecture materials and other materials that will be announced at the lectures

Assessment methods and criteria:

This course utilizes continuous assessment including lecture diaries and three intermediate exams. Alternatively, the course can also be completed by taking the end exam.

Grading:

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

Person responsible:

Ari Ämmälä

Working life cooperation:

No

Other information:

-

477122A: Bulk Solids Handling, 5 op

Voimassaolo: 01.08.2015 - 31.07.2023

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

477120A Fluid and Particle Engineering 5.0 op

477102A Bulk Solids Handling 4.0 op

ECTS Credits:

5 ECTS / 133 h of work

Language of instruction:

Finnish

Timing:

Implementation in period 2 (autumn term)

Learning outcomes:

Upon completion of the course, a student should be able to identify auxiliary mechanical unit processes as well as equipments and phenomena related to them. In addition, the student can explain application of unit processes and can describe their operational principles.

Contents:

Liquid and suspensions: fluid mechanics, pumping and hydraulic transport, mixing. Gases and aerodispersions: gas dynamics, compression, pneumatic transport. Granular bulk material: properties, storage, mechanical transportation, fluidization.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

The implementation methods of the course vary. Lectures and exercises max. 48 h. A part of teaching can be replaced by home or group works.

Target group:

Bachelor students in process or environmental engineering

Prerequisites and co-requisites:

477101A Particle Technology

Recommended optional programme components:

-

Recommended or required reading:

Lecture materials and other materials that will be announced at the lectures

Assessment methods and criteria:

This course utilizes continuous assessment including lecture diaries and three intermediate exams. Alternatively, the course can also be completed by taking the end exam.

Grading:

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

Person responsible:

Ari Ämmälä

Working life cooperation:

No

Other information:

-

461103A: Strength of materials I, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Lahtinen, Hannu Tapio

Opintokohteen kielet: Finnish

Leikkaavuudet:

461010A-01 Strength of Materials I, examination 0.0 op

461010A-02 Strength of Materials I, exercises 0.0 op

461010A Strength of Materials I 7.0 op

Ei opintojaksokuvauksia.

461106A: Dynamics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Koivurova Hannu

Opintokohteen kielet: Finnish

Leikkaavuudet:

461018A-01 Dynamics, examination 0.0 op

461018A-02 Dynamics, exercises 0.0 op

461018A Dynamics 4.0 op

Ei opintojaksokuvauksia.

492300A: Rock mechanics, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

English

Timing:

3rd year 3rd period

Learning outcomes:

Upon completion of the course students should: (1) know the basic properties of rock; (2) be able to make stress or strain analysis to a rock sample and a rock structure; (3) be able to analyse rock failure under compression, shear and tension loads; (4) know which factors influence rock failure or fracture and know how those affect rock fracture; (5) know the basic principles and methods in rock support; (6) be able to do rock support design; (7) be able to apply rock mechanics theory to tunnelling, mining planning, rock drilling, rock excavation, slope engineering, and other rock-related engineering.

Contents:

The course will: (1) introduce basic properties and characteristics of rock and rock mass; (2) introduce stress analysis method; (3) present basic theory on rock failure or fracture; (4) introduce basic methods for measuring rock strengths (compressive, shear and tensile) in laboratory; (5) present methods for measuring in-situ stresses; (6) introduce methods for rock support; (7) give knowledge on how to apply rock mechanics to mining engineering and other types of rock engineering.

Mode of delivery:

Face to face teaching

Learning activities and teaching methods:

Lectures, seminars, written reports, and assignments (mine visit if available).

Target group:

Students from mining and mineral processing, geophysics and geology

Recommended or required reading:

Brady BHG and Brown ET. Rock Mechanics for underground mining, third edition. New York: Kluwer Academic Publishers, 2004.

Goodman RE. Introduction to rock mechanics, second edition. New York: John Wiley & Sons, 1989.

Zhang ZX. Rock fracture and blasting: theory and applications. Oxford: Elsevier, 2016 (Chapters 1, 3-7, 10, 17-19, 21-24).

Assessment methods and criteria:

Assessment methods include oral presentations, written reports, seminars, assignments and written examination. The total points gained from the above determine the final grade of the course, and it is given on the scale Fail-1-5.

- For grade 1, the student must be able to know and understand the basic knowledge in this course.
- For grade 2, the student must know how to make stress analysis and rock failure analysis.
- For grade 3 the student must be able to make a plan for rock support.
- For grade 4, the student must be able to make a plan for rock support and evaluate such a plan.
- For grade 5, the student must be able to apply the acquired knowledge to make a very good plan for mining and rock engineering operation by using rock mechanics. He or she must do an outstanding design in at least one aspect, e.g. he/she can find a problem related rock mechanics or rock fracture and know how to solve the problem or how to make improvement.

Grading:

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

Person responsible:

Zongxian Zhang

Working life cooperation:

No

Other information:

-

493302A: Chemical phenomena in mineral processes, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opettajat: Saija Luukkanen

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS / 133 hours of work

Language of instruction:

Finnish, course material in English

Timing:

The course is held in the spring semester, during period 3. It is recommended to complete the course at the 3rd spring semester

Learning outcomes:

Upon successful completion student can explain physical-chemical phenomena (especially surface and electrochemical) affecting various unit operations in mineral processing. Student can also describe general phases in mineral processing and unit operation from standpoint of physical chemistry.

Contents:

Basic equations in thermodynamics; chemical interactions especially in interfaces; electrochemical interactions.

Mode of delivery:

Face to face teaching

Learning activities and teaching methods:

32 h lectures and practicals

Target group:

Major students in Mining engineering and mineral processing, minor subject students in Geosciences and Process engineering.

Prerequisites and co-requisites:

493300A Principles of Mineral Processing

Recommended optional programme components:

-

Recommended or required reading:

Lecture and electronic material

Assessment methods and criteria:

Final exam, practicals, activity

Grading:

1-5/fail

Person responsible:

Saija Luukkanen

Working life cooperation:

No

Other information:

477201A: Material and Energy Balances, 5 op**Voimassaolo:** 01.08.2005 - 31.12.2019**Opiskelumuoto:** Intermediate Studies**Laji:** Course**Vastuuyksikkö:** Field of Process and Environmental Engineering**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Tiina Leiviskä**Opintokohteen kielet:** Finnish**Leikkaavuudet:**

477221A Material and Energy Balances 5.0 op

470220A Fundamentals of Chemical Process Engineering 5.0 op

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

Finnish. The course can be completed in English as a book examination.

