Opasraportti

Department of mechanical engineering (2010 - 2011)

1.1. Degree Programme in Mechanical Engineering

1.1.1. Professional goals

Degree Programme in Mechanical Engineering offers a wide scope of career paths: tasks related to machine and structural design, product development, production, sales and marketing, materials, quality control in industry, maintenance and research. The programme also prepares for teaching engineering and working with technology and commerce.

Graduates from the programme work mainly in Finnish metals industry such as basic production and workshops, etc., but increasingly also in electronics industry. The significance of metals industry for Finnish economy is great in both creating new jobs and increasing exports.

1.1.2. Aims of the Degree Programme

Degree Programme in Mechanical Engineering aims at preparing its graduates for research, product development, design, production management and maintenance tasks. The programme also gives the students the ability to work in administrative tasks, sales and education.

Bachelor's degree in engineering, in addition to professional skills, prepares well for studying for a Master's degree and with that degree, to continue to study for a doctor degree in technology.

Masters in Mechanical Engineering master a wide set of strongly specialised concepts, methods and knowledge in the field of their specialization, and are able to use these as a basis of individual thinking and research. They understand their field in relation to other fields and can consider the differences and new knowledge critically. They can solve challenging problems in research and innovation work that is targeted to develop new knowledge and methods and adapts and combines knowledge from diverse fields.

Graduates can work independently as experts in engineering or as private entrepreneurs. They can manage and develop complicated and new strategic approaches. They can manage matters and people. They can assess the operations of single persons and groups of people. They can gain new knowledge and practises in their field and help others to develop.

Graduates are prepared for constant learning. They can communicate their ideas well orally and in written form to audiences with or without technological knowledge. They are able to communicate in international environment and use in addition of the both national languages at least one foreign language.

1.1.3. Specialization Areas

In the end of the autumn term during the second year of studies students can choose as a specialization area: automotive engineering, machine design, materials engineering, mechatronics and machine diagnostics, structural engineering and construction technology, engineering mechanics, production technology and industrial engineering.

The first year of studies mainly concentrates on basic studies in mathematics and natural sciences and common professional subjects. The next two years include common and specialization area -specific professional studies and

complementary and optional studies. Learning methods include attending lectures, practice lessons, seminars, design and laboratory work. Integral part of studying are also visits to plants and practical work in industry as a trainee.

The aim is to give the student a sound base of principles of mathematics and natural sciences. Professional and advanced studies are taught according to the specialization area. Teaching always aims to give a wide knowledge base in Mechanical Engineering. At the master's level the studies consist of intermediate and advanced studies in the specialization area and complementary studies that broaden the scope of knowledge.

Automotive engineering: Students learn about design, product development and construction technology of heavy transportation equipment and mobile production machinery. Graduates' work ranges from product development to public administration tasks. Students can take optional studies from engineering mechanics, mechatronics, machine diagnostics or industrial engineering.

Machine design: There are two majors in machine design: general machine design and design, technologies and maintenance of machines of paper and pulp industry. Both prepare for tasks in design, product development and maintenance. In addition to major studies, students can take optional studies in machine automation, mechatronics and robot technology, information technology and industrial production and management. Graduates work in research, product development, production, maintenance and marketing. Programme is versatile and offers skills to continue to work even in demanding management tasks.

Materials engineering: Majors include: Physical Metallurgy, Materials Research Technology and Production and Properties of Metals. It is also possible to specialize in materials in electronics or fabrication technology. The programme aims its graduates to become experts in the production and usage of various materials, metals, ceramics and plastics, and to work in versatile development, quality control, materials selection and research tasks in metals and engineering industry, workshops, electronics industry or in research institutes.

Mechatronics and machine diagnostics: Mechatronics offers also adequate basic knowledge of electronics and information technology. These are used in the automation of machines and in design of new types of machines. The field is well connected with electronics industry in the Oulu region.

Machine diagnostics' graduates work in paper, steel and process industry and in maintenance tasks in power plants. In addition they can work in demanding modernising, product development and maintenance tasks in workshops. Some of them specializes in diagnostics and reliability research. Maintenance tasks give the possibility to advance to even higher management tasks in the industry.

Engineering mechanics: Graduates can analyse the mechanical behaviour of machines, structures and devices analytically, numerically and experimentally. Topics studied include statics, dynamics, finite element methods and vibrations mechanics. The skills obtained can be used e.g. in the mechanics for surgery and mrdicine. Graduates can work in research, product development, damage analysis or engineering design.

Industrial engineering: In addition to technological knowledge, graduates have good knowledge of financial, administrative and leaderships aspects related to production and marketing. They work in tasks demanding knowledge of business economics and marketing, in industrial companies, in their interest groups and public administration.

Production technology: Majors include machine shop production technology, production automation, production management and planning, electronics production, and industrial production and management. Graduates work in machine shops and other manufacturing industry, managers in technical design of production, production managers, maintenance engineers and in technological commerce.

Structural engineering and construction technology: The programme includes topics that are required for the planning, structural design and operational maintenance of structures in building and bridge construction as well as of related facilities. It thus covers the engineering tasks as they are to be done in engineering offices, construction companies, authorities and research and development institutions. It also gives good basis for work in research and teaching.

Students choose their specialization after the autumn term in the second year of studies. There will be an information event for students; it's time and the details of the application process will be displayed on the notice board. Application will be returned by the end of November. In case there are more applicants to a certain specialization area than the Department sees fit, success in studies is used as a selection criteria.

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

461020S: Advanced Course in Finite Element Methods, 5 op
462052S: Advanced Course in Mechatronics, 8 op
555345S: Advanced Course in Product Development, 6 op
465093S: Advanced Course in Welding Technology, 5 op
555324S: Advanced Supply Chain Management, 3 op
462050A: Automotive Engineering, 5 op
555280P: Basic Course of Project Management, 2 op
555281A: Basic Course of Quality Management, 5 op
780109P: Basic Principles in Chemistry, 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
031018P: Complex Analysis, 4 op
462044S: Computer Aided Design, 3,5 op
463059S: Computer Aided Manufacturing, 4 op
460145A: Concrete Structures, 6 op
461026S: Continuum Mechanics, 6 op
477602A: Control System Analysis, 4 op
477603A: Control System Design, 4 op
460148S: Design of Concrete Structures, 4 op
460127S: Design of Steel Structures, 4 op
464088S: Diagnosis of Machine Condition, 8 op
031017P: Differential Equations, 4 op
477605S: Digital Control Theory, 4 op
521413A: Digital Techniques 1, 4 op
521404A: Digital Techniques 2, 5 op
461018A: Dynamics, 4 op
761103P: Electricity and Magnetism, 4 op
521142A: Embedded Systems Programming, 5 op
461012A: Energy Principles and Their Use in Beam Structures, 7 op
460085A: Engineering Software Tools, 3 op
465084S: Exercises in Physical Metallurgy, 4 op
461028S: Experimental Methods in Engineering Mechanics, 6 op
460075S: Experimental Methods in Internal Combustion Engines, 3,5 op
465079S: Failure Analysis, 3,5 op
461033A: Finite Element Methods I, 3,5 op
461034A: Finite Element Methods II, 3,5 op
477305S: Flow Dynamics, 5 op
463058A: Foundry Technology, 3,5 op
461021S: Fracture Mechanics, 5 op
465094A: Furnace Technology, 4 op
477505S: Fuzzy-neuromethods in Process Automation, 4 op
031029S: Graph Theory, 8 op
461035A: Heat and Mass Transfer I, 3,5 op
461036S: Heat and Mass Transfer II, 3,5 op
555325S: Human Resources Management, 3 op
030005P: Information Skills, 1 op
460073A: Internal Combustion Engines I, 3,5 op
460074S: Internal Combustion Engines II, 5 op
031047S: Introduction Course to the Boundaryelement Method, 6,5 op
460125A: Introduction to Design of Steel Structures, 4 op
463052A: Introduction to Manufacturing Technology, 5 op
465071A: Introduction to Materials Science, 3,5 op
460088P: Introduction to Programming, 3 op
463066A: Introduction to Sheet Metal Design, 3,5 op

761121P: Laboratory Exercises in Physics 1, 3 op
477409S: Laboratory Exercises of Metallurgy, 4 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: Maintenancy Technology, 5 op
721172P: Management Accounting, 5 op
555344S: Management Information Systems, 5 op
463053A: Manufacturing Technology I, 3,5 op
463054S: Manufacturing Technology II, 17 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
465061A: Materials Engineering I, 5 op
465062S: Materials Engineering II, 3 op
031044A: Mathematical Methods, 4 op
031019P: Matrix Algebra, 3,5 op
464089S: Measuring Instrumentation and Techniques for Diagnosis of Machine Condition, 5 op
461019S: Mechanical Vibrations, 6 op
461027S: Mechanics of Composites, 5 op
462035A: Mechanisms, 3,5 op
462051S: Mechatronics, 5 op
477406S: Melting and Solidification, 4 op
460076A: Mobile Hydraulics, 3,5 op
031022P: Numerical Analysis, 5 op
031073S: Numerical Methods, Advanced Topics, 8 op
555342S: Operations Research, 5 op
461023S: Optimization of Structures, 5 op
030001P: Orientation Course for New Students, 1 op
477407S: Oxidation and Reduction in Pyrometallurgy, 5 op
464074S: Paper Machinery Construction, 7 op
464085A: Patenting, 3,5 op
465081S: Physical Metallurgy I, 7 op
465082S: Physical Metallurgy II, 7 op
463060S: Planning of Flexible Manufacturing System, 3,5 op
461013A: Plates and Shells, 5 op
460001A: Practical Training, 3 - 5 op
460002S: Practical Training II, 3 - 5 op
462038A: Precision Engineering, 3,5 op
521431A: Principles of Electronics Design, 5 op
721409P: Principles of Marketing, 5 op
031072S: Principles of the Boundary Element Method, Homework Exercise, 2 op
031021P: Probability and Mathematical Statistics, 5 op
465089S: Processing and Properties of Steels, 3,5 op
555343S: Product Data management, 5 op
555341S: Productivity and Performance Management, 3 op
464079S: Programmable Controllers and Field Bus Systems, 5 op
521143A: Programming, 7,5 op
555382S: Project Business, 5 op
555381S: Project Leadership, 5 op
555282A: Project Management, 4 op
464058S: Project Work in Machine Design, 8,5 op
464084S: Project Work in Paper Machinery Construction, 8,5 op
555388S: Project Work in Project Management, 5 op
555323S: Purchase Management, 3 op
555380S: Quality Management, 5 op
463062S: Quality in Production, 3,5 op
031024A: Random Signals, 5 op

555326S: Research Project in Production Management, 5 op
555348S: Research Project in Technology Management, 5 op
465075A: Research Techniques for Materials, 3,5 op
555321S: Risk Management, 3 op
465090A: Rolling Technology, 8 op
555362S: Safety in Process Industry, 5 op
901008P: Second Official Language (Swedish), 2 op
462053A: Sensor Technology of Machine Automation, 5 op
465095A: Sheet Metal Forming, 3,5 op
477408S: Slags and Slag Formation in Pyrometallurgy, 5 op
521457A: Software Engineering, 5 op
477604S: Software and Calculation Tools in Control Engineering, 3 op
461016A: Statics, 5 op
555320S: Strategic Management, 5 op
461010A: Strength of Materials I, 7 op
461011A: Strength of Materials II, 7 op
460071A: Structural Systems in Automotive Vehicles I, 5 op
460072S: Structural Systems in Automotive Vehicles II, 8,5 op
477405S: Surfaces and Phase Boundaries in Pyrometallurgy, 4 op
900060A: Technical Communication, 2 op
464061A: Techniques of Creative Working, 3 op
555340S: Technology Management, 4 op
555263A: Technology, Society and Work, 2 op
477404S: Thermodynamics of Hydrometallurgical Solutions, 3 op
477403S: Thermodynamics of Pyrometallurgical Solutions, 5 op
462040A: Tribology, 3,5 op
465088S: Utilization of Electron Optical Methods, 3,5 op
031026A: Variational Methods, 5 op
462055S: Virtual Engineering of Mechatronic Products, 5 op
761104P: Wave Motion, 3 op
465080S: Welding Metallurgy, 8,5 op
465077A: Welding Technology, 3,5 op

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

461020S: Advanced Course in Finite Element Methods, 5 op

Voimassaolo: - 31.07.2021
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Mechanical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Sjölind, Yngve Stig-Göran
Opintokohteen kielet: Finnish
Leikkaavuudet:

461113S Finite element methods III 5.0 op

Learning outcomes:
The aim of the course is to give students an enhanced understanding of the finite element method and to familiarize students with the analysis of non-linear problems.

Learning Outcomes **:** Upon completion of this course, the student is able to apply the finite element method in analyzing the most important non-linear phenomena in engineering mechanics. He/she is able to choose suitable modeling and solution methods for different phenomena.
Contents:
Non-linear phenomena in engineering mechanics; Geometrical nonlinearities, buckling, and contact problems; Non-linear materials, plasticity, visco-elasticity, visco-plasticity and non-linear vibrations.
Recommended optional programme components:
461033A Finite Element Methods I, 461034A Finite Element Methods II
Recommended or required reading:
Belytschko, T., Liu, W. K., Moran, B.: Finite Elements for Nonlinear Continua and Structures, John Wiley & Sons Ltd., 2000; Bathe, K.-J.: Finite Element Procedures, Prentice-Hall, 1996; Hinton, E.: NAFEMS Introduction to Nonlinear Finite Element Analysis, Bell and Bain Ltd., 1992.
Assessment methods and criteria:
The assessment of this course will be either a final exam or mid-term exams

462052S: Advanced Course in Mechatronics, 8 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Nevala, Aimo Kalervo

Opintokohteen kielet: Finnish

Leikkaavuudet:

462110S Advanced course in mechatronics 8.0 op

Learning outcomes:
The main objective of the course is to familiarize the students with the control techniques used in the design process of mechatronic products. The rather large design exercise included in the course aims to deepen the students' design skills.
Learning outcomes: Upon completion of the course, the student is able to analyze and design control systems for mechatronic products using advanced control design methods. The student can also choose the suitable technology for the mechatronic product as well as compare the properties of different technologies. Furthermore, student can evaluate the usability and possibilities of various intelligent actuators as mechatronic products.
Contents:
Intelligent control systems; Advance control methods; Distributed control; Integrated actuator controllers; Control system hardware; Selection of implementation techniques for a mechatronics product; Design or investigation exercise regarding mechatronic machine or device
Learning activities and teaching methods:
This course consists of 20 hours of lectures and 20 hours of exercises, design exercises and seminar meetings. The design exercise is carried as out as teamwork and it includes essential techniques required in designing a mechatronic product. In order to pass the course and maintain the right to come to the examination, students have to complete the exercises. The final grade is determined by the sum of the exercises and examination.
Recommended optional programme components:
Mechatronics, Sensor Technology of Machine Automation
Recommended or required reading:
Airila, M. Mekatroniikka, 5. edition, Otatieto (897), 1999. 405 p. Koivo, A.J. Fundamentals for control of robotic manipulators, 468 p. Students will be notified of the other literature in 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 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.

