

# Opasraportti

## Department of Industrial Engineering and Management (2008 - 2010)

### Degree Programme in Industrial Engineering and Management

### General Description of the Department of Industrial Engineering and Management

The Department of Industrial Engineering and Management is a part of the Faculty of Technology. The Department is divided into three research and teaching units: Industrial Management, Quality and Project Management, and Work Sciences.

### Bachelor's Degree and Key Learning Outcomes

During the first three years students typically earn their Bachelor's Degree. The studies give comprehensive basis for the Master's Degree studies, and capabilities to work in basic level tasks in the field of industrial engineering and management. The bachelor's degree consists of basic studies in mathematics and natural sciences, intermediate studies in industrial engineering and management, and technical minor studies that the students can choose from other engineering departments at the faculty.

### Master's Degree and Key learning outcomes:

The fourth and fifth year of the programme consist of studies aiming at Master's Degree. During the Master's degree studies, the students can choose from four minor subjects specialising in different fields of industrial engineering and management. In addition, during the master's degree studies, the students continue their technical studies, already started during the bachelor degree.

M.Sc. (Eng.) in Industrial Engineering and Management has wide based knowledge over engineering sciences, business economics and human sciences. This includes knowledge over related terminologies and theories that can be utilised generally for enhancing productivity and wellbeing. M.Sc. (Eng.) in Industrial Engineering and Management is capable of applying the gained knowledge for solving challenges relating to innovation and production activities in all areas of economic life.

### Minor specific key learning outcomes:

Minor in *Technology Management* has an aim to educate engineers to have necessary skills and capabilities for analysing, planning and developing technologies. After completing the minor, the student will have readiness to operate especially in product development projects, but also in various functions of different development activities. Specialisation is based on a strong techno-scientific teaching, and occurs also aside teaching. Strong basis for specialisation is created through studying product technologies, product development, managing innovation process, measuring performance, and management information systems. Other study modules in Industrial Engineering and Management complement the core content of minor in Technology Management.

Minor in *Production Management* has an aim to educate engineers to have necessary skills and capabilities of analysing production systems, engineers who can prepare production system related development plans, and have basic skills of managing production activities. Technical studies, chosen by the students, support understanding technical issues relevant to production, and are supported by organisational viewpoints. After completing the minor, the student will have readiness to operate in production related activities, including planning, development, and management. Specialisation is based on a strong techno-scientific teaching, and occurs also aside teaching.

Minor in *Management of Wellbeing at Work and Usability* specialises in possibilities of exploiting of human resources in sustainable way, inclusion of human-centred viewpoints in design, and risk management in industrial and other work environments. Specialisation is based on a strong techno-scientific teaching, and occurs also aside teaching. Specialisation includes safety engineering, safety management, user interfaces, cognitive technologies, work psychology, organising work, creativity, productivity and study modules on organising production and planning. The study modules also include relevant assignments and examples from industry. After completing the minor, the student will have readiness to operate in management & specialist roles relating to human resources, safety, ergonomic-oriented planning and design, research, and evaluation of systems and products.

Minor in *Quality and Project Management* has an aim to educate engineers who are capable of choosing and applying management methods relevant to different situations. Quality management based on statistical process control (SPC) is well suitable for operations management of repeated processes in production and services, while project management methods can be applied to the management of complex and unique projects. The focus in quality management teaching is on statistical process control and improvement methods. After completing quality management studies of the minor student should be apply different quality management methods to analyzed production and service processes. Project management teaching takes a more business oriented perspective and it has focus in addition to a single project on the management of a project based-firm and project business. After completing project management studies of the minor, the student can work in different roles in a project team and understands how project is related to the business objectives of a firm.

## Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

555360S: Administration, Organization and Education in Working Life, 5 op  
 555345S: Advanced Course in Product Development, 6 op  
 555386S: Advanced Course in Project Management, 5 op  
 555385S: Advanced Course in Quality Management, 5 op  
 555346S: Advanced Course in Technology Management, 5 op  
 555311S: Advanced Internship, 3 op  
 555324S: Advanced Supply Chain Management, 3 op  
 555200A: Bachelor's Thesis / Industrial Engineering and Management, 8 op  
 555261A: Basic Course in Occupational Psychology, 3 op  
 555260P: Basic Course in Occupational Safety and Wellbeing at Work, 3 op  
 555240A: Basic Course in Product Development, 3 op  
 555280P: Basic Course of Project Management, 2 op  
 555281A: Basic Course of Quality Management, 5 op

761101P: Basic Mechanics, 4 op  
721704P: Business Logistics, 5 op  
464052A: CAD, 3,5 op  
031010P: Calculus I, 5 op  
031011P: Calculus II, 6 op  
555366S: Chemical and Physical Hazards in Industrial Environments, 3 op  
521302A: Circuit Theory 1, 5 op  
521306A: Circuit Theory 2, 4 op  
900062P: Communicative Oral Skills for Production Engineering and Management, 2 op  
031018P: Complex Analysis, 4 op  
463059S: Computer Aided Manufacturing, 4 op  
521267A: Computer Engineering, 4 op  
555365S: Computer-Aided Methods in Ergonomics, 3 op  
477602A: Control System Analysis, 4 op  
477603A: Control System Design, 4 op  
470460A: Controls and Systems Engineering Fundamentals, 5 op  
555363S: Creativity at Work and in Product Development, 5 op  
031017P: Differential Equations, 4 op  
521337A: Digital Filters, 5 op  
521413A: Digital Techniques 1, 4 op  
521404A: Digital Techniques 2, 5 op  
461018A: Dynamics, 4 op  
521109A: Electrical Measurement Principles, 5 op  
761103P: Electricity and Magnetism, 4 op  
521405A: Electronic System Design, 5 op  
521432A: Electronics Design I, 5 op  
521443S: Electronics Design II, 5 op  
521141P: Elementary Programming, 5 op  
521270A: Embedded Software Project, 5 op  
521268A: Embedded Systems, 4,5 op  
521142A: Embedded Systems Programming, 5 op  
488201A: Environmental Ecology, 5 op  
555364S: Ergonomics, 5 op  
555367S: Exercises in Work Science, 6 op  
521331S: Filters, 4 op  
461033A: Finite Element Methods I, 3,5 op  
477101A: Fluid and Particle Engineering I, 3 op  
463058A: Foundry Technology, 3,5 op  
477302A: Heat Transfer, 3 op  
461036S: Heat and Mass Transfer II, 3,5 op  
555325S: Human Resources Management, 3 op  
488104A: Industrial and Communal Waste Management, 5 op  
030005P: Information Skills, 1 op  
477012P: Introduction to Automation Engineering, 5 op  
811376A: Introduction to Data Structures, 3 op  
488011P: Introduction to Environmental Engineering, 5 op  
463052A: Introduction to Manufacturing Technology, 5 op  
521104P: Introduction to Material Physics, 5 op  
521218A: Introduction to Microelectronics and Micromechanics, 4 op  
477011P: Introduction to Process Engineering, 5 op  
811122P: Introduction to Programming, 5 op  
521319A: Introduction to Telecommunication Engineering, 2,5 op  
521481P: Introduction to the Use of Workstation, 1 op  
521433A: Laboratory Exercises on Analogue Electronics, 3 op  
721614A: Labour Law, 7 op  
463068S: Laser Processing, 3,5 op  
462021A: Machine Automation I, 5 op  
462022S: Machine Automation II, 5 op  
464055A: Machine Design I, 8 op  
464056A: Machine Design II, 6 op  
464057S: Machine Design III, 7 op  
464051A: Machine Drawing, 3,5 op  
555361A: Machine Safety and Usability, 3,5 op  
464087A: Maintenance Technology, 5 op

721172P: Management Accounting, 5 op  
 555344S: Management Information Systems, 5 op  
 463053A: Manufacturing Technology I, 3,5 op  
 463055S: Manufacturing Technology II, 5 op  
 463067A: Manufacturing Technology of Sheet Metal Products, 3,5 op  
 463064S: Manufacturing of Electronics Products, 5 op  
 463065A: Manufacturing of Plastics Products, 3,5 op  
 477303A: Mass Transfer, 3 op  
 477201A: Material and Energy Balances, 5 op  
 465061A: Materials Engineering I, 5 op  
 465062S: Materials Engineering II, 3 op  
 031019P: Matrix Algebra, 3,5 op  
 461019S: Mechanical Vibrations, 6 op  
 462035A: Mechanisms, 3,5 op  
 031022P: Numerical Analysis, 5 op  
 521453A: Operating Systems, 5 op  
 555342S: Operations Research, 5 op  
 030001P: Orientation Course for New Students, 1 op  
 464074S: Paper Machinery Construction, 7 op  
 761121P: Physical Measurements I, 3 op  
 555210A: Practice, 3 op  
 721210P: Principles of Economics, 5 op  
 521431A: Principles of Electronics Design, 5 op  
 721409P: Principles of Marketing, 5 op  
 521205A: Principles of Semiconductor Devices, 4,5 op  
 031021P: Probability and Mathematical Statistics, 5 op  
 477601A: Process Automation Systems, 4 op  
 477501A: Process Control Engineering I, 5 op  
 477502A: Process Control Engineering II, 5 op  
 555343S: Product Data management, 5 op  
 555322S: Production Management, 3 op  
 555341S: Productivity and Performance Management, 3 op  
 521024A: Programmable Electronics, 5 op  
 555382S: Project Business, 5 op  
 555283A: Project Communication, 3 op  
 555381S: Project Leadership, 5 op  
 555282A: Project Management, 4 op  
 555387S: Project Work in Quality Management, 5 op  
 555388S: Project Work in Project Management, 5 op  
 555323S: Purchase Management, 3 op  
 555380S: Quality Management, 5 op  
 031024A: Random Signals, 5 op  
 555326S: Research Project in Production Management, 5 op  
 555348S: Research Project in Technology Management, 5 op  
 555321S: Risk Management, 3 op  
 555362S: Safety in Process Industry, 5 op  
 900061A: Scientific Communication for Production Engineering and Management, 2 op  
 901008P: Second Official Language (Swedish), 2 op  
 555327S: Seminar in Production Management : Lab to Market, 5 op  
 555347S: Seminar in Technology Management, 5 op  
 477304A: Separation Processes, 5 op  
 465095A: Sheet Metal Forming, 3,5 op  
 521457A: Software Engineering, 5 op  
 461016A: Statics, 5 op  
 555320S: Strategic Management, 5 op  
 461010A: Strength of Materials I, 7 op  
 461011A: Strength of Materials II, 7 op  
 903012P: Technical German 3, 6 op  
 555340S: Technology Management, 4 op  
 555263A: Technology, Society and Work, 2 op  
 521359A: Telecommunication Engineering 1, 2,5 op  
 521361A: Telecommunication Engineering II, 3 op  
 477401A: Thermodynamic Equilibria, 5 op  
 462040A: Tribology, 3,5 op

813352A: Usability Testing, 5 op  
 555262A: Usability and Safety in Product Development, 3 op  
 761104P: Wave Motion, 3 op  
 465077A: Welding Technology, 3,5 op

## Opintojaksojen kuvaukset

### Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

#### 555360S: Administration, Organization and Education in Working Life, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Kisko, Kari Juhani

**Opintokohteen kielet:** English

**Leikkaavuudet:**

555371S Human Resource Management 5.0 op

555376S Organisational development 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish/English.

**Learning outcomes:**

To deal with the themes of organization theory, administration, supervision, education and human resources in working life.

Learning outcomes : After the course the student has an understanding of different organizations and how to work in organizations.

**Contents:**

For example: 1. Organization theory and models. 2. Interest groups of organization. 3. Organization culture. 4. Human resource management. 5. Organization development. 6. Exercises on the above themes.

**Recommended or required reading:**

Vartiainen, M. *Työn muutoksen työvälineet*. Otatieta OY 1994; Sarala, U. & Sarala, A. *Oppiva organisaatio - oppimisen, laadun ja tuottavuuden yhdistäminen*. 8. painos. Palmenia-kustannus 2003. Hatch, M. J. *Organization theory*. Oxford University Press, New York, USA 2006. Other literature reported at the beginning of the course.

#### 555345S: Advanced Course in Product Development, 6 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Haapasalo, Harri Jouni Olavi

**Opintokohteen kielet:** English

**Leikkaavuudet:**

555351S Advanced Course in Product Development 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

English

**Learning outcomes:**

The course is divided into two parts, the first of which is focused on the creative design process and comparing between different product development methods. The second part focuses on commercialization of an idea. The aim of the course is to persuade students with basic technological knowledge, towards innovativeness, to critical thinking, and to understanding the significance and challenges of customer driven product development. Learning outcomes: After finishing the course, the student will be able to analyze product development processes and the work of a designer in context-linked development processes. The student will also be able to create methods for an efficient development process and its management.

**Contents:**

During the course create and systematic working methods as basis for product development are compared. The course covers the concepts of competence management, compares different product development methods and creates a link between research and development work in commercialization of innovations. The practical work of the course goes deeper into the planning phase of a product development process, its organization and controlling.

## **555386S: Advanced Course in Project Management, 5 op**

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Jaakko Kujala

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555378S Seminar in industrial engineering and management 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish/English.

**Learning outcomes:**

To familiarise with research focus areas of project management and project business.

Learning outcomes: Upon completion the student can present research areas related to project management and project business. He can evaluate research of the areas and discuss it critically.

**Contents:**

Research themes of project management and project business.

**Learning activities and teaching methods:**

Student must attend six seminars of his choice and act as a chair in one of them. The course goes on continuously and the student can choose the seminars he attends. The student must write a literary report of one of the research themes discussed.

**Recommended optional programme components:**

Bachelor in Industrial Engineering and Management or equivalent.

**Recommended or required reading:**

Seminary readings.

## **555385S: Advanced Course in Quality Management, 5 op**

**Voimassaolo:** 01.08.2005 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Jaakko Kujala

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555378S Seminar in industrial engineering and management 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish/English

**Learning outcomes:**

To learn to apply different methods in decision making related to a company's strategy or operation.

Learning outcomes: Upon completion the student can systematically analyse the challenges related to a company's business and develop alternative solutions to them.

**Contents:**

Changing content on topical subjects.

**Learning activities and teaching methods:**

Depending on the topic

**Recommended optional programme components:**

Bachelor in Industrial Engineering and Management or equivalent.

**Recommended or required reading:**

Depending on the topic

## **555346S: Advanced Course in Technology Management, 5 op**

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Arto Tolonen

**Opintokohteen kielet:** English

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

English

**Learning outcomes:**

The aim of the course is to familiarize students with a current issue in technology management.

Learning outcomes: After finishing the course, the student will be able to use the methods and models studied during the course.

**Contents:**

During the course a specific topic in technology management is studied in detail. The topic is chosen from the current issues in technology management at that point in time

**Recommended or required reading:**

## **555311S: Advanced Internship, 3 op**

**Voimassaolo:** 01.01.2008 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Practical training

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555304S Advanced Internship 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish / English

**Learning outcomes:**

Learning outcomes: During the course, students learn to observe his/her working environment from the point of view of theories of Industrial Engineering and Management (IEM). From the working environment, the student is able to a research problem related to IEM themes. The student is able to describe the problem or its solution by building a model, a process description, chart, etc. The student is able to critically use different kind of references related to the topic. The student is able to draw up a report based on given instructions.

**Learning activities and teaching methods:**

Students will write a report concerning summer job at least for 2 months period. Departmental coordinator will review and grade the report.

**Target group:**

Students of IEM

**Assessment methods and criteria:**

Departmental coordinator will review and grade the thesis. More detailed instructions will be found from internet pages of the department.

**Grading:**

Pass / Fail

**555324S: Advanced Supply Chain Management, 3 op**

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Kess, Pekka Antero

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555331S Supply Network Management 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish

**Learning outcomes:**

Learning outcomes: After completing the course student knows the key concepts of supply chain management and can explain these. The student can describe the structures of supply chains and can explain the meaning of management in the performance of supply chain operations. The student can analyse the supply chain activities in a company and can produce improvement proposals based on the analysis. After the course the student can take part in the supply chain development in the role of an expert.

**Contents:**

Demand Supply Chain Management in general. Networked production systems. E-business in demand supply chains.

**Learning activities and teaching methods:**

The course includes lectures and team work.

**Target group:**

Main target groups are the Students of Industrial Engineering and Management as well as those students in the departments of Mechanical Engineering and Process and Environmental Engineering who have the orientation to Industrial Engineering and Management. Other engineering students are accepted.

**Recommended optional programme components:**

555224A Tuotannon ja logistiikan menetelmät.

**Recommended or required reading:**

Lecture notes. Other material will be informed during the lectures.

**Assessment methods and criteria:**

Course is completed and assessed by team work report and its presentation in the closing seminar.

**Grading:**

fail ... 1...5/5

**555200A: Bachelor's Thesis / Industrial Engineering and Management, 8 op**



**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Language of instruction:**

Finnish / English

**Learning outcomes:**

Learning outcomes:

After the course, the students will be able to solve small problems of organizations by himself/herself. This means that the student is able to prepare a study plan, including defining research problem and research questions, and follow the plan. The student is able to critically use different kind of references. The student is able to draw up a report based on given instructions.

**Learning activities and teaching methods:**

Students will discuss the topic and schedule for the work with his/her personal Omaope. Omaope will review and grade the thesis.

**Target group:**

Undergraduate students of IEM

**Assessment methods and criteria:**

Omaope will review and grade the thesis. More detailed instructions will be found from internet pages of the department.

## 555261A: Basic Course in Occupational Psychology, 3 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Kisko, Kari Juhani

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555264P	Managing well-being and quality of working life	5.0 op
ay555261A	Basic Course in Occupational Psychology (OPEN UNI)	3.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish.

**Learning outcomes:**

To introduce the aim, the contents and the methods of occupational and organisational psychology.

Learning outcomes: After the course the student has an understanding of people at work. He understands what means individual differences, work motivation, stress in the workplace, groups and teams at work and so on.

**Contents:**

For example: 1. Models of man. 2. The history of occupational psychology. 3. The aim of occupational psychology. 4. The psychological structure of work and organization. 5. The research and evaluation of work and organisation. 6. The development of work and organisation.

**Recommended or required reading:**

Arnold, J. *Work Psychology: Understanding Human Behavior in the Workplace*. Prentice Hall . Luoma, J. (edited): *Johdatus työpsykologiaan* , Otatiето 2000. Other literature reported at the beginning of the course.

## 555260P: Basic Course in Occupational Safety and Wellbeing at Work, 3 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Seppo Väyrynen, Henri Jounila

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555265P Occupational Safety and Health Management 5.0 op

ay555260P Basic Course in Occupational Safety and Wellbeing at Work (OPEN UNI) 3.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish.

**Learning outcomes:**

The course gives a general view of the legislation, safety promotion, occupational health, ergonomics development, and organising principles in modern production systems and in other work environments.

Learning outcomes: After the course the student is capable of explaining basic terms, obligations and opportunities of work environment. He is able to assess the importance of occupational safety, health and well-being at work. In addition, he is able to explain the significance of occupational safety in the improving of productivity and quality.

**Contents:**

Students will acquire knowledge and practical skills which they will be able to utilize and integrate on ordinary engineering practice. Work accidents and occupational diseases. Legislation of occupational health.

**Recommended or required reading:**

*Työsuojelun perusteet*. Työterveyslaitos 2009. Other literature reported at the beginning of the course.

## 555240A: Basic Course in Product Development, 3 op

**Voimassaolo:** 01.06.2007 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Haapasalo, Harri Jouni Olavi

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555242A Product development 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish

**Learning outcomes:**

This study module introduces product development, innovations and technology management in a company environment. Basic course in product development provides fundamental understanding over tools and frameworks that can be used for analysing and managing products, innovations, and technology development. The aim is to create a connection between product development and other company functions.