Timing:

Autumn period 1

Learning outcomes:

The student is able to formulate material and energy balances for a process by taking into account the restrictions set by reaction stoichiometry. The student knows how the created mathematical formulation can be exploited in process consideration.

Contents:

Formulation of material and energy balances by taking into account the effects of chemical reactions.

Mode of delivery:

Lectures and group exercise

Learning activities and teaching methods:

Lectures 40h, group work 10h and self-study 80h

Target group:

Bachelor students in of Process or Environmental Engineering

Prerequisites and co-requisites:

Basics from the course Introduction to Process Engineering

Recommended optional programme components:

-

Recommended or required reading:

Reklaitis, G.V.: Introduction to Material and Energy Balances. John Wiley & Sons, 1983. ISBN 0-471-04131-9.

Assessment methods and criteria:

During the course, there are two intermediate exams and both of them must be passed. Alternatively student can participate in final exam after the course. In addition to this, the students will be making a group exercise, which will be evaluated.

Read more about the course assessment and grading systems of the University of Oulu at www.oulu.fi/english/studying/assessment

Grading:

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

Person responsible:

Dr Tiina Leiviskä

Working life cooperation:

No

Other information:

-

488102A: Hydrological Processes, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay488102A Hydrological Processes (OPEN UNI) 5.0 op

480207A Hydraulics and Hydrology 5.0 op

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

Finnish, course can also be completed in English as a self-study/book exam

Timing:

The course unit is given in the autumn semester during period 1. Also the English version of the course is only available in the autumn semester.

Learning outcomes:

After the course, the student understands and can describe the main hydrological processes, water movements and hydraulics phenomenon quantitatively through mathematical methods. The student also understands and quantifies the relation between state and flow with relation to snowmelt, evaporation, infiltration and groundwater flow. After course student have knowledge also to design pipe and open channel projects.

Contents:

Hydrological cycle, physical properties of water, distribution of water resources, water balance, precipitation, evapotranspiration, soil and ground water, infiltration, runoff, snow hydrology, hydrometry, water quality of rivers and lakes, open channel flow, flow in pipe systems.

Mode of delivery:

Face-face teaching in Finnish, self-study package in English

Learning activities and teaching methods:

For the English self-study package, 4 tutor sessions are arranged during the autumn semester

Target group:

Students in international programs of environmental engineering

Prerequisites and co-requisites:

No

Recommended optional programme components:

The course is a prerequisite for Master level studies

Recommended or required reading:

Physical Hydrology (Dingman SL, 2002, 2nd Edition, ISBN 978-1-57766-561-8), Fluid Mechanics and Hydraulics (Giles, Evett and Liu, 3rd Edition, ISBN 0-07-020509-4)

Assessment methods and criteria:

Both hydrology and hydraulics assignments must be returned and passed with threshold of 50% in order to get final examination. The final grade of the course is weighted average of assignments (80%) and examination (20%)

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail. Read more about [assessment criteria](#) at the University of Oulu webpage.

Person responsible:

University Lecturer Anna-Kaisa Ronkanen

Working life cooperation:

No

Other information:

-

477052A: Fluid Mechanics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

477301A Momentum Transfer 3.0 op

ECTS Credits:

5 ECTS / 133 hours of work.

Language of instruction:

Finnish, can be completed in English as a book examination.

Timing:

Implementation in spring semester during 3rd period. It is recommended to complete the course at the second (Bachelor's) spring semester.

Learning outcomes:

After the course the student is able to determine the viscosity of pure substances and mixtures and to estimate the effect of temperature and pressure on viscosity. The student is able to recognise the interactions between a solid body and flowing fluid and to distinguish the forces, their directions and to calculate their magnitudes. The student is able to formulate momentum balance equations and to solve these in order to calculate velocity distribution, flow rate and pressure drop. The student is able to distinguish laminar and turbulent flow regimes from others and is able to use the correct equations according to flow regime. After the course the student is able to design pipelines and other simple flow mechanical process equipment.

Contents:

Viscosity. Mechanism of momentum transfer. Creating and solving differential momentum balances. Friction factor. Macroscopic balances. Flow in pipes and open-channels.

Mode of delivery:

Face-to-face teaching in Finnish. Book examination in English.

Learning activities and teaching methods:

Lectures 45 h, homework 15 h and self-study 73 h. For foreign students written examination based on given literature.

Target group:

Bachelor's degree students of process and environmental engineering.

Prerequisites and co-requisites:

Knowledge of solving differential equations.

Recommended optional programme components:

The course is part of a stream that aims at skills needed in the phenomenon-based modelling and planning of industrial processes.

Recommended or required reading:

Munson, B.R., Young, D.F. & Okiishi, T.H. Fundamentals of Fluid Mechanics.

Assessment methods and criteria:

This course utilizes continuous assessment. During the course there are 5 intermediate exams. The course can also be completed by final examination. Read more about the course assessment and grading systems of the University of Oulu at www oulu.fi/english/studying/assessment.

Grading:

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

Person responsible:

University teacher Kaisu Ainassaari

Working life cooperation:

No

Other information:

-

493300A: Principles of mineral processing, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opettajat: Saija Luukkanen

Opintokohteen kielet: English, Finnish

Leikkaavuudet:

ay493300A Principles of mineral processing (OPEN UNI) 5.0 op

ECTS Credits:

5 ECTS / 133 hours of work

Language of instruction:

Finnish; material mainly in English

Timing:

2nd period in the autumn. Recommended for the 3rd year students.

Learning outcomes:

Upon completion the course the student can explain the main unit process used in ore beneficiation and understands the main chemical and mineralogical factors playing the key role in process development. The student is able to calculate the most relevant process related calculations, such as mass balances, concentrate recoveries and grindability. The student is aware of the environmental as well as H&S aspects of mineral processing.

Contents:

The main unit processes used in mineral processing. Understanding how the mineralogy and chemistry of the ore influences in the process development.