465093S: Advanced Course in Welding Technology, 5 op

Voimassaolo: - 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

Language of instruction:
Finnish
Learning outcomes:
The objective of the course is to familiarize the student with the present phase of development in welding technology, the modern welding processes, automation and mechanization of welding, and quality, productivity and profitability matters.
Learning outcomes: After the course, the student is able to analyze the factors affecting welding productivity. He /she is capable of applying the mechanization and automation of welding in an engineering workshop. The student is also able to explain the most essential matters concerning the welding quality and common quality standards. He/she is able to estimate weldability of the most often used structural materials and compare their weldabilities with each other. In addition, the student is able to explain the most essential principles concerning safety at work, safe structures, costs and the profitability of welding.
Contents:
Possibilities and limitations of the conventional welding processes; Modern welding processes including e.g., beam welding processes and high energy processes/modifications; Automation of welding; Welding standards and their application in the welding industry; The factors resulting in high quality; Productivity, economy and the profitability of welding
Learning activities and teaching methods:
Lectures will be held during period 4. The exercise is to be completed in small group during periods 4 and 5. The final grade is based on the points from the final exam or two small exams and the exercise.
Recommended optional programme components:
Welding Technology
Recommended or required reading:
Lecture booklet (in Finnish).

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 manegment 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

462050A: Automotive Engineering, 5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Haataja, Mauri Kalevi

Opintokohteen kielet: Finnish

Leikkaavuudet:

464121A Automotive engineering principles 5.0 op

Learning outcomes:
The goal of the course is to provide the student with basic concept of vehicle mechanics and mobility, motor vehicle regulations and technical inspections, structural systems of automotives, vehicle design principles, environmental effects of vehicles and exhaust gas emission treatment methods.
Learning outcomes: The student is capable of identifying requirements of type approval and periodic technical inspections. The student will know the functions of steering, brake and electronic systems, axles and wheels support mechanisms. The student is capable of determining tires for vehicles and the force mechanism of pneumatic tire on road surface. He/she will know the provisions concerning exhaust gas emission limit values and

measuring methods for motor vehicle and construction machines. The student is able to determine mobility maps and fuel consumption for on- and off road vehicles accordingly and is capable of determining the capacity of engine and transmission systems as well as steering geometry and performing technical measurements in automotive laboratories and road conditions.

Contents:

Road legislation for vehicles; Type approval; Periodic technical inspections; Structural systems of automotives; Driving resistances and mobility maps for on-road and off-road vehicles; Tire categories and standards; Force mechanism of pneumatic tire on road surface; Steering geometry of automotives; Engine and transmission systems; Automotive electrical systems; Fuel consumption; EU, EPA and Japan exhaust gas emission legislation;

Learning activities and teaching methods:

Lectures and calculation exercises will be during periods 3 and 4 . Practical automotive technology exercises will be performed during periods 4 and 6. Automotive laboratory exercises will be performed in the OAMK automotive laboratory. Grades will be based on an exam, practical exercises and laboratory experiments.

Recommended or required reading:

Lecture notes and the material will be handed out during the lectures. International vehicle regulations and directives. Ajoneuvohallintokeskuksen (AKE) määräyskokoelmat. Autoteknillinen taskukirja. 6.painos 2003. Gummerus Oy. Juhala, M; Moottorialan sähköoppi. 2005. Autoalan Koulutuskeskus. Rengasnormit .2006 Scandinavian Tire and Rim Organization. STRO.

Additional literature: J., Y., Theory of Ground Vehicles. John Wiley&Sons, Inc., 2001; Braess, H-H., Seiffert, U., Handbook of Automotive Engineering.2005. SAE. Gillespie, T.D. Fundamentals of Vehicle Dynamics. 1992. SAEMitschke, M. Dynamik der Kraftfahrzeuge, Band A: Antrieb und Bremsung. 1995. Springer Verlag, Berlin.. .

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: Jaakko Kujala, Osmo Kauppila

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

780109P: Basic Principles in Chemistry, 4 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Chemistry

Arvostelu: 1 - 5, pass, fail

Opettajat: Minna Tiainen

Opintokohteen oppimateriaali:
Petrucci, Ralph H., , 2002

Opintokohteen kielet: Finnish

Leikkaavuudet:

780120P Basic Principles in Chemistry 5.0 op
ay780117P General and Inorganic Chemistry A (OPEN UNI) 5.0 op
780115P General and Inorganic Chemistry II 6.0 op
780114P General and Inorganic Chemistry I 6.0 op
780113P Introduction to Chemistry 12.0 op
780101P Introduction to Physical Chemistry 7.0 op
780101P2 Physical Chemistry I 4.0 op
780107P Basic Course in Inorganic and Physical Chemistry 7.5 op
780152P Inorganic and Physical Chemistry I 7.5 op
780153P General and Inorganic Chemistry 7.5 op
780154P Basic Inorganic Chemistry 7.5 op

ECTS Credits:
4 credits
Language of instruction:
Finnish
Timing:
1st autumn.

Learning outcomes:
Upon completion the student should be able to display an understanding of basic chemistry phenomenon; equilibrium of acids and bases, chemical equilibrium, redox reactions and stoichiometry.
Contents:
Introduction to chemistry, stoichiometry, redox reactions, chemical equilibrium, the equilibrium of acid and bases, buffer solutions, titration.
Learning activities and teaching methods:
36 hours of lectures, one final examination.
Target group:
Biology, Geology, Mechanical Engineering, Process Engineering, compulsory.
Geography, optional.
Recommended or required reading:
Petrucci, R.H., Harwood, W.S., and Herring, F.G.: General Chemistry: Principles and Modern Applications, Prentice Hall, 8th edition (2002) or a newer edition.
Person responsible:
Lecturer M. Tiainen
Other information:
This course is only for students who have chemistry as a minor subject.
This course has partly the same contents as the course Introduction to Chemistry (780113P) (and the course Introduction to Physical Chemistry). If a student performs also the course Introduction to Chemistry, this course will be cancelled in his/hers study register.

721704P: Business Logistics, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Basic Studies

Laji: Course

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

ECTS Credits:
5 ects.

Language of instruction:
English.

Timing:
Period B.

Learning outcomes:
The student understands how logistics contributes to business competitiveness and knows the central planning principles of logistics activities and their mutual relationships.

Contents:
Course topics include logistics trade-offs, logistics service level, transport and inventory management, logistics performance measurement, basic production planning and order scheduling, just-in-time logistics, and green logistics. The development of the logistics discipline and current logistics issues will also be discussed.
Learning activities and teaching methods:
Lectures (30 h), including basic calculations and exercises in classes.
Recommended or required reading:
Jonsson, P. (2008), Logistics and Supply Chain Management, McGraw-Hill, and supplementary study material in OPTIMA.

Check availability from here.
Assessment methods and criteria:
Exam (course book, lectures, basic calculation problems).

Grading:
1-5.

Person responsible:
Professor of logistics.

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
Timing:
Period 1-3
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
Timing:
Period 4-6
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. ***Työhygienia*** , Työterveyslaitos 2008; Other literature reported at the beginning of the course.

031018P: Complex Analysis, 4 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: Finnish

Leikkaavuudet:

031077P Complex analysis 5.0 op

Language of instruction:
Finnish
Timing:
Period 1-2
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.

462044S: Computer Aided Design, 3,5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Korpela

Opintokohteen kielet: Finnish

Leikkaavuudet:

464105S Computer aided design 5.0 op

Learning outcomes:
The aim of the course is to teach for students how the computer systems are used in different fields of mechanical machine design.
Learning outcomes: After the course, the student is able to define what computer systems belong to the customer centered computer integrated manufacturing. He/she is able to explain what design knowledge is produced in these systems and what design knowledge is transferred between these systems. The student is able to use the CAD/CAM system used in the course in different fields of mechanical machine design.
Contents:
The course will focus on the use of computer systems in different fields of mechanical machine design. The emphasis is on the utilization of product data and the realization of product based design systems, where there is often a need to integrate many systems functionally together
Learning activities and teaching methods:
The course consists of lectures, guided exercises in a computer class room and a personal exercise assignment. When a student has completed the personal exercise assignment, he/she is allowed to take part in the exam. The final grade is calculated based on the exam and the exercise assignment.
Recommended or required reading:
Lee, K. Principles of CAD/CAM/CAE Systems, Addison-Wesley, Inc.: New York, 1999, 581 s.; Zeid, I. CAD/CAM theory and practice, McGraw-Hill, Inc.: New York, 1991, 1052 s.

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.

460145A: Concrete Structures, 6 op

Voimassaolo: 01.08.2005 - 31.07.2011
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Mechanical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Hannila, Raimo Sakari
Opintokohteen kielet: Finnish

Language of instruction:
Finnish
Learning outcomes:
The student has the basic knowledge in the design and the manufacturing technology of the concrete structures belonging to the design level A.
Learning outcomes: The student knows the material properties of concrete and reinforcing steel and is able to design typical, basic reinforced concrete structures in accordance with the requirements of Eurocodes. The student knows the principles for manufacturing and testing in concrete technology.
Contents:
The stress-strain relations and the strength properties of the concrete and reinforcing steel material; The time dependent material properties; Durability and service life design; Anchorage length and laps of the reinforcements; The limit state design for flexure, shear and compression in concrete structures
Learning activities and teaching methods:
The lessons contain theory and practical training as well as laboratory work. The project work and the laboratory work should be done successfully. The grading is determined by the mid-term or the final exam.
Recommended optional programme components:
Basics in Statics, Mechanics of Materials and Structural Mechanics of Beam Structures.
Recommended or required reading:
Lecture material (in Finnish); Leskelä: By210 Betonirakenteiden suunnittelu ja mitoitus 2005. By202 Betonitekniikan oppikirja 2004. By47 Betonirakentamisen laatuohjeet 2007. By60 Suunnitteluohje EC2 osat1-1 ja 1-2. SFS-EN 1992-1-1 (other EN standards, as appropriate).

461026S: Continuum Mechanics, 6 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:

461111S Continuum mechanics 5.0 op

Language of instruction:
Finnish

Learning outcomes:
The aim of this course is to provide an introductory understanding of continuum mechanics, the fundamental concepts and methods used in the mathematical modeling of solids and the engineering use of mechanistic models and analysis techniques.
Learning outcomes: Upon completing the required coursework, the student knows the theoretical background of the strength of materials and he/she is able to the use of specialized literature as a source of further information. The student is able to apply the fundamentals of tensor calculus in the orthogonal coordinate system and knows the most important characteristics of the second order symmetric tensor. He/she is able to explain the differences both on the description of linear and nonlinear deformation and on the Eulerian and Lagrangian description. The student is able to calculate the most important measures of the deformation and strain. He/she recognizes the different measures of stress in the different configurations, and can transform them in to the different configurations. He/she is able to identify the symmetries of the linear elastic material and is able to use the constitutive equation and constants of the isotropic linear elastic material.
Contents:
Fundamentals of tensor calculus; State of deformation and stress in the linear and non-linear theory; Basic conservation laws in continuum mechanics; Constitutive properties of materials; Introduction of linear elasticity and three dimensional plasticity
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 final exam. Note: The course is held every other year.
Recommended or required reading:
Mase, G. E., Mase , G. T. (2000) Continuum Mechanics for Engineers. CRC Press Inc. Malvern, L.E. (1969) Introduction to the mechanics of a continuous medium. Prentice-Hall, Englewood Cliffs; Mattiasson, K. (1981) Continuum mechanics principles for large deformation problems in solid and structural mechanics. Publ. 81:6, Department of Structural Mechanics, Chalmers University of Technology; Fung, Y.C. (1965) Foundations of solid mechanics. Prentice-Hall, Englewood Cliffs.

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, Hiltunen, Jukka Antero

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:
4,0 cr
Language of instruction:
Finnish, it is possible to complete the course in English.
Timing:
Implementation in 1st-2nd periods.
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.: Säätötekniikan harjoitustehtäviä. Hakapaino Oy 1994. 252 pp.
Person responsible:
Professor Ensi Ikonen, Lecturer Jukka Hiltunen

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: Ikonen, Mika Enso-Veitikka, Seppo Honkanen

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:
4,0 cr
Language of instruction:
Finnish, it is possible to complete the course in English.
Timing:
Implementation in 4th-5th periods.
Learning outcomes:
To give the student knowledge about the mathematical and practical methods used in control system design.
Learning outcomes: After completing the course *t*he 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.: Säätötekniikan harjoitustehtäviä. Hakapaino Oy 1994. 252 pp.

Person responsible:
Professor Enso Ikonen, Lecturer Jukka Hiltunen

460148S: Design of Concrete Structures, 4 op

Voimassaolo: 01.08.2008 - 31.07.2021

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Hannila, Raimo Sakari

Opintokohteen kielet: Finnish

Leikkaavuudet:

485106A Design of concrete structures 5.0 op
466107S Design of concrete structures 6.0 op

Language of instruction:
Finnish
Learning outcomes:
The student has advanced knowledge in the design of the concrete structures belonging to the design level A. Learning outcomes: The student is able to design common reinforced concrete structures and the characteristic details in accordance with the requirements of Eurocodes.
Contents:
The limit state design of the flanged reinforced concrete beams with holes, slabs, flat slabs, walls, deep beams, foundations and the appropriate details
Learning activities and teaching methods:
The lessons contain both theory and practical training. The project work should be done successfully. The grading is determined by the mid-term or final exam.
Recommended optional programme components:
460145A Concrete Structures, Basics in Statics, Mechanics of Materials, Structural Mechanics of Beam Structures, Plates and Shells
Recommended or required reading:
Lecture material (in Finnish). Leskelä: By210 Betonirakenteiden suunnittelu ja mitoitus 2005. By202 Betonitekniikan oppikirja 2004. By47 Betonirakentamisen laatuohjeet 2007. By60 Suunnitteluohje EC2 osat1-1 ja 1-2. SFS-EN 1992-1-1 (other EN standards, as appropriate).