Learning outcomes: After this study module, a student is capable of explaining the role of product development as a company function. The student understands the difference between innovation activities and systematic product development, and knows the difference between different phases of product development process and its activities. Additionally, the student is able to define the meaning of other company functions to product development activities.

**Contents:**

Meaning of products for the operations of an industrial enterprise. Product development paradigm and defining relevant concepts. Realising product development methodologically (Cooper's stage-gate model, QFD), managing innovations, and product development success factors.

**Learning activities and teaching methods:**

The course includes lectures and compulsory course work. The course work entails simulating product development in practical situations.

**Recommended or required reading:**

Study material include: handouts, course work, and a collection of articles. Ulrich, K. & Eppinger, S. (2008) 'Product Design and Development'. McGraw-Hill. 358 p.

**Assessment methods and criteria:**

Final exam.

**Grading:**

1-5/fail

## 555280P: Basic Course of Project Management, 2 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Jaakko Kujala

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555288A Project Management 5.0 op

555285A Project management 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish

**Learning outcomes:**

The objective of the course is to familiarise the student with the basics and the basic methods of project management.

Learning outcomes: Upon completion the student can explain the essential concepts related to project management. He can present the main features of a project plan and can use different methods of partitioning a project. The student can also schedule a project and estimate its costs. The student can explain the terms related to Earned value method and can apply the method on simple tasks. Upon completion the student recognizes the essential tasks of project risk management.

**Contents:**

Defining project management, project planning, organising and scope management, schedule management, cost management, earned value calculation and project risk management.

**Learning activities and teaching methods:**

Lectures and exercise book. The final grade is derived from the course exam.

## 555281A: Basic Course of Quality Management, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Osmo Kauppila, Jaakko Kujala

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555286A Process and quality management 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish

**Learning outcomes:**

The objective of the course is to familiarise the student on managing production processes from a point of statistical process control.

Learning outcomes : Upon completion the student can explain the essential concepts of quality management and recognizes the significance of quality in different working environments. The student gains basic level skills for applying the methods of statistical process control. The student is able to solve problems of production process by using quality management problem solving methods.

**Contents:**

The significance of quality to a company, quality in open and closed systems, quality costs, quality tools and methods of statistical process control and the use of them in practical problem solving, basics of total quality management.

**Learning activities and teaching methods:**

Lectures and exercise are integrated. A group study is made during the course. The final grade is determined by the group study and a final exam.

**Recommended or required reading:**

Lecture materials, lecture handout and exercise book

## 761101P: Basic Mechanics, 4 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

761118P	Mechanics 1	5.0 op
761118P-01	Mechanics 1, lectures and exam	0.0 op
761118P-02	Mechanics 1, lab. exercises	0.0 op
761111P-01	Basic mechanics, lectures and exam	0.0 op
761111P-02	Basic mechanics, lab. exercises	0.0 op
761111P	Basic mechanics	5.0 op
761101P2	Basic Mechanics	4.0 op

Ei opintojaksokuvauksia.

## 721704P: Business Logistics, 5 op

**Voimassaolo:** 01.08.2005 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Faculty of Economics and Business Administration

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Jari Juga

**Opintokohteen kielet:** English

**Leikkaavuudet:**

ay721704P	Business Logistics (OPEN UNI)	5.0 op
721704A	Business Logistics	5.0 op

Ei opintojaksokuvauksia.

## 464052A: CAD, 3,5 op

**Voimassaolo:** 01.08.2005 - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Tapio Korpela

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

464101A Machine drawing and CAD 5.0 op

**Language of instruction:**

Finnish

**Learning outcomes:**

The objective of the course is for students to learn how to use the computer system for modeling and drafting machine parts and assemblies.

Learning outcomes: After the course, the student is able to model the parts and assemblies which he/she has designed by using the CAD/CAM system used in this course. A student is able to make detail drawings and assembly drawings by using the CAD/CAM system used in this course.

**Contents:**

The course is started with a lecture, which is an introduction to the parametric feature based modeling of machine parts. A 3D model and a detail drawing of a prismatic part, which is able to machine in a milling machining is introduced. A 3D model and a detail drawing of a rotational part, which is able to machine in a lathe is also introduced. An assembly drawing from the given parts is part of this course..

**Learning activities and teaching methods:**

The course is started with a lecture, which is an introduction to the parametric feature based modeling of machine parts. There will be guided modeling and drafting exercises in a computer class room and a personal exercise work.

**Recommended optional programme components:**

The machine drawing course

**Recommended or required reading:**

The manuals of the CAD/CAM system will be used in the course.

## 031010P: Calculus I, 5 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Mathematics Division

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Ilkka Lusikka

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

ay031010P Calculus I (OPEN UNI) 5.0 op

**Language of instruction:**

Finnish

**Learning outcomes:**

The course gives the basics of vector algebra, analytic geometry, elementary functions and differential and integral calculus of real valued functions of one variable.

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.

**Learning activities and teaching methods:**

Term course. Lectures 5 h/week. Two examinations or a final examination.

**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).

## 031011P: Calculus II, 6 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Mathematics Division

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Ilkka Lusikka

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

031075P Calculus II 5.0 op

ay031011P Calculus II (OPEN UNI) 6.0 op

**Language of instruction:**

Finnish

**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.

Learning outcomes : After completing the course the student is able to examine the convergence of series and power series of real terms and estimate the truncation error. Furthermore, the student can explain the use of power series e.g. in calculating limits and approximations for definite integrals and is able to solve problems related to differential and integral calculus of real and vector valued functions of several variables.

**Contents:**

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

**Learning activities and teaching methods:**

Term course. Lectures 5 h/week. Two examinations or a final examination.

**Recommended optional programme components:**

Calculus I.

**Recommended or required reading:**

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

## 555366S: Chemical and Physical Hazards in Industrial Environments, 3 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Seppo Väyrynen

**Opintokohteen kielet:** Finnish

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish.

**Learning outcomes:**

To familiarise students with the theoretical background of the chemical and physical hazards in industrial environments.

Learning outcomes: After the course the student is capable of identifying chemical, physical and biological hazards of working environment. He has the basic skills to plan measurements as well as document and analyze results of measurements. In addition, the student is able to use the most common sound level meters and photometer.

**Contents:**

The main emphasis is on learning measurement, monitoring and control principles and practices. EU-directives. Lighting. Occupational diseases. Safety management. Occupational health services.

**Recommended optional programme components:**

555260P Basic course in occupational safety.

**Recommended or required reading:**

*Työhygieeniset mittaukset*, Työterveyslaitos 2007; Starck, J. et al. *Työhygieniä*, Työterveyslaitos 2008; Other literature reported at the beginning of the course.

## 521302A: Circuit Theory 1, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Rahkonen, Timo Erkki

**Opintokohteen kielet:** Finnish

### **Language of instruction:**

The course and exercises are held in Finnish.

### **Learning outcomes:**

In this course the student learns to analyse simple DC, AC, and transient circuits. The course gives necessary basic knowledge for all analogue electronics courses (Basics of Electronic Design, Electronics Design I - III, Analog Filters).

Learning Outcomes: After completing the course the student can write and solve a system of equations describing the behaviour of electric circuits, use complex phasor arithmetics to solve the response of circuits driven by sinusoidal signals, solve time responses of circuits, simplify circuit by employing equivalent circuits and series and parallel combinations, and run simple circuit simulations and understands the differences and limitations of different types of analyses.

### **Contents:**

Electric quantities, circuit laws, systematic writing and solving of circuit equations using nodal and mesh analysis, time and frequency response, phasor calculation. Basics of circuit simulation.

### **Learning activities and teaching methods:**

6 hours lectures and exercises per week. Basic circuit simulation exercises. The course is passed by a final exam and the simulation exercises (contact the lecturer for exam in English).

### **Recommended optional programme components:**

Matrix Algebra, Differential Equations.

### **Recommended or required reading:**

Handouts. The same topics are covered in Nilsson, Riedel: Electric Circuits (6th ed., Prentice-Hall 1996), chapters 1-11.

## 521306A: Circuit Theory 2, 4 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Rahkonen, Timo Erkki

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

521303A Circuit Theory 2 5.0 op

### **Language of instruction:**

The course and exercises are held in Finnish.

### **Learning outcomes:**

This course gives basic knowledge about the analysis and modelling of electrical circuits. After passing this course the student is capable of analyzing frequency responses of circuits implemented using lumped circuit elements.

Learning outcomes: After completing the course the student can use Laplace transform for solving transient and steady-state responses, can derive the transfer function of a continuous-time system, solve its poles and zeros, and understand their meaning, can draw the pole-zero map and Bode plots of a given transfer function, can construct and use a 2-port parameter presentation of a circuit, and understands the principles of circuit synthesis and limitations of linear circuit analysis.

**Contents:**

Use of Laplace transformation in circuit analysis. Properties of network functions, concept of poles and zeros. Pole-zero plot, Bode amplitude and phase plots. Behavioral modeling of electric circuits. One and two-port parameter presentations. Basics of network synthesis.

**Learning activities and teaching methods:**

This course includes 4 hours of lectures and exercises per week. The course is passed by a final exam.

**Recommended optional programme components:**

Circuit Theory I, Calculus I - II, Differential Equations.

**Recommended or required reading:**

Handouts. Nilsson, Riedel: Electric Circuits (6th or 7th ed., Prentice-Hall 1996), chapters 12-18.

**900062P: Communicative Oral Skills for Production Engineering and Management, 2 op**

**Voimassaolo:** 01.08.2008 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Language Centre

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

**031018P: Complex Analysis, 4 op**

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Mathematics Division

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Seikkala, Seppo

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

031077P Complex analysis 5.0 op

**Language of instruction:**

Finnish

**Learning outcomes:**

The objective of the course is to supply the student with basic understanding of the use of complex numbers and complex functions in various applications of technics, especially in signal processing. Learning outcomes : Upon completing the required coursework, the student is able to apply complex numbers and functions to modeling, solving and analysing of problems arising in technics, especially in signal processing. The student also knows how to use mapping properties and differential and integral calculus of complex functions in applications of technics .

**Contents:**

Complex numbers, complex exponential function and discrete linear system, mapping properties of complex functions, differential calculus, conformal mapping, integral calculus, Cauchy formula, residue, residue calculus, Möbius transformation, applications to signal processing.

**Learning activities and teaching methods:**

Term course. Lectures 4 h/week. Two intermediate exams or a final examination.

**Recommended optional programme components:**

Calculus I.

**Recommended or required reading:**

Lecture notes and exercise materials. Kreyszig, E.: Advanced Engineering Mathematics; Spiegel : Complex Variables; Lang: Complex Analysis.



## 463059S: Computer Aided Manufacturing, 4 op

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Karjalainen, Jussi Antero

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

463109S Computer aided manufacturing 7.0 op

### Learning outcomes:

The aim of this course is for the student to obtain the basic knowledge of computer-assisted manufacturing by lectures, demonstrations and practical projects.

Course outcomes: After the course, the student knows how to utilize computer-aided methods and systems with different manufacturing processes in machine shops. The student can describe the main features, capabilities and limitations of different methods and processes as well as the trends of computer-aided manufacturing.

Additionally, the student can apply his/her knowledge to solving practical problems.

### Contents:

Application areas and interfaces in integrated, computer-aided manufacturing of mechanical parts; programming and simulating numerically controlled (NC) production machinery and processes; creating and processing of control information in the NC manufacturing. Methods, processes and control of rapid prototyping; simulation of sheet metal forming and laser processing.

In project section of the course the knowledge is applied to solving practical problems in manufacturing.

### Learning activities and teaching methods:

This course consists of both classes and a group project. Classes are held, in Finnish, during period 1, with demonstrations and projects during periods 2 and 3. The grade is based on the exam and project.

### Recommended optional programme components:

Production Technology I, CAD

### Recommended or required reading:

Course notes (mainly in Finnish); Contemporary articles.

References: Chang, T-C. & al. Computer-aided manufacturing, Prentice Hall, 2006. Dowden, J.M. The Mathematics of Thermal Modeling, Chapman & Hall, 2001. Hosford, W.F. & Caddel, R.M. Metal forming, Cambridge University Press, 2007. Ion, J.C. Laser processing of engineering materials, Elsevier, 2005, 556 p. Lee, K. Principles of CAD/CAM/CAE Systems, Addison-Wesley, 1999, 432 p.

## 521267A: Computer Engineering, 4 op

**Voimassaolo:** 01.08.2005 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Computer Science and Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Janne Haverinen

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

810122P Computer Architecture 5.0 op

### Learning outcomes:

The aim of the course is to provide basic understanding to the operation of a digital computer, and to provide basic knowledge for programming using a symbolic programming language.

Learning objectives: After passing the course, student can explain the basic operation principle of a computer, the phases of an instruction execution, and an interrupt mechanism. The student can explain the basic organization of a computer including CPU, ALU, memory, I/O device, bus, and a register. The

student can describe some basic operations of a computer using a register transfer language, and explain the role of instruction format as a part of the control logic. The student can perform conversions between number systems such as decimal, binary and hexadecimal systems. The student can use and interpret the basic data representations used in a digital computer such as integers, fixed point numbers, floating point numbers, and ASCII symbols. The student can explain the arithmetic operations performed using two's complement, the basic principles of a RISC architecture, and the connection of these principles to the performance of the computer. The student can explain a typical memory organization and terms like address space, cache memory, and virtual memory. The student can explain the principles of asynchronous communication, and the operation of the assembler. The student can create small programs using an assembly language.

**Contents:**

Computer organization and architecture, the operation principle of a computer, register transfer language, data types, interrupt, I/O devices, and memory organization. Assembly language and the operation of an assembler.

**Learning activities and teaching methods:**

Lectures, programming exercise, and exam.

**Recommended optional programme components:**

Digital Techniques I

**Recommended or required reading:**

Mano M., Computer System Architecture. Prentice Hall, Englewood Cliffs, New Jersey 1993; Patterson D., Hennessy J., Computer Organization and Design. Morgan Kaufman, San Francisco, CA, 2005.

### 555365S: Computer-Aided Methods in Ergonomics, 3 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Seppo Väyrynen

**Opintokohteen kielet:** English

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish/English

**Learning outcomes:**

The course familiarizes the student with some of the internationally well-known pieces of CAD-software for ergonomics design and evaluation.

Learning outcomes: After completion of the course students are able to use the key ergonomic design principles of computer-assisted programs and knows the latest scientific development in the field.

**Contents:**

The principles and methods of Computer-Aided Design methods in ergonomics

**Recommended or required reading:**

Landau, K. (ed.): *Ergonomic Software Tools in Product and Workplace Design*, Verlag ERGON GmbH Stuttgart 2000. 275 p.; Manuals, brochures and www-sites of software examples; Väyrynen, S.: *Suunnittelijan ergonomia*. Soveltavan ergonomian laboratorio, 1996. 199 p.; Väyrynen, S.: *Examples of computer-aided design, modeling and learning applications in ergonomics*. In: Course book on gerontechnology, COST A5, *Normal and pathological ageing and the impact of technology*, selected topics (Ed. By S-L. Kivelä, K. Koski & J. Rietsema). Eindhoven University of Technology & University of Oulu, 1995. pp. 114-124.

**Other information:**

Course is taking place only every second year starting in 2004

### 477602A: Control System Analysis, 4 op

**Voimassaolo:** 01.08.2005 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Process and Environmental Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Seppo Honkanen

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

- 477621A Control System Analysis 5.0 op  
 470460A Controls and Systems Engineering Fundamentals 5.0 op

**Learning outcomes:**

To give the student knowledge about control system analysis with mathematical methods.

Learning outcomes: After completing the course the student can describe the process dynamics of mathematical and graphical methods. The student can independently: form linear process models, analyse linear system stability, Bode diagrams, Routh's stability criterion and the Jury's test, and evaluate the behaviour of processes in time and frequency range specifications through.

**Contents:**

Introduction to Matlab. Laplace- and Z-transforms. Transfer functions and block diagrams. Dynamical systems. Time and frequency analysis. System stability

**Learning activities and teaching methods:**

Lectures and exercises. Examination.

**Recommended or required reading:**

Dorf, R.: Modern Control System. 11th ed. Prentice-Hall 2008, 1018 pp.; Ogata, K., Modern Control Engineering. 4th ed. Prentice-Hall 2002. 964 pp.

Additional literature : DiStefano, J.: Feedback and Control Systems. 2nd ed. Prentice-Hall 1990, 512 pp.; Ylen; J-P.: Sääätötekniikan harjoitustehtäviä. Hakapaino Oy 1994. 252 pp.

## 477603A: Control System Design, 4 op

**Voimassaolo:** 01.08.2005 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Process and Environmental Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Seppo Honkanen

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

- 477622A Control System Design 5.0 op  
 470461A Fundamentals of Control and Systems Engineering II 5.0 op

**Learning outcomes:**

To give the student knowledge about the mathematical and practical methods used in control system design.

Learning outcomes: After completing the course the students can apply mathematical and graphical methods to the dynamics of process characterisation and control design. The period of study completed, the student can form the on-off-controller, PID-, lead- and lag controllers for the process, and tune them to the accuracy requirements of the customer and evaluate the behaviour of closed-loop systems with the root locus technique.

**Contents:**

Controllers. Root locus method. Compensators in control system design. State-space representation of systems. Modern control engineering.

**Learning activities and teaching methods:**

Lectures and exercises. Examination

**Recommended or required reading:**

Dorf, R.: Modern Control System. 11th ed. Prentice-Hall 2008, 1018 pp.; Ogata, K., Modern Control Engineering. 4th ed. Prentice-Hall 2002. 964 pp.

Additional literature : DiStefano, J.: Feedback and Control Systems. 2nd ed. Prentice-Hall 1990, 512 pp.; Ylen; J-P.: Sääätötekniikan harjoitustehtäviä. Hakapaino Oy 1994. 252 pp.

## 470460A: Controls and Systems Engineering Fundamentals, 5 op

**Voimassaolo:** - 31.07.2010

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Process and Environmental Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Kortela, Urpo, Seppo Honkanen

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

477602A Control System Analysis 4.0 op

Ei opintojaksokuvauksia.

## 555363S: Creativity at Work and in Product Development, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Kisko, Kari Juhani

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

ay555363S Creativity at Work and in Product Development (OPEN UNI) 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish

**Learning outcomes:**

The course aims at raising the student's interest in seeing the objects that need development in the working environment. The course also provides the methods to improve these objects.

Learning outcomes : After the course the student understands what is creativity and how to use various methods of creative work and how to get new ideas and how to develop new products.

**Contents:**

The basic elements of creativity will be introduced to students through real life examples. Training various methods of creative work plus completing a development project and presenting the results will be accomplished in teams.

**Recommended or required reading:**

***Luova työote - tuottava työ.*** Työhallinnon julkaisu 345. Työministeriö 2005. Rajala, H-K. & Kisko, K. ***Yhdessä paja paremmaksi.*** Teknologiateollisuus ry. 2005. Langford, J. & McDonagh, D. (edited) ***Focus groups - supporting effective product development.*** London: Taylor & Francis 2003. Other literature reported at the beginning of the course.

## 031017P: Differential Equations, 4 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Mathematics Division

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Hamina, Martti Aulis

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

800320A Differential equations 5.0 op

031076P Differential Equations 5.0 op

**Language of instruction:**

Finnish

**Learning outcomes:**

The students learn the concepts concerning differential equations and get the ability to read associated literature. The students will achieve adequate mathematical skills for treating differential equations. They can identify simple analytically solvable differential equations and they can solve these by using various methods.

Learning outcomes: The students can apply differential equations as a mathematical model. They can identify and solve various differential equations and they have knowledge on basic solvability of differential equations. The student can use the Laplace transform as a solution method.