Mode of delivery:

Mainly face-to-face teaching

Learning activities and teaching methods:

Lectures, demonstrations, assignments

Target group:

Student with mineral processing as major; students of mining engineering, geosciences and process engineering

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

The material provided during the course. B.A. Wills: Mineral processing technology

Assessment methods and criteria:

Final exam, home works and practicals, energy

Grading:

1-5/fail

Person responsible:

Saija Luukkanen

Working life cooperation:

No

Other information:

-

A439127: Mineral Processing, Module of the Option, 0 - 60 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Study module

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Mineral Processing

772694S: Geometallurgy and mineral processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opettajat: Pertti Lamberg

Opintokohteen kielet: English

ECTS Credits:

5 credits

Language of instruction:

English

Timing:

4th or 5th year

Learning outcomes:

Upon completion of the course students should be able to: 1) Describe the principles of different areas of Geometallurgy (ore geology, process mineralogy, minerals processing, modeling and simulation) and how they are linked in a geometallurgical concept. 2) Use different research and analytical methods of importance for Geometallurgy and interpret the results. 3) Evaluate, analyze and interpret the geometallurgical data in a quantitative way. 4) Design a geometallurgical sampling, analysis and research campaign. 5) Design a geometallurgical program.

Contents:

The course will introduce main parts of the Geometallurgy: 1) ore geology, 2) process mineralogy and 3) minerals processing. The focus is in process mineralogy, mineral processing and in assimilating the geo-metallurgical concept. Exercises, assignments and seminars concentrate on practical aspects of Geometallurgy needed in mining industry.

Mode of delivery:

Face to face

Learning activities and teaching methods:

Lectures and PC classes with assignments 33 h.

Target group:

geology majors, minor subject students. Prerequisites and co-requisites: Ore geology (772385A), Introduction to Ore mineralogy (772335A).

Prerequisites and co-requisites:

Ore geology (772385A), Ore microscopy (772335A).

Recommended optional programme components:

- ü Petruk, W. (2000) Applied Mineralogy in the Mining Industry, Elsevier Science B.V., Amsterdam.
- ü Wills, B. & Napier-Munn, T. (2006) Wills' Mineral Processing Technology, Elsevier Science & Technology Books, ISBN: 0750644508.
- ü Becker et al. (2016) Process Mineralogy, JKMRRC Monograph Series in Mining and Mineral Processing: No. 6, ISBN: 978-1-74272-171-2

Recommended or required reading:

Petruk, W. (2000). Applied Mineralogy in the Mining Industry, Elsevier Science B.V., Amsterdam.
Will, B. & Napier-Munn, T. (2006) Wills' Mineral Processing Technology, Elsevier Science & Technology Books, ISBN: 0750644508.
The availability of the literature can be checked from [this link](#).

Assessment methods and criteria:

Laboratory classes, Geometallurgical investigations (for the seminar) and the seminars are compulsory. Seminars, the investigation and the opposition are each awarded points based on the attained level. Assignments and reports must be delivered in time or there will be an automatic deduction of points. The total points production determines the grand grade of the course, and it is given on the scale Fail-1-5.

- . For grade 1, the student must be able to describe different parts and procedures of Geometallurgy and to conduct a routine geometallurgical analysis.
- . For grade 2, the student must be able to collect geometallurgical data and perform an analysis with interpretation.
- . For grade 3 the student must be able to evaluate and interpret geometallurgical data provided by different analytical and research techniques and to report the results.
- . For grade 4, the student must be able to design geometallurgical campaign, interpret the result and establish a geometallurgical program.
- . For grade 5, the student must be able to apply the acquired skills to a new geometallurgical case, interpret, report and present the results and to defend the conclusions.

Grading:

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

Person responsible:

Jussi Liipo

Working life cooperation:

No

493606S: Mine Geology, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

English

Timing:

4th year 1st period

Learning outcomes:

Upon completion of the course the students should know about the principle activities along the mineral value chain in the mining environment (exploration, mining, mineral processing, environmental management). The course is given at the active Pyhäsalmi mine to optimize interaction with professionals and working live experience.

Contents:

Based on the processes in an active mine environment (Pyhäsalmi mine) various aspects of the development and operation of mines will be investigated. This includes the ore exploration and mine development, rock mechanics and mining technologies, mineral processing principles, and environmental management. Face to face teaching and mine visit

Mode of delivery:

Face to face teaching and mine visit

Learning activities and teaching methods:

Lectures, interaction with professionals at the Pyhäsalmi mine, and exercises (e.g. drill core logging).

Target group:

Masters students in the mining engineering and mineral processing study programme (compulsory course) and Masters students in Geosciences (optional course to fulfill the obligation of 10 ECTS in mining engineering and mineral processing study programme courses)

Prerequisites and co-requisites:

Introduction to Geology I and II; Basic course in mineralogy; Principles of mineral processing, Rock mechanics (BSc level courses) or completed BSc degree

Recommended optional programme components:

493301A Mining geophysics
774636S Geochemistry of mining environment
772632S Regional Ore Geology of Fennoscandia
772694S Geometallurgy and mineral processing

Recommended or required reading:

Abzalov, M. (2016) Applied Mining Geology, Springer, Modern approaches in solid Earth sciences 12, 448 p

Assessment methods and criteria:

Learning diary and report

Grading:

pass/fail

Person responsible:

Holger Paulick, Zongxian Zhang

Working life cooperation:

Course will be conducted in co-operation with partners from the Pyhäsalmi mine.

Other information:

Location of instruction is Pyhäsalmi mine

772335A: Introduction to ore mineralogy, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opettajat: Eero Hanski

Opintokohteen kielet: English

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits

Language of instruction:

English

Timing:

2nd or 3rd year

Learning outcomes:

Students will obtain basic knowledge on ore minerals and their mode of occurrence, learn to recognize the most common ore minerals and textures under the ore microscope.

Contents:

Division and structure of ore minerals, composition and texture, phase diagrams and their applications. Ore microscope and how it is used, microscopic properties of ore minerals. Identify ore mineral and assemblages.

Mode of delivery:

Face to face

Learning activities and teaching methods:

14 h lectures, 21 h exercises

Target group:

Students specializing in geology and mineralogy.