460127S: Design of Steel Structures, 4 op

Voimassaolo: - 31.07.2021
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Mechanical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Kangaspuoskari, Matti Johannes
Opintokohteen kielet: Finnish
Leikkaavuudet:

466105S Design of Steel Structures 6.0 op

Learning outcomes:
Learning outcomes: After the course, the student is able to design the steel structure after considering appropriate action effects. He/she is able to analyze stability problems and is able understand the effects of imperfections and interaction duo the combined load components. He/she is able to explain the basic design of welded steel structures under a fatigue load.

464088S: Diagnosis of Machine Condition, 8 op

Voimassaolo: - 31.07.2021
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Mechanical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Lahdelma, Sulo Olavi
Opintokohteen kielet: Finnish
Leikkaavuudet:

462111S Machine diagnostics 10.0 op

Language of instruction:
Finnish
Learning outcomes:

The objective of the course is to provide the student with more in-depth knowledge of machine diagnostics after the Maintenance Technology Course. Skills for independent diagnosis are developed through a variety of exercises.
Learning outcomes: After the course, the student is able to evaluate machine conditions independently using the most common diagnostics measuring instruments and identify potential fault types. He/she will recognize the connection between machine condition and product quality. The student is able to apply the most common signal processing methods and features used in condition monitoring and use the standards of this field. He/she is also able to draw up a measurement plan, carry out the measurements and report the measurement results.
Contents:
The course discusses ways of diagnosing typical faults occurring in power plants or the process and steel industry and diagnostic means for improving reliability, product quality, environmental protection and the modernization of machines.
Learning activities and teaching methods:
The course consists of lectures arranged during the 1st period and exercises during the periods 1 and 2. The grade for the course is based on a final examination.
Recommended optional programme components:
The Maintenance Technology Course is recommended.
Recommended or required reading:
Klein, U., Schwingungsdiagnostische Beurteilung von Maschinen und Anlagen. Düsseldorf, Verlag Stahleisen GmbH, 2003. (In German); Lahdelma, S., Lecture notes: Diagnosis of machine condition, 2008. (In Finnish); English material is also available.
Supplementary reading: Rao, B., Handbook of Condition Monitoring. Oxford, Elsevier Advanced Technology, 1996.; PSK-käsikirja 3 – Vibration measurement in condition monitoring. Helsinki, PSK Standardisointiyhdistys ry, 2009. Most standards are available in Finnish and in English.

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
Timing:
Period 4-6
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

477605S: Digital Control Theory, 4 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Seppo Honkanen

Opintokohteen kielet: Finnish

Leikkaavuudet:

477624S	Control System Methods	5.0 op
470453S	Digital Control Theory	5.0 op

ECTS Credits:
4,0 cr
Language of instruction:
Sinnish, it is possible to complete the course in English.
Timing:
Implementation in 2nd-3rd periods.
Learning outcomes:
Introducing the computer controlled, sampled data systems. Acquiring the knowledge of designing and tuning discrete-time control systems.
Learning outcomes *:* After completing the course students can identify the problems of the sampled data systems, and know how to apply discrete time methods for systems analysis and control design.
Contents:
1. Sampled data systems: sampling, Z transformation of signals. 2. Discrete-time modelling: difference equation, shift operator, pulse transfer function, polynomial and state-space description. 3. Analysis of discrete-time systems: z-plane, stability. 4. Discrete-time control design strategies: general RST structure, various pole-zero placement control algorithms, minimum-variance control, model-based control, state-space design methods.
Recommended or required reading:
Lecturer’s note. Landau & Zito (2005): Digital Control Systems, Springer, 485 pp. Åström, K.J. & Wittenmark, B. (1984, 1997): Computer Controlled Systems: Theory and Design. Prentice-Hall International 544 pp.
Person responsible:
Assistent Seppo Honkanen
Other information:
Courses 470602A and 470603A are recommended beforehand. Course material is in English. The course concludes in a written exam; to request an exam in English, contact the lecturer via email beforehand.

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

Language of instruction:
In Finnish.
Timing:
Period 5-6.
Learning outcomes:

After having completed the coursest student are expected to understand functional principles, implementation options, and logic design principles of the most usual digital equipmet.
Learning outcomes: After the course, students are able to ably binary number system and Boolean algebra in the form of switching algebra to the design and functional analyze 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, analyze 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 digitaaliteknisten 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

Opettajat: Hannu Heusala

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Period 1-2.
Learning outcomes:
The goal of the cource is to familiarize students to the professional design flow, design methodology and implementaion options of digital integrated circuits.
Osaamistavoitteet: After the cource 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 ably design methodologies and tools. Design verification and implementation analysis are emphasised. Students can simulate and model (VHDL modelling and VHDL simulation) digital systems and critically revalue 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 particl;. 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.

761103P: Electricity and Magnetism, 4 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761119P Electromagnetism 1 5.0 op
761119P-01 Electromagnetism 1, lectures and exam 0.0 op
761119P-02 Electromagnetism 1, lab. exercises 0.0 op
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

ECTS Credits:
4 credits
Language of instruction:
The lectures will be in Finnish. The textbook is in English and exercises are selected from the textbook. For further information, contact the responsible person of the course.
Timing:
Spring
Learning outcomes:
The student masters the basic concepts of electricity and magnetism and is able to apply those when solving the problems related to electromagnetism.
Contents:
Electromagnetic interaction is one of the four fundamental interactions in physics and many phenomena like light, radio waves, electric current, magnetism and formation of solid matter are based on electromagnetism. The current technological development is largely based on applications of electromagnetism in energy production and transfer, telecommunications and information technology.
Contents in brief: Coulomb's law. Electric field and potential. Gauss's law. Capacitors and dielectrics. Electric current, resistors, electromotive force and DC circuits. Magnetic field, motion of a charged particle in electric and

magnetic fields, and applications. Ampère's law and Biot-Savart law. Electromagnetic induction and Faraday's law. Inductance and inductors. R-L-C circuits, alternating current and AC circuits.
Learning activities and teaching methods:
Lectures 32 h, 6 exercises (12 h), four mini examinations and end examination or final examination.
Target group:
Secondary subject students.
Recommended optional programme components:
Knowledge of vector calculus and basics of differential and integral calculus are needed.
Recommended or required reading:
Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 12th edition, 2008, chapters 21-31. Also 11th and 10th editions can be used.
Lecture material: Finnish lecture material will be available on the web page of the course.
Person responsible:
Anita Aikio
Other information:
https://wiki.oulu.fi/display/761103P/

521142A: Embedded Systems Programming, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Riekki, Jukka Pekka

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

Language of instruction:
Finnish.
Timing:
Period 4-6.
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

461012A: Energy Principles and Their Use in Beam Structures, 7 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Sjölind, Yngve Stig-Göran

Opintokohteen kielet: Finnish

Learning outcomes:

The aim of this course is to familiarize students with the essential energy and variational principles of solid mechanics. The course will provide students with the ability to apply approximate methods based on these principles in analyzing beam and frame problems.
Learning Outcomes **:** Upon completion of the course, the student is able to use the most important energy and variational methods. He/she is also able to apply approximate and numerical methods, which are based on energy and variational methods and in analyzing truss, beam and frame structures.
Contents:
Fundamental equations in the theory of elasticity; Energy theorems in solid mechanics; General variational principles, approximate, and numerical methods; Static, vibration, and stability analysis of frame and truss structures; Plasticity theory and residual stresses in truss, beam, and frame structures. A final exam or mid-term exams will be given.
Recommended or required reading:
Outinen, H.:Lujuusoppi III, TTKK:n opintomoniste 65, 2.tark. p., Tampere, 1983; Outinen, H., Pramila, A.: Lujuusopin elementtimenetelmän käyttö. TTKK, opintomoniste 110 A, Tampere, 1988; Krishnamoorthy, C. S.: Finite Element Analysis: Theory and Programming, 2nd ed., McGraw Hill: New Delhi, 1997; Cook, R. D., Malkus, D. S., Plesha, M. E.: Concepts and Applications of Finite Element Analysis, 3rd ed., John Wiley & Sons: New York, 1989.

460085A: Engineering Software Tools, 3 op

Voimassaolo: - 31.07.2021
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Department of Mechanical Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

460020A	Basics of computing and programming in mechanical engineering	5.0 op

465084S: Exercises in Physical Metallurgy, 4 op

Voimassaolo: 01.08.2008 - 31.07.2021
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Mechanical Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

465114S	Exercises in physical metallurgy	5.0 op

Learning outcomes:
This course aims at giving the student the skills to find and use of materials engineering literature and to write a clear, well arranged report. The student also will become familiar with some topic areas of physical metallurgy on a deeper level.
Learning outcomes: After the course, the student is capable of finding relevant and reliable literature on the topic of his/her research work. In addition, he/she is able to use this literature for solving his/her research problem and for preparing a well arranged research report. In the future, the student will be able to go deep into essential matters of his/her research subject of physical metallurgy.
Learning activities and teaching methods:
The course consists of three personal less extended experimental or literary works on given topics. Each exercise includes a report. Timing is free.
Recommended optional programme components:
Physical metallurgy I and II

461028S: Experimental Methods in Engineering Mechanics, 6 op

Voimassaolo: - 31.07.2021
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Mechanical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Väliheikki, Osmo Tapani
Opintokohteen kielet: Finnish
Leikkaavuudet:

461116S Experimental methods in engineering mechanics 5.0 op

Learning outcomes:
The course focuses on experimental methods in engineering mechanics, where the student becomes familiar with measurements principles, application potentials and constraints.
Learning outcomes: Student can make strain gage and vibration measurements in engineering mechanics field of know-how. With modal analysis tests, student can prepare measurements, make tests and estimate accuracy of the results and compare them to calculated results. He/she can find out characteristic magnitudes from the measurements. He/she can independently make strain gage measurements and estimate the inaccuracies.

Learning activities and teaching methods:
The course consists of exercises and practical work. To pass this course, the student must take a final exam and complete the approved practical work.

460075S: Experimental Methods in Internal Combustion Engines, 3,5 op

Voimassaolo: - 31.07.2021
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Mechanical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Haataja, Mauri Kalevi
Opintokohteen kielet: Finnish

Learning outcomes:
The aim of this course is to familiarize the student with experimental research methods in engine laboratory, measuring and data acquisition methods, measuring technology, systematic planning and implementation of measurements, discussion of experimental results, reporting and quality systems of laboratory measurements as well as product development activities.
Learning outcomes: The student is capable of using international standards related to measurements of internal combustion engines and quality systems with expertise. The student is able to account for operating principles and requirements of engine load device, measuring device and data acquisition system. The student is able to draw up measuring plans, perform measurements, write measuring reports and perform a critical analysis of the results.
Contents:
Measuring and data acquisition systems of engine laboratory; Measurements of experimental room conditions; Engine braking benches; Engine load cycles; Power; torque and speed of rotation; Measuring air quantity; Measuring fuel mass; Determining the air coefficient; Lambda sensor; Exhaust gas emission analyzers; Combustion pressure sensor of a cylinder; Experiments: determining engine load cycles; Characteristic fuel consumption with various loadings; Determining exhaust gas emissions with various tests cycles.; Testing exhaust gas catalytic converter; Reporting experimental measurements
Learning activities and teaching methods:
Engine technical measurements will be performed at the OAMK automotive vehicle and engine laboratory. Grades will be determined by an exam, exercises and laboratory experiments.
Recommended optional programme components:
460073A Internal Combustion Engine I
Recommended or required reading:

Lecture notes and the material will be handed out during the lectures. Autoteknillinen taskukirja, 6. painos 2003. Gummerus Oy. Engine laboratory measurements and quality system standards.
Additional literature: Zhao,H., Ladommatos,N., Engine Combustion Instrumentation and Diagnostics.2001. SAE. Standardit EC 80/1269, ISO 1585, ISO 8178. JIS D 1001 , SAE J 1349 , DIN 70020. Plint,M., Martyr A., Engine Testing. Theory and Practice. 2nd Edition. Butterworth-Heinemann. Stone,R., Introduction to Internal Combustion Engines 3rd Edition. SAE. 1999. van Basshuysen, R.,Schäfer,F., Internal Combustion Engine Handbook. SAE. 2004. Blair. G.,P., Design and Simulation of Four-Stroke Engines. 1999. SAE. Aumala; Mittaustekniikan perusteet. 359 Otatieto..1989.

465079S: Failure Analysis, 3,5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Karjalainen, Pentti

Opintokohteen kielet: Finnish

Leikkaavuudet:

465113S Failure mechanisms in metals 5.0 op

Language of instruction:
Finnish
Learning outcomes:
This course provides the necessary skills and knowledge to make interpretations and identification of material failures and structural damage and to suggest cures to avoid those failures.
Learning outcomes: Upon completing of the required coursework, the student is able to list the typical stages of failure analysis. He/she can explain the influence of loading conditions on the direction of the fracture surface. The student is able to list and justify the potential failure mechanisms based on certain detectable features on the fracture surface. He/she has the skills to present justified advice and cures to avoid further failures.
Contents:
General principles, concepts and techniques applied in failure analysis; Failure modes and mechanisms (mechanical overloading, creep, fatigue, corrosion, hydrogen effects, wear); Identification of failure mechanisms based on characteristic features on fracture surfaces; Examining fractured components during lectures; Case studies
Learning activities and teaching methods:
Lectures will be held during the 5th period with interfering students. A translation of a article will also be part of the course work along with a final exam.
Recommended or required reading:
Lecture notes (in Finnish)
Wulpi, D.J.: Understanding How Components Fail, ASM 1985.
Engel L. and Klingele H.: Atlas of Metals Damage, Carl Hauser Verlag.

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. Zienkiewcz & R. L. Taylor: The Finite Element Method, 4th ed, Vol. 1: Basic Formulation and Linear Problems.