**Contents:**

Principles of mathematical modelling. Ordinary differential equations of first and higher order. Laplace transform with applications to differential equations.

**Learning activities and teaching methods:**

Lectures 3h/week. Two intermediate exams or one final exam.

**Recommended optional programme components:**

Calculus I.

**Recommended or required reading:**

Lecture notes in Finnish. Kreyszig. E., Advanced Engineering Mathematics

## 521337A: Digital Filters, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Computer Science and Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

ay521337A Digital Filters (OPEN UNI) 5.0 op

**Learning outcomes:**

The objective of the course is to supply the student with basic understanding of digital signal processing and applications.

Learning outcomes: Upon completing the required coursework, the student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods. He is also able to solve for the impulse and frequency responses of FIR and IIR filters given as difference equations, transfer functions, or realization diagrams, and can present analyses of the aliasing and imaging effects based on the responses of the filters. Moreover, the student is able to explain the impacts of finite word length in filter design. After the course the student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

**Contents:**

Aliasing, imaging, and their control using analog and digital filtering, discrete Fourier Transform, FTT, correlation, convolution, and their use for finite length subsequences, FIR and IIR filter design and realization structures, modeling and analysis of finite word length effects, fundamentals of multi-rate signal processing, fundamentals of adaptive filtering, and design tools for digital signal processing.

**Learning activities and teaching methods:**

The course is based on lectures and design exercises. The lectures follow a regular weekly schedule with Mondays reserved for easy problems that illuminate the theory and Tuesdays for more demanding exercises that illuminate design issues. These are followed by a week exam each Thursday. In total 10 week exams will be held. The recommended way to participate the course is in groups of four, in which case the points from each week exam is based on the answers of a member selected at random. The design exercises familiarize the students with the methods of digital signal processing using the Matlab software package. The course can be passed either with week exams or a final exam. In addition, the exercises need to be returned and accepted.

**Recommended optional programme components:**

signals and systems, complex analysis.

**Recommended or required reading:**

Ifeachor, E., Jervis, B.: Digital Signal Processing, A Practical Approach, Second Edition, Prentice Hall, 2002; lecture notes (in Finnish); materials in the Optima e-learning environment (some material in English).

## 521413A: Digital Techniques 1, 4 op

**Voimassaolo:** - 31.07.2012

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Hannu Heusala

**Opintokohteen kielet:** Finnish

### Learning outcomes:

After having completed the course student are expected to understand functional principles, implementation options, and logic design principles of the most usual digital equipment.

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

### Contents:

Boolean algebra, number notations, analysis and synthesis of combinatorial circuits, flip-flops, principles of state machine behavior, CPLD- and FPGA-circuits, physical characteristics of CMOS technology.

### Learning activities and teaching methods:

Kurssissa tutustutaan luennoilla ja harjoituksissa konkreettisten esimerkkien kautta nykyaikaisten digitaalitekniikan laitteiden toimintaan ja rakenteeseen. Kurssiin sisältyy luennot ja laskuharjoitukset. Opintojakso suoritetaan loppukokeella. Kurssiin liittyy Ohjelmoitava elektroniikka -kurssi, jolle osallistuminen edellyttää Digitaalitekniikka I -kurssin sisällön hallintaa.

### Recommended or required reading:

Brown, S., Vranesic, Z. Fundamentals of Digital Logic with VHDL Design, McGraw Hill, 2005

## 521404A: Digital Techniques 2, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

### Learning outcomes:

The goal of the course is to familiarize students to the professional design flow, design methodology and implementation options of digital integrated circuits.

Osaamistavoitteet: After the course students are able to design high level architectures of digital systems and blocks of the system implemented by special hardware (ASIC and FPGA). Students are able to apply design methodologies and tools. Design verification and implementation analysis are emphasized. Students can simulate and model (VHDL modelling and VHDL simulation) digital systems and critically evaluate the design also from the implementation's point of view.

### Contents:

1. Implementation technologies of digital circuits, 2. Description levels of digital systems, 3. VHDL modelling of digital circuits and systems, 4. System level specification and design, 5. Design of ASICs and FPGAs, 6. High level VHDL synthesis, 7. RTL-VHDL synthesis, 8. Planning of production test of digital ASICs.

## 461018A: Dynamics, 4 op

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Koivurova Hannu

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

461106A Dynamics 5.0 op

**Language of instruction:**

Finnish

**Learning outcomes:**

The aim of this course is to provide students with the ability to examine the relationship between the forces on a solid body and the resulting motion, position, speed and acceleration of the body.

Learning outcomes: Upon completing the required coursework, the student knows and is able to explain the fundamental quantities and the base laws of the classical mechanics. He/she is able to choose an appropriate coordinate system and analyze the motion - position, velocity, and acceleration - of the parts of a device. The student is able to draw a free body diagram of a moving system, and compose and derive the equations of motion for a system using the direct momentum method, the work-energy method, and the impulse-momentum method.

**Contents:**

Introduction; Kinematics of a particle; Plane kinematics of a rigid body; Kinetics of a particle; Basics of mechanical vibrations; Kinetics of a system of particles; Plane kinetics of a rigid body

**Learning activities and teaching methods:**

The course is based on lectures and exercises. The students will be informed about the practical arrangements at the beginning of the course. The final grade is based on the combined points from exercises and three exams.

**Recommended optional programme components:**

Statics, Basis of Integral and Differential Calculus and Vector and Matrix Algebra.

**Recommended or required reading:**

Salmi, T. (2003) Dynamiikka 1, kinematiikka, Pressus; Salmi, T. (2002) Dynamiikka 2, kinetiikka, 2. p.; Pressus. Beer, F., Johnston, E. (1996) Vector Mechanics for Dynamics, 6.ed., McGraw-Hill.

## 521109A: Electrical Measurement Principles, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Juha Saarela

**Opintokohteen kielet:** Finnish

**Learning outcomes:**

The goal of this course is to give the theoretical and practical basis on electrical measuring techniques and to give basic knowledge to later studies. The course will also provide knowledge to use of general electrical measurement equipment.

Learning outcomes: Upon completion of the course, students are be able to measure basic measurements with a ammeter, voltmeter and oscilloscope. They can estimate the validity of their measurements.

**Contents:**

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

**Learning activities and teaching methods:**

Lectures and laboratory exercises. One or two exams and passed lab exercises.

**Recommended optional programme components:**

Calculus I and II, Physics S.

**Recommended or required reading:**

O. Aumala: Mittaustekniikan perusteet, Otatiето 1999 (in Finnish). A.D. Helfrich, W.D. Cooper: Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall, 1990.

## 761103P: Electricity and Magnetism, 4 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

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

Ei opintojaksokuvauksia.

## 521405A: Electronic System Design, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Learning outcomes:**

The main goal of the course is to introduce methods and techniques needed in designing larger electronic entities such as equipment and systems.

Learning outcomes: On completion of the study module a student is able to explain all the phases of a development project of an electronic device. He or she is able to explain how to protect results obtained during the development process and on the other hand the student is able to explain the restrictions caused by standards and patents of other companies. The student is able to choose the optimum method of the choices presented in the course in the field of power supply, thermal design, grounding, and routing of the high speed signals. The student is able to calculate problems, caused by electrical disturbances, crosstalk and nonidealities of electrical components. After passing the course the student can calculate reliability of an electrical device or system.

**Contents:**

Electronic product design process, patents, test design, and EMC/LVD standards, Characteristics of ASIC technology and design, Characteristics of highspeed digital design. Reliability engineering. Documentation design

**Learning activities and teaching methods:**

The course includes 3 h of lectures and 2 h of exercises per week. The course will be passed by means of a final exam.

**Recommended optional programme components:**

Circuit Theory I-II, Analogue Electronics I-II, Digital Techniques I-II, Filter Theory, Computer engineering, Embedded Systems.

**Recommended or required reading:**



Handout. Ward & Angus: Electronic Product Design, m Hall&Hall&McCall: Highspeed Digital Design, Montrose: EMC and the Printed Circuit Board, Ott: Noise Reduction Techniques.

## 521432A: Electronics Design I, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Kilpelä, Ari Juhani

**Opintokohteen kielet:** Finnish

### **Learning outcomes:**

To give the student the basic information about analogue electronics design. The course is continuation to Principles of Electronics Design.

Learning outcomes: On completion of the study module students should be able to recount the principles governing the design of multistage amplifiers, analyse and set the frequency response of a transistor amplifier and make use of feedback to improve the properties of an amplifier in the desired manner. They should also be able to analyse the stability of a given degree of feedback amplification and to dimension an amplifier correctly to ensure stability. Students should similarly be able to describe the principles governing the design of power amplifiers, to make widespread use of operational amplifiers for realizing electronic structural blocks and to take account of the limitations imposed by the non-idealities inherent in operational amplifiers. They should be able to design low-frequency oscillators, to explain the operating principles of radio frequency oscillators and resonance amplifiers and to recount the basic principles governing the functions and properties of emitter-coupled logic.

### **Contents:**

Frequency response of transistor amplifier, differential amplifier, feedback, stability and nonidealities of feedback amplifier, comparator, output stages and power amplifiers, application of operational amplifier, oscillators, tuned amplifiers and ECL logic. Implementation: Lectures and exercises. This course is required when participating in Laboratory Exercises on Analogue Electronics. Final exam.

### **Recommended optional programme components:**

Circuit Theory II, Principles of Electronics Design, Principles of Semiconductor Devices.

### **Recommended or required reading:**

Handout. Sedra, Smith: Microelectronic Circuits (4th edition), Chapters 2, 6-12. OR Hambley: Electronics (2nd edition), chapter 2; chapters 7 – 12 to most part.

## 521443S: Electronics Design II, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

### **Learning outcomes:**

The goal is to reinforce and further develop the student's understanding of concepts of analogue circuit blocks and their application and use in the design of electronic equipment. The course also gives basic skills for the design of integrated building blocks. Noise and modeling of noise in electrical circuits, and the structures and properties of DA/AD converters are covered.

Learning outcomes: On completion of the study module students should be able to explain the structures and operating principles of the passive and active (BJT and MOS) components available for use in modern IC technologies, analyse and design integrated structural blocks based on these components, such as operational amplifiers, comparators and sampling circuits, and estimate and minimize the effects of noise on these. They should also be able to explain the terminology connected with DA and AD conversion and converters and to analyse and outline their main structural principles and evaluate their characteristics.

### **Contents:**

Modeling of BJT and MOS transistors, CMOS and BJT building blocks especially as IC-realizations, noise and analysis of noise, internal structure of operational amplifiers, critical parameters, comparators, S/H-circuits, structures and properties of A/D and D/A converters.

**Learning activities and teaching methods:**

Lectures, exercises and a small design work. Final exam.

**Recommended optional programme components:**

Electronics Design I.

**Recommended or required reading:**

Lecture notes, D. A. Johns & K. Martin: Analog integrated circuit design, Wiley & Sons 1997, chapters 1, 3, 4, 5, 7, chapter 8 partially, 11, 12 and 13. OR P. E. Allen & D. R. Holberg: CMOS Analog Circuit Design, Oxford University Press 2002, chapters 1, 3, 4, 5, 6, 8 and 10.

## 521141P: Elementary Programming, 5 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Computer Science and Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Riekki, Jukka Pekka

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

ay521141P Elementary Programming (OPEN UNI) 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish

**Learning outcomes:**

Learning outcomes: Upon completing the required coursework, the student is able to recognize the basic programming concepts and structures. Moreover, the student is able to implement small programs.

**Contents:**

History of programming, basic concepts of programming, basic structures of programming languages, solving problems by programming

**Learning activities and teaching methods:**

Lectures, many programming exercises

**Recommended or required reading:**

Will be announced later

## 521270A: Embedded Software Project, 5 op

**Voimassaolo:** 01.08.2005 - 31.07.2012

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Computer Science and Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Juha Röning

**Opintokohteen kielet:** English

Ei opintojaksokuvauksia.

## 521268A: Embedded Systems, 4,5 op

**Voimassaolo:** 01.08.2005 - 31.07.2012

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Computer Science and Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Janne Haverinen

**Opintokohteen oppimateriaali:**

**Berger, Arnold S.** , , 2002

**Opintokohteen kielet:** English

**Learning outcomes:**

The aim of the course is to provide the basic knowledge about the design and implementation of embedded systems. The course will introduce the design life cycle of the embedded systems, and a basic tool set for embedded systems development. The course also provides the basic knowledge about the hardware programming with an Atmel AVR series microcontroller.

Learning objectives: After passing the course a student can explain the life cycle of the embedded system, the characteristic features related to embedded systems development, and the risks involved. In addition, the student can explain the roles of the client and the system developer during the requirements specification, and the role of the iteration phase as a part of the requirements specification phase. The student can explain the factors affecting to SW/HW partitioning process, and the concept of SW/HW dualism. The student can fairly analyze the factors affecting to the selection of the processor and the operating system. The student can recognize the basic development tools used and their possible advantages and disadvantages. The student can compare various testing approaches. The student can explain how a design error affects to the final cost of the system in different phases of the development. The student can do some basic I/O programming using C programming language.

**Contents:**

The embedded design life cycle, the selection process, the partitioning decision, the development environment, the special software techniques, a basic toolset, JTAG/ICE, testing, I/O programming.

**Learning activities and teaching methods:**

Lectures, laboratory exercise, and exam.

**Recommended optional programme components:**

Computer Engineering, Programming Exercise, Introduction to C Programming, Digital Techniques I.

**Recommended or required reading:**

Berger, Arnold S. (2002) Embedded Systems Design: An introduction to Processes, Tools, & Techniques, CMP Books, USA. ISBN:1578200733.

## 521142A: Embedded Systems Programming, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Computer Science and Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Riekk, Jukka Pekka

**Opintokohteen kielet:** Finnish

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish

**Learning outcomes:**

Learning outcomes: Upon completing the required coursework, the student is able to implement small C programs both in PC environment and for embedded systems with memory-mapped I/O. Moreover, the student is able to recognize how embedded systems programming differs from programming general-purpose computers.

**Contents:**

Basics of C, bitwise operations, memory management, memory-mapped I/O devices, hardware registers, interrupts

**Learning activities and teaching methods:**

Lectures, many programming exercises

**Recommended optional programme components:**

Elementary programming

**Recommended or required reading:**

Will be announced later

**488201A: Environmental Ecology, 5 op**

**Voimassaolo:** 01.08.2005 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Process and Environmental Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** English

**Leikkaavuudet:**

488210A	Environmental science and technology	5.0 op
ay488201A	Environmental Ecology (OPEN UNI)	5.0 op
480001A	Environmental Ecology	5.0 op

**Language of instruction:**

In Finnish or English.

**Learning outcomes:**

The objective of the course is to provide a basic understanding of environmental ecology.

Learning outcomes : The student is able to define the basic concepts of environmental ecology. He/she has knowledge about the state of the environment and is able to explain the essential environmental problems and the main effects of pollution. In addition, the student knows some solutions to environmental problems and is aware of ethical thinking in environmental engineering. The student also has basic knowledge about toxicology and epidemiology.

**Contents:**

Principles of environmental ecology. Roots of environmental problems. Global air pollution: ozone depletion, acid deposition, global warming and climate change. Water pollution, eutrophication, overexploitation of ground and surface water. Main effects of pollution and other stresses.

Nonrenewable and renewable energy. Energy conservation and efficiency. Hazardous and solid waste problem. Principles of toxicology, epidemiology, and risk assessment. Environmental ethics.

**Learning activities and teaching methods:**

E-learning in the Optima learning environment.

**Recommended or required reading:**

Materials in the Optima environment.

**555364S: Ergonomics, 5 op**

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Seppo Väyrynen

**Opintokohteen kielet:** Finnish

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish.

**Learning outcomes:**

The course familiarises the student with the fundamental principles of ergonomics.

Learning outcomes: After the completion of the course students are able to present and justify human artefacts and the interaction of the essential principles for the production and use of products. He can choose the methods which will enhance the employees safety, health, well-being to achieve work satisfaction. Still, he can develop and design products in the production according to physical, cognitive and organizational ergonomics.

**Contents:**

The anthropometrics, biomechanics, gerontechnology, work physiology, cognitive psychology and organisational and participative approaches. The principles of design and measurement (CAD, simulation, participative design). Usability.

**Recommended or required reading:**

Väyrynen, S, Nevala, N & Päivinen, M (2004), *Ergonomia ja käytettävyys suunnittelussa*.

Teknologiaateollisuus. 336 s. **Additional literature:** Bridger, R. (2009). *Introduction to ergonomics*. 3rd edition. CRC Press ; SFS-ergonomiastandardit (EN-ISO, [www.sfs.fi](http://www.sfs.fi)), Copies from lectures.

**555367S: Exercises in Work Science, 6 op**

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Seppo Väyrynen

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555379S Research Project in Industrial Engineering and Management 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish.

**Learning outcomes:**

The various previous courses on safety, ergonomics and maintenance will give the knowledge which will be applied to real industrial problems in this course.

Learning outcomes: After the course the student is able to apply know-how and methods to the working environment and organizational development. He knows how to utilize the above-mentioned principles of academic knowledge, jobs and businesses in planning and management situations. Students are able to respond to current practice, work system or a product development challenge, methodical and evidence-based equipment.. The students can also take advantage of research-based approach to a research problem in a company, research organization, or in a R & D project.

**Contents:**

The participants are familiarized with systematic methods presented in well-known textbooks or research reports. Computer-aided systems.

**Recommended or required reading:**

Reported at the beginning of the course.

**521331S: Filters, 4 op**

**Voimassaolo:** - 31.07.2012

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Rahkonen, Timo Erkki

**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

**461033A: Finite Element Methods I, 3,5 op**

**Voimassaolo:** 01.08.2007 - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Lumijärvi, Jouko Veikko Juhani

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

461107A Finite Element Methods I 5.0 op

461014S Finite Element Methods 5.0 op

**Language of instruction:**

Finnish

**Learning outcomes:**

The aim of this course is for students to gain an understanding of the basic idea and restrictions of FEM and the preparedness to the use of commercial FE-programs.

Learning outcomes: After this course, the student can explain the basic idea of the FEM. He/she can analyze simple truss- and frame structures and explain the theoretical background of the calculations. In addition, the student can analyze two-dimensional and heat transfer problems by using FEM.

**Contents:**

The basic idea of FEM and its use in static analyses of bars, beams and plane structures. Some general principles of the use of FEM.

**Learning activities and teaching methods:**

Lectures and exercises take place during periods 1 and 2. The course can be passed either by completing two mid-term exams or a final exam

**Recommended optional programme components:**

Strength of Materials I and II.

**Recommended or required reading:**

Lecture notes (in Finnish), N. Ottosen & H. Petersson: Introduction to the Finite Element Method, NAFEMS: A Finite Element Primer, O. C. Zienkiewicz & R. L. Taylor: The Finite Element Method, 4th ed, Vol. 1: Basic Formulation and Linear Problems.

## 477101A: Fluid and Particle Engineering I, 3 op

**Voimassaolo:** 01.08.2005 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Process and Environmental Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

477121A Particle Technology 5.0 op

470101A Mechanical Process Engineering I 5.0 op

**Learning outcomes:**

After the course the student knows fundamentals and methods connected with properties of granular material processing, grain size determination, crushing, grinding, sieving and mineral concentration.

*Learning outcomes:* Upon completion of the course, a student should be able to identify the mainline mechanical processes enhancing the degree of upgrading, as well as recovery operations related to those mechanical main processes. The student is able to identify the equipment 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.

**Learning activities and teaching methods:**

Lectures and exercises. A written final exam.