Prerequisites and co-requisites:

Introduction to ore geology (771108P), Basic mineralogy (771102P) and Optical mineralogy (772339A).

Recommended or required reading:

Craig, J.P. & Vaughan, D.J. (1994) Ore Microscopy and Ore Petrography. Wiley & Sons, 2nd ed. 434 p.
 Ramdohr, P.: The Ore Minerals and their Intergrowths, vol. 1 and 2. Pergamon Press, 1205 p.
 Spry P.G. & Gedlinski B.L. (1987) Tables for Determination of Common Opaque Minerals. Economic Geology Publishing Co. 52 p.
 Barnes H.L. (1997) Geochemistry of Hydrothermal Ore Deposits. John Wiley & Sons, Inc., New York, 3rd ed. 992 p.
 Nesse W.D. (2012) Introduction to Mineralogy, Oxford University Press. 480 p.
 Pracejus B. (2008) The ore minerals under the microscope – An optical guide. Atlases in Geosciences 3, Elsevier, 875 p.

The availability of the literature can be checked from [this link](#).

Assessment methods and criteria:

Examination, laboratory exercises.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

5-1/fail

Person responsible:

Eero Hanski

Working life cooperation:

No

477713S: Automation in Mineral Processing, 5 op

Voimassaolo: 01.08.2013 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Leiviskä, Kauko Johannes

Opintokohteen kielet: Finnish

Leikkaavuudet:

477510S Automation in Mineral Processing 5.0 op

477724S Numerical Mine Modelling 5.0 op

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

English

Timing:

Implementation in the 4th period (spring term)

Learning outcomes:

The target is to give the students the skills to understand and develop models for minerals processing and apply these models in process monitoring and control.

Contents:

Models for processes like crushing, grinding, flotation, leaching, separation etc. Examples how to use these models in process control and what kind of benefits can be drawn from their use.

Mode of delivery:

Lectures and demonstrations

Learning activities and teaching methods:

Lectures during one period

Target group:

Master's students in process and environmental engineering. Exchange students.

Prerequisites and co-requisites:

Basic knowledge in minerals processing and control engineering

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes in English

Assessment methods and criteria:

Continuous evaluation: lectures and test

Grading:

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

Person responsible:

Professor Kauko Leiviskä

Working life cooperation:

No

Other information:

-

493605S: Ore beneficiation technologies, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opettajat: Saija Luukkanen

Opintokohteen kielet: English, Finnish

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

English

Timing:

Master's degree 1st year 1st period

Learning outcomes:

Upon completion of the course students should be able to: 1) Describe the principles and applications of the main mineral processing technologies 2) Describe the variables effecting on the selection of the process technique and evaluate the most suitable technique for processing different types of materials based on their composition The main focus is put in understanding the nature of the feed material and it's influence in process selection, mineral processing technologies used in selected cases (especially with sulphide minerals and industrial minerals) and process optimization. Exercises and lectures form the main frame of the course.

Contents:

Size reduction,; common mineral beneficiation technologies: gravity separation, magnetic separation, froth flotation, hydrometallurgy, filtration and sedimentation; estimation and calculation of main equipment.

Mode of delivery:

Lectures and exercises

Learning activities and teaching methods:

Lectures during one period

Target group:

Mineral processing majors, minor subject students

Prerequisites and co-requisites:

Principles in Mineral Processing, Chemical Phenomena in Mineral processing.

Recommended or required reading:

Wills & Napier-Munn: Mineral processing technology; Elsevier Science & Technology Books, ISBN: 0750644508; articles and references given during the course.

Assessment methods and criteria:

Continuous evaluation: exercises, seminars, reports

Grading:

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

Person responsible:

Saija Luukkanen, Maria Sinche Gonzalez

Working life cooperation:

No

493602S: Mineral process simulation, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English, Finnish

Ei opintojaksokuvauksia.

493607S: Quality requirements for concentrate, 5 op**Voimassaolo:** 01.08.2016 -**Opiskelumuoto:** Advanced Studies**Laji:** Course**Vastuuyksikkö:** Oulu Mining School**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Saija Luukkanen**Opintokohteen kielet:** English**ECTS Credits:**

5 ECTS /133 hours of work

Language of instruction:

English

Timing:1st year in Master's degree 3rd period**Learning outcomes:**

After finishing this course student understands the main quality requirements of the final mineral processing concentrate which effect on further processing in each selected case. The student knows the main economic and technical factors and limitations related to the successful process.

Contents:

Quality requirements for selected concentrates, Distribution of penalty elements in final concentrates, Calculation of Net Smelter Return, Price variation, Typical pricing clauses, Exercises

Learning activities and teaching methods:

Lectures and exercises

Target group:

Mineral processing majors, minor subject students

Prerequisites and co-requisites:

Principles of mineral processing

Recommended optional programme components:

Ore beneficiation technologies

Assessment methods and criteria:

Exam and exercises

Grading:

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

Person responsible:

Saija Luukkanen, Maria Sinche Gonzalez

Working life cooperation:

No

493608S: Development of beneficiation processes, 10 op**Voimassaolo:** 01.08.2016 -**Opiskelumuoto:** Advanced Studies**Laji:** Course**Vastuuyksikkö:** Oulu Mining School**Arvostelu:** 1 - 5, pass, fail**Opintokohteen kielet:** English**ECTS Credits:**

10 ECTS /266 hours of work

Language of instruction:

English

Timing:

2nd year in Master's degree 1st and 2nd period

Learning outcomes:

Upon completion of the course student is able to 1) describe the development of the mineral processing chain starting from mineralogy and laboratory scale tests, proceeding to pilot and industrial scale process and 2) describe the essential parameters from process development and optimization points of view. 3) analyse reasons for selection of processes based on raw material properties 4) develop a process for the selected raw material 5) evaluate the results obtained from the experimental work

Contents:

The course includes both theoretical and practical studies. Characterization of feed material, selection of the process, optimization of the process in laboratory scale, process scale-up factors, test trials in continuous mode.