461034A: Finite Element Methods II, 3,5 op

Voimassaolo: 01.08.2008 - 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:

461109A Finite element methods II 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 in dynamic and buckling analyses and the preparedness to use and complement commercial FE-programs.
Learning outcomes: After this course, the student can explain the basic idea of the FEM in
the case of two- and three dimensional, geometrically complicated structures. In addition to the linear displacement and heat transfer problems, he/she is able to critically utilize the ready to use FEM-programs in the analysis of buckling-, modal- and dynamic problems. Also, the student knows the basic types of nonlinearity and recognizes their effect on the computations.

Contents:
Shell and solid elements. Buckling and modal analyses. Dynamic analyses. An introduction to the nonlinearities.

Learning activities and teaching methods:
Lectures and exercises take place during periods 3 and 4. The final assessment will be a final examination.

Recommended optional programme components:
Strength of Materials I and II, Finite Element Methods I.

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. Zienkiewcz & R. L. Taylor: The Finite Element Method,
4th ed, Vol. 1: Basic Formulation and Linear Problems. NAFEMS: A Finite Element Dynamics Primer, NAFEMS:

Introduction to Nonlinear Finite Element Analysis.

477305S: Flow Dynamics, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Muurinen, Esa Ilmari

Opintokohteen kielet: Finnish

Leikkaavuudet:

470303S Flow Dynamics 3.5 op

Language of instruction:
Finnish
Learning outcomes:
To familiarise the student with mathematical modelling of flow phenomena using computational fluid dynamics (CFD).
Learning outcomes: After completing the course the student is able to formulate the partial differential equations describing flow and to solve these equations in systems with simple geometry using difference, finite element and finite volume methods. He/she is able to choose the experimental methods for validation of the calculated results and the methods to measure the most common properties describing fluid flow. After the course the student is able to model simple flow configurations and to design experimental systems and measurements for verifying computational results.
Contents:
Equations in fluid dynamics. Partial differential equations. Difference method. Graphical representation. Modelling the turbulence. Finite element method. Finite volume method. Experimental fluid dynamics.
Learning activities and teaching methods:
Lectures and compulsory exercise done in small groups. Examination.
Recommended optional programme components:
Courses Momentum Transfer 477301A, Matrix Algebra and Numerical Methods are recommended.
Recommended or required reading:
Anderson J.D.: Computational Fluid Dynamics, McGraw-Hill, 1995, 608 pp. Hämäläinen J. & Järvinen J.: Elementtimenetelmä virtauslaskennassa, CSC – Tieteellinen laskenta Oy, 1994, 212 pp. Versteeg, H. K. & Malalasekera, W.: An Introduction to Computational Fluid Dynamics, Longman Scientific and Technical, 1995, 257 pp. Tavoularis, S.: Measurements in Fluid Mechanics, 2005, 354 pp.
Additional literature: Shaw, C.T.: Using Computational Fluid Dynamics, Prentice Hall, 1992, 251 pp.; Nakayama, Y. & Boucher, R.F.: Introduction to Fluid Mechanics, Arnold, 1999, 308 pp.: Haataja J., Käpyaho, J. & Rahola, J.: Numeeriset menetelmät. CSC – Tieteellinen laskenta Oy, 1993, 236 pp; Rathakrishnan, E.:Instrumentation, Measurements, and Experiments in Fluids, 2007, 492 pp.
Person responsible:
Laboratory engineer Esa Muurinen

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.

461021S: Fracture Mechanics, 5 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:

461115S Fracture mechanics 5.0 op

Language of instruction:
In Finnish
Learning outcomes:
The aim of the course is to familiarise students with the fracture of materials and with the use of fracture mechanics in design, which has become popular in machine construction and especially in the design of welded steel structures.
Learning outcomes: Upon completion of the course, a student should be able to know the fracture mechanisms and influence of material properties to them. He/She is also able to solve linear elastic fracture mechanics problems using tablebooks. Moreover the student is able to solve fatigue crack growth problems. The student is able to use finite element method to solve fracture mechanics problems. After the course the student has the basic skills to use fracture mechanics in design.
Contents:
Fracture mechanisms. Influence of material properties. Linear elastic fracture mechanics. Advanced fracture mechanics. Energy principles. Fatigue crack growth. Experimental methods.
Learning activities and teaching methods:
The course is given when necessary. Timetable and working methods are notified later.
Recommended optional programme components:
461010A, 461011A, 461012A and 461013A , recommended 465071A
Recommended or required reading:
Ikonen, K. & Kantola, K.: Murtumistekniikka, Moniste 844, Otatieto Oy 1991 ; How to - Undertake Fracture Mechanics Analysis, NAFEMS, 1999 ; Hellan, K.: Introduction to Fracture Mechanics, McGraw-Hill 1985 ; Broek, D.: Elementary Engineering Fracture Mechanics, 3rd revised edition, Martinus Nijhoff Publishers, Hague 1982.

465094A: Furnace Technology, 4 op

Voimassaolo: - 31.07.2021
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Mechanical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Pyykkönen
Opintokohteen kielet: Finnish

Language of instruction:
Finnish
Learning outcomes:
The objective of the course is to supply the student with a basic understanding of the modern heat treatment furnaces and reheating furnaces, heat transfer and basics of the developing of furnaces.
Learning outcomes: Upon completing the required coursework, the student can explain the reasons for the heat treatment and its effects on the final properties of the product. With the help of a short theoretical background, the student can explain the principles of heat transfer which are important from the point of view of the furnace technology. Furthermore, the student can explain how the properties of the furnace and of the material to be heat-treated affect the final result of the heat treatment. The student can propose modern methods in connection with the furnace technology, with the heat treatment technology and material technology after completing the course.
Contents:
Reasons and needs for the heat treatment; Furnace types; Selection criteria of furnaces; Choice of the form of energy of the furnace; Measurement of the temperature from furnace, and adjusting and control of the temperature; Refractory lining alternatives; Heat transfer; Heating and thermal insulation analysis; Optimization of the refractory lining
Learning activities and teaching methods:
The lectures will make up 20 hours of the course. Furthermore, the course includes literature work. The lectures take place during the 3rd period. An examination will be taken after the course has ended.
Recommended optional programme components:
Introduction to Materials Science.
Recommended or required reading:
Lecture notes; Metals Handbook, vol. 4 Heat Treating, ASM Metals

477505S: Fuzzy-neuromethods in Process Automation, 4 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Process and Environmental Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Esko Juuso
Opintokohteen kielet: Finnish
Leikkaavuudet:

477525S	Computational intelligence in automation	5.0 op
470438S	Fuzzy Sets and Neural Networks in Process Automation	3.5 op

ECTS Credits:
4,0 cr
Language of instruction:
Finnish and English
Timing:
Implementation in 5th period.
Learning outcomes:
The objective of the course is to provide advanced understanding on the methodologies and applications of intelligent systems, especially in process automation.

Learning outcomes **:** After the course the student is capable of explaining the concepts of intelligent systems and operation principles of fuzzy set systems, neural networks, neuro-fuzzy systems and genetic algorithms. The student has skills to construct and tune fuzzy models in Matlab-Simulink environment and to explain the operation of these models. The student is able to explain in an integrating way the principle concepts of neural computing and construct neural network models in Matlab-Simulink environment. The student recognizes the key problems of the data-driven modelling and is able to choose suitable solutions which ensure generalization. The student is able to explain the operation principles of genetic algorithms and to use them in optimization. Moreover, the student is able to describe alternative solutions for dynamic models, hyper plane methods and hybrid solutions. The student can explain the key concepts of cellular automata and evolutionary computation. After the course the student is able to search other relevant programming tools.

Contents:

Modelling, modular and equation based simulation, dynamic simulation, intelligent methods in simulation, simulation in automation, event handling in continuous simulation, simulation of production processes, distributed simulation, integration with other systems, simulation languages and programming tools.

Learning activities and teaching methods:

The course consists of lectures, several exercises, a case study, two seminars and a final report. The case study covers several topics applied in a chosen problem. Each seminar presentation concentrates on a single topic. The final grade is based on the combined points from exercises, case study, seminar and the final report. Final exam is an alternative for the final report. Reports and exams can be done also in English.

Recommended or required reading:

Lecture notes and exercise materials. Material is in Finnish and in English.

Person responsible:

University teacher Esko Juuso

031029S: Graph Theory, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Matti Peltola

Opintokohteen kielet: Finnish

Leikkaavuudet:

031084S	Graph Theory	5.0 op
031082S	Graph Theory	10.0 op

Language of instruction:

Finnish

Timing:

Period 4-6

Learning outcomes:

The course gives the elementary theory of graphs and directed graphs. Trees and bipartite graphs is introduced. Connectivity, coloring and embedding properties of a graph is studied. Ramsey numbers, Eulerian and Hamiltonian graphs as well as planar graphs is introduced. Graph algorithms, tournaments and networks is studied.

Learning outcomes: After completing the course the student is able to express fundamental properties of a graph. He can analyze connecticity, colouring and embedding properties of a graph and recognize the central part of a graph. He can apply basic methods of discrete mathematics to proving simple statements of graph theory. He can categorise graphs by the parameters, subgraphs and other properties of graphs.

Contents:

Consepts of graphs. Trees and bipartite graphs. Distance and connectivity. Eulerian and Hamiltonian graphs. Colouring of a graph and Ramsey numbers. Planar graphs. Directed graphs and networks.

Learning activities and teaching methods:

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

Recommended or required reading:

Diestel R.: Graph Theory. Harary F.: Graph Theory.

461035A: Heat and Mass Transfer I, 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: Lahtinen, Hannu Tapio
Opintokohteen kielet: Finnish
Leikkaavuudet:

461105A	Technical thermodynamics	5.0 op
460093A	Technical Thermodynamics	5.0 op

Learning outcomes:
The students will gain the knowlegde of fundamental laws in thermodynamics and their application in engines and power plants as well as the basics of fluid flow in pipes and heat transfer.
Learning outcomes: After the course, the student can explain the principal laws of thermodynamics and their impact on energy conversions. He/she can apply the energy balance equations for closed and open systems in the calculation of properties and path functions of different processes. The student can explain the theoretical foundations of combustion engines, gas and vapor power plants, and refrigerators and heat pumps. In addition, he /she can solve problems regarding fluid flow in pipes and heat transfer.

Contents:
Heat transfer and fluid flow in pipes; Principal laws in thermodynamics and basic concepts involved; Applications in production, transformation, transfer and use of energy.

Learning activities and teaching methods:
Lectures and exercises are held at spring during periods 5 and 6, and a final exam is required.

Recommended optional programme components:
Basic courses in Physics
Recommended or required reading:
Jokilaakso, A., Virtaustekniikan ja aineensiirron perusteet, Otakustantamo, 1987; Krannila, M., Termodynamiikka, Tampereen pikakopio Oy, Tampere, 1980; Cengel, Y.A. & Boles, M.A., Thermodynamics; An Engineering Approach, Fifth edition in SI-units, 2006.

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 viscid 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-Heineman.

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. Garnegie 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 .

030005P: Information Skills, 1 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Faculty of Technology

Arvostelu: 1 - 5, pass, fail

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

Opintokohteen kielet: Finnish

Leikkaavuudet:

030004P Introduction to Information Retrieval 0.0 op

ECTS Credits:
1 credit.
Language of instruction:
Finnish/English
Timing:
2nd or 3rd year.
Learning outcomes:
Students know the different phases of information retrieval process and basic techniques of scientific information retrieval. They will find the most important reference databases of their discipline and know how to evaluate information sources and retrieval results.
Contents:
Retrieval of scientific information, the retrieval process, key databases of the discipline, and evaluation of information retrieval and information sources.
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 from Toolbox of Reseach (https://wiki.oulu.fi/display/tor/1.1+Finding+scientific+information)
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
Other information:
http://www.kirjasto.oulu.fi/index.php?id=738

460073A: Internal Combustion Engines I, 3,5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Haataja, Mauri Kalevi

Opintokohteen kielet: Finnish

Leikkaavuudet:

464124A Internal combustion engines 5.0 op

Learning outcomes:
The aim of the course is to provide students with general conception of vehicle and machinery engines, operating principles, main dimensioning methods, thermodynamic work cycles, environmental issues and maintenance. Learning outcomes: The student is capable of accounting for working principles of a piston engine. The student is able to explain mixture formation, factors affecting cylinder filling and burning processes, exhaust gas emission formation and methods of maintenance. The student is able to perform basic dimensioning of charged and naturally aspirated piston engines and thermodynamic calculations as well as draw up characteristic drawings.

Contents:
Structural systems and basics of piston engines; Mixture formation and cylinder filling; Engine fuels; Exhaust gas emission formation; Ignition, fuel and control systems; Main dimensioning methods for piston engines; Theoretical work cycles and efficiencies; Charging methods; Technical measurements for engines
Learning activities and teaching methods:
The course consists of lectures and calculation exercises. There will also be exercises and laboratory experiments in the course. Engine technical measurements will be performed at the OAMK automotive vehicle and engine laboratory. Grades will be determined by an exam, exercises and laboratory experiments.
Recommended or required reading:
Lecture notes and the material will be handed out during the lectures.
Additional literature: Heywood, John B.,Internal Combustion Engine Fundamentals. McGraw-Hill Book Company. 1988. Stone, R., Introduction to Internal Combustion Engines. 3rd Edition. 1999.
SAE. Pulkrabek, W., Engineering Fundamentals of the Internal Combustion Engine. 2nd Edition. 2004. Baines,N. C., Fundamentals of Turbocharging. 2005. Concepts NREC.USA.. van Basshuysen, R.,Schäfer,F., Internal Combustion Engine Handbook. SAE.2004. Heisler, H., Advanced Engine Technology. 2003. Butterworth-Heinemann. Merker, G.P., Stiesch,G., Technische Verbrennung. Motorische Verbrennung. 1999. B.G.Teubner Dietzel,F., Wagner, W., Technische Wärmelehre. 7. Auflage.1998. Vogel-Buchverlag.