**Recommended or required reading:**

Allen, T.: Particle Size Measurement. 4th ed., Chapman and Hall, London 1990, 806 p.; Allen, T.: Particle Size Measurement – Powder Sampling and Particle Measurement, Volume 1. 5th ed., Chapman and Hall, London 1997, 525 p.; Allen, T.: Particle Size Measurement – Surface Area and Pore Size Determination, Volume 2. 5th ed., Chapman and Hall, London 1997, 251 p.; Hukki, R.T.: Mineraalien hienonnus ja rikastus. Teknillisten tieteiden akatemia, Keuruu 1964, 656 p.; Lowrison, G. C.: Crushing and Grinding. Butterworth & Co London 1974, 286 p.; Lukkarinen, T.: Mineraalitekniikka osa I – Mineraalien hienonnus. Insinööritieto Oy, 1984, 330 p.; Lukkarinen, T.: Mineraalitekniikka osa II – Mineraalien rikastus. 1. P. 1987, Insinööritieto Oy. 442 p.; Svoboda, J.: Magnetic Methods for Treatment of Minerals. Developments in Mineral Processing, Volume 8. Elsevier Science Publishers B. V., Amsterdam 1987, 692 p.; Wills, B.A.: Mineral Processing Technology. 4th ed., Pergamon Press, Oxford 1998, 785 p.

## 463058A: Foundry Technology, 3,5 op

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Valtonen, Markku Kullervo

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

463105A Casting techniques 8.0 op

### **Language of instruction:**

Finnish

### **Learning outcomes:**

The aim of the course is to give the students basic information concerning founding processes and how those are suited to different kinds of production and also what those methods require for product constructions.

Learning outcomes: After completing the course, the student can estimate which kinds of products are possible and are profitable to make by casting. The student can analyze the possibilities and limits of founding technology in parts design. The student can tell the main principles of common founding methods and how those methods are suited to different kinds of products and various sizes. The student can also explain the main principles of the process plan and founding system design.

### **Contents:**

Different pattern and mould types; Mould making methods; Casting methods; Mechanization of foundry; Smelting technology; Casting metals; Post treating of cast part; Part design of product; Design of founding system

### **Learning activities and teaching methods:**

The course is based on lectures, design exercises and laboratory exercises in the autumn of the third year. The lectures follow a regular weekly schedule in the second period, and the schedule for the exercises in second and third period are given later. The grade of the course is based on an examination and exercises.

### **Recommended or required reading:**

Materials are given by the teacher.

## 477302A: Heat Transfer, 3 op

**Voimassaolo:** 01.08.2005 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Process and Environmental Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Tuomaala, Eero Juhani

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

477322A Heat and Mass Transfer 5.0 op

470620A Heat Transfer 3.0 op

**Learning outcomes:**

To familiarise the student with the mechanism and models of heat transfer, applying them in practical problems, creating and solving differential energy balances, design of heat transfer networks and analysing working potential of heat flow.

*Learning outcomes :* After passing the course the student knows what happens when heat is transferred by conduction, convection and radiation. After the course the student can describe energy transfer with differential energy balances connected with momentum balances. In macro scale the student is able to solve practical heat transfer problems by correlating heat transfer coefficients to dimensionless flow and material characteristics. With the help of these transfer coefficients the student is capable of estimating the size of heat transfer equipment, especially heat exchangers and select the most suitable and profitable types. To sketch large heat nets and to diminish the costs of the equipments, the student is able to use the pinch method which optimises the number of heat exchangers and total energy consumption. He/she is also able to apply the exergy principle to make work from thermal energy. With the aid of this principle he/she is able to divide the costs of the used energy in right proportion based on the processing stage.

**Contents:**

Mechanism of heat transfer. Creating and solving differential energy balances. Heat transfer coefficient. Macroscopic balances. Selection of a proper type of heat exchanger. Scale-up and design of a heat exchanger. Design of heat exchanger networks using pinch technology. Exergy analysis for the heat flows.

**Learning activities and teaching methods:**

Lectures including exercises. Homework assignments affect the course grade. Examination.

**Recommended optional programme components:**

Course Momentum Transfer 477301A recommended beforehand.

**Recommended or required reading:**

Bird, R. B., Stewart, W.E. & Lightfoot, E.N., Transport Phenomena, John Wiley & Sons, 1976, 780 pp.; Linnhoff, B. et al.: A User Guide on Process Integration for the Efficient Use of Energy, The Institution of Chemical Engineers, 1987, 247 pp.

*Additional literature:* Jokilaakso, A., Virtaustekniikan, lämmönsiirron ja aineensiirron perusteet, 496, Otakustantamo, 1987, 194 pp. Coulson, J.F. et al., Chemical engineering vol.1, 4th ed., Pergamon Press, 1990. 708 pp. Peters, M.S. & Timmerhaus, K.D., Plant design and economics for chemical engineers, 4th ed., McGraw-Hill, 1991, 910 pp. Sussman, M.V., Availability (exergy) analysis, Mulliken House, 1985, 94 pp.

**Other information:**

*Language of instruction:* In Finnish

**461036S: Heat and Mass Transfer II, 3,5 op**

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Koivurova Hannu

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

461110S Fluid mechanics 5.0 op

**Language of instruction:**

Finnish

**Learning outcomes:**

The aim of this course is to familiarize students with the physical principles of heat transfer and fluid mechanics and their applications.

Learning outcomes: Upon completing the required coursework, the student is able to design machines for the production, transfer and use of energy. Moreover, he/she is able to calculate the amount of loads the flow directs towards the structures. The above requires that the student is able to explain the fundamentals of fluid statics and calculate its applications. He/she can explain the characteristics of flowing fluid and the fundamental concepts of the flow mechanics. The student is able to use mass, momentum and energy conservation equations to solve engineering fluid mechanics problems in a controlled volume. The student is able to determine the frictional



losses, piping size and pump power requirements for laminar and turbulent flow in closed conduits for viscous and inviscid fluids.

**Contents:**

Introduction, dimension analysis and its applications; Fluid statics: Equilibrium equations, pressure center, stability of a floating body; Fluid dynamics: inviscid and viscous incompressible flow, basics of compressible flow, use of numerical methods; Technical applications including flow in pipes, wind loads and wave loads.

**Learning activities and teaching methods:**

The course is based on lectures and exercises. The final grade is based on the combined points from exercises and a final exam.

**Recommended optional programme components:**

461034A Heat and Mass Transfer I

**Recommended or required reading:**

Nakayama & Boucher (2000) Introduction to Fluid Mechanics, Barthsworth-Heinemann.

## 555325S: Human Resources Management, 3 op

**Voimassaolo:** - 31.07.2012

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Kess, Pekka Antero

**Opintokohteen kielet:** Finnish

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish

**Learning outcomes:**

Learning outcomes: After completing the course student knows the key concepts of human resource management and can explain these. The student can describe the structures of human resource organizations and can explain the meaning of management in the performance of human resource management. The student can analyse the human resources activities in a company and can produce improvement proposals based on the analysis. After the course the student can take part in the human resources management development in the role of an expert.

**Contents:**

People Capability Maturity Model

**Target group:**

Main target groups are the Students of Industrial Engineering and Management as well as those students in the departments of Mechanical Engineering and Process and Environmental Engineering who have the orientation to Industrial Engineering and Management. Other engineering students are accepted.

**Recommended or required reading:**

Curtis B, Hefley H & Miller S. (2002) The People Capability Maturity Model. Guidelines for Improving the Workforce. SEI Series. Management of Human Resources. Carnegie Mellon. Software Engineering Institute. Pearson Education, Lecture notes, Other material will be informed during the lectures.

**Assessment methods and criteria:**

Course is completed and assessed by team work report and its presentation in the closing seminar .

## 488104A: Industrial and Communal Waste Management, 5 op

**Voimassaolo:** 01.08.2005 - 31.07.2017

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Process and Environmental Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Elisangela Heiderscheidt

**Opintokohteen kielet:** English

**Leikkaavuudet:**

480160S Waste Management of Communities and Industry 5.0 op

**Learning outcomes:**

Introduction to waste management legislation, management methods, technical principles and terminology.

**Contents:**

EU and Finnish legislation, control of waste flows and amounts, recycling and utilisation, sorting and logistics, hazardous waste, environmental protection

**Learning activities and teaching methods:**

Lectures, exercises, and field visits.

**Recommended or required reading:**

Will be announced later.

### 030005P: Information Skills, 1 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Faculty of Technology

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Koivuniemi, Mirja-Liisa, Sassali, Jani Henrik

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

030004P Introduction to Information Retrieval 0.0 op

**Language of instruction:**

English

**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.

**Learning activities and teaching methods:**

The course involves training sessions (8h), web-based learning materials, exercises in the Optima learning environment and a final assignment on a topic of the student's own choice.

**Recommended or required reading:**

Web-based learning material (<http://www.kirjasto.oulu.fi/index.php?id=822>)

**Assessment methods and criteria:**

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

**Grading:**

pass/fail

**Person responsible:**

Science and Technology Library Tellus, tellustieto (at) oulu.fi , <http://www.kirjasto.oulu.fi/index.php?id=738>

### 477012P: Introduction to Automation Engineering, 5 op

**Voimassaolo:** 01.08.2005 - 31.07.2013

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Process and Environmental Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Leiviskä, Kauko Johannes, Hiltunen, Jukka Antero, Harri Aaltonen, Aki Sorsa

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

488010P Introduction to Process and Environmental Engineering II 5.0 op

470433A Introduction to Control Engineering 5.0 op

470304S Fundamentals of Process Automation 2.5 op

**Learning outcomes:**

The student knows the essential concepts, principles and device solutions of industrial automation, understands and also knows how to produce documents used in automation technology.

*Learning outcomes:* After completing the course the students know how to use the automation technique concepts for action descriptions and identifying problems. The students can draw on the PI- and block diagrams, using professional automation terms. The students will be able to use block diagrams, and adjustment problems of characterisation and solution. In addition, the student can select the appropriate instrument and conduct measurements using the most common field instruments. Students can identify physical and programming automation systems, as well as their meaning and purpose in relation to an operator's tasks requiring accuracy.

**Contents:**

Controlling the phenomena with the help of process and automation technology; structure of industrial automation: operational and structural description; process control and operation; PI-charts, symbols, block diagrams and block diagram algebra; control circuits: principles and implementation; process measurements, sensors and measuring equipment; control elements and dimensioning (mostly valves and motors); placing, installation and connection of field devices, signals and cabling.

**Recommended or required reading:**

Lecture handout.

## 811376A: Introduction to Data Structures, 3 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Information Processing Science

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Martti Luodonpää

**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

## 488011P: Introduction to Environmental Engineering, 5 op

**Voimassaolo:** 01.08.2005 - 31.12.2013

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Process and Environmental Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Väisänen, Virpi Maria, Jarmo Sallanko

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

488010P Introduction to Process and Environmental Engineering II 5.0 op

480002A Basics of Environmental Technology 5.0 op

**Learning outcomes:**

(Please note: the next description of the aims for this course applies to the lecture course taught in Finnish, not the book examination given in English). After performing this course, the student will have

basic knowledge about hydrology, water protection and sanitary engineering, waste management, air protection, noise abatement, radiation protection and fundamentals of environmental biotechnology, as well as about the respective techniques. The student will have an understanding of the principles and necessity of environmental protection, and knowledge about the environmental detriments of different industries, traffic and communities, and their prevention methods.

Learning outcomes:

(Please note: the next description of the learning outcomes for this course applies to the lecture course taught in Finnish, not the book examination given in English). After completing this course by the lectures, the student will recognise and be able to verbally describe the basic features of hydrology, water protection and water and waste management. The student will also be able to define the most important factors associated with air protection, industrial ecology and noise abatement. He/she will also identify the different fields of environmental biotechnology and be able to list techniques related to those. Further, he/she can describe the environmental detriments caused by different industries, traffic and communities and well as the traditional and modern prevention methods of these. The student will be able to justify the necessity of environmental protection by using the terminology of technology.

**Other information:**

(Lecture course in Finnish). For foreigners, e.g. exchange students, the course is organised as a book examination in English. Books for the exam: Förstner U.1995. Integrated pollution control, pages 81-373; and Scragg A. 1999. Environmental Biotechnology. ISBN 0 582 27682 9, p. 1-21, 78-104 (or newer edition). Contact the teachers in advance to agree about the examination.

## 463052A: Introduction to Manufacturing Technology, 5 op

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Martti Juuso

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

463101A Introduction to manufacturing technology 5.0 op

**Learning outcomes:**

The aim of this course is to give students a general view of manufacturing methods. The primary emphasis of the course is on the cutting methods of metals.

Learning Outcomes: Upon completion of the course, the student is able to name the central areas of manufacturing technology and the most important cutting methods. In addition, the student is able to choose the applicable cutting methods and tools for achieving the basic manufacturing tolerances. The student is able to explain the basic features of the most usual materials of cutting tools.

**Contents:**

The course includes 10 hours lectures, an examination and the practical exercises of metal cutting in the laboratory.

**Learning activities and teaching methods:**

In the spring, 10 hours of lectures and exercises will be held during periods 4 and 5. The exam and exercises will be graded 0-5. The final grade is based on the combined points from exercises and the final exam.

**Recommended or required reading:**

Copies of lecture material, other material to be notified at the start of lectures.

Ihalainen, E., Aaltonen, K., Aromäki, M., Sihvonen, P.: Valmistustekniikka. Otatieto Oy: Helsinki, 2007, 490 p.

## 521104P: Introduction to Material Physics, 5 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Learning outcomes:**

The students are introduced to the physical principles of electronic and atomic phenomena existing in electronic materials and components. The connections to the general principles of solid state physics are emphasized in the consideration of the phenomena.

Learning outcomes: After completing the course, student is able to explain the basic concepts related to materials physics. He can outline the crystal structure of the solids and the crystalline binding and is able to explain the principles of the theory used in describing the different kinds of waves traveling in solids. Moreover, he can explain of the statistical models used in describing the thermal properties of the solids and is able to apply those on calculation of the charge carrier distributions of the semiconductors. He can also outline the free electron model of metals and formation of the energy band structure of the crystals and their significance to the electrical properties of materials. He is able to explain the basic phenomena related to semiconductors and pn-junctions and can apply this information on analyzing the operation of the components based on semiconductor materials.

**Contents:**

Crystal structures and cohesion. Waves and defects in crystals. Basic principles of quantum mechanics and thermal properties (statistics). Free electron model of metals, energy bands and brillouin zones in crystals. Basic phenomena of semiconductors and pn-junctions.

**Learning activities and teaching methods:**

Lectures and exercises. The course is passed by a final exam.

**Recommended optional programme components:**

Basic physics and mathematics

**Recommended or required reading:**

H.M. Rosenberg: The Solid State, Clarendon Press, Oxford, 1988. B. Streetman: Solid State Electronic Devices, Prentice Hall, New Jersey, 1995.

**521218A: Introduction to Microelectronics and Micromechanics, 4 op**

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

521070A Introduction to Microfabrication Techniques 5.0 op

**Learning outcomes:**

The student is introduced to the fabrication methods of integrated circuits (IC) and structures of micromechanics.

Learning outcomes : After completing the course the student has an extensive knowledge of different fabrication methods of microelectronics and micromechanics. The student knows the required properties of semiconducting materials, the processing of the source material and basic principles of the semiconductor wafer fabrication. The student is able to apply her/his knowledge of the fabrication of semiconductor components. The student has also an understanding of the micromechanics processing methods and thick-film circuit design and fabrication.

**Contents:**

Integrated circuits: materials, methods, components and circuit technologies. Thick film hybrid techniques. Fabrication of micromechanical structures. Application examples.

**Learning activities and teaching methods:**

Lectures and demonstration including design work. Final exam.

**Recommended or required reading:**

Lecture notes. D.V. Morgan, K. Board: An Introduction to Semiconductor Microtechnology, John Wiley & Sons, New York 1990/1995.

**477011P: Introduction to Process Engineering, 5 op**

**Voimassaolo:** 01.08.2005 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Process and Environmental Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Eetu-Pekka Heikkinen

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

470219A Introduction to Process Engineering 3.5 op

**Learning outcomes:**

The goal is to understand industrial unit operations as well as the phenomena related to these operations on a descriptive level. It should however be noted that this course is not organised in English and it is impossible to pass it in any other language besides Finnish. Therefore there are no requirements for the non-Finnish-speaking students.

Learning outcomes : Student recognizes the most essential phenomena and unit operations (as well as their relations) that are related to industrial activities and process engineering. Additionally, (s)he recognizes the factors influencing industrial activities in such a way that enables her/him to include all the analytical skills (s)he will learn in the following courses to be a part of her/his ever increasing knowledge concerning process engineering as a science as well as practical activity. In other words the course helps student to create the foundation on which the information, views and attitudes concerning process engineering will be built in the later courses. In addition to this, student is able to use the essential vocabulary of the field and capable of recognizing more detailed vocabulary.

**Contents:**

The course is divided into four parts. The first one deals with flow chart diagrams, material and mass balances, energy balances, homogenous chemical equilibrium, kinetics of the homogenous reactions and reactors. The second one handles sieving and sorting, mixing, mechanical separation, filtering and grinding. The third part concentrates on agglomeration and granulation, structure and properties of the solid materials, phase transitions, oxidation and reduction and heterogeneous phase equilibria. The fourth part deals with momentum transfer, heat transfer, mass transfer and catalysis.

**Learning activities and teaching methods:**

The course is lectured in Finnish during the periods 1 to 3 during which the four parts of the course are taken separately. Please note the course is not organised for the English speaking students.

**Recommended or required reading:**

Material used during the course.

## 811122P: Introduction to Programming, 5 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Information Processing Science

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Ilkka Räsänen

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

ay811122P Introduction to Programming (OPEN UNI) 5.0 op

Ei opintojaksokuvauksia.

## 521319A: Introduction to Telecommunication Engineering, 2,5 op

**Voimassaolo:** 01.08.2006 - 31.07.2012

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Matti Latva-aho

**Opintokohteen kielet:** Finnish

**Learning outcomes:**

The course gives an overview to wireless communication systems, basic concept, key technologies and future trends as well as an overview to teaching and research given by Telecommunication laboratory

Learning outcomes: Upon completing the required coursework, the student is able to use the basic concepts of different areas of data communication systems to describe the functionality of a communication system. The student recognizes the different parts of a digital communication system and is capable of answering simple questions related to the system.

**Contents:**

History of telecommunications, wireless transmission techniques, radio engineering, communication networks, communication signal processing, basics of communication theory.

**Learning activities and teaching methods:**

Two to four hours of lectures per week. Written final exam.

**Recommended or required reading:**

Lecture notes.

## 521481P: Introduction to the Use of Workstation, 1 op

**Voimassaolo:** - 31.07.2012

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Computer Science and Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** English

**Language of instruction:**

Finnish and English

**Learning outcomes:**

Give the student basic skills in using Unix-based workstations. After the course the student has a user account in the electrical engineering workstation network.

Osaamistavoitteet: After passing the course, the student can explain the directory structure of a Unix-based system and is able to use a workstation from the command line interface. The student finds help for new commands from the manual pages, can modify file access rights and finds files from the directory tree.

**Contents:**

Using Unix-based workstations from the command line interface, moving around in the directory tree, manual pages. Creating, moving, searching and deleting files. File permissions. Establishing connections to remote servers.

**Learning activities and teaching methods:**

Lab exercises. Preliminary assignments.

**Recommended or required reading:**

Hand-out.

## 521433A: Laboratory Exercises on Analogue Electronics, 3 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Juha Kostamovaara

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

521307A Laboratory Exercises on Analogue Electronics 5.0 op

**Learning outcomes:**

Design exercises are used to deepen the understanding of the material presented in Principles of Electronics Design and Analogue Electronics I. Implementation: Independent design exercise, which is checked by CADsimulations and experimentally. Simulations are carried out in PSpice environment  
 Learning outcomes: On completion of the study module students should be able to design basic electronic structural blocks and verify their functioning in a CAD simulation environment. They should be able independently to realize and test a small-scale design object employing the analogue technique.