Mode of delivery:

Lectures, exercises and practical work in groups

Learning activities and teaching methods:

Lectures and practical work during two periods

Target group:

Mineral processing majors

Prerequisites and co-requisites:

Chemical phenomena in mineral processing, Ore beneficiation technologies, Introduction to ore mineralogy, Requirements for the concentrate

Recommended or required reading:

Wills, B. & Napier-Munn, T. (2006) Wills' Mineral Processing Technology, Elsevier Science & Technology Books, ISBN: 07506444508. Mular, Habe, Barrat; (2002) Mineral processing plant design, practice and control, Vol. 1 and 2, SME Proceedings. Articles and references given during the course.

Assessment methods and criteria:

Continuous evaluation and group exercise

Grading:

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

Person responsible:

Saija Luukkanen, Maria Sinche Gonzalez

Working life cooperation:

No

492603S: Mining Project feasibility study, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

English

Timing:

1st year in Master's degree 3rd and 4th period

Learning outcomes:

After completion of the course the student should be able to understand the content of feasibility study, calculate economical conditions and profitability for mining project, describe and explain differences in feasibility studies of different project stages. The student also understands and is able to evaluate the quality of feasibility studies. This involves addressing the underlying technical principles, applying these to mineral projects and demonstrating how these influence the financial modelling. The student will be able to prepare an economical calculation for feasibility study of the mining project and calculate free cash flow to it.

Contents:

Role of different feasibility studies; Guidelines and criteria for resource and reserve classification. Sources of technical information for feasibility study industry-level information; Quality requirements of technical and economical information; Pre-production planning and optimization of the rate of mining in relation to the size of the resource; Mining methods; Importance of dilution, waste rock ratio, recovery and net smelter return; Estimation of operating and capital costs.

Mode of delivery:

Lectures and exercises

Learning activities and teaching methods:

Lectures and exercises during two periods

Target group:

Mineral processing majors, minor subject students

Prerequisites and co-requisites:

Courses on economy and mining engineering are suggested

Recommended or required reading:

Course materials and literature list will be delivered at the lectures.

Assessment methods and criteria:

Exercises and final exam, or participation to the lectures plus exercises and literature summary

Grading:

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

Working life cooperation:

No

488133A: Environmental Impact Assessment, 5 op

Voimassaolo: 01.08.2015 - 31.07.2017

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Leikkaavuudet:

488103A Environmental Impact Assessment 4.0 op

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

English

Timing:

The course unit is given in the autumn semester, during period 1

Learning outcomes:

The student will acquire a broad and multidisciplinary and sustainable approach to environmental impact assessment (EIA). The student will know the all steps in EIA process and the different methods used in environmental impact assessment. During the course students develop their working life skills (e.g. writing, communication and presentation skills) and the ability to review environmental problems. They also learn how to resolve extensive environmental projects related problems, causes and consequences.

Contents:

EIA process and legislation, environmental change, principles and assessment methods in ecology, hydrology, economics and social sciences

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

The course contains lectures (20 h), seminars (9 h) and independent works (104 h)

Target group:

Master students in the Environmental Engineering study program

Prerequisites and co-requisites:

The required prerequisite is the completion of the following course or to have corresponding knowledge prior to enrolling for the course unit: Introduction to process and environmental engineering I (477011P) and II (488010P)

Recommended optional programme components:

-

Recommended or required reading:

Environmental Impact Assessment: Cutting Edge for the Twenty-First Century (Gilpin A, 1995, ISBN 0-521-42967-6). Lecture hand-outs and other materials delivered in lectures.

Assessment methods and criteria:

The assignment (60 %) and seminar (40%). More information about assessment methods of each module is given during the course.

Grading:

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

Person responsible:

University lecturer Anna-Kaisa Ronkanen

Working life cooperation:

No

Other information:

The course is arranged in alternate years (even autumn semesters).

493609S: Mining, environment and society, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

English

Timing:

During period 3

Learning outcomes:

After completion of this course the student is able to develop, apply and assess the targets, practices and methods of environmentally and socially responsible mining in practice.

Mode of delivery:

Implemented as distance learning

Learning activities and teaching methods:

Lectures and exercises by distance learning & learning diaries.

Target group:

The students of the Mineral Processing study option in the study programmes Process Engineering or Environmental Engineering, etc. and the students of Luleå University of Technology (LTU) within the Nordic Mining School (NMS) agreement between LTU and the University of Oulu.

Prerequisites and co-requisites:

The Bachelor level studies of the process or environmental engineering study programmes or respective knowledge, and the preceding Master level studies or respective knowledge.

Recommended optional programme components:

The other courses of the Master's phase curriculum.

Recommended or required reading:

Lectures + articles delivered during lectures

Assessment methods and criteria:

Participation to the lectures & learning diary.

Grading:

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

Person responsible:

Rauno Sairinen (University of Eastern Finland)

Working life cooperation:

No

A439128: Mining Engineering, Module of the Option, 0 - 60 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Study module

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Mining Engineering

493301A: Mining geophysics, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opettajat: Elena Kozlovskaya

Opintokohteen kielet: English

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

English

Timing:

In first period

Learning outcomes:

The students got familiar with geophysical methods and instrumentation used to solve practical problems arising at all stages of mine life cycle.

Contents:

The course is intended for geophysicists, geologists and mining and rock mechanics engineers working at mines. The basic techniques of applied geophysics are introduced and explained with application to problems of exploration, development, planning, operation, closure and reclamation of open and underground mines. For each method, principles, instrumentation, field procedures, interpretation and case histories are discussed. The students get familiar with the geophysical instrumentation used in specific mining environment. A part of the course is introduction to mining seismology and the modern methods and techniques used to monitor and study seismicity and rock bursts in underground mines.

Target group:

geophysics, geology, mining engineering students

Assessment methods and criteria:

continuous assessment (home work), final exam

Grading:

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

Person responsible:

Elena Kozlovskaya

Working life cooperation:

No

493606S: Mine Geology, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

English

Timing:

4th year 1st period

Learning outcomes:

Upon completion of the course the students should know about the principle activities along the mineral value chain in the mining environment (exploration, mining, mineral processing, environmental management). The course is given at the active Pyhäsalmi mine to optimize interaction with professionals and working life experience.