460074S: Internal Combustion Engines II, 5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Haataja, Mauri Kalevi

Opintokohteen kielet: Finnish

Leikkaavuudet:

464126S Machine dynamics of piston engines 5.0 op

Learning outcomes:
The student will become familiar with mechanical dynamics and vibrations of piston engines and basis for dimensioning of mechanical elements of crank shaft mechanism.
Learning outcomes: The student is capable of determining kinematics and characteristic drawings. The student will be familiar with mass, gas, tangential and bearing force diagrams. Student is able to determine balancing method of mass forces and vibration damping method of the crankshaft mechanism. In addition to this, the student is able to determine dimensions of machine elements and analyze them using methods applicable for engine design.
Contents:
The kinematics and kinetics of crank shaft mechanism; Gas, mass and bearing forces; Tangential force and torque; Mass forces balancing methods; Vibration mechanics of crank shaft mechanism; Dimensioning methods for machine elements of crank shaft mechanism; Analysis methods of piston engines
Learning activities and teaching methods:
Lectures and calculation exercises will be held during periods 3 and 4. Exercises and laboratory experiments will be performed during periods 5 and 6. Engine technical measurements will be performed at the OAMK automotive vehicle and engine laboratory. The grades will be determined by an exam, exercises and laboratory experiments.
Recommended optional programme components:
460073A Internal Combustion Engine I
Recommended or required reading:
Lecture notes and the material will be handed out during the lectures.
Additional literature: Heywood, John B.,Internal Combustion Engine Fundamentals. McGraw-Hill Book Company. 1988. Stone, R., Introduction to Internal Combustion Engines. . 3rd Edition 1999. Pulkrabek, W., Engineering Fundamentals of the Internal Combustion Engine. 2nd Edition. 2004. Baines,N.C., Fundamentals of Turbocharging. 2005. Concepts NREC. van Basshuysen, R.,Schäfer,F., Internal Combustion Engine Handbook. SAE.2004. Heisler, H., Advanced Engine Technology. 2003. Butterworth-Heinemann. Merker, G.P., Kessen,U., Technische Verbrennung Verbrennungsmotoren. 1999.Teubner , Hoag,K., L., Vehicular Engine Design. SAE. 2006. . Blair. G.,P., Design and Simulation of Four-Stroke Engines. 1999. SAE.

031047S: Introduction Course to the Boundaryelement Method, 6,5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Hamina, Martti Aulis

Opintokohteen kielet: Finnish

Leikkaavuudet:

031083S Principles of the boundary element method 7.0 op

Language of instruction:
Finnish
Timing:
Period 1-2
Learning outcomes:
The student is given a description of the mathematical machinery which is necessar
for implementation of the boundary element method. Both theoretical and practical aspects are included.
Learning Outcomes **:** The students will be able to program a solution algorithm by using the Boundary Element Method. They understand the underlying principles of basic numerical methods (FDM, FEM, BEM) used for approximate solution of the boundary value problem of the potential equation.
Contents:
Connections between differential and integral equations. The variational form and minimum characterization of a boundary value problem. Formulation of a potential problem as a boundary integral equation. The numerical solution of a boundary integral equation. Spline interpolation. Numerical integration. Funkcional analytical background. The Lax-Milgram theorem. Comparison between the method of finite differences, finite elements and boundary elements. Convergence.
Learning activities and teaching methods:
Lectures and classroom exercices.
Recommended optional programme components:
Calculus I and II, matrix algebra, differential equations, numerical methods.
Recommended or required reading:
Lecture notes in Finnish. Chen G., Zhou J.: Boundary Element Methods. Hackbush W.: Integralgleichungen. Brebbia C.A, Dominguez J.: Boundary Elements. An Introductory Course.

460125A: Introduction to Design of Steel Structures, 4 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Kangaspuoskari, Matti Johannes

Opintokohteen kielet: Finnish

Leikkaavuudet:

466105S Design of Steel Structures 6.0 op

Learning outcomes:
Learning outcomes: After the course, the student is capable of explaining the crystalline structure of steel material and he/she understands the elasto-plastic material model. He/she is able to explain the effect of inclusions, heat treatment and the welding process on the mechanical properties of steel material. The student is familiar with fire design of steel structures. He/she is able to explain common types of corrosion. The student is able to design the most common joints in steel structures and he can analyze a simple steel memberpart.

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.

465071A: Introduction to Materials Science, 3,5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Leinonen, Jouko Iivari

Opintokohteen kielet: Finnish

Language of instruction:
Finnish; Laboratory exercises also in English
Learning outcomes:
The student will know the fundamental principles of materials science and the most important physical phenomena occurring in solid state of metallic structures.
Learning outcomes: After the course, the student is able to explain the fundamental characteristics of crystalline structure and special features attached. He/she is able to judge the effects of plastic deformation on metal structure and mechanical properties. In addition, he/she is able to present recovery and recrystallization of cold deformed metal and their significance in practice. Based on a phase diagram, the student is capable of estimating the microstructure of a metal alloy after solidification and phase transformations appearing in a solid state. He/she is also able to explain behavior of metal under pressure in cases of different type stresses and at different temperatures.
Contents:
Crystalline structure of metals; Plastic deformation, recovery and recrystallization; Phase diagrams; Phase transformations; Behavior of metal under pressure
Learning activities and teaching methods:
Lectures will be held during period 4, and the three laboratory exercises in small groups will be during periods 5 and 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. The course is recommended to be completed during the third study year.
Recommended or required reading:
Lecture booklet (in Finnish); Exercise materials
Additional material: Lindroos, V, Sulonen, M.,Veistinen, M.: Uudistettu Miekk-ojan metallioppi. Otava: Helsinki, 1986.

460088P: Introduction to Programming, 3 op

Voimassaolo: 01.08.2007 - 31.07.2009
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Department of Mechanical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Pekka Tyni
Opintokohteen kielet: Finnish
Leikkaavuudet:

811119P Principles of Programming 4.0 op

Learning outcomes:
Learning outcomes: Upon completion of the course, the student should be capable of making a little console-operated program written in C in a Windows-environment.
Learning activities and teaching methods:
The course consists of lectures that take place during the first year, autumn term. Exercises and an exercise assignment will take place after the lectures. Please check the timing for them.
Recommended or required reading:
A literature list will be handled out during the course.

463066A: Introduction to Sheet Metal Design, 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 students to obtain the basic knowledge of sheet metal design and its methods and tools by lectures, seminars and practical projects.
Learning outcomes: After the course, the student can describe the main features of designing sheet metal products. He/she also will know how to design sheet metal parts or assemblies from material, functional or manufacturing point of view.
Contents:
Classes and seminars deal with the basics of sketching, design methodology and computer-aided tools for designing sheet metal parts. Additionally, the dimensioning principles, selection of materials and their surface finishes, as well as the pros and cons of different manufacturing processes are explained. Finally, the student can apply his/her knowledge to designing production-friendly sheet metal products and assemblies.
Learning activities and teaching methods:
The course will consist of classes, seminar as well as a group project. Classes and seminars, which are mainly in Finnish, are held during period 2, and the project is completed during period 3. The grade will be based on the exam, seminar, and the project.
Recommended optional programme components:
Machine Drawing, Machine Design I, CAD
Recommended or required reading:
Course notes (mainly in Finnish); Contemporary articles
References: Ion, J.C.: Laser processing of engineering materials, Elsevier, 2005. SSAB: Fogningshandboken, SSAB Tunnplåt AB, Borlänge, 2004. SSAB: Formningshandboken, SSAB Tunnplåt AB, Borlänge, 1997. SSAB: Plåthandboken, SSAB Tunnplåt AB, Borlänge, 1996.Schuler GmbH (Ed.): Metal forming handbook, Springer, Verlag, Berlin, 1998.

761121P: Laboratory Exercises in Physics 1, 3 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Department of Physics
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

ECTS Credits:
3 credits
Language of instruction:
The lectures and the instruction material will be in Finnish. The laboratory experiments will be made in groups guided either in Finnish or in English.
Timing:
Autumn, spring.
Learning outcomes:
Main aim is to learn to make safe physical measurements, use different measurement tools, read different scales, handle the data, calculate the error estimations and make a sensible report of the measurements. After this course the student is able to make laboratory experiments and reports independently.
Contents:
The skill to make laboratory measurements is important for physicists. This is an introductory course how to make physical measurements and how to treat the measured data. Laboratory works are made in groups. The laboratory security is an essential part also in physics. Different measurements are made with different instruments. As a result the most probable value is determined as well as its errors. Five different works will be made during the course in groups of up to 8 students. The skills obtained during this course can be applied in the other laboratory courses Laboratory exercises in physics 2 and 3.
Learning activities and teaching methods:
Lectures 12 h, exercises 20 h (5 x 4 h). Written reports of the experiments and a written examination.
Target group:
Compulsory.
Recommended optional programme components:
Upper secondary school physics and mathematics.
Recommended or required reading:
English material is given from laboratory.
Person responsible:
Kari Kaila
Other information:
https://wiki.oulu.fi/display/761121P/
Registration for the course and exams will be found by using the code 761121P-01

477409S: Laboratory Exercises of Metallurgy, 4 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Process and Environmental Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Fabritius, Timo Matti Juhani
Opintokohteen kielet: Finnish

Leikkaavuudet:

470306S Laboratory Exercises in Process Engineering 3.5 op

Language of instruction:
Finnish.
Learning outcomes:
The student will have an idea about the laboratory research and industrial research projects. 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 factors that must be taken into account in experimental laboratory research and industrial campaigns. (S)he can also execute experimental research and/or process evaluation based on measurement data as a part of a research group and write a report in which the experimental results are considered and reflected from the perspective of theoretical knowledge. During the course student is also familiarized with experimental apparatus used in the pyrometallurgical research.
Contents:
Lectures: laboratory research and occupational safety. Laboratory exercises will be determined according to prevailing research work.
Learning activities and teaching methods:
Lectures, an exercise work in the laboratory of Process Metallurgy Laboratory and exercise works in the steelworks of Tornio and Raahe. Please not the course is not organised for the English speaking students.
Recommended optional programme components:
Courses Structure of Solid Materials, Surfaces and Phase Boundaries in Pyrometallurgy, Melting and Solidification, Slags and Slag Formation in Pyrometallurgy recommended beforehand.
Recommended or required reading:
Material will be distributed during lectures and exercises.

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

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: Hydraulitekniikka, 2008; Mäkinen Reijo:
Hydrauliikka 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

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); ***Turvallisuusjohtaminen*** , Työsuojeluoppaita ja -ohjeita 35. Työsuojeluhallinto 2008.; www.vtt.fi/proj/riskianalyysit/

464087A: Maintenancy 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

Arvostelu: 1 - 5, pass, fail

Opettajat: Janne Järvinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay721172P	Management Accounting (OPEN UNI)	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
5 ects.
Language of instruction:
English (course is lectured separately in Finnish and in English).
Timing:
Period C.
Learning outcomes:

After passing the course, the student knows the basic cost concepts and the elements of cost accounting systems. Students are able to apply the basic cost information in the company's decision making.
Contents:
Theoretical framework for understanding cost accounting, cost concepts, cost recording, different product costing methods, cost-volume-profit analysis, using cost accounting information in decision making.
Learning activities and teaching methods:
40 h lectures and exercises, independent reading of study materials.
Recommended or required reading:
Drury, C.: Management and cost accounting. Thomson Business Press, 5th ed. 2000 or newer. Chapters 1-14 (in 6th edition pages 3-584); Supplementary material in Finnish: Vehmanen P. & Koskinen K.: Tehokas kustannushallinta. WSOY, Ekonomia -sarja 1997 Chapters 1-2, 4-7, 9.
Availability of course books.
Assessment methods and criteria:
Lectures and literature examination.
Grading:
1-5.
Person responsible:
Professor Janne Järvinen.

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.

463054S: Manufacturing Technology II, 17 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:

463107S Manufacturing technology II 20.0 op

463054S2 Manufacturing technology II 17.0 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. Laboratory and design exercises will be done according to the project plan during the fall and spring semesters in groups of four. A seminar attendance and presentation will be included in the course during the fall semester. A visit to a factory is included to the course. The course will be passed by taking either two mid-term examinations or a final examination and completing the exercises which need to be done, returned and accepted. The final grade is a combined result of exercises and a final 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.

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, IndustrialPress, 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 Tunnplåt AB, Borlänge, 2004. SSAB: Formningshandboken, SSAB Tunnplåt AB, Borlänge, 1997. SSAB: Plåthandboken, SSAB Tunnplåt 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 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)-

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

031044A: Mathematical Methods, 4 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Mathematics Division
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Language of instruction:
Finnish
Timing:
Period 1-3
Learning outcomes:

The course objective is to give to students the basic knowledge of Fourier methods in engineering, how to compute Fourier series, Fourier transforms, Z-transforms and how to apply these transforms for solving some problems in engineering. Furthermore, in the course the student will be provided with the elements of multivariate calculus. Finally at the end of the course some elementary partial differential equations are introduced and solved by the Fourier techniques.
Learning outcomes: The student learns to compute the Fourier-series representaion of a periodic function and form its frequency spectrum. He/She is able to compute the Fourier-transform and its inver Fourier transform. The student is able to find the Z-transform of discrete sequence and perform the inverse Z-transform. As one of the learning outcomes the student is able to calculate the gradient of a function as well as the divergence and the curl of a vector field. Finally, he/she knows the basic analytic solution methods for the partial differential equations.
Contents:
Complex numbers. Fourier-series. Fourier-transform. Z-transform. Gradient, divergence and curl. Partial differential equations
Learning activities and teaching methods:
Lectures 4h/week. Two intermediate exams or one final exam.
Recommended optional programme components:
Calculus 1, Matrix algebra and Differential Equations.
Recommended or required reading:
- K. Ruotsalainen, Mathematical methods (lecture notes in finnish)
- Glyn James; Advanced Modern Engineering Mathematics

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

Language of instruction:
Finnish
Timing:
Period 1-3
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 _nd the solution of the system of linear equations. The student is able to recognise the vector space and can relate the consepts 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 linaer 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.