**Recommended optional programme components:**

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

**721614A: Labour Law, 7 op**

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Faculty of Economics and Business Administration

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

ay724612P	Labour law (OPEN UNI)	5.0 op
ay721614A	Labour Law (OPEN UNI)	7.0 op

**Voidaan suorittaa useasti:** Kyllä

Ei opintojaksokuvauksia.

**463068S: Laser Processing, 3,5 op**

**Voimassaolo:** 01.08.2005 - 31.07.2021

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Karjalainen, Jussi Antero

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

463104A	Advanced manufacturing methods	7.0 op
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**Learning outcomes:**

The aim of this course is for the student to obtain the basic knowledge of laser processes and equipment utilized through lectures, seminars and practical projects. The student will also obtain the basic knowledge of laser processes and equipment utilized in machine shops.

Course outcomes: After the course, the student will know how to utilize lasers and laser systems in different manufacturing processes in machine shops. The student can describe the main features, capabilities and limitations of different laser methods and processes, as well as the trends of lasers and laser processing.

Additionally, the student can apply his/her knowledge to solving practical problems.

**Contents:**

Classes and seminars deal with the basics of laser processes and equipment for manufacturing. Fundamentals of lasers, optical energy coupling with materials and beam delivery systems; possibilities and limitations of applying lasers in manufacturing are presented. Additionally, laser safety and thermal simulation of laser processes are explained. Finally, the student can apply his/her knowledge to solving practical problems in laser processing in the project phase.

**Learning activities and teaching methods:**

The course consists of classes, seminars as well as a group project. The classes and seminars, which are mainly in Finnish, are held during period 3. The project will be completed during period 5. The grade will be based on the exam, the seminar and the project.

**Recommended or required reading:**



Course notes (mainly in Finnish); Contemporary articles

References: Ion, J. C. Laser Processing of Engineering Materials, Elsevier, 2005. Steen, W. K. Laser Material Processing, 3rd Ed., Springer, 2003. Dowden, J. M. The Mathematics of Thermal Modeling, Chapman & Hall, 2001 .

## 462021A: Machine Automation I, 5 op

**Voimassaolo:** 01.08.2005 - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Pekka Tyni

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

462102A Machine automation actuators 5.0 op

### Learning outcomes:

The objective of the course is to have students take into consideration electrical, pneumatic and hydraulic actuator systems when designing modern machines.

Learning outcomes: Upon completion of the course, a student should be capable of explaining the operational principle of pneumatic system. He/she is able to design a small system with pneumatic actuators and other necessary components. He/she is also able to select a programmable controller for a small system and program it.

### Contents:

Pneumatic, hydraulic and electric actuators for machine automation and their use; Fundamentals of control of machines, designing a logical control; Constructions and operation principles of programmable controllers

### Learning activities and teaching methods:

Teaching is arranged during the spring term. Lectures are during periods 4 and 5, and the exercises take place during periods 5 and 6. An exercise assignment and a written exam are required.

### Recommended or required reading:

Hulkkonen Veli: Pneumatiikka

I, 6. painos, 1991, s. 1...140; Fonselius,

Hautanen, Mutikainen, Pekkala, Salmijärvi,

Simpura: Pneumatiikka, 8. painos, 1997.

## 462022S: Machine Automation II, 5 op

**Voimassaolo:** 01.08.2005 - 31.07.2021

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Pekka Tyni

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

462104A Machine automation 5.0 op

### Learning outcomes:

The objective of the course is to provide students with the opportunity to take into consideration hydraulic actuator systems when designing modern machines and implementing them in a real work.

Learning outcomes: Upon completion of the course, the student should be capable of explaining the main principles of hydraulic power system and possibilities of using hydraulic actuators and other hydraulic

components. He/she is able to select suitable components for an open hydraulic system. A student is also able to explain the fundamentals of selecting an induction motor, the most commonly used electric motor in the industry.

**Contents:**

Hydraulic and electric actuators for machine construction and their use; Fundamentals of creating hydraulic energy; Principles of machine control

**Learning activities and teaching methods:**

Teaching is arranged during the autumn term. Lectures and the exercises take place during periods 2 and 3. An exercise assignment in a group and a written exam are required.

**Recommended or required reading:**

Kauranne, Kajaste, Vilenius: Hydrauliteknikka, 2008; Mäkinen Reijo: Hydraulikka II, 3. uudistettu painos, 1991, s. 1...120, 132...148; Aura, L.; Tonteri, A. J.: Teoreettinen sähkötekniikka ja sähkökoneiden perusteet.

## 464055A: Machine Design I, 8 op

**Voimassaolo:** 01.08.2005 - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Karhunen, Pauli Jouko Allan

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

464102A	Design of machine elements	10.0 op
462033A	Machine Design	7.0 op

**Learning outcomes:**

Upon completion of this course, the student will know operating principals, material selection and dimensioning of machine elements.

Learning outcomes: Upon completion of this course, the student is able to measure dimensions of the machine elements.

**Contents:**

Joint elements (screws, welds, etc.); Rotating machine elements (shafts, bearings, clutches, brakes); Power transmission elements (gears, chains, belts, etc.); Basics of needed vibration isolation to ensure smooth operation of machines

**Learning activities and teaching methods:**

The course's lectures will take place during periods 1 – 3 for second year students. Exercises are held during periods 3 and 4. The design exercise is done during periods 5 and 6. There will be two mid-term exams or a final exam. The student's ability to start a design exercise is evaluated based on exams and exercises. The design exercise has to be completed during the same study year as the other parts of the course. The final grade is the average of the exam and exercise grades.

**Recommended or required reading:**

Airila, M.& al. Koneenosien suunnittelu. Porvoo WSOY, 1995; Shigley, J. E. ja Mischke, C. R. Mechanical Engineering Design. New York, McGraw-Hill,1983.

## 464056A: Machine Design II, 6 op

**Voimassaolo:** 01.08.2007 - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Karhunen, Pauli Jouko Allan

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

464103A	Machine design	5.0 op
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**Learning outcomes:**

Upon completion of this course, the student is familiar with numerous starting points used in design, dimensioning and material selection of machine elements.

Learning outcomes: Upon completion of this course, the student is able, as a member of a design group, to design an entire machine, explain material selections and answer for meaning to be responsible of dimensioning of machine elements.

**Contents:**

Welded structures and frames; Casted structures; Joints of structures; Shaft structures; Hub joints; Drives; Bearing arrangements; Lubrication; Design of machine foundations.

**Learning activities and teaching methods:**

The course's lectures will take place during periods 2 and 3 for third year students. The design exercise is done during periods 4 – 6. The final grade is the average of the exam and exercise grades.

**Recommended or required reading:**

Airila, M. & al. Koneenosien suunnittelu. Porvoo WSOY, 1995; Shigley, J. E. ja Mischke, C. R. Mechanical Engineering Design. New York, McGraw-Hill, 1983. Tuomaala, J. Koneensuunnitteluoppi, first part. Oulu, 1995.

**464057S: Machine Design III, 7 op**

**Voimassaolo:** 01.08.2007 - 31.07.2021

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Karhunen, Pauli Jouko Allan

**Opintokohteen kielet:** Finnish

**Learning outcomes:**

Upon completion of this course, the student is familiar with the systematic design methods in product development.

Learning outcomes: After completing this course, the student can either develop a totally new product or essentially improve an old product. The student has also learned to work as part of a group working on the same task because without this, today's wide development projects cannot be realized rapidly enough.

**Contents:**

Systematic method VDI 2222; Ullman's design method; Intuitive design method; Design method for a product program; Optimization; Utilization of automation; Utilization of new materials and their properties.

**Learning activities and teaching methods:**

This fourth year course is based on lectures and a design exercise from an industrial topic is done during periods 4 to 6. The final grade is the average of the grades of exams and exercises.

**Recommended or required reading:**

Tuomaala, J. : Koneensuunnitteluoppi, latter part, Oulu, 1995. Dieter, G. E. : Engineering Design, McGraw-Hill: New York, 2000.

**464051A: Machine Drawing, 3,5 op**

**Voimassaolo:** 01.08.2005 - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Tapio Korpela

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

464101A Machine drawing and CAD 5.0 op

**Learning outcomes:**

The aim of the course is to teach students to read and to draw machine drawings and to carry out standard specifications of description methods, legends and dimensioning.

Learning outcomes: After the course, the student is able to read machine drawings and he/she is able to draw them according to the standardized projection methods, legends and dimensioning.

**Contents:**

Purpose of machine drawing; Description and dimensioning of parts; Design and viewpoints of manufacturing; Specifications of welds and surface roughness and tolerances on drawings; Principles of diagrammatic drawings

**Learning activities and teaching methods:**

Lectures and problem solving exercises are held in the first and the second period. A personal exercise work is done during the third period. After the passed problem solving exercises and the personal exercise work a student is allowed to take part in an exam. Half of the final grade is based on the grade of the exercises and another half of the final grade is based on the grade of the exam.

**Recommended or required reading:**

Pere, A.: Koneenpiirustus

## 555361A: Machine Safety and Usability, 3,5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Seppo Väyrynen

**Opintokohteen kielet:** Finnish

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish.

**Learning outcomes:**

The course makes students familiar with the design of machinery, product or plant, which is characterized by proper usability and safety features. The course also develops the abilities to analyse, enhance and maintain a high level of safety and productivity by means of modern management and leadership.

Learning outcomes: After the course the student is able to choose the design and management methods that enable the organization to remove risks especially on machines and products, and secondly to increase the usability of machines and products and user-friendliness of the work stations. He is able to apply the course's contribution to the company fulfilling the EU's obligations under the newest regulation. The student knows the responsibilities for risk control and opportunities of high quality well-being and usability in design and management.

**Contents:**

The new EU and global standardization and harmonization of machine safety. Safety analysis. Work accidents related to machines. Ergonomics and usability in design.

**Recommended or required reading:**

Väyrynen, S, Nevala, N & Päivinen, M (2004); *Ergonomia ja käytettävyys suunnittelussa*. Teknologiateollisuus. 336 s ..; Laitinen, H, Vuorinen, M & Simola, A: *Työturvallisuuden ja -terveyden johtaminen*. Tietosanoma, 2009. 494 s.; *Valtioneuvoston asetus koneiden turvallisuudesta* (12.6.2008/400 ); *Valtioneuvoston asetus työvälineiden turvallisesta käytöstä ja tarkastamisesta* (12.6.2008/403) ; *Riskin arviointi*, Työsuojeluoppaita ja -ohjeita 14. Työsuojeluhallinto 2009.

**Additional literature:** Dul, J & Weerdmeester, B (2008): *Ergonomics for beginners: a quick reference guide*. 3rd ed. CRC Press; SFS-koneturvallisuusstandardit (EN-ISO, [www.sfs.fi](http://www.sfs.fi)); *Turvallisuusjohtaminen*, Työsuojeluoppaita ja -ohjeita 35. Työsuojeluhallinto 2008.; [www.vtt.fi/proj/riskianalyysit/](http://www.vtt.fi/proj/riskianalyysit/)

## 464087A: Maintenance Technology, 5 op

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Lahdelma, Sulo Olavi

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

462103A Introduction to Maintenance 5.0 op

462107A Maintenance of machines 5.0 op

**Language of instruction:**

Finnish

**Learning outcomes:**

The objective of the course is to provide an overview of targets and lines of action in the maintenance of industrial plants. In addition, the student is introduced to machine diagnostics and reliability technology.

Learning outcomes: After the course, the student is able to talk about the significance and targets of the maintenance of industrial plants and use the most important terms or concepts related to maintenance and reliability. He/she will recognize the elements affecting the life-cycle costs of products or the overall effectiveness of production lines. The student also knows how to use different reliability technology models and can introduce the most common maintenance strategies and organizing methods. After the course, the student is capable of explaining the significance of machine diagnostics in maintenance and indicating the main diagnosis tools. He/she is able to identify the most typical machine faults by means of overall level and time domain measurements and frequency spectra. The student is also able to evaluate machine vibration severity and carry out single and two-plane balancing. In addition, he/she knows how to take into consideration the requirements that maintenance places on the machine design.

**Contents:**

The general part of the course discusses the basics of reliability technology, maintenance management and economics, and the issue of taking maintenance into consideration in machine design. The content of the diagnostics section of the course is: 1. Overall level measurements and evaluation of vibration severity; 2. Time and frequency domain analysis; 3. Dynamic balancing.

**Learning activities and teaching methods:**

The course consists of lectures and exercises arranged during the 6th period. The grade of the course is based on a final examination. The student must pass the exercises before taking the examination.

**Recommended or required reading:**

Lahdelma, S., Lecture notes: Diagnosis of machine condition, 2008. (In Finnish); Järviö, J., et al., Kunnossapito. Helsinki, KP-Media Oy / Kunnossapitoyhdistys ry 2007. (In Finnish); Lectures and other material will be distributed during the course. English course material is also available.

Supplementary readings: Järviö, J., Luotettavuuskeskeinen kunnossapito. Rajamäki, KP-Tieto Oy / Kunnossapitoyhdistys ry 2000. (In Finnish); Käynnissäpidon johtaminen ja talous. Loviisa, SCEMM 1996.

Available also in English: Keep It Running - Industrial Asset Management. Loviisa, SCEMM 1998.

## 721172P: Management Accounting, 5 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Faculty of Economics and Business Administration

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Petri Sahlström

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

ay721172P Management Accounting (OPEN UNI) 5.0 op

**Voidaan suorittaa useasti:** Kyllä

Ei opintojaksokuvauksia.

## 555344S: Management Information Systems, 5 op

**Voimassaolo:** - 31.07.2015

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** English

**Leikkaavuudet:**

555314S Management Information Systems 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

English

**Learning outcomes:**

The aim of the course is to provide readiness for enterprise information system designing, -purchasing, and development tasks. The aim is to familiarize a student with the significance of information and its management when controlling processes. Learning outcomes: After completing the course student knows the key concepts of management information systems and can explain these. The student can define the information needs of management processes and how information systems can meet these needs. The student can describe the key features of the following types of systems: DSS, GDSS, EIS, BI, and ERP. The student can analyse the state of the management in an organisation, and can suggest a suitable type of information system to support the management. After the course the student can take part in the organisational development from MIS points of view.

**Contents:**

The main content is based on exploiting information systems in decision making and leadership. The following topics are covered during the course; Decision Support Systems (DSS), Group Support Systems (GSS), and Executive Information Systems (EIS). Also covered are the effects of information technology in operations, examining the effects of information and communication technology on productivity, financial growth, and the formation of national competitiveness.

## 463053A: Manufacturing Technology I, 3,5 op

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Lappalainen, Kauko Tapio

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

463102A Manufacturing technology I 5.0 op

463053A2 Manufacturing Technology I 5.0 op

**Language of instruction:**

Finnish

**Learning outcomes:**

The objective of the course is to familiarize students with the fundamentals of the functions and manufacturing methods of an engineering workshop. In order to apply manufacturing technology, students must know the features of different alternatives and be able to make technically and economically correct choices and combinations. This course emphasizes practicality and a general view of production.

Learning outcomes: After the course, the student is capable of explaining manufacturing functions and methods of an engineering workshop. He/she is able to select parts manufacturing methods, machining data, machine tools and tooling equipment. In addition he/she can evaluate the alternatives of production automation in manufacturing functions.

**Contents:**

Features of different machining methods and machine tools; Selection of a blank machining method and machine tool according to type of work piece, accuracy and volume of production; Costs and technological possibilities of different machining methods; A review of control techniques, programming, jigs and tools

**Learning activities and teaching methods:**

Lectures and exercises are held during periods 4 and 5. The course will be passed with a final exam and exercises which need to be returned and accepted. The final grade is a combined result of exercises and a final exam.

**Recommended optional programme components:**

463052A Introduction to Manufacturing Technology

**Recommended or required reading:**

Materials include lecture notes and exercise materials. The material that is in English will be given distributed at the lectures.

## 463055S: Manufacturing Technology II, 5 op

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Lappalainen, Kauko Tapio

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

463108S	Manufacturing technology II	10.0 op
463055A2	Manufacturing Technology II	5.0 op

**Language of instruction:**

Finnish

**Learning outcomes:**

This course is the major subject for those who are majoring in Manufacturing Engineering. The aim of the course is to give the student the necessary knowledge for production management and for development of a manufacturing instrument. It also provides the student with the competence to choose the most economical equipment and machining methods.

Learning outcomes: After the course, the student is capable of explaining the objectives and functions of production as well as production planning systems and manufacturing systems. He/she is able to find competitive operation methods for different production cases. He/she is capable of evaluating machine tool structure knowledge with select productive manufacturing solutions. In addition he/she is able to apply tool systems and machining methods of the different parts manufacturing.

**Contents:**

Production management; Production systems; Lean- and Just In Time-production; Production automation; Construction and choice of machine tools; Fundamentals of tool design; The theory of cutting process; The theory of choosing economical cutting parameters

**Learning activities and teaching methods:**

Lectures are held in the fall during periods 2 and 3. A seminar attendance and presentation will be included to the course during the fall semester. The course will be passed by taking either two mid-term examinations or a final exam, and the seminar needs to be accepted. The final grade is a result of the exam.

**Recommended optional programme components:**

463053A Manufacturing Technology I

**Recommended or required reading:**

The materials for this course include lecture notes and exercise materials. The material that is in English will be distributed at the lectures.

## 463067A: Manufacturing Technology of Sheet Metal Products, 3,5 op

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Karjalainen, Jussi Antero

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

463106S Design and manufacture of sheet and plate metal products 8.0 op

**Learning outcomes:**

The aim of this course is for the student to obtain the basic knowledge of sheet metal manufacturing, its methods and tools as well as automation through lectures, seminars and practical projects.

Course outcomes: After the course, the student can describe the main features of processes and machinery utilized in manufacturing sheet metal products and assemblies and current trends sheet metal production; as well as he/she knows how to design sheet metal parts or assemblies from manufacturing point of view.

**Contents:**

Classes and seminars deals with basics of processes, machinery and tooling for manufacturing sheet metal parts or assemblies. Additionally, computer-aided methods in creating control information and utilizing CAD models, as well as the pros and cons of different manufacturing processes, machinery and systems are explained. Finally, the student can apply his/her knowledge to solving practical production-oriented problems in sheet metal manufacturing in the project phase.

**Learning activities and teaching methods:**

Classes, seminar as well as group project. Classes and seminars (mainly in Finnish) during 4. period, project during 5. period. Mark according to the exam (weight 0,4), seminar (0,2) and project (0,4).

**Recommended or required reading:**

Course notes (mainly in Finnish); Contemporary articles

References: Boljanovic, V. Sheet metal forming processes and die design, Industrial Press, Inc.: New York, 2004. Hosford, W. F. & Caddell, R. M. Metal Forming # Mechanics and Metallurgy, 3rd Ed, Cambridge University Press: New York, 2007. Ion, J.C. Laser processing of engineering materials, Elsevier, 2005. SSAB: Fogningshandboken, SSAB Tunnpått AB, Borlänge, 2004. SSAB: Formningshandboken, SSAB Tunnpått AB, Borlänge, 1997. SSAB: Plåthandboken, SSAB Tunnpått AB, Borlänge, 1996. Schuler GmbH (Ed.): Metal forming handbook, Springer, Verlag: Berlin, 1998.

**463064S: Manufacturing of Electronics Products, 5 op**

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Lappalainen, Kauko Tapio

**Opintokohteen kielet:** Finnish

**Language of instruction:**

Finnish

**Learning outcomes:**

The aim of the course is to give students a general view of electronics products and how they are manufactured.