Contents:

Based on the processes in an active mine environment (Pyhäsalmi mine) various aspects of the development and operation of mines will be investigated. This includes the ore exploration and mine

development, rock mechanics and mining technologies, mineral processing principles, and environmental management. Face to face teaching and mine visit

Mode of delivery:

Face to face teaching and mine visit

Learning activities and teaching methods:

Lectures, interaction with professionals at the Pyhäsalmi mine, and exercises (e.g. drill core logging).

Target group:

Masters students in the mining engineering and mineral processing study programme (compulsory course) and Masters students in Geosciences (optional course to fulfill the obligation of 10 ECTS in mining engineering and mineral processing study programme courses)

Prerequisites and co-requisites:

Introduction to Geology I and II; Basic course in mineralogy; Principles of mineral processing, Rock mechanics (BSc level courses) or completed BSc degree

Recommended optional programme components:

493301A Mining geophysics
774636S Geochemistry of mining environment
772632S Regional Ore Geology of Fennoscandia
772694S Geometallurgy and mineral processing

Recommended or required reading:

Abzalov, M. (2016) Applied Mining Geology, Springer, Modern approaches in solid Earth sciences 12, 448 p

Assessment methods and criteria:

Learning diary and report

Grading:

pass/fail

Person responsible:

Holger Paulick, Zongxian Zhang

Working life cooperation:

Course will be conducted in co-operation with partners from the Pyhäsalmi mine.

Other information:

Location of instruction is Pyhäsalmi mine

772694S: Geometallurgy and mineral processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opettajat: Pertti Lamberg

Opintokohteen kielet: English

ECTS Credits:

5 credits

Language of instruction:

English

Timing:

4th or 5th year

Learning outcomes:

Upon completion of the course students should be able to: 1) Describe the principles of different areas of Geometallurgy (ore geology, process mineralogy, minerals processing, modeling and simulation) and how they are linked in a geometallurgical concept. 2) Use different research and analytical methods of

importance for Geometallurgy and interpret the results. 3) Evaluate, analyze and interpret the geometallurgical data in a quantitative way. 4) Design a geometallurgical sampling, analysis and research campaign. 5) Design a geometallurgical program.

Contents:

The course will introduce main parts of the Geometallurgy: 1) ore geology, 2) process mineralogy and 3) minerals processing. The focus is in process mineralogy, mineral processing and in assimilating the geometallurgical concept. Exercises, assignments and seminars concentrate on practical aspects of Geometallurgy needed in mining industry.

Mode of delivery:

Face to face

Learning activities and teaching methods:

Lectures and PC classes with assignments 33 h.

Target group:

geology majors, minor subject students. Prerequisites and co-requisites: Ore geology (772385A), Introduction to Ore mineralogy (772335A).

Prerequisites and co-requisites:

Ore geology (772385A), Ore microscopy (772335A).

Recommended optional programme components:

ü Petruk, W. (2000) Applied Mineralogy in the Mining Industry, Elsevier Science B.V., Amsterdam.

ü Wills, B. & Napier-Munn, T. (2006) Wills' Mineral Processing Technology, Elsevier Science & Technology Books, ISBN: 0750644508.

ü Becker et al. (2016) Process Mineralogy, JKMRRC Monograph Series in Mining and Mineral Processing: No. 6, ISBN: 978-1-74272-171-2

Recommended or required reading:

Petruk, W. (2000). Applied Mineralogy in the Mining Industry, Elsevier Science B.V., Amsterdam.

Will, B. & Napier-Munn, T. (2006) Wills' Mineral Processing Technology, Elsevier Science & Technology Books, ISBN: 0750644508.

The availability of the literature can be checked from [this link](#).

Assessment methods and criteria:

Laboratory classes, Geometallurgical investigations (for the seminar) and the seminars are compulsory.

Seminars, the investigation and the opposition are each awarded points based on the attained level.

Assignments and reports must be delivered in time or there will be an automatic deduction of points. The total points production determines the grand grade of the course, and it is given on the scale Fail-1-5.

. For grade 1, the student must be able to describe different parts and procedures of Geometallurgy and to conduct a routine geometallurgical analysis.

. For grade 2, the student must be able to collect geometallurgical data and perform an analysis with interpretation.

. For grade 3 the student must be able to evaluate and interpret geometallurgical data provided by different analytical and research techniques and to report the results.

. For grade 4, the student must be able to design geometallurgical campaign, interpret the result and establish a geometallurgical program.

. For grade 5, the student must be able to apply the acquired skills to a new geometallurgical case, interpret, report and present the results and to defend the conclusions.

Grading:

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

Person responsible:

Jussi Liipo

Working life cooperation:

No

492604S: Rock engineering, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish, English

ECTS Credits:

5 cr

Language of instruction:

Finnish or English

Timing:

Autumn term of the 4th academic year

Learning outcomes:

Upon successful completion student can explain basic terms rock mechanics and explosives and blasting and unit operations in rock mining, select mining methods and equipments and apply these in mining.

Contents:

This course provides a basic introduction to the fundamental operations involved in mining operation. Topics to be covered include stages, surface and underground mining methods, rock drilling, explosives and blasting, rock support systems, haulage and hoisting. Site visits to working mines during mid-term break will also be included.

Mode of delivery:

Face to face teaching

Learning activities and teaching methods:

Lectures and exercises, final examination

Target group:

Master's level students in mining technology and mineral processing

Prerequisites and co-requisites:

The Bachelor level studies of Mining engineering and mineral processing or process or environmental engineering study programmes or respective knowledge 492300A Rock mechanics.

Recommended optional programme components:

-

Recommended or required reading:

Material given during lectures and/or via Optima. Hakapää A. & Lappalainen P. (eds.) 2011 (2.painos): Kaivos- ja louhintatekniikka. Opetushallitus, Kaivannaisteollisuusyhdistys. 388 p. ISBN 978-952-13-4615-6. H.L. Hartman, J.M. Mutmanský, 2002: Introductory Mining Engineering, 2nd edition, John Wiley & Sons, 584 p., ISBN: 978-0-471-34851-1. J.F. Stiehr (ed.) ISEE Blasters Handbook, 18th Edition

Assessment methods and criteria:

Final exam

Grading:

5-1/fail

Person responsible:

Saija Luukkanen

Working life cooperation:

No

Other information:

-

492600S: Mining Engineering, 10 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opettajat: Zongxian Zhang

Opintokohteen kiellet: English

ECTS Credits:

10 ECTS /266 hours of work

Language of instruction:

English

Timing:

Spring term of the 4th academic year

Learning outcomes:

Upon completion of the course students should be able to: 1) use the knowledge of rock mechanics, rock drilling and blasting to make mining planning and mine designs; 2) perform better operations or improve current operations in drilling, blasting, extraction, tunnelling, and comminution; 3) understand the effect of ore recovery on mining economy and resource recovery; 4) gain knowledge on how to improve recovery; 5) gain the knowledge of reducing the damage to the environment due to mining activities.