464089S: Measuring Instrumentation and Techniques for Diagnosis of Machine Condition, 5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Lahdelma, Sulo Olavi

Opintokohteen kielet: Finnish

Leikkaavuudet:

462112S Measuring instruments in machine diagnostics 5.0 op

Language of instruction:
Finnish
Learning outcomes:
The objective of the course is to provide students with more in-depth knowledge of the most common measuring instruments used in machine diagnostics, their operating principles and calibration techniques.
Learning outcomes: After the course, the student is able to design, build and calibrate different types of measurement sequences which are needed in machine diagnosis. He/she knows how to use data recorders, analyzers, PC-based measuring systems, data acquisition boards and filters as well as other typical measuring devices and is able to explain their operating principles. The student is also able to recognize typical sources of errors which can influence the reliability of the measuring results.
Contents:
Measuring instruments used in machine diagnostics are handled in the course such as data recorders, analyzers, PC-based measuring systems, filters and data acquisition boards, calibrators, permanently installed measuring systems as well as other typical measuring devices and their operating principles.
Learning activities and teaching methods:
The course consists of lectures arranged during the 2nd period and exercises during periods 2 and 3. The grade of the course is based on a final examination.
Recommended optional programme components:
The Maintenance Technology Course is recommended.
Recommended or required reading:
Klein, U., Schwingungsdiagnostische Beurteilung von Maschinen und Anlagen. Düsseldorf, Verlag Stahleisen GmbH 2003. (In German); Lahdelma, S., Lecture notes: Diagnosis of machine condition 2008. (In Finnish); Lectures and other material notified in the course.; English material is also available.
Supplementary reading: Aumala, O., et al., Mittaussignaalien käsittely. Tampere: Pressus Oy, 1998. (In Finnish); Hoffmann, J., Taschenbuch der Messtechnik. München: Fachbuchverlag Leipzig, 2007. (In German); Aumala, O., Mittaustekniikan perusteet. Helsinki, Otatieto, 2003. (In Finnish)

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.

461027S: Mechanics of Composites, 5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Lahtinen, Hannu Tapio

Opintokohteen kielet: Finnish

Leikkaavuudet:

461114S Mechanics of composites 5.0 op

Learning outcomes:
The aim of this course is to learn about the fundamentals of microscopic and
macroscopic behavior of composite materials and their application in analysis and dimensioning of composite structures.
Learning outcomes: After the course, the student can use terminology of composite materials and their typical mechanical properties in the design of structures. He/she can explain how the elastic properties of anisotropic materials affect the mechanical behavior of laminated shells and plates and calculate stresses and strains of laminae and laminates. In addition, he/she is capable of analyzing bending, buckling and vibration problems of composite laminates by using the classical lamination theory and the finite element method.

Contents:
Terminology of composite materials; Elastic properties of anisotropic materials; Micro and macro mechanics of lamina; Macro mechanics of laminates; Bending, buckling and vibration of laminates; Principles of dimensioning of laminated structures.

Learning activities and teaching methods:
The course is held in every second autumn. Further information on the structure of the course will be given at the beginning of the course.

Recommended optional programme components:
Strength of Materials I ja II.

Recommended or required reading:
Jones, R.M., Mechanics of Composite Materials, McGraw-Hill, 1975; Tsai, Composite Design, Think Composites, 1987; Vinson & Sierakowski, The Behaviour of Structures Composed of Composite Materials, Martinus Nijhoff, 1986.

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.

462051S: Mechatronics, 5 op

Voimassaolo: - 31.07.2021
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Mechanical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Nevala, Aimo Kalervo
Opintokohteen kielet: Finnish
Leikkaavuudet:

462108S Mechatronics 6.0 op

Learning outcomes:
The main objective of the course is to provide the students with skills to exploit their knowledge of mechanics, electronics and information technology in designing mechatronic products.
Learning outcomes: Upon completion of the course, the student is able to use the most common simulation and design methods used in the field of mechatronics. Student can choose and measure actuators for electric and hydraulic servo systems. Student can also analyze the kinematical properties of simple mechanisms as well as calculate set points for the actuators driving the mechanisms. Furthermore, student can define the basic structure of a digital control system and is able to evaluate the operating preconditions of the digital control.

Contents:
Simulation and modeling techniques used in the field of mechatronics; Actuators suitable for servo systems; Intelligent actuators; Electrohydraulic servo systems; Digital control of electrical drives; Sensors in feedback systems; Set point calculation; Modeling of the kinematics and dynamics as well as inverse kinematics; Digital control of actuator systems
Learning activities and teaching methods:
This course consists of 30 hours of lectures, 20 hours of exercises and 10 hours of laboratory exercises. Exercises familiarize students with common calculation and design problems in mechatronics. The lectures involve small-scale design exercises. In order to pass the course and maintain the right to come to the

examination, students have to complete the exercises. The final grade is determined by the sum of the exercises and examination.

Recommended optional programme components:

Sensor Technology of Machine Automation

Recommended or required reading:

Airila, M. Mekatroniikka, 5. edition, Otatieto (897), 1999. 405 p. Niiranen, J. Sähkömoottorikäytön digitaalinen ohjaus, Otatieto (590), Espoo 1999, 379 p. Students will be notified of the other literature in the beginning of the course.

477406S: Melting and Solidification, 4 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Tanskanen

Opintokohteen kielet: Finnish

Leikkaavuudet:

470616S Casting and Solidification 3.0 op

Language of instruction:

Finnish

Timing:

Implementation in 1st period.

Learning outcomes:

Student passing the cource can describe the melting and solidyfying process of inorganic pure substances and multicomponent systems and factors having affects on these. Additionally, the student can read phase diagrams and predict behavior of inorganic materials exposed to changing conditions.The student can tell examples of industrial processes containing melting and solidifying processes and can give detailed describtions about phenomena acting in the progresses. 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 passing the cource can describe the melting and solidyfying process of inorganic pure substances and multicomponent systems and factors having affects on these.

Additionally, the student can read phase diagrams and predict behavior of inorganic materials exposed to changing conditions.The student can tell examples of industrial processes containing melting and solidifying processes and can give detailed describtions about phenomena acting in the processes.

Contents:

Melting and solidification of pure phases and substances, effect of alloyed compounds, multicomponent systems. Fundamentals of phase diagrams, application of phase diagrammatic approach and operations on the melting and crystallization of materials. Industrial examples containing continous casting of steel among others

Learning activities and teaching methods:

Contact teaching during the 1 st period, during which further information will be given concerning the examination. Please not the course is not organised for the English speaking students.

Recommended optional programme components:

Passing the course Structure of solid materials or equal knowledge. Sufficient knowledge about thermodynamics and mass and heat transfer.

Recommended or required reading:

Material used during the course.

Supplementary literary material **:** T o the appropriate extent of Heikkinen, E-P.: Metallurgin hyvä tietää, moniste 58: Pyrometallurgisten prosessien teoria (in Finnish). Other possible materials will be announched during the course.

Person responsible:

University teacher Pekka Tanskanen

460076A: Mobile Hydraulics, 3,5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Liedes, Toni Mikael

Opintokohteen kielet: Finnish

Leikkaavuudet:

464122A Mobile hydraulics 5.0 op

Learning outcomes:
The objective of the course is to provide the students with a general idea of the design and dimensioning of hydraulic systems used in mobile machines.
Learning outcomes: Upon completion of the course, the student is able to describe the basic circuits and characteristics in mobile hydraulics. The student can also describe the most important components and operational preconditions of the mobile hydraulic systems. The student can explain the structure and characteristics of a hydropneumatic suspension system. The student is able design simple mobile hydraulic systems. Furthermore, the student is able have discussions with the experts in the field of mobile hydraulics using relevant terminology.
Contents:
Applications of hydraulic systems in mobile machines; Fundamentals of proportional- and hydraulic technique;. Components and their properties; Basics of design and dimensioning; Maintenance and safety of hydraulic systems
Learning activities and teaching methods:
The course consists of lectures, exercises and laboratory work. At least two reports regarding the laboratory works must be completed. The grade is determined by the sum of examination and exercises.
Recommended or required reading:
Fonselius, J: Koneautomaatio: Hydrauliikka. 1995. Fonselius, J: Koneautomaatio: Servotekniikka. 1998. Mäkinen, R: Hydrauliikka II. 3rd ed. 1991. Louhos, P&J-P: Ajoneuvo- ja työkonehydrauliikat. 1992. Current publications in the field of mobile machines and hydraulics.

031022P: Numerical Analysis, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: Finnish

Language of instruction:
Finnish.
Timing:
Period 4-6
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 spesific 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

Prequisites: Calculus 1, Calculus 2, Matrix algebra and Differential Equations.

031073S: Numerical Methods, Advanced Topics, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Hamina, Martti Aulis

Opintokohteen kielet: Finnish

Leikkaavuudet:

031081S Numerical methods, advanced topics 10.0 op

ECTS Credits:
8
Language of instruction:
Finnish
Timing:
1-3
Learning outcomes:
The student gets an understarding of basic conceps of functional analysis and can apply operator methods for planning and analyzing numerical algorithms. The student achieves the knowledge of the interconnection between variational principles and the finite element method (FEM).
Contents:
Review of functional analysis. Approximation theory. Numerical integration. The approximate solution of linear operator equations. Introduction to nonlinear operator techniques. Variational principles. The finite element method. Implementation: Lectures and classroom exercises. Final exam.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures 40 h / Group work 20 h.
Target group:
-
Prerequisites and co-requisites:
The recommended prerequisite is the completion of the courses 031010P Calculus I, 031011P Calculus II, 031017P Differential equations and 031019P Matrix Algebra.
Recommended optional programme components:
-
Recommended or required reading:
Lecture notes and exercises in Finnish; Atkinson, K., Han, W., Theoretical Numerical Analysis: A Functional Analysis Framework; Linz P.: Theoretical Numerical Analysis; Eriksson K., Estep D., Hansbo P., Johnson C.: Computational Differential Equations;
Assessment methods and criteria:
Intermediate exams or a final exam.
Grading:
1-5
Person responsible:
Martti Hamina
Working life cooperation:
-
Other information:
-

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

461023S: Optimization of Structures, 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:

461117S Engineering optimization 5.0 op

Language of instruction:
Finnish
Learning outcomes:
The aim of this course is to familiarize students with the principles of optimization of structures and their applications in the design of machine parts, welded plate structures, trusses and frames.
Learning outcomes: Upon completing the required coursework, the student knows the fundamental concepts of the optimization and recognizes the different mathematical definitions of the optimum, so called Kuhn Tuckers conditions. He/she is able to formulate the optimization problem mathematically and knows the most important solution methods for the linear and the nonlinear problem both in the constrained and unconstrained cases. The student knows the steps
and the structure of the most widely used algorithms, the pros and cons of the different methods, and their suitability in the different problem types. He/she is able to use a commercial computer
software for the application in the optimization of machine parts.
Contents:

Formulation of an optimization problem; Linear and non-linear optimization in the design of load-bearing structures; Computer software for optimization of structures; Optimization as a part of a computer aided design system

Learning activities and teaching methods:
The course is based on lectures, calculation and design exercises. The final grade is based on the combined points from exercises and the final exam. Note: The course is held every other year.

Recommended or required reading:
Arora, J.S. (2004) Introduction to Optimum Design. Elsevier, 728s. Kirsch, U. (1981) Optimus structural design, McGraw-Hill, 441s. Haftka, R. T., Gurdal, Z., Kamat, M. P. (1990) Elements of Structural Optimization, Kluwer, 396 s.

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

ECTS Credits:
1 crecit.

Language of instruction:
Finnish.

Timing:
1-3 period.

Learning outcomes:
Upon completion of the course, students will be familiar with the university and the structure of the degree programme. They will be able to gain the tools they need for their studies and the planning of them.
Learning outcome: After the course the student is able to recognize his/her own study environment and can make use of the student services of the university. The course provides with skills to draft individual study plan and gives information about different methods of studying. The student can describe some specific professional aspects in the field of architecture or engineering and he/she is also able to use the facilities of academic libraries.

Contents:
Introduction to studies. Overview of the services offered by the university, student organizations and the Finnish social system (f.eg. student financial aid, academic sports services, student health services). Introduction to the University and the Faculty and their administration, degrees and studies at the Faculty of Technology. Overview of the professional aspects in the fields of engineering and architecture and job prospects. Introduction to the methods of studying and to the skills in gaining the tools needed for planning of the studies. Overview of library services, Oula - library catalogue and Nelli - e-resources.

Learning activities and teaching methods:
1. Orientation day for all new students organized by the Faculty of Technology. 2. Orientation to the degree programmes organized by the departments. 3. Student tutoring during the autumn term. Groups are formed during the degree programme orientation. 4. Information on areas of specialization within the degree programmes (during the 2 nd or 3 rd year). 5. Orientation (2 hours) to the library and Oula - library catalogue and Nelli - e-resources at the Science and Technology Library Tellus.
Participation in orientations 1, 2 and 5 and min. 5 student tutorials are required for completion of the course.

Grading:
Pass/fail.

Person responsible:
Chief academic officer of the faculty, study advisors of the departments, library.

477407S: Oxidation and Reduction in Pyrometallurgy, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Fabritius, Timo Matti Juhani

Opintokohteen kielet: Finnish

Leikkaavuudet:

470618A Laboratory Work of Process Engineering 3.0 op

Language of instruction:
Finnish
Timing:
Implementation in 2nd period.
Learning outcomes:
Student passing the cource can characterize transformations of pyrometallurgical systems expoced to oxidation or reduction conditions. The student can use chemical reactions, phase transformations and system transformations as the describing tools. Additionaly, the student can tell examples about industrial processes using oxidation-reduction –reactions and can give detailed describtions about phenomena acting in the 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 passing the cource can characterize transformations of pyrometallurgical systems expoced to oxidation or reduction conditions. The student can use chemical reactions, phase transformations and system transformations as the describing tools. Additionaly, the student can tell examples about industrial processes using oxidation-reactions and can give detailed describtions about phenomena acting in the processes.
Contents:
Prometallurgical reducton-oxidation reactions between gas-solid-, gas-liquid-, liquid-liquid- and solid-liquid phases, for example reduction of iron oxides. Industrial process applications: reduction reactions in the blast furnace, high temperature corrosion and reducton-oxidation reactions of the liquid steel.
Learning activities and teaching methods:
Contact teaching during the 2 nd period, during which further information will be given concerning the examination. Please not the course is not organised for the English speaking students.
Recommended optional programme components:
Passing the course Structure of solid materials or equal knowledge. Sufficient knowledge about thermodynamics and mass and heat transfer.
Recommended or required reading:
Material used during the course.
Supplementary literary material: T o the appropriate extent of Heikkinen, E-P.: Metallurgin hyvä tietää, moniste 58: Pyrometallurgisten prosessien teoria (in Finnish). Other possible materials will be announched during the course.
Person responsible:
Professor Timo Fabritius

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

464085A: Patenting, 3,5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Niskanen, Juhani

Opintokohteen kielet: Finnish

Leikkaavuudet:

464104A	Product innovations	5.0 op
ay464085A	Patenting (OPEN UNI)	3.5 op

Learning outcomes:

The purpose of this course is to provide students with the knowledge of principals and different ways to protect industrial property rights in Finland and internationally. The main emphasis is on patenting; how to protect valuable product design from imitation; and how to avoid infringement of competitors' industrial property rights. Learning outcomes: Upon completion of the course, the student can explain conditions for a patentable design and compare patenting to other ways of protecting industrial rights and is able to make an application for patent. The student also knows employer's and employee's rights in case of making an invention as an employee.