Learning outcomes: Upon completion of the course, a student should be able to recognize the special characteristics of electronics products on different assembly levels. He/she can explain the electronics components, manufacturing operations and assembly process requirements. He/she can also list and explain the essential factors affecting to quality and methods to ensure it.

**Contents:**

Electronics products; Components; Manufacturing process; Assembly process; Manufacturing systems and quality control

**Learning activities and teaching methods:**

Lectures are held during periods 3 and 4. The exercise project is done after lectures. The final grade is a combined result of the exercise project and a final exam .

**Recommended or required reading:**

Landers, Brown, Fant, Malmstrom & Schmitt: Electronics Manufacturing Processes, 1994 Prentice-Hall, Inc.

**463065A: Manufacturing of Plastics Products, 3,5 op**

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Intermediate Studies



**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Karjalainen, Jussi Antero

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

463105A Casting techniques 8.0 op

**Learning outcomes:**

The aim of this course is to give the student a basic knowledge of the manufacturing of plastic parts and their production tooling.

Course outcomes: After the course, the student will know the basic terminology of plastics processing as well as how to utilize computer-aided methods and systems with different manufacturing processes in machine shops.

The student can describe the main features, capabilities and limitations of different methods and machinery in plastic processing. Additionally, the student can apply his/her knowledge to designing production-friendly plastics products and their tooling.

**Contents:**

Properties of common plastic materials; Processes and machinery in manufacturing of plastic parts; Design of plastics parts and their tooling; Assembly of plastic components; Computer-aided tools for designing plastics parts and their manufacturing processes

In the project section of the course, the student's knowledge is applied to solving practical problems in manufacturing.

**Learning activities and teaching methods:**

The course consists of classes as well as a group project. During periods 2 and 3, classes will be held, in Finnish, at the same time as the project. The grade will be based on the exam and project.

**Recommended optional programme components:**

CAD

**Recommended or required reading:**

Course notes (mainly in Finnish); Contemporary articles

References: Chanda, M. & Roy, S. K.: Plastics Technology Handbook, 4th Edition, CRC Press, 2007, (selected parts)-

## 477303A: Mass Transfer, 3 op

**Voimassaolo:** 01.08.2005 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Process and Environmental Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

477322A Heat and Mass Transfer 5.0 op

470621A Mass Transfer 3.0 op

**Learning outcomes:**

*Aim:* To understand the physical and chemical phenomena in mass transfer. Creating mass transfer models and applying theory to analysis and scale-up of mass transfer processes.

*Learning outcomes:* After the course the student is able to explain diffusion as a phenomenon and the factors affecting it. He/she is able to model mass transfer in simple systems by using the theories of Fick and Maxwell-Stefan and to compare the models to each other. The student is capable of modeling diffusion by differential mass balances. He/she recognises the special features of mass transfer in turbulent systems and the role of different transport phenomena in mass transfer equipment. He/she has rudimentary practical skills applicable to the scale-up of the equipment used for absorption.

**Contents:**

Diffusion. The laws of diffusion by Fick and Maxwell-Stefan. Mass transfer in simple systems.

Differential mass balances. Models of mass transfer in turbulent systems. Interphase mass transfer.

Absorption. Drying of solid.

**Learning activities and teaching methods:**

Lectures including exercises. Homework assignments affect the course grade. Examination.

**Recommended optional programme components:**

Courses Momentum Transfer 477301A and Heat Transfer 477302A recommended beforehand.

**Recommended or required reading:**

Bird, R.B., Stewart, W.E. & Lightfoot, E.N.: Transport Phenomena, John Wiley & Sons, 1976, 780 pp.; King, C.J.: Separation Processes, McGraw-Hill, 1980, 850 pp.; Wesselingh J.A. & Krishna R.: Mass Transfer, Ellis Horwood, 1990, 243 pp.

*Additional literature:* Jokilaakso, A., Virtaustekniikan, lämmönsiirron ja aineensiirron perusteet, 496, Otakustantamo, 1987, 194 pp.; Coulson, J.F. et. al.: Chemical Engineering vol.1, 4th ed., Pergamon Press, 1990. 708 pp.; McCabe, W.L. et al.: Unit Operations of Chemical Engineering, 5th ed., McGraw-Hill, 1993, 1130 pp.

**Other information:**

*Language of instruction:* In Finnish

## 477201A: Material and Energy Balances, 5 op

**Voimassaolo:** 01.08.2005 - 31.12.2019

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Process and Environmental Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

477221A Material and Energy Balances 5.0 op

470220A Fundamentals of Chemical Process Engineering 5.0 op

**Learning outcomes:**

*Learning outcomes :* By completing the course the student is able to apply the first law of thermodynamics to various chemical processes. Especially the student will acquire the skill to produce material and energy balances to chemical processes in the presence of stoichiometric constraints. The student can give examples of opportunities for computer-based simulation in chemical process engineering.

**Contents:**

Material and energy balances of processes taking into account chemical reaction. Introduction to the use of simulation programs.

**Learning activities and teaching methods:**

Lectures and small group exercises.

**Recommended or required reading:**

Reklaitis, G.V.: Introduction to Material and Energy Balances. John Wiley & Sons, 1983.

**Assessment methods and criteria:**

Combination of examinations and group exercises.

## 465061A: Materials Engineering I, 5 op

**Voimassaolo:** 01.01.2006 - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Leinonen, Jouko Iivari

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

465101A Introduction to materials for mechanical engineering 5.0 op

**Language of instruction:**

Finnish; Laboratory exercises also in English

**Learning outcomes:**

The objective of the course is to familiarize the student with basic matters concerning properties of metallic and non-metallic structural materials, the area within which the materials are in use, and the principles of materials selection.

Learning outcomes: After the course, the student is able to explain the measurement of mechanical properties by using different material testing methods and draw conclusions from the measurement results. He/she is able to separate corrosion properties of different metals can apply different corrosion protection methods. The student is also able to classify steels, cast irons, non-iron metals, plastics and structural ceramics. He/she can explain phase diagrams of metal alloys. The student masters structural materials and their selection so that he/she is able to select the most proper structural material for a product or component.

**Contents:**

Common structural materials in mechanical engineering; Materials selection taking into account different demands

**Learning activities and teaching methods:**

The course is made up of lectures, a materials selection exercise in small group during periods 1 and 2 and three laboratory exercises in small groups during periods 1 - 3. The final grade is based on the points from the final exam or small exams (weight 3) and from the materials selection exercise (weight 1). The laboratory exercises will be graded as pass/fail. The course is recommended to be completed during the second study year.

**Recommended or required reading:**

Lecture booklet (in Finnish); Exercise materials

**465062S: Materials Engineering II, 3 op**

**Voimassaolo:** 01.01.2006 - 31.07.2021

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Leinonen, Jouko Iivari

**Opintokohteen kielet:** Finnish

**Learning outcomes:**

The student will gain a wider and deeper knowledge than earlier in heat treatment of metals, in the substance of corrosion, and in the measures needed to corrosion protection.

Learning outcomes: After the course, the student is able to explain the main manufacturing stages from ore and/or recycled metal to common structural metals. He/she is capable of selecting suitable heat treatments and also to give the main characteristics of the heat treating parameters. The student is also able to apply his/her knowledge of corrosion when analyzing possibilities of corrosion in certain environments. In addition, he/she is able to classify corrosion modes occurring in different metals and to select a suitable corrosion protection method for iron based metals.

**Contents:**

Heat treatments of different metals; Corrosion and corrosion protection of metals; Manufacturing of most important structural metals

**Learning activities and teaching methods:**

Lectures will take place during period 3, and the three laboratory exercises in small groups will be during periods 4 – 6. The final grade is based on the points from the final exam or small exams. The laboratory exercises will be graded as pass/fail.

**Recommended optional programme components:**

Finnish; Laboratory exercises also in English

**Recommended or required reading:**

Lecture booklet (in Finnish); Exercise materials

**031019P: Matrix Algebra, 3,5 op**

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Mathematics Division

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Matti Peltola

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

031078P Matrix Algebra 5.0 op

**Learning outcomes:**

The course gives the elementary theory of linear equations, matrices and vector spaces. The eigenvalues and eigenvectors with applications are introduced.

Learning outcomes : After completing the course the student is able to apply arithmetic operations of matrices. He can solve system of linear equations by matrix methods and can apply iterative methods to find the solution of the system of linear equations. The student is able to recognise the vector space and can relate the concepts of linear transform and matrix. He can analyse matrices by the parameters, vectors and vector spaces of matrices. The student is able to diagonalize matrices and apply diagonalization to the simple applications.

**Contents:**

Vectors and matrices. Systems of linear equations. Vector spaces and linear transformations. The rank, nullity, row space and the column space of a matrix. The determinant of a matrix. Eigenvalues and eigenvectors of a matrix. The diagonalization with applications. The iterative methods of solving linear system of equations. The theorems of Gershgorin and Cayley- Hamilton.

**Learning activities and teaching methods:**

Term course. Lectures 4 h/week. Two examinations or final examination.

**Recommended or required reading:**

Grossman, S.I. : Elementary Linear Algebra.

## 461019S: Mechanical Vibrations, 6 op

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Laukkanen, Jari Jussi

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

461112S Mechanical vibrations 5.0 op

**Language of instruction:**

Finnish

**Learning outcomes:**

The aim of this course is to familiarize students with the principles and phenomena of mechanical vibrations and show how different vibrations can be represented by a theoretical model and how detrimental vibrations can be avoided in structures and machines.

Learning outcomes : After the course, the student is capable of forming the equations of motion for a single and multi-degree-of-freedom systems and continuous models and is able to solve them using analytical, numerical and approximate methods. Moreover, the student is able to use finite element methods to solve basic vibration problems.

**Contents:**

Basic principles; Vibrations of single degree-of-freedom systems; Vibrations of multi-degree-of-freedom systems; Torsional vibration of a power drive chain; Longitudinal, transverse and torsional vibrations of a beam represented by a continuous model; Some approximation methods; Use of FEM in vibration analysis; Introduction to the theory of balancing; Experimental modal analysis

**Learning activities and teaching methods:**

This course is based on lectures and exercises during periods 4 - 6. Students are required to take a final exam or mid-term exams.

**Recommended optional programme components:**

First year mathematics, Strength of Materials I & II and Dynamics

**Recommended or required reading:**

Pramila, A.: Värähtelymekaniikka, luku 10 teoksessa: Koneenosien suunnittelu

4, WSOY, 1985; James, M.L. & al.: Vibration of Mechanical and Structural Systems: With Microcomputer Applications, Harper & Row, 1989.

## 462035A: Mechanisms, 3,5 op

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Louhisalmi, Yrjö Aulis

**Opintokohteen kielet:** Finnish

### **Language of instruction:**

Finnish

### **Learning outcomes:**

Learning outcomes: Upon completion of the course, the student can classify different mechanisms and they parts as structures of machines and can complete mechanism analysis and synthesis by graphical and analytic methods.

### **Contents:**

Terminology and definitions of mechanisms, classifications; Four bar linkages; Straight-line generators; Cam mechanisms; Indexers; Couplers; Gear mechanisms; other

### **Learning activities and teaching methods:**

The course consists of lectures and exercise assignments

### **Recommended optional programme components:**

Statics and Dynamics

### **Recommended or required reading:**

Uicker J.J., Pennock G.R., Shigley, J.E.: Theory of Machines and Mechanisms, 3. ed., New York 2003, Oxford University Press.

Additional literature: Sandor, G.N., Erdman, A.G.: Mechanism Design: Analysis and Synthesis,

Vol. 1., New Jersey, 1991, Prentice-Hall; Hartenberg, R.S., Denavit J.: Kinematic Synthesis of Linkages. New York 1964, McGraw-Hill.

## 031022P: Numerical Analysis, 5 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Mathematics Division

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

### **Language of instruction:**

Finnish.

### **Learning outcomes:**

The objective of the course is to provide the mathematical foundations of numerical methods, to analyze their basic theoretical properties (stability, accuracy and computational complexity), and demonstrate their performances on examples.

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 linearalgebra. Basics of the approximation theory. Numerical quadratures. Numerical methods for ordinary and partial differential equations.

### **Learning activities and teaching methods:**

Lectures 4h/week. Two intermediate exams or one final exam.

### **Recommended or required reading:**

- K. Ruotsalainen, Numeeriset menetelmät (lecture notes in finnish)
- Faires and Burden; Numerical methods

•A. Quarteroni, R. Sacco and F Salieri; Numerical mathematics  
 Prerequisites: Calculus 1, Calculus 2, Matrix algebra and Differential Equations.

## 521453A: Operating Systems, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Computer Science and Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Juha Röning

**Opintokohteen kielet:** English

**Leikkaavuudet:**

ay521453A Operating Systems (OPEN UNI) 5.0 op

**Language of instruction:**

In Finnish.

**Learning outcomes:**

The objective of the course is to provide basic knowledge of computer operating system structures and functioning.

Learning outcome: After the course the student is capable of explaining the basic structure and functioning of operating system. He/She is able to point the problems related to process management and synchronization as well as is able to apply learned methods to solve basic problems. Student is capable of explaining the cause and effect related to deadlocks and is able to analyse them related to common circumstances in operating systems. Additionally, the student is able to explain the basics of memory management, the use of virtual memory in modern operating systems as well as the structure of the most common file-systems.

**Contents:**

Operating system structure and services, process management, process synchronization, deadlocks, memory management, virtual memory, file-systems.

**Learning activities and teaching methods:**

The course consists of lectures and laboratory work, which includes pre-exercise and guided exercise performed in a group of one or two students in the unix environment. The final grade is based on the final examination and accepted laboratory work.

**Recommended optional programme components:**

Elementary Programming, Embedded Systems Programming, Computer Engineering

**Recommended or required reading:**

Lecture notes (in Finnish) and exercise material. Silberschatz A., Galvin P., and Gagne G.: Operating System Concepts, 6th edition (or newer), John Wiley & Sons, Inc., 2003. Chapters 1-12.

## 555342S: Operations Research, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555332S Operations and supply network analytics 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish

**Learning outcomes:**

This study module introduces operations research methods. The course provides prerequisites for applying mathematical methods for practical problem solving.

Learning outcomes : After this study module, a student is capable of applying quantitative methods typical to the field of industrial engineering and management. The student will also be capable of defining development plans for production processes by using these methods.

**Contents:**

Mathematical methods typical for operations research. These methods include multivariate analysis for decision making and simulation.

**Learning activities and teaching methods:**

The course includes lectures and compulsory course work. The course work entails in depth familiarisation with the methods typical for operations research through practical examples

**Recommended or required reading:**

Study material include: handouts, course work, and a collection of articles.

**Assessment methods and criteria:**

Final exam.

**Grading:**

1-5/fail

## 030001P: Orientation Course for New Students, 1 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Faculty of Technology

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

477000P Planning of Studies and Career 1.0 op

## 464074S: Paper Machinery Construction, 7 op

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Niskanen, Juhani

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

464106S Production machine design, Paper machinery 10.0 op

**Learning outcomes:**

The aim of this course is to provide students with good knowledge of applications of machine construction in the pulp and paper industry, especially in design and manufacturing of paper machines and maintenance duties serving pulp and paper industry, as well as export trade and research.

Learning outcomes: Upon completion of the course, the student can explain the importance of the pulp and paper industry to domestic economy, can describe the main stages of paper making processes, is able to analyze the affect of different paper machine designs on its production and product quality and knows design criteria of main paper machine components.

**Contents:**

Fundamentals of pulp and paper making processes, structures, functions and design criteria of paper machines and related workshop production; Detailed design criteria of paper machine parts, calenders, rolls as well as construction materials

**Learning activities and teaching methods:**

The course includes lectures and several excursions to domestic paper mills and machine shops. The course also includes a limited excursion to foreign destinations. Two mid-term exams or a final exam and a seminar work from given topic will be part of this course.

**Recommended or required reading:**

Copies of lecture material

## 761121P: Physical Measurements I, 3 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

761115P	Laboratory Exercises in Physics 1	5.0 op
761118P-01	Mechanics 1, lectures and exam	0.0 op
761115P-02	Laboratory Exercises in Physics 1, laboratory exercises	0.0 op
761115P-01	Laboratory Exercises in Physics 1, lecture and exam	0.0 op
761114P-01	Wave motion and optics, lectures and exam	0.0 op
761113P-01	Electricity and magnetism, lectures and exam	0.0 op

Ei opintojaksokuvauksia.

## 555210A: Practice, 3 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Practical training

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555204A	Internship	5.0 op
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**Voidaan suorittaa useasti:** Kyllä

### **Learning outcomes:**

Learning outcomes: During the course, students learn to observe his/her working environment from the point of view of theories of Industrial Engineering and Management (IEM). From the working environment, the student is able to identify IEM themes and classify them. The student is able to select theoretical references relevant for the topic and is able to make judgements concerning the working environment based on the theoretical references. The student is able to draw up a report based on given instructions.

### **Learning activities and teaching methods:**

Students will write a report concerning summer job at least for 2 months period. Student's personal Omaope will review and grade the report.

### **Target group:**

Students of Industrial engineering and management

### **Assessment methods and criteria:**

Omaope will review and grade a written report which must contain testimonial from the employer.

### **Grading:**

Pass/Fail

### **Person responsible:**

Omaope

## 721210P: Principles of Economics, 5 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Faculty of Economics and Business Administration

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Maria Kopsakangas-Savolainen



**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

ay721210P Economics for Business (OPEN UNI) 5.0 op

**Voidaan suorittaa useasti:** Kyllä

Ei opintojaksokuvauksia.

## 521431A: Principles of Electronics Design, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Kari Määttä

**Opintokohteen kielet:** Finnish

### **Learning outcomes:**

To give the students all the basic information that all electrical engineers needs about circuit techniques of analogue electronics and internal structure of digital circuits.

### **Contents:**

Analogue and digital circuits, basic amplifier related concepts, operational amplifier, diodes and diode circuits, single stage bipolar- and MOS-transistor amplifiers and how to bias them, small signal modeling and analyzing ac-properties of the amplifiers, internal structures of digital circuits (mainly CMOS), the principles of AD/DA –conversion and principles of VLSI-technology.

### **Learning activities and teaching methods:**

Lectures and exercises. Final exam.

### **Recommended optional programme components:**

Basic knowledge in Circuit Theory (Circuit Theory I). Also, understanding the basic operation of semiconductors helps (Principles of Semiconductor Devices).

### **Recommended or required reading:**

Handout. Sedra, Smith: Microelectronic Circuits (4th edition), chapters 1, 3-5, 10.9, 13 and 14. OR Hambley: Electronics (2nd edition), chapters 1, 2, 3, 4, 5; 6 partially and some parts of other chapters.

## 721409P: Principles of Marketing, 5 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Faculty of Economics and Business Administration

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Alajoutsijärvi, Kimmo Jouni

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

ay721409P Principles of Marketing (OPEN UNI) 5.0 op

**Voidaan suorittaa useasti:** Kyllä

Ei opintojaksokuvauksia.

## 521205A: Principles of Semiconductor Devices, 4,5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

521071A Principles of Semiconductor Devices 5.0 op

**Learning outcomes:**

The students are introduced to principles of operation and characteristics of semiconductor devices. Learning outcomes: Student is able to describe main characteristics of semiconductor materials and junctions, main types of semiconductor devices, their design and main operational characteristics.

Student is able to explain physical principles of operation of idealized devices. Student is able to estimate main parameters of idealized devices.

**Contents:**

Semiconductor pn-junctions, metal-semiconductor junctions, heterojunctions. Diodes. Bipolar junction transistors. Field effect transistors. Semiconductor lasers. Switching devices.