Contents:

The course will first give a compact introduction to basic rock mechanics, rock drilling, rock blasting and ventilation, and then introduce basic principles for mining planning and operation design such as development and different excavations. After these, the course will introduce each mining method in detail, including mass mining methods such as sublevel caving and block caving and other common mining methods such as cut-and-fill, room-and-pillar, shrinkage, open stope, etc. In the last part of the course, mining economy related to mining operation and mining technology will be discussed, optimum fragmentation aiming to save energy will be described, and then vibration control will be introduced.

Mode of delivery:

Face to face

Learning activities and teaching methods:

Lectures, seminars, written reports, and assignments (mine visit if available).

Target group:

Students from mining and mineral processing, geophysics and geology

Prerequisites and co-requisites:

Bachelor degree in mining or mineral processing or geology or other civil engineering.

Recommended optional programme components:

-

Recommended or required reading:

Recommended materials to read:

Zhang ZX. Mining Science and Technology. Compendium for course Mining Technology, University of Oulu, 2017.

Hamrin H. Underground mining methods and applications. In: Underground mining methods—engineering fundamentals and international case studies, eds. By WA Hustrulid and RL Bullock. Littleton (Colorado): Society for mining, metallurgy, and exploration, Inc, (SME), 2001, p.3-14.

Hustrulid WA, Bullock RL. Underground mining methods—engineering fundamentals and international case studies. Littleton (Colorado): Society for mining, metallurgy, and exploration, Inc, (SME), 2001.

Vergne J. Hard Rock Miner's Handbook, Edition 5. Edmonton: Stantec Consulting Ltd, 2008.

Zhang ZX. Rock fracture and blasting: theory and applications. Oxford: Elsevier, 2016 (Chapters 1, 3-7, 10, 17-19, 21-24).

Assessment methods and criteria:

Assessment methods include oral presentations, written reports, seminars, assignments and written examination. The total points gained from the above determine the final grade of the course, and it is given on the scale Fail-1-5.

- For grade 1, the student must be able to know and understand the basic knowledge in this course.
- For grade 2, the student must know how to make a preliminary plan for mining and rock support by using the knowledge in rock mechanics and mining science.
- For grade 3 the student must be able to make a plan for mining and rock support and evaluate such a plan

- For grade 4, the student must be able to make a plan for mining and rock support and evaluate such a plan. In addition, the student should be able to improve any current plan for mining and rock support by using his/her knowledge in mining science.
- For grade 5, the student must be able to apply the acquired knowledge to make a very good plan for mining and rock support. He or she must do an outstanding design in at least one aspect, e.g. he/she can find a problem in one operation or one design and know how to solve the problem or how to make improvement.

Grading:

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

Person responsible:

Zongxian Zhang

492606S: Modelling of mining, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish, English

Ei opintojaksokuvauksia.

492602S: Financial and Project valuation of mining, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

English

Timing:

4th year 2nd period

Learning outcomes:

After completion of the course the student should be able to understand how to finance a mining project. What are requirements of venture capital financing and other type of financing? What are the sources of mining financing and how to seek financing? What are the sources of financing? The student understands the importance of cash flow, NPV and IRR calculations. The student will even understand what kind of parameters impacts the value of a mining project. The aim of the course is to provide a guide to understanding the main factors involved in financing of mining projects through equity and debt. The student will be able to prepare a simple valuation model of exploration properties and companies.

Contents:

Different tools for analyzing financial information, problems in analyzing financial information, and the use of financial and mineral resource information in project valuation.

Mode of delivery:

Face to face teaching

Learning activities and teaching methods:

Lectures 24 hr

Target group:

Master/ mining technology

Prerequisites and co-requisites:

Courses on economy and mining engineering, and course "Mining project – feasibility study" are suggested

Recommended optional programme components:

-

Recommended or required reading:

Course materials and literature list will be delivered at the lectures

Assessment methods and criteria:

Exercises and final exam, or participation to the lectures plus exercises and literature summary

Grading:

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

Person responsible:

Prof. Timo Lindborg

Working life cooperation:

No

Other information:

-

492603S: Mining Project feasibility study, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

English

Timing:

1st year in Master's degreee 3rd and 4th period

Learning outcomes:

After completion of the course the student should be able to understand the content of feasibility study, calculate economical conditions and profitability for mining project, describe and explain differences in feasibility studies of different project stages. The student also understands and is able to evaluate the quality of feasibility studies. This involves addressing the underlying technical principles, applying these to mineral projects and demonstrating how these influence the financial modelling. The student will be able prepare an economical calculation for feasibility study of the mining project and calculate free cash flow to it.

Contents:

Role of different feasibility studies; Guidelines and criteria for resource and reserve classification. Sources of technical information for feasibility study industry-level information; Quality requirements of technical and economical

information; Pre-production planning and optimization of the rate of mining in relation to the size of the resource; Mining methods; Importance of dilution, waste rock ratio, recovery and net smelter return; Estimation of operating and capital costs.

Mode of delivery:

Lectures and exercises

Learning activities and teaching methods:

Lectures and exercises during two periods

Target group:

Mineral processing majors, minor subject students

Prerequisites and co-requisites:

Courses on economy and mining engineering are suggested

Recommended or required reading:

Course materials and literature list will be delivered at the lectures.