Contents:

Product protection models and their use in competition; Comprehension and legitimacy of the protection by patent; Applying for patent and making an application for a patent; Applying for a patent in a foreign country; Situations involving a conflict; Patent legislation

Learning activities and teaching methods:

The course includes lectures with several practical examples. The guided exercise is to make a domestic patent application. The final exam and an exercise where a group of students prepare a patent application will be part of the course. The final grade is the average of the exam and exercise.

Recommended or required reading:

Copies of lecture material

465081S: Physical Metallurgy I, 7 op

Voimassaolo: - 31.12.2014

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Karjalainen, Pentti

Opintokohteen kielet: Finnish

Leikkaavuudet:

465110S Strength of metallic alloys 7.0 op
465064S Strength of metal alloys 7.0 op

Language of instruction:
Finnish
Learning outcomes:
The aim of the course is to introduce the factors and phenomena in metals and alloys under plastic straining affecting their plastic flow, strain hardening rate and strength properties. In particular, the role of the stacking fault energy on dislocation movement and resultant dislocation structures and plastic flow are considered.
Learning outcomes: Upon completing of the required coursework, the student is able to explain the strengthening mechanisms in metals and alloys. He/she can explain the influence of alloying on the stacking fault energy of an alloy and its influence on the characteristics of dislocations and their ability to move in a lattice. He/she is able to compare the strain-hardening rates of alloys and can explain the effect of grain size on static, fatigue and creep strengths. He/she also has skills to analyse simple transmission electron microscopy pictures, knows the main mechanisms in fatigue and creep deformations and is able to list the most important factors affecting the behaviour. The student is able to utilize deformation maps in creep analysis and is able to list the main terms affecting texture formation and analysis.
Contents:
Strengthening mechanisms: dislocation hardening, solid solution, precipitation, grain size refinement, multiphase structures; A brief introduction to the dislocation theory; Fatigue; Creep; Texture; Fracture process
Learning activities and teaching methods:
The course consists of 45 hours of lectures and a seminar during periods 2 and 3..
Recommended optional programme components:
465061A Materials Engineering I and 465075A Research Techniques for Materials
Recommended or required reading:
Lecture notes
R.W. Cahn and P. Haasen, Physical Metallurgy, 4 ed., North Holland, 2005. (electric version)
R.E. Smallman and R.J. Bishop, Modern Physical Metallurgy & Materials Engineering, 6th ed., Butterworth-Heinemann, Elsevier Science Ltd, 1999. (electric version 2002).

465082S: Physical Metallurgy II, 7 op

Voimassaolo: - 31.12.2014

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

465109S Microstructural changes in metallic alloys 7.0 op
465063S-01 Microstructural changes in metallic alloys, examination 0.0 op
465063S-02 Microstructural changes in metallic alloys, exercises 0.0 op
465063S Microstructural changes in metallic alloys 7.0 op

Language of instruction:
Finnish
Learning outcomes:
The aim of the course focuses on the combination and adaptation of contents of the material from previous science courses into practical and applicable knowledge with an advanced understanding on physical metallurgy.
Learning outcomes: After the course, the student is capable to apply basic principles of thermodynamics and kinetics to phase transformations. He/she is able to estimate the effect of a phase diagram on the microstructure of a metal alloy. On the basis of diffusion theory, the student is able to explain solidification, recrystallization and precipitation of metal alloys, and additionally the phase transformation of steels during austenite dissociation (ferrite, pearlite, bainite,
martensite). He/she is also able to explain phase structures and their mechanical properties in steels on the basis of TTT diagrams.
Contents:

Thermodynamics and kinetics of phase transformations in a solid state; Phase diagrams; Diffusion; Solidification; Recrystallization; Precipitation; Martensitic transformation; Pearlite and bainite reactions; TTT diagrams and their applications

Learning activities and teaching methods:
The course consists of lectures and seminars during periods 4 to 6. The final grade is based on the weighed combined points from the final exam or the small exams and the personal seminar work.

Recommended optional programme components:
Materials Engineering I, Introduction to Materials Science

Recommended or required reading:
Lecture booklet (in Finnish)
Additional material: Porter, D. & Easterling, K.: Phase Transformations in Metals, Van Nostrand Reinhold Company: New York, 1981; Honeycombe, R.W.: Steels - Microstructure and Properties.

463060S: Planning of Flexible Manufacturing System, 3,5 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:
This course provides the student with the knowledge concerning the development of a flexible manufacturing system, its problems and their possible solutions. After this course the student is able to choose the most economical machinery and automation level.
Learning outcomes: After the course the student is able to explain the benefits of the flexible manufacturing system in small batch manufacturing. He/she can describe the main phases of the planning project. He/she knows how to use different technologies in implementation of manufacturing automation. He/she is also able to evaluate the profitability of equipment choices.

Contents:
Flexible manufacturing systems; Realization of a production automation project; Setting of objectives and standards; Layout planning; Strategic planning; Productivity

Learning activities and teaching methods:
Lectures and exercise project are during periods 4 and 5. The final grade is a combined result of exercise project and a final exam.

Recommended optional programme components:
463053A Manufacturing Technology I

Recommended or required reading:
All study materials will be given at the start of the lectures

461013A: Plates and Shells, 5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Sjölind, Yngve Stig-Göran

Opintokohteen kielet: Finnish

Learning outcomes:
The aim of this course is to familiarize students with the basic principles and methods of designing and analyzing the behavior of structures assembled from plane elements and curved shells.

Learning Outcomes **:** Upon completion of the course, the student is able to assess the action of slabs, plates, and shells in load carrying structures. He/she is able to apply the most important analytical and numerical methods for determining stress and strain states in structures. The student is also able to analyze stability and vibrations problems in structures.
Contents:
Analytical and approximate methods for analyzing structures in plane stress and plane strain conditions; Application of energy principles, analytical, and numerical methods (FEM) in solving bending, stability and vibration problems for plate structures; Membrane theory, bending theory and stability of shell structures; Analytical and approximate solution methods for axisymmetric shells
Recommended optional programme components:
461012A Energy Principles and Their Use in Beam Structures
Recommended or required reading:
Girkmann, K.: Flächentragwerke, VI-auflage, Springer-Verlag: Berlin, 1965; Timoshenko, S., Woinowsky-Krieger, S.: Theory of Plates and Shells, McGraw-Hill Book Company: Tokyo, 1959; Szilard, S.: Theory of Plates, Prentice Hall: New Jersey, 1974; Outinen, H.; Pramila, A.: Lujuusopin elementtimenetelmän käyttö, TTKK, Opintomoniste 110A&B, Tampere, 1988; Krishnamoorthy, C. S.: Finite Element Analysis: Theory and Programming 2nd ed., McGraw Hill:
New Delhi, 1997; Cook, R., Malkus, D., Plesha, M. E.: Concepts and Applications of Finite Element Analysis, 3rd ed., John Wiley & Sons: New York, 1989.

460001A: Practical Training, 3 - 5 op

Voimassaolo: - 31.07.2021
Opiskelumuoto: Intermediate Studies
Laji: Practical training
Vastuuyksikkö: Department of Mechanical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Pyykkönen
Opintokohteen kielet: Finnish
Leikkaavuudet:

460003A Practical training I 5.0 op

Ei opintojaksokuvauksia.

460002S: Practical Training II, 3 - 5 op

Voimassaolo: 01.08.2005 - 31.07.2021
Opiskelumuoto: Advanced Studies
Laji: Practical training
Vastuuyksikkö: Department of Mechanical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Pyykkönen
Opintokohteen kielet: Finnish
Leikkaavuudet:

460004S Practical Training II 5.0 op

Ei opintojaksokuvauksia.

462038A: Precision Engineering, 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

Leikkaavuudet:

462106A Precision engineering 5.0 op

Language of instruction:
Finnish
Learning outcomes:
Learning outcomes: Upon completion of the course, the student can analyze working principles of structures and components used in precise engineering products, can explain special features of design and manufacturing, and can design new qualified and easily manufactured precise engineering products.
Contents:
Introduction; Design of devices; Housings and frames; Permanent joints; Detachable joints; Springs; Bearings; Guides; Pins and shafts; Couplings and clutches; Screw, toothed and friction gears; Flexible connector drives; Indicators; Micromechanical systems
Learning activities and teaching methods:
The course consists of lectures and an exercise assignment
Recommended or required reading:
Lecture notes (in Finnish).
Additional literature: Krause, W.: Grundlagen der konstruktion, elektronik, elektrotechnik, feinwerktechnik, 7 aufl., Hanser, 1994; Ullman, D.: The mechanical design process, 3. ed., Mac-Graw-Hill, 2003.

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

Language of instruction:
Finnish.
Timing:
Period 1-3.
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
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

ECTS Credits:
5 ects.

Language of instruction:
Finnish.

Timing:
Period A.

Learning outcomes:
Upon the completion of this course, the students will have a general view of the background of academic marketing education and research; as well as understands the nature of marketing discipline. After the course, students will have knowledge about exchange in world history and understand the effects of industrialization to marketing science and practice. They will identify the connections between marketing and business economics and have acquired knowledge about business schools and their importance to business management. In addition, students will recognize the core concepts of marketing.

Contents:
The role of marketing education and research in business schools, definition and phenomena's of marketing, the history of marketing, marketing as a part of business management, core concepts of marketing, marketing as a practice and science.

Learning activities and teaching methods:
25 hours of lectures and independent reading of the textbooks.

Recommended or required reading:
Gummesson, E.: Suhdemarkkinointi: 4P.stä 30R:ään. Kauppakaari Oy. 1997.

Check availability from here.
Assessment methods and criteria:
Lectures and literature examination.

Grading:
1-5.

Person responsible:
Professor Kimmo Alajoutsijärvi.

031072S: Principles of the Boundary Element Method, Homework Exercise, 2 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Mathematics Division
Arvostelu: 1 - 5, pass, fail
Opettajat: Hamina, Martti Aulis
Opintokohteen kielet: Finnish

Language of instruction:
Finnish

Learning outcomes:
The purpose of the homework exercise is to deepen the students understanding on the implementation of a mathematical algorithm.
Learning Outcomes **:** The student will be faced against various problems which occur while implementing a numerical solution by using the Boundary Element Method. This will be very instructive for the student.
Contents:
A homework exercise from the field of the course: Principles of the Boundary Element Method. Usually it consists of programming and documentation of a boundary element algorithm (C, MATLAB, Fortran, etc.). Literature work is also optional. A reasonable documentation is required.
Recommended optional programme components:
Principles of the boundary element method.

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

Language of instruction:
Finnish
Timing:
Period 4-6
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).

465089S: Processing and Properties of Steels, 3,5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Karjalainen, Pentti

Opintokohteen kielet: Finnish

Leikkaavuudet:

465115S Processing and properties of steels 5.0 op

Language of instruction:
Finnish
Learning outcomes:
The course provides the students with an extensive introduction to manufacturing and properties of modern steels: the influence of the processing route, ladle metallurgy and thermo-mechanical treatments on microstructure and mechanical properties. Properties of various steel grades available are described and their developmental trends discussed. The influence of inclusions on steel properties are also dealt with.
Learning outcomes: Upon completing of the required coursework, the student is able to explain most important factors and stages affecting the quality of liquid steel. He/she can explain the metallurgical phenomena taking place during thermo-mechanical processing of steels, and in particular, the techniques utilized for grain size refinement. The student is able to list and describe most important construction steel types, the main features of their properties and their development trends. The student can also explain the factors affecting the inclusion formation and techniques to control them. Furthermore, he/she can assess the influence of inclusions on steel properties.
Contents:
Processing and treatments of crude iron and steel; Continuous casting and thermo-mechanical processing of steels; Physical metallurgy behind the phenomena in the course of thermo-mechanical treatments; Modern steel grades and their development; Impurities and inclusions in steel and their influence on strength, fatigue, toughness, formability, weldability, etc.
Learning activities and teaching methods:
The course consists of lectures during the 2nd period and a laboratory exercise work. The assessment is given in the form of a final exam.
Note: The course is given in every other year.
Recommended or required reading:
Lecture notes
Tamura, T.: Thermomechanical Processing of High Strength Low Alloy Steels, Butterworths Co Ltd: London, 1988
Rautaruukin terästuotteet, Suunnittelijan opas, 2000
Rautaruukin teräkset ääriolosuhteissa, 2000.

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 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.

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 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 in 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 it’s 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.

464079S: Programmable Controllers and Field Bus Systems, 5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Tyni

Opintokohteen kielet: Finnish

Learning outcomes:
The objective of the course is to provide students with the principles of general control technology and instructions on how to use programmable controllers and field buses in machine automation.
Learning outcomes: Upon completion of the course, the student should be capable of explaining the operational principle of a programmable logic system. He/she is able to select proper equipment and program it. In addition, the student is able to give examples of the use of a programmable controller in the industry. He/she can also explain the operational principle of field buses and the pros and cons of using them.
Contents:
How to connect a control system to the system to be controlled using sensors and actuators; Constructions and operation principles of programmable controllers; Programming principles; Fundamentals of choosing programmable controllers; Fundamentals of field buses and their use with control systems
Learning activities and teaching methods:
Teaching is arranged during the autumn term. Lectures are during the first period and the exercises are held during periods 2 and 3. An exercise assignment and a written exam are required.
Recommended or required reading:
A literature list will be handled out during the course.

521143A: Programming, 7,5 op

Voimassaolo: - 31.07.2012

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Riekki, Jukka Pekka

Opintokohteen kielet: Finnish

Language of instruction:
Finnish.
Timing:
Period 4-6.
Learning outcomes:
Learning outcomes: Upon completing the required coursework, the student is able to evaluate algorithms and data structures and alternatives for implementing them. Moreover, the student is able to design and implement algorithms and data structures using different programming paradigms.
Contents:
Data structures, algorithms, complexity, programming paradigms.
Learning activities and teaching methods:
Will be lectured first time in spring term 2010
Recommended optional programme components:
Elementary programming, Embedded Systems Programming
Recommended or required reading:
Will be announced later

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.