**Learning activities and teaching methods:**

Lectures and calculation exercises. Final exam.

**Recommended optional programme components:**

Basic physics. Introduction to materials physics. Electronic components.

**Recommended or required reading:**

Selected chapters from Streetman, B.: Solid State Electronic Devices, Prentice-Hall, New Jersey, 2000. Lecture notes.

### 031021P: Probability and Mathematical Statistics, 5 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Mathematics Division

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

ay031021P Probability and Mathematical Statistics (OPEN UNI) 5.0 op

**Learning outcomes:**

The course provides the student the fundamental knowledge of the basic concepts of probability, random variables, management of statistical material, hypothesis testing and estimation methods.

Learning outcomes : After completing the course the student is able to use the basic concepts of probability and most important random variables and is also able to apply these to calculate probabilities and expected values. The student is also able to analyze statistical material by calculating confidence intervals, formulating and testing hypotheses and by performing maximum likelihood estimations.

**Contents:**

Basic concepts of probability, conditional probability, discrete and continuous random variables and their distributions, expectation and variance, joint distributions, central limit theorem, elements of statistics, interval of confidence, hypothesis testing, maximum likelihood estimation.

**Learning activities and teaching methods:**

Term course. Lectures 4 h/week. Two examinations or a final examination.

**Recommended optional programme components:**

Calculus I and Calculus II.

**Recommended or required reading:**

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

### 477601A: Process Automation Systems, 4 op

**Voimassaolo:** 01.08.2005 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Process and Environmental Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Hiltunen, Jukka Antero

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

477051A Automation Engineering 5.0 op  
470445S Digital Process Automation 4.0 op

**Learning outcomes:**

To give the student knowledge about automation systems and configuration especially in process technology. The student will have the basic information to work on design assignments in the field of process automation systems. Learning outcomes : The period of study completed, the students know how to handle the application designer in automation design, implementation and commissioning projects. Students can configure the basic automation features of automation systems and program them with logic.

**Contents:**

Procurement and delivery of automation in a project, system configuration, telecommunication technology used in automation, field buses, examples from commercial systems and field bus products.

**Learning activities and teaching methods:**

Lectures. Configuration exercises. Industrial visit. Examination.

**Recommended or required reading:**

Lecture handout. Additional literature : Will be announced later.

## 477501A: Process Control Engineering I, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Process and Environmental Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Leiviskä, Kauko Johannes

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

ay477501A Process Control Engineering I 5.0 op  
470431A Process Control Engineering I 5.0 op

**Learning outcomes:**

To provide understanding of analytical process modelling, dynamics of industrial processes and industrial control principles.

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 larger processes.

**Learning activities and teaching methods:**

Lectures and exercises. Home work and special tests. Possibility to take a book test and home exercises from the book by Luyben (see below).

**Recommended optional programme components:**

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

**Recommended or required reading:**

Lecture handout in the web.

Additional literature : Luyben, W.L.: Process Modeling, Simulation and Control for Chemical Engineers. McGraw Kogakusha Ltd., Tokyo 1973, 558 pp.; Yang, W.J., Masubuchi, M.: Dynamic Process and System Control. Gordon and Breach Science Publishers, New York 1970, 448 pp.

## 477502A: Process Control Engineering II, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Process and Environmental Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Leiviskä, Kauko Johannes

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

470432A Process Control Engineering II 5.0 op

### Learning outcomes:

To provide understanding of experimental process modelling, design of process experiments and analysis and use of experimental data.

Learning outcomes : After the course, the student knows different experimental design methods and their applicability for different problems. He can also design experiments for multivariable 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.

### Learning activities and teaching methods:

Lectures and extensive exercise work. Examination. Possibility to take the course also according to the principle of continuous evaluation.

### Recommended optional programme components:

Course Process Control Engineering I recommended beforehand.

### Recommended or required reading:

Lecture handout in the web.

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

## 555343S: Product Data management, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Arto Tolonen

**Opintokohteen kielet:** English

**Voidaan suorittaa useasti:** Kyllä

### Language of instruction:

English

### Learning outcomes:

The course familiarizes a student with the product processes of an enterprise. The course also covers the methods and systems that are used to control information related to products, and to manage production as well as usage during the product's entire lifecycle. Learning outcomes: After finishing the course, the student will be able to analyze existing and future products from product structure viewpoint and to build the basis for a data system needed to manage product data.

### Contents:

Product information management concepts, its history and challenges. PDM-processes: managing product models, managing specific products, managing nomenclature, managing documents and configurations as well as

tracing information. PDM-system and its functions. PDM-project and implementation of the system. Product and control systems integration.

## 555322S: Production Management, 3 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Haapasalo, Harri Jouni Olavi

**Opintokohteen kielet:** English

**Leikkaavuudet:**

555333S Production Management 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

English

**Learning outcomes:**

Aim: the aim of this course is to reach understanding of the role of the principles of production management at operational, tactical and strategic level. Learning outcomes: After finishing this course, the student will be able to analyze production processes and to define the cornerstones of managing different production modes. In addition the student will know how to analyze the bottlenecks in different production processes. By combining this and previous courses, the student will be able to define the most important development areas in production processes.

**Contents:**

Analysing and developing manufacturing environment. Controllability analysis. Change management. Management and operation information methods. Mass customization.

## 555341S: Productivity and Performance Management, 3 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Haapasalo, Harri Jouni Olavi

**Opintokohteen kielet:** English

**Language of instruction:**

English

**Learning outcomes:**

The course familiarizes a student with the concepts of productivity and performance, with meters, and with the relationships between productivity and the different sectors of an enterprise. It also covers the evaluation of a firm's internal performance and the financial effects of developing productivity. Learning outcomes: After finishing the course, the student will be able to analyze the efficiency of activities in an organization, from both internal and external viewpoints. The internal analysis is based on Balanced Score Card or other equivalent performance measurement. External measurement of efficiency is based on analyzing productivity development and the factors affecting it.

**Contents:**

The concepts of productivity and performance and the levels to their examination. Productivity and its significance to an enterprise's processes and profitability. Measuring productivity and performance. The meters of productivity and operative steering tools. An enterprise's internal and external productivity. The analysis and the tools for analysis of productivity and the approaches for measuring productivity in industry.

## 521024A: Programmable Electronics, 5 op

**Voimassaolo:** 01.08.2005 - 31.07.2014

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Antti Mäntyniemi

**Opintokohteen kielet:** Finnish

**Language of instruction:**

In Finnish

**Learning outcomes:**

The objective of the course is to deepen the understanding of basic digital logic with practical design exercises.

Learning outcomes: Upon completing the required coursework, the student is able to analyse the operation of a simple digital device and to formulate a design specification document. The student is also able to formulate a design document of a simple digital system and based on that to describe the behaviour of a digital system with VHDL-language and to implement the device with an FPGA-circuit.

**Contents:**

Design specification, logic design, VHDL-language, logic simulation, logic synthesis, FPGA-programming.

**Learning activities and teaching methods:**

The course is based on a starting lecture and collaborative exercises. The course consists of three subtasks. In the first task the structure and operation of a digital device is analysed and documented. The result of the task is a design specification. In the second task a Register Transfer Level description following the design specification is designed. In the third task the behaviour of the logic is described using VHDL-language and the operation of the logic is verified with logic simulator software and tested in practice with a programmable logic device. The course is passed by accepted and documented exercises.

**Recommended optional programme components:**

Digital Techniques I and Computer Engineering.

**Recommended or required reading:**

Instruction site in Optima and sample documents.

## 555382S: Project Business, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Jaakko Kujala

**Opintokohteen kielet:** Finnish

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish/English

**Learning outcomes:**

The course provides the student with basic skills to manage a company practicing project business. Upon completion the student can explain the management areas of project business and their essential contents. The student can compare the specific features of project business in different working environments and analyse their effect on the business model of the company. The student can evaluate the significance of a single projects and its management in reaching business goals.

**Contents:**

The specific features of project business, business models of a project company, sales and marketing of projects, project portfolio management, management of project networks.

**Learning activities and teaching methods:**

Lectures and related exercises, group exercise. A learning diary, report of the group study and presentation are required to pass the course.

**Recommended optional programme components:**

Bachelor in Industrial Engineering and Management or equivalent.

**Recommended or required reading:**

Lecture material and course readings.

**555283A: Project Communication, 3 op**

**Voimassaolo:** - 31.07.2012

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Jokinen, Tauno Jaakko

**Opintokohteen kielet:** Finnish

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish

**Learning outcomes:**

*Upon completion the student should be able to:*

Apply the concepts of effective communications in project environment

**Learning activities and teaching methods:**

Lectures, exercises learning report

**Assessment methods and criteria:**

The assessment is based on learning report

**555381S: Project Leadership, 5 op**

**Voimassaolo:** 01.08.2005 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Jokinen, Tauno Jaakko

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555391S Advanced Course in Project Management 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish

**Learning outcomes:**

*Upon completion the student should be able to:*

Describe and apply essential theories of leadership

**Learning activities and teaching methods:**

Essey, intensiveday and learning report

**Recommended or required reading:**

Northouse PG (2001) Leadership: Theory and Practice; Second Edition. Sage Publications, Thousand Oaks.

**Assessment methods and criteria:**

The assessment is based on essay

**555282A: Project Management, 4 op**

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Jaakko Kujala, Jokinen, Tauno Jaakko

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555288A Project Management 5.0 op

555285A Project management 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish

**Contents:**

*Upon completion the student should be able to:*

Apply the advanced concepts of project management.

**Learning activities and teaching methods:**

Lectures, exercises, learning report

**Assessment methods and criteria:**

Evaluation of learning report

## **555387S: Project Work in Quality Management, 5 op**

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Haapasalo, Harri Jouni Olavi

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555379S Research Project in Industrial Engineering and Management 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish/English.

**Learning outcomes:**

Applying the methods of quality management in a company's activities and development. On the course the student can combine and apply earlier gained knowledge in the form of a wide study. The student familiarises with research work and reporting of the results.

Learning outcomes: Upon completion the student can analyse and develop the activities of a company using the methods of quality management.

**Contents:**

Subject and type of work changes by the case. Mostly the subjects come from the industry and relate to actual problems.

**Learning activities and teaching methods:**

The methods are agreed with the instructor of the work. Research plan, familiarizing with related literature, solving the problem and a literary report are required to pass. The work can be done individually or in a group.

**Recommended optional programme components:**

Bachelor in Industrial Engineering and Management or equivalent.

**Recommended or required reading:**

Changes by the case.

## **555388S: Project Work in Project Management, 5 op**



**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555379S Research Project in Industrial Engineering and Management 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish/English.

**Learning outcomes:**

Applying the methods of project and project business management in a company's activities and development. On the course the student can combine and apply earlier gained knowledge in the form of a wide study. The student familiarises with research work and reporting of the results.

Learning outcomes : Upon completion the student can analyse and develop the activities of a project company.

**Contents:**

Subject and type of work changes by the case. Mostly the subjects come from the industry and relate to actual problems.

**Learning activities and teaching methods:**

The methods are agreed with the instructor of the work. Research plan, familiarizing with related literature, solving the problem and a literary report are required to pass. The work can be done individually or in a group.

**Recommended optional programme components:**

Bachelor in Industrial Engineering and Management or equivalent.

**Recommended or required reading:**

Changes by the case.

## 555323S: Purchase Management, 3 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Kess, Pekka Antero

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555330S Sourcing Management 5.0 op

**Language of instruction:**

Finnish

**Learning outcomes:**

Learning outcomes: After completing the course student knows the key concepts of purchase management and can explain these. The student can describe the structures of purchasing organizations and can explain the meaning of management in the performance of purchasing operations. The student can analyse the purchasing activities in a company and can produce improvement proposals based on the analysis. After the course the student can take part in the purchasing operations development in the role of an expert.

**Contents:**

The purpose of the purchasing operations. The principles of the purchase strategy and practices. Development of the purchasing function. Suppliers. Acquisitions. Terms of purchase.

**Learning activities and teaching methods:**

The course includes lectures and team work.

**Target group:**

Main target groups are the Students of Industrial Engineering and Management as well as those students in the departments of Mechanical Engineering and Process and Environmental Engineering who have the orientation to Industrial Engineering and Management. Other engineering students are accepted.

**Recommended optional programme components:**

555224A Tuotannon ja logistiikan menetelmät.

**Recommended or required reading:**

Lecture notes. Other material will be informed during the lectures.

**Assessment methods and criteria:**

Course is completed and assessed by team work report and its presentation in the closing seminar .

**Grading:**

fail ... 1...5/5

**555380S: Quality Management, 5 op**

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Jaakko Kujala

**Opintokohteen kielet:** English

**Leikkaavuudet:**

555390S Process Analytics 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Learning outcomes:**

The course gives the student a broad conceptions of contents of total quality management and applying it in different environments.

Learning outcomes: Having completed the course, the student can analyze the central principles and contents of quality management and related management approaches. The student can apply the learned things and methods in different kinds of situations and industries.

**Contents:**

Total quality management and its basic assumptions, the methods of TQM in different environments, quality systems, quality award competitions, process management, performance measurement, organisational capability models.

**Learning activities and teaching methods:**

Lectures, lecture pre-exercises, group study and presentation. Grade is derived from group study, presentation and a final exam.

**Recommended or required reading:**

Lecture materials, course readings.

**031024A: Random Signals, 5 op**

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Mathematics Division

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Kotila, Vesa Iisakki

**Opintokohteen kielet:** Finnish

**Language of instruction:**

Finnish

**Learning outcomes:**

The course acts as a mathematical introduction to statistical methods used in signal processing.

Learning outcomes : After the course the student is able to study the stationarity, the ergodicity and the frequency content of random signals. The student is able to explain the mathematical grounds of the most central optimal systems used in signal estimation and detection, and can solve related elementary problems. Further, the student can solve simple problems related to Markov chains.

**Contents:**

Random variable. Random signal. Stationarity, ergodicity, autocorrelation. Power spectral density. Noise. Autoregressive, Markov, Gaussian and Poisson processes. Some optimal filters. Markov chains. Signal estimation and detection.

**Learning activities and teaching methods:**

Lectures 4 h/week, class room exercises 2 h/week. Home assignments. Two partial exams or final exam.

**Recommended optional programme components:**

Matrix Algebra, Probability and Mathematical Statistics, Signals and Systems.

**Recommended or required reading:**

Lecture notes (an online version in English is available), exercise materials (in Finnish). Shanmugan, K. S., Breipohl, A.M.: Random Signals, Detection, Estimation and Data Analysis.

**555326S: Research Project in Production Management, 5 op**

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555379S Research Project in Industrial Engineering and Management 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish

**Learning outcomes:**

Aim: Applying the methods of production management in a company's activities and development. On the course the student can combine and apply earlier gained knowledge in the form of a wide study. The student familiarizes with research work and reporting of the results.

Learning outcomes: After finishing the course, the student will be able to systematically analyze and develop operations of a company by utilizing methods of production management. The student can also present research areas related to production management and can evaluate research of the area and discuss it critically.

**Contents:**

Changing content on topical subjects.

**Learning activities and teaching methods:**

The methods are agreed with the instructor of the work. Research plan, familiarizing with related literature, solving the problem and a literary report are required to pass. The work can be done individually or in a group.

**Recommended or required reading:**

Depending on the topic.

**555348S: Research Project in Technology Management, 5 op**

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Haapasalo, Harri Jouni Olavi

**Opintokohteen kielet:** English

**Leikkaavuudet:**

555379S Research Project in Industrial Engineering and Management 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

English

**Learning outcomes:**

The student is offered an opportunity to combine and apply knowledge from earlier courses in technology management in form of a broad research project. The student familiarizes himself/herself with doing research and reporting their findings.

Learning outcomes: After finishing the course, the student will be able to analyze and develop company activities using technology management methods.

**Contents:**

Completion of the course is agreed on one-to-one with the instructor. An accepted completion of the work requires planning of a research plan, familiarization with related literature, presented a solution to the researched question, and a written report. It is also possible to complete the course as a broader work piece of more than 5 ECTS credits if agreed so with the instructor.

### **555321S: Risk Management, 3 op**

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Hanna Kropsu-Vehkaperä

**Opintokohteen kielet:** English

**Leikkaavuudet:**

555377S Risk Management 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

English

**Learning outcomes:**

The course familiarizes a student with the overall concept of risk management. During the course we cover the classification of risks in business and the different methods of risk management. Learning outcomes: After completing the course student knows the key concepts of risk and risk management and can explain these. The student can describe risk classifications and can explain the importance of the risk management to organisations. The student can analyse business risks from new point of view and can produce improvement proposals based on the risk analysis. After the course the student can take part in the organisational development in a role of an expert in the area of risk management.

**Contents:**

Theoretical definition of risks. Risks in entrepreneurship and their classifications. Methods of risk management. Tools for corporate risk management.

### **555362S: Safety in Process Industry, 5 op**

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Seppo Väyrynen

**Opintokohteen kielet:** Finnish

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish.

**Learning outcomes:**

The course makes the student familiar with the design of process plant, which is characterised by proper ergonomic and safety features. The course also develops the abilities to analyse, enhance and maintain a high level of safety and productivity by means of modern management and leadership.

Learning outcomes : After the course the student is capable of identifying various hazards at the process plant. He is able to perform various safety analyses. He is also able to explain the impacts of technology, organization and person for risks and accidents. In addition, the student is able to make conception of the risk management as a part of safety management.

**Contents:**

For example: new EU standards and legislation. The methods of safety analysis and industrial maintenance.

**Recommended optional programme components:**

555260P Basic course in occupational safety.

**Recommended or required reading:**

Laitinen, H, Vuorinen, M & Simola, A: *Työturvallisuuden ja -terveyden johtaminen*. Tietosanoma, 2009. 494 s. Documentation about the issues from lectures and exercises, among others the material from TUKES, STM and TVL. [www.vtt.fi/proj/riskianalyysit/](http://www.vtt.fi/proj/riskianalyysit/) Other literature reported at the beginning of the course.

**Advanced literature:** Harms-Ringdahl, L.: *Safety analysis: principles and practice in occupational safety. Second edition. Taylor & Francis, 2001*. Bollinger, R. E. et al.: *Inherently safer chemical processes - a life cycle approach*. Center for Chemical Process Safety of the American Institute of Chemical Engineers 1996 (suitable chapters only).;

**900061A: Scientific Communication for Production Engineering and Management, 2 op**

**Voimassaolo:** 01.08.2008 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Language Centre

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

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

**Voimassaolo:** 01.08.1995 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Language Centre

**Opintokohteen kielet:** Swedish

**Leikkaavuudet:**

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

Ei opintojaksokuvauksia.

**555327S: Seminar in Production Management : Lab to Market, 5 op**

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Kess, Pekka Antero

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555375S Lab to Market 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish

**Learning outcomes:**

The aim of the course is to learn to apply different production management methods in decision making related to a company's strategy or operations.

Learning outcomes: After finishing the course, the student will be able to analyze and develop operations of a company by utilizing methods of production management.

**Contents:**

Changing content on topical subjects.

**Learning activities and teaching methods:**

Depending on the topic.

**Recommended or required reading:**

Depending on the topic.

## 555347S: Seminar in Technology Management, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Haapasalo, Harri Jouni Olavi

**Opintokohteen kielet:** English

**Leikkaavuudet:**

555378S Seminar in industrial engineering and management 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

English

**Learning outcomes:**

The aim of the course is to go deeper into the specific questions of technology management and doing related research. A student may specify his/her studies in a certain area by completing a seminar or a research project.

Learning outcomes: After finishing the course, the student will be able to present research areas related to technology management. The student will also be able to assess related research and to critically discuss it.

**Contents:**

Each seminar piece discusses a certain topic in technological management in great detail. The topic area is specified according to students' wishes. On top of lectures the course includes completion of a personal research report.