Assessment methods and criteria:

Exercises and final exam, or participation to the lectures plus exercises and literature summary

Grading:

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

Working life cooperation:

No

466107S: Design of concrete structures, 6 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Hannila, Raimo Sakari

Opintokohteen kielet: Finnish

Leikkaavuudet:

485106A	Design of concrete structures	5.0 op
460147A	Introduction to Design of Concrete Technology	4.0 op
460147A-01	Introduction to Design of Concrete Technology, examination	0.0 op
460147A-02	Introduction to Design of Concrete Technology, exercise work	0.0 op
460148S	Design of Concrete Structures	4.0 op
460148S-01	Design of Concrete Structures I, examination	0.0 op
460148S-02	Design of Concrete Structures I, exercises	0.0 op

Ei opintojaksokuvauksia.

488133A: Environmental Impact Assessment, 5 op

Voimassaolo: 01.08.2015 - 31.07.2017

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Leikkaavuudet:

488103A	Environmental Impact Assessment	4.0 op
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ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

English

Timing:

The course unit is given in the autumn semester, during period 1

Learning outcomes:

The student will acquire a broad and multidisciplinary and sustainable approach to environmental impact assessment (EIA). The student will know the all steps in EIA process and the different methods used in environmental impact assessment. During the course students develop their working life skills (e.g. writing, communication and presentation skills) and the ability to review environmental problems. They also learn how to resolve extensive environmental projects related problems, causes and consequences.

Contents:

EIA process and legislation, environmental change, principles and assessment methods in ecology, hydrology, economics and social sciences

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

The course contains lectures (20 h), seminars (9 h) and independent works (104 h)

Target group:

Master students in the Environmental Engineering study program

Prerequisites and co-requisites:

The required prerequisite is the completion of the following course or to have corresponding knowledge prior to enrolling for the course unit: Introduction to process and environmental engineering I (477011P) and II (488010P)

Recommended optional programme components:

-

Recommended or required reading:

Environmental Impact Assessment: Cutting Edge for the Twenty-First Century (Gilpin A, 1995, ISBN 0-521-42967-6). Lecture hand-outs and other materials delivered in lectures.

Assessment methods and criteria:

The assignment (60 %) and seminar (40%). More information about assessment methods of each module is given during the course.

Grading:

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

Person responsible:

University lecturer Anna-Kaisa Ronkanen

Working life cooperation:

No

Other information:

The course is arranged in alternate years (even autumn semesters).

493609S: Mining, environment and society, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5 ECTS /133 hours of work

Language of instruction:

English

Timing:

During period 3

Learning outcomes:

After completion of this course the student is able to develop, apply and assess the targets, practices and methods of environmentally and socially responsible mining in practice.

Mode of delivery:

Implemented as distance learning

Learning activities and teaching methods:

Lectures and exercises by distance learning & learning diaries.

Target group:

The students of the Mineral Processing study option in the study programmes Process Engineering or Environmental Engineering, etc. and the students of Luleå University of Technology (LTU) within the Nordic Mining School (NMS) agreement between LTU and the University of Oulu.

Prerequisites and co-requisites:

The Bachelor level studies of the process or environmental engineering study programmes or respective knowledge, and the preceding Master level studies or respective knowledge.

Recommended optional programme components:

The other courses of the Master's phase curriculum.

Recommended or required reading:

Lectures + articles delivered during lectures

Assessment methods and criteria:

Participation to the lectures & learning diary.

Grading:

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

Person responsible:

Rauno Sairinen (University of Eastern Finland)

Working life cooperation:

No

491602S: Professional practical training, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Practical training

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English, Finnish

ECTS Credits:

5 ECTS, 2 months working full-time

Language of instruction:

Finnish or English

Timing:

Student usually works in summer time.

Learning outcomes:

During the advanced practical training the student is exposed to his/her working environment from the point of view of his/her studies and becomes acquainted with another possible future job or to a different assignment already in a familiar working environment. The student can identify the problems of the working environment and can solve them. The student can apply theoretical knowledge in practical tasks. The student identifies the tasks appropriate for the Master of Science in Technology at his/her workplace.

Contents:

Suitable areas for practical training are, for example, the mining and metallurgical industry and mining projects.

Mode of delivery:

Working as employee

Learning activities and teaching methods:

-

Target group:

Master's students in Mining Technology and Mineral Processing

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Student has to show original references and leave the application. In addition she/he has to participate to seminar where she/he reports own summer job. In reference must be training time period and duties.

Grading:

Verbal scale Passed/Failed

Person responsible:

Student advisor Saara Luhtaanmäki

Working life cooperation:

Yes

Other information:

The Objective is to give a deeper and more detailed conception of the industrial area where the student will possibly work after graduation. Suitable tasks would be supervision tasks and R&D tasks. Students will land the jobs themselves.

491601S: Master's thesis, 30 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English, Finnish

ECTS Credits:

30 cr

Language of instruction:

Finnish or English

Timing:

Spring term of the 5th academic year

491600S: Maturity test, 0 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish, English

Ei opintojaksokuvauksia.

Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

493611S: Pilot-scale Mineral Processing, 5 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Mining School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5 ECTS / 133 hours of work

Language of instruction:

English

Timing:

1st - 3rd year in Master's degree. Course is organized as a intensive course occasionally.

Learning outcomes:

Upon completion of the course students understand the role of metallurgical testwork in mine development, know the principles of common mineral processing techniques, especially flotation. Students also know the basics of the main calculations needed in concentrating plants, understand the principles of process scale-up and are aware of general safety rules in concentrating plants.

Contents:

The course will give an introduction to the fundamentals of flotation including theory on flotation chemistry, flotation circuits, technology, flotation of sulphide and non-sulphide ores, development of flowsheets, process control as well as mass balances. Theoretical part of the course also includes calculation exercises related to the subject (mass balances, circulating loads etc.). Preceding subjects before the experimental hands-on work at the OMS minipilot plant are safety training and introduction to the minipilot flowsheet, related installations and process automation. Minipilot practice covers minipilot test runs aiming at producing high quality copper con maintaining a stable flotation process and producing a high quality concentrate from the selected ore. Research reports will be written based on the results obtained.

Mode of delivery:

Face to face teaching, Minipilot practice in groups.

Learning activities and teaching methods:

48 h lectures and group works in Minipilot environment.

Target group:

Mineral processing majors, minor subject students

Recommended optional programme components:

Principles in mineral processing.

Assessment methods and criteria:

Participation to the lectures (80%), learning diary and/or research report and group presentation.

Grading:

Pass/Fail

Person responsible:

Saija Luukkanen