## 477304A: Separation Processes, 5 op

**Voimassaolo:** 01.08.2005 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Process and Environmental Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

470323A Separation Processes 5.0 op

**Language of instruction:**

Finnish

**Learning outcomes:**

Separation processes are usually the most expensive part in industrial processes. Separation processes based on mass transfer theory are studied: the operational principle, factors affecting the operation, principles of design, and real equipment.

*Learning outcomes:* After the course the student is able to define the position of separation processes based on mass transfer in process and environmental engineering. He/she is capable of solving phase equilibrium problems in multistage separations for binary mixtures. The student is able to explain the phenomena behind the following separation processes: distillation, absorption, stripping, liquid-liquid extraction, supercritical extraction, crystallisation, adsorption, chromatography separation, membrane

separations, and reactive separations. He/she recognises the equipment used for these processes and is able to compare the methods to each other with heuristic rules.

**Learning activities and teaching methods:**

Lectures including exercises. Homework assignments affect the course grade. Examination.

**Recommended optional programme components:**

Courses Momentum Transfer 477301A, Heat Transfer 477302A and Mass Transfer 477303A recommended beforehand.

**Recommended or required reading:**

King, C.J.: Separation Processes, McGraw-Hill, 1980, 850 pp.; Noble, R.D. & Terry, P.A.: Principles of Chemical Separations with Environmental Applications. Cambridge 2004, Cambridge University Press, 321 pp.

*Additional literature:* Henley, E.S. & Seader, J.D.: Equilibrium Stage Separation Operations in Chemical Engineering, John Wiley & Sons, 1981, 742 pp.; McCabe, W.L. et al.: Unit Operations of Chemical Engineering, 5th ed., McGraw-Hill, 1993, 1130 pp.; Rousseau, R.W.: Handbook of Separation Process Technology, John Wiley & Sons, 1987, 1010 pp.

## 465095A: Sheet Metal Forming, 3,5 op

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Jari Larkiola

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

465103A Principles of metal shaping and forming 5.0 op

**Language of instruction:**

Finnish

**Learning outcomes:**

The aim of the course is to supply the student with a basic understanding of the plasticity theory and sheet metal forming methods.

Learning outcomes: Upon completing the required coursework, the student knows different manufacturing methods and, based on this information, can make the right decisions in connection with the making of the desired product and the choice of the suitable manufacturing method. Furthermore, the student can propose suitable materials for the different applications by also paying attention to the manufacturing costs. Among others, the plasticity theory is used as a support mechanism of the decision-making.

**Contents:**

During the course the mechanical testing methods of metals, the plasticity theory, the effect of material properties on the forming and the forming methods of sheet metal are studied.

**Learning activities and teaching methods:**

Lectures will make up 24 hours of the course. Furthermore, the course includes literature work.

**Recommended optional programme components:**

Introduction to Materials Science

**Recommended or required reading:**

Lecture notes; R. Pierce: Sheet Metal Forming, 1991.

## 521457A: Software Engineering, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Computer Science and Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Juha Röning

**Opintokohteen kielet:** English

**Leikkaavuudet:**

**Learning outcomes:**

The purpose of this course is to give an overview of software development related to real-time systems.

Learning outcomes: After finishing the course, the student knows the basic concepts of software and real-time systems, the different areas of project management, the phases of software development and the goals and tasks of them, is able to use structural methods for defining systems and knows the principles of object-oriented design and analysis. After the course, the student has basic knowledge of utilizing software tools for structural analysis and design.

**Contents:**

Problematics of software development and the special features of real-time systems in this regard. Software development is viewed in regard to project management and actual implementation: 1. process models, 2. requirements specification, 3. project management basics:

design, metrics, risk management, resource management, followup, quality control, product control, 5. structural analysis and design, 5. software testing methods and strategies, 6. introduction to object-oriented analysis and design.

**Learning activities and teaching methods:**

The course consists of lectures and a laboratory design exercise.

The course is completed by a final exam and a successfully completed exercise.

**Recommended optional programme components:**

Introduction to Programming

**Recommended or required reading:**

R.S. Pressman: Software Engineering - A Practitioner's Approach. Sixth Edition. McGraw-Hill 2005, chapters 1-11, 13-14 and 21-27. Older editions (4th and 5th) can also be used as a reference. In this case the lectures are based on chapters 1-20.

**461016A: Statics, 5 op**

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Lahtinen, Hannu Tapio

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

ay461102A Statics (OPEN UNI) 5.0 op

461102A Statics 5.0 op

**Learning outcomes:**

The aim of this course is to give an understanding of the static equilibrium of structures and skills to balance force systems. This course also prepares students for later studies.

Learning outcomes: After the course, the student can calculate forces and moments of loaded structures using equations of vector algebra and trigonometry. He/she can draw a free body diagram of the force system and then solve the unknown forces by using equations of equilibrium. He/she can determine resultants from uniformly distributed loads and apply Coulomb's law of friction in the problem equilibrium. The student can solve problems of internal and external forces of particle systems and rigid body systems in case of static equilibrium. Especially, he/she can draw shear force and bending moment diagrams for beam structures.

**Contents:**

Fundamental laws and concepts in statics; Force systems and their treatment; Equilibrium of particles and rigid bodies; Static forces in isostatic structures such as beams, frames, cables and trusses; Friction; The principle of virtual work for rigid bodies; Stability of equilibrium.

**Learning activities and teaching methods:**

Lectures and exercises take place at autumn periods 1-3. Four mid-term exams or one final exam required.

**Recommended or required reading:**

Salmi, T.: Statiikka, Pressus Oy, Tampere 2005; Beer, F., Johnston, R.: Vector Mechanics for Engineers, Statics, McGraw-Hill Book Company, 1990; Meriam, J.: Statics, SI version, 2 ed., New York, London, 1975.



## 555320S: Strategic Management, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Kess, Pekka Antero

**Opintokohteen kielet:** English

**Leikkaavuudet:**

555370S Strategic Management 5.0 op

**Voidaan suorittaa useasti:** Kyllä

### **Language of instruction:**

English

### **Learning outcomes:**

The aim of the course is to familiarize a student with strategic thinking, business strategy development as well as the processes, methods, and tools involved with the management of change, in both theory and practice. Learning outcomes: After completing the course student knows the key concepts of strategic thinking, strategic management and strategic planning and can explain these. The student can describe structures and can explain the importance of the strategic management to organisations. The student can analyse strategic management in companies and can produce improvement proposals based on the analysis. After the course the student can take part in strategic planning in organisations.

### **Contents:**

Analysis of the structure of industry and anticipation of development possibilities. The basic types of competition strategy for an enterprise. Sources of competitive advantage. Strategic thinking. Development of a business strategy based on the core competences. Management of the company's strategy. Tools for strategic analysis. Special cases with the strategy process.

## 461010A: Strength of Materials I, 7 op

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Lahtinen, Hannu Tapio

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

461103A Strength of materials I 5.0 op

### **Learning outcomes:**

The aim of this course is to give fundamental concepts in the field of strength of materials and provide a capability to dimension such basic structures as tension and compression bars, torsion bars and beams.

Learning outcomes: After the course, the student can determine stresses and strains of structures under loading. He/she can change the general stress and strain states from one coordinate system to another and can also apply constitutive equations in calculations. The student can dimension typical structures such as tension and compression bars, torsion bars, straight beams and buckling struts.

### **Contents:**

Purpose and goals of strength of materials; Experimental elastic properties and strength of steel; Tension and compression of straight bars; Round torsion bar under shear force and torsion loads; Stresses and deflection curves in straight beams under bending moments; Elastic buckling; Stress state, strain state and constitutive equations, principal stresses, Mohr's circle; Stress hypotheses.

### **Learning activities and teaching methods:**

Lectures and exercises take place during the spring periods 4 - 6. Four midterm exams or one final exam is required.

### **Recommended optional programme components:**

Statics

**Recommended or required reading:**

Outinen, H., J., Salmi, T.: Lujusopin perusteet, Pressus Oy, Tampere, 2004, Pennala, E.: Lujusopin perusteet, Moniste 407, Otatiето 2002; Karhunen, J. & al.: Lujusoppi, Otatiето 2004; Ylinen, A.: Kimmo- ja lujusoppi I ja II, WSOY. 1976. Beer, F., Johnston, E., Mechanics of materials , McGraw-Hill, 1992

## 461011A: Strength of Materials II, 7 op

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Laukkanen, Jari Jussi

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

461104A Strength of materials II 5.0 op

**Language of instruction:**

Finnish

**Learning outcomes:**

The aim of this course is to provide students with a general view of the different areas concerning the strength of materials.

Learning outcomes : Upon completion of the course, the student should be able to use the basic methods of fatigue strength estimation and fracture mechanics to estimate the life of simple structures. He/she is also able to solve the problem concerning the buckling of columns and beam columns. Moreover, the student is able to solve the problem of the bending of curved beams and free and warping torsion of beams. After this course the student will have the basic skills to form linear visco-elasticity models.

**Contents:**

Basic methods of fatigue strength estimation; Basics of fracture mechanics; Buckling of columns and beam columns; Bending of curved beams; Free and warping torsion; Linear visco-elasticity

**Learning activities and teaching methods:**

This course will be based on lectures and exercises during periods 1 - 3 and will have a final exam or mid-term exams.

**Recommended optional programme components:**

Statics and Strength of Materials I

**Recommended or required reading:**

Pennala, E.: Lujusopin perusteet, Moniste 407, Otatiето, 1998; Outinen, H., Koski, J., Salmi, T.: Lujusopin perusteet, Pressus Oy: Tampere, 2000; Salmi, T., Virtanen, S.: Materiaalien mekaniikka, Pressus Oy: Tampere, 2008; Ylinen, A.: Kimmo- ja lujusoppi I ja II. WSOY, 1976; Bära brista, grundkurs i hållfasthetslära, AWE/Gebers: Stockholm, 1979.

## 903012P: Technical German 3, 6 op

**Voimassaolo:** 01.08.1995 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Language Centre

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** German

Ei opintojaksokuvauksia.

## 555340S: Technology Management, 4 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Haapasalo, Harri Jouni Olavi

**Opintokohteen kielet:** English

**Leikkaavuudet:**

555350S Research and Technology Management 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

English

**Learning outcomes:**

The aim of the course is to highlight the significance of technology from the perspective of competition. To present the speed of technological development and the effects that the scope of technology has on the operations of a productive firm. To create a basis for understanding the meaning of innovation. To create a link between organization strategy and technological strategy. Learning outcomes: After finishing the course, the student will be able to differentiate product development and technology management in a company. The student will be able to piece together the development needs and cycles of technologies in an organization. In addition, the student will know how to combine technology development and technology management with strategic planning of a company.

**Contents:**

The consists of defining technology and its role within an enterprise and within society. During the course we study the meaning of innovation in technological competition. The lifecycles of technology including development, acquirement, and movement are also covered.

## 555263A: Technology, Society and Work, 2 op

**Voimassaolo:** 01.08.2006 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Kisko, Kari Juhani

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555265P Occupational Safety and Health Management 5.0 op

**Language of instruction:**

Finnish.

**Learning outcomes:**

The course focuses on the social, scientific and cultural significance and effects of technology. That is considered to be one of the general goals of research in engineering.

Learning outcomes: After the course the student understands how technology, society and work together have an affect on the life of people.

**Contents:**

The viewpoints stem mainly from the concepts of technology assessment and the philosophy of technology; STS (Science Technology Society) includes aspects of e. g. globalisation, environmental management, responsibility of technology, ethics, history and philosophy.

**Recommended or required reading:**

*Pienyrityksen työympäristö tuloksen tekijänä.* Työsuojeluoppaita ja -ohjeita 5. Työsuojeluhallinto 2006. Other literature reported at the beginning of the course.

## 521359A: Telecommunication Engineering 1, 2,5 op

**Voimassaolo:** - 31.07.2012

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Learning outcomes:**

To learn the basic principles of analog amplitude, phase and frequency modulation methods, their implementation methods, and to compare their performance under the influence of noise and single-tone interference. The course aids to understand digital communication systems that are based on discrete message signals.

Learning outcomes:

After completing the course student can identify operation principles of the most important functional blocks for an analog telecommunication system. Student also can tell operation principles of various analog carrier- and pulse modulation methods both in time- and frequency domains. Student can also analyze the limitations resulting from channel interference and also estimate the influence of non-ideal realizations and operations on system performance. Student can also perform numerical SNR-, etc. calculations.

**Contents:**

Basic blocks of a communication system, linear and angle modulations, phase-lock loop and its applications, analog and digital pulse modulations, multiplexing methods, comparison of modulation methods without interference, SNR performance analysis of various continuous-wave and pulse modulations and their comparison, influence of a single-tone interference and phase-error, threshold effect, methods to improve system performance.

**Learning activities and teaching methods:**

Lectures and exercises. A final exam concludes the course.

**Recommended optional programme components:**

Signals and Systems, Stochastic Processes.

**Recommended or required reading:**

R.E. Ziemer & W.H. Tranter: Principles of Communications # Systems, Modulation and Noise, 5th edition, 2002, John Wiley & Sons, chapter 1 partly, all of ch 3 and ch 6 partly.

## 521361A: Telecommunication Engineering II, 3 op

**Voimassaolo:** 01.08.1950 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

521330A Telecommunication Engineering 5.0 op

**Learning outcomes:**

To learn the basics of digital transmission systems that are based on amplitude, phase and frequency modulation of a discrete-valued symbol sequence, the influence of transmission channel on system performance, the basics of information and coding theory.

Learning outcomes:

After completing the course student can tell and analyze the essential and optional blocks of a digital communication system both in time and in frequency domain. Student can tell the limitations resulting from transmission channel and can tell various methods to combat such effects. Using simple assumptions, student can analyze system performance mathematically and compare various modulation methods from the viewpoint of system resources. Student can evaluate standards and specifications of communication systems. Student can also apply obtained knowledge for practical system and sub-system design.

**Contents:**

Basic blocks of a digital transmission system, baseband digital transmission, digital continuous-wave modulations (ASK, MPSK, MFSK), correlation and matched filter receivers, receiver structures and their bit error probability performance with AWGN channel, effect of band-limiting and multipath propagation, basics of information theory, discrete channel models, entropies, source coding, channel capacity, basics of error-correction coding methods.

**Learning activities and teaching methods:**

Lectures and exercises. A final exam concludes the course.

**Recommended optional programme components:**

Stochastic Processes

**Recommended or required reading:**

R.E. Ziemer & W. H. Tranter: Principles of Communications – Systems, Modulation and Noise, 5th edition, 2002, John Wiley & Sons, chapter 7, partially chapters 8 and 10

**477401A: Thermodynamic Equilibria, 5 op**

**Voimassaolo:** 01.08.2005 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Process and Environmental Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Eetu-Pekka Heikkinen

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

470611A Metallurgy Processes 7.0 op

**Learning outcomes:**

The goal is to understand the fundamentals of thermodynamics in order to be able to consider thermodynamic equilibria in industrial processes. It should however be noted that this course is not organised in English and it is impossible to pass it in any other language besides Finnish. Therefore there are no requirements for the non-Finnish-speaking students.

*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 reaction 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, entropy and Gibbs free energy. 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.

**Learning activities and teaching methods:**

The course is lectured in Finnish during the 2<sup>nd</sup> period during which the students are required to make a portfolio consisting of a learning diary and exercises. Please note that the course is not organised for the English speaking students.

**Recommended optional programme components:**

Kemian perusteet and Material and Energy Balances.

**Recommended or required reading:**

Material used during the course.

Supplementary literary material: Atkins' Physical Chemistry (some parts).

**462040A: Tribology, 3,5 op**

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Louhisalmi, Yrjö Aulis

**Opintokohteen kielet:** Finnish

**Language of instruction:**

Finnish

**Learning outcomes:**

Learning outcomes: Upon completion of the course, the student can explain basic terminology and definitions of tribology by engineering design, use and maintenance point of views.

**Contents:**

Two bodies in contact; Theory of friction, wear and lubrication; Diagnosis of failures; Selection of materials; Use of lubricants and design examples

**Learning activities and teaching methods:**

The course consists of lectures and exercise assignments.

**Recommended or required reading:**

Kivioja, S., Kivivuori, S., ja Salonen, P. Tribologia - Kitka, Kuluminen ja Voitelu. Espoo, 1997, Otatiето Oy. 351 s. (in Finnish); Halling, J., Principles of Tribology, London & Basingstoke, 1978, MacMillan, Press 401 s; Booser, E. R.: CRC Handbook of Lubrication (Vol II Theory and Design) Florida, 1984, CRC Press Inc., 689 s.; SKF laakerien kunnossapito, 1994 (in Finnish). Additional literature: Kunnossapito -magazine (in Finnish).

## 813352A: Usability Testing, 5 op

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Information Processing Science

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

## 555262A: Usability and Safety in Product Development, 3 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Industrial Engineering and Management

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Seppo Väyrynen

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

555264P Managing well-being and quality of working life 5.0 op

**Voidaan suorittaa useasti:** Kyllä

**Language of instruction:**

Finnish.

**Learning outcomes:**

The course focuses on the theory and practice of a product design process that promotes safe and usable products.

Learning outcomes: After the course the student is able to analyze the usability of artefacts and design products that have good characteristics in usability. Students are able to compare the usability of artefacts using different methods.

**Contents:**

Requirement specification, user research, usability research, creation and evaluation of alternatives and the main course the standards are discussed. Examples and special topics are mostly related to information and communication technology or process technology areas. The course emphasizes these factors, management

options and the emphasis on the specific product, product development and design, and the role of usability and security goals.

**Recommended or required reading:**

S. Väyrynen, N. Nevala & M. Päivinen (2004), *Ergonomia ja käytettävyys suunnittelussa* 336p. Other literature reported at the beginning of the course.

## 761104P: Wave Motion, 3 op

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

761310A	Wave motion and optics	5.0 op
761310A-01	Wave motion and optics, lectures and exam	0.0 op
761310A-02	Wave motion and optics, lab. exercises	0.0 op
761114P-01	Wave motion and optics, lectures and exam	0.0 op
761114P-02	Wave motion and optics, lab. exercises	0.0 op
761114P	Wave motion and optics	5.0 op

Ei opintojaksokuvauksia.

## 465077A: Welding Technology, 3,5 op

**Voimassaolo:** - 31.07.2021

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Mechanical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Leinonen, Jouko Iivari

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

465104A	Heat treatment and welding of metals	5.0 op
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**Language of instruction:**

Finnish, Laboratory exercises also in English

**Learning outcomes:**

The objective of the course is to familiarize the student with conventional welding processes, weldability of different materials, the possibilities and conditions of welding technology in product design, and to give the student the ability to solve problems occurring in welding production.

Learning outcomes: After the course, the student is able to explain the most essential principles and applications of the conventional welding and cutting processes. He/she is able to estimate weldability of different materials and to analyze the factors affecting weldability. He can also explain the most essential matters regarding welding mechanization and automation, weld defects and their inspection, fatigue strength of a structure, and a healthy working environment. In addition, the student is generally able to take into account the effects of productivity and costs on the competitiveness.

**Contents:**

Welding processes and their applicability; Weldability of steels and other metallic materials; Welding distortions, weld defects, and inspection methods; Design of welded joint; Welding costs

**Learning activities and teaching methods:**

The course is made up of lectures, welding exercises (in laboratory) during period 1. The final grade is based on the points from the final exam or two small exams. The course is recommended to be completed during the second study year.

**Recommended or required reading:**

Study material: Lecture booklet (in Finnish)

Additional material: Lukkari, J.: *Hitsaustekniikka. Perusteet ja kaarihitsaus*. Edita: Helsinki, 1997.