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: Jokinen, Tauno Jaakko, 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
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

464058S: Project Work in Machine Design, 8,5 op

Voimassaolo: 01.08.2005 - 31.07.2021

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Karhunen, Pauli Jouko Allan

Opintokohteen kielet: Finnish

Leikkaavuudet:

464107S Machine design project 10.0 op

Learning outcomes:
Upon completion the student has realised a demanding development or design project from a topic given by the industry.

Learning outcomes: After completion of the course, the student is able to develop a totally new product or improve essentially an existing product.
Contents:
Carrying out a wide industry based product development project
Learning activities and teaching methods:
Project work is done in groups of 1 to 3 students depending on the size and requirements of the work. Work can be started during the exercises of Machine Design III.
Recommended or required reading:
Supplied according to needs

464084S: Project Work in Paper Machinery Construction, 8,5 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:

464107S Machine design project 10.0 op

Learning outcomes:
The aim of this course is to deepen the student’s knowledge of constructions of paper machines with the help of extensive exercises. Upon completion of the course, the student has realized a demanding research, development or design project from a topic given by the industry.
Learning outcomes: After completion of the course, the student is able to analyze, develop or improve existing paper machine components or processes.
Contents:
Carrying out a wide industry based product development, research or design project
Learning activities and teaching methods:
Project work is done in groups of 1 to 3 students depending on the size and requirements of the work. Work can be started during the lectures of the course Paper Machine Construction.
Recommended or required reading:
Supplied according to needs

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.

463062S: Quality in Production, 3,5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Martti Juuso

Opintokohteen kielet: Finnish

Leikkaavuudet:

463103A Quality in production and dimensional measurements 5.0 op

Learning outcomes:
Quality in Production is the supplementary course for the students graduating in the field of Functions of Management in Industry. The aim of this course is to understand the effects of a comprehensive quality control on the functions and costs of an enterprise and the principles of realization of quality assurance
Learning Outcomes: Upon completion of the course, the student is able to specify the concept of quality, explain the quality control in different phases of production and explain how it is possible to realize quality assurance by using different methods and principles of quality assurance. In addition, the student is able to explain the principle of quality system and to plan the quality system according to the requirements of quality standards.
Contents:
Concept of quality; TQC managing philosophy; Quality control in different phases of production; Quality costs; Methods of quality assurance; Quality system of a company; Quality policy in subcontracting; Quality circles.;SFS-ISO 9000 quality standards
Learning activities and teaching methods:
The course consists of lectures, exercises and the practical work. Lectures and exercises take place during periods 1 and 2. The final grade is based on the combined points from the final exam and exercises.
Recommended or required reading:
Study materials include copies of lecture material. Other material will be distributed at the start of lectures.
Ishikawa, Kaoru: What is Total Quality Control, Prentice-Hall, 1985.
Ishikawa, Kaoru: Introduction to Quality Control, Chapman & Hall, London, 1990.
Shingo, Shigeo: Zero Quality Control; Source Inspection and the Poka-Yoke System, Productivity Press, 1986

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.
Timing:
Period 1-2.
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. Markov chains. Signal estimation, Wiener-filter and orthogonality principle. Matched filter, signal detection and MAP-receiver.
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 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 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.

465075A: Research Techniques for Materials, 3,5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Karjalainen, Pentti

Opintokohteen kielet: Finnish

Leikkaavuudet:

465105A Research techniques for materials 5.0 op

Language of instruction:
Finnish
Learning outcomes:
This course gives an introduction to the broad spectrum of experimental techniques used in materials research, excluding materials testing. The principles, advantages and limitations of the various methods and their field of applications are described.
Learning outcomes: Upon completing of the required coursework, the student can explain the structure, functioning and contrast formation as well as factors affecting the resolution of various metal microscopes. He/she is also able to explain the concepts of the thermal analysis, dilatometry, and magnetic and electrical measurements and list typical applications for these techniques and methods.
Contents:
Optical microscopy; Transmission and scanning electron microscopes; Microanalysis; Quantitative metallography and image analysis; Spectroscopic methods; Thermal, dilatometric,
electric and magnetic methods; Measurement of residual stresses; Demonstrations of some techniques
Learning activities and teaching methods:

Lectures and demonstrations will be held during the 1st period. The final assessment will be in the form of a final exam.
Study material: Lecture notes
Kettunen, P.O.: Elektronimikroskopia I ja II, Otakustantamo: Espoo, 1983

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.

465090A: Rolling Technology, 8 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Pyykkönen

Opintokohteen kielet: Finnish

Leikkaavuudet:

465116S Rolling technology 10.0 op

Language of instruction:
Finnish
Learning outcomes:
The target for the course is for the student to gain knowledge of the basic concepts of the rolling technology, the basic character of the rolling process and some special characteristics also which are related to it.
Learning outcomes: Upon completing the required coursework, the student can explain the effects of hot rolling and cold rolling on the quality of the final product. With the help of the learned theory, the student can explain the significance of the process modeling on the control of the rolling process. Furthermore, the student understands the connection between rolling and materials engineering and can estimate their effect on the manufacturing process and on the quality of the final product.
Contents:

Concepts of the rolling technology and terminology; Basics of the plasticity theory; Calculation of roll force and characteristics of roll gap; Temperature behavior during rolling; Flatness and profile analysis; Accuracy of manufacturing and its statistical applications; Modeling of the rolling process
Learning activities and teaching methods:
Lectures will make up 45 hours of the course. Furthermore, the course will include laboratory work for 25 hours. The lectures are in periods 1 – 3. An examination will be taken after the course has ended. The exercises consist of the demonstrations of the modeling programs which are suitable for the rolling technology, of one laboratory work (hot rolling) and of an industry visit.
Recommended optional programme components:
Introduction to Materials Science
Recommended or required reading:
Lecture notes; Starling: Theory and practise of flat rolling

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/ 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).;

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.

462053A: Sensor Technology of Machine Automation, 5 op

Voimassaolo: - 31.07.2021
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Mechanical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Nevala, Aimo Kalervo
Opintokohteen kielet: Finnish
Leikkaavuudet:

462105A Machine Sensor Technology 5.0 op

Learning outcomes:
The objective of the course is to provide the students with a theoretical and practical basis for understanding the sensor technology used in machine automation.
Learning outcomes: Upon completion of the course, the student is able to identify, classify and exploit the most common type of sensors in machine automation. The student is able to choose sensors for typical machine automation applications. Furthermore, the student is able to design a typical signal path having both analog and digital characteristics. The student is also able to design and implement a sensor system for closed loop control systems. In addition to discrete sensors, the student knows the most common positioning systems and can choose a suitable system for a given application.
Contents:
Displacement, velocity and acceleration sensors; Pressure, force and torque sensors; Position and orientation sensors; Transmission and conditioning of sensor signal; Shielding the sensor signal against disturbance; Sensors in feedback control; Positioning systems and their use in control automation
Learning activities and teaching methods:
This course consists of 30 hours of lectures, 10 hours of exercises and 20 hours of laboratory exercises. The exercises familiarize the student with sensor signal conditioning. In order to pass the course and maintain the right to come to the examination, students have to complete the exercises. The final grade is determined by the sum of the exercises and examination.
Recommended or required reading:
Airila, M. Mekatroniikka, 5. edition, Otatieto (897), 1999. 405 p. Kuoppala, R., Nevala, K. & Tyni, P. Anturit koneautomaatiossa. Metalliteollisuuden keskusliiton tekninen tiedotus no.21/8, 87 p. + appendices 98 p. Students will be notified of the other literature in the beginning of the course.

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.

477408S: Slags and Slag Formation in Pyrometallurgy, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Tanskanen

Opintokohteen kielet: Finnish

Leikkaavuudet:

470617S Refractory Materials in Pyrometallurgical Processes 3.0 op

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

Implementation in 3rd period.

Learning outcomes:

The student understands the properties and behaviour of slags in high temperature processes, especially in metallurgy. 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 can explain the structures, properties and relevance of pyrometallurgical slags in high temperature processes. Additionally, (s)he can estimate the relations between process conditions and slag formation based on the structure and properties of the slags.

Contents:

Slags' chemical and physical properties, formation and tasks in different high temperature processes. As applications manufacturing processes of iron and steel.

Learning activities and teaching methods:

Contact teaching and exam during the 3 rd period. Please not the course is not organised for the English speaking students.

Recommended optional programme components:

Passing the course Structure of solid materials or equal knowledge. Sufficient knowledge about thermodynamics and mass and heat transfer

Recommended or required reading:

Material used during the course.

Supplementary l iterary material **:** T o the appropriate extent of Heikkinen, E-P.: Metallurgin hyvä tietää, moniste 58: Pyrometallurgisten prosessien teoria (in Finnish). Other possible materials will be announched during the course.

Person responsible:

University teacher Pekka Tanskanen

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:

ay521457A Software Engineering (OPEN UNI) 5.0 op

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.

477604S: Software and Calculation Tools in Control Engineering, 3 op

Voimassaolo: 01.08.2005 - 31.07.2013

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Manne Tervaskanto

Opintokohteen kielet: Finnish

Leikkaavuudet:

470463S2 Design Software in Automation 5.0 op

ECTS Credits:
3,0 cr

Language of instruction:
Finnish

Timing:
Implementation in 1st period.

Learning outcomes:
Introduction to design and analysis software in automation.

Learning outcomes *:* The student can use software tools for system analysis and control design. The student can autonomously: build models for linear dynamic delayed systems, design PID controllers for them, and assess the closed loop behaviour.
Contents:
Modelling of continuous and discrete systems, Simulation of continuous and discrete systems, Systems analysis, Design of feedback control systems, Identification, Monitoring and control software.
Learning activities and teaching methods:
The course includes exercises with MATLAB. The course concludes in a written exam or skill tests.
Recommended or required reading:
Lecture handout
Person responsible:
University teacher Manne Tervaskanto

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 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.: Lujuusopin perusteet, Pressus Oy, Tampere, 2004, Pennala, E.: Lujuusopin perusteet, Moniste 407, Otatieto 2002; Karhunen, J. & al.: Lujuusoppi, Otatieto 2004; Ylinen, A.: Kimmo- ja lujuusoppi 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.: Lujuusopin perusteet, Moniste 407, Otatieto, 1998; Outinen, H., Koski, J., Salmi, T.: Lujuusopin perusteet, Pressus Oy: Tampere, 2000; Salmi, T., Virtanen, S.: Materiaalien makaniikka, Pressus Oy: Tampere, 2008; Ylinen, A.:Kimmo- ja lujuusoppi I ja II. WSOY, 1976; Bära brista, grundkurs i hållfasthetslära, AWE/Gebers: Stockholm, 1979.

460071A: Structural Systems in Automotive Vehicles I, 5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Haataja, Mauri Kalevi

Opintokohteen kielet: Finnish

Leikkaavuudet:

464123S Structural systems in automotive vehicles 5.0 op

Learning outcomes:
The aim of this course is for the student to become familiar with the basic principles of designing automotive vehicles and construction machines, product development and maintenance.
Learning outcomes: The student is able to design an automotive vehicle chassis, support mechanisms for axles and wheels, and a fastening mechanism for load structures. The student is capable of accounting for basic principles in railway vehicle design. In addition to this, the student is able to measure brake and transmission systems for automotive vehicles, determine load models and dynamic stability of automotive vehicles and construction machines. The student is capable of explaining the regulations and standards that need to be taken into account in automotive vehicles and construction machines design and dimensioning. The student is capable of planning maintenance for a life-cycle of a vehicle and performing technical measurements in automotive laboratories and road conditions.
Contents:
Chassis construction and dimensioning of automotive vehicles; Support and fastening mechanism of axles and load structures; Stability of tilting load structure, crane equipment and machinery; Rollover stability of container vehicles and busses; Support solutions for automotive tires; Power transmission systems for automotive vehicles; Steering systems of automotive vehicles; Automotive brake legislation; The basics of automotive braking; Braking systems of light- and heavy-duty vehicles and trailers combinations; Automotive electrical systems; An

introduction into the design principles of railway vehicles; utomotive technical measurements in automotive laboratories and road conditions

Learning activities and teaching methods:

Lectures and calculation exercises will take place during period 1st. Practical exercises and laboratory experiments will be done during periods 2 and 3rd. Automotive technical measurements will be performed at the OAMK automotive laboratory. Grades will be determined by an exam, exercises and laboratory experiments.

Recommended optional programme components:

462050A Automotive Engineering

Recommended or required reading:

Lecture notes and the material will be handed out during the lectures. International vehicle and machinery regulations and directives will be used.

Additional literature: Happian-Smith, J., An Introduction to Modern Vehicle Design. Butterworth-Heinemann. 2001; Reimpell, J., Stoll, H., Betzler, J. W., Automotive Chassis: Engineering Principles. Butterworth-Heinemann. 1995; Anselm, D., The Passenger Car Body. Vogel Fachbuch, 2000; Braess ,H-H., Seiffert, U., Handbook of Automotive Engineering.SAE, 2005; Beerman, H,J., Rechnerische Analyse von Nutzfahrzeugtragwerken. Verlag TÜV Rheinland,1986; Lechner, G., Naunheimer, H., Automotive Transmissions. Springer-Verlag, 1999; Reimpell, J., Fahrwerktechnik: Radaufhängungen. Vogel-Verlag, Würzburg, 1988. Bosch, Automotive Brake Systems. 1995. Bosch GmbH; Limbert, R., Brake Design and Safety. Second Edition. SAE 1999; Breuer, B., Dausend, U., Advanced Brake Technology. SAE; Breuer., B., Bremsenhandbuch. 2004. SAE; Burckhardt, M., Fahrwerktechnik: Bremsdynamik und Pkw-Bremsanlagen. 1.Auflage. Vogel –Verlag, 1991; Klug H-P., Nutzfahrzeug-Bremsanlagen. Vogel Buchverlag Wurzburg, 1990, 2001; Mitschke, M. Dynamik der Kraftfahrzeuge, Band A: Antrieb und Bremsung, Springer Verlag, Berlin, 1995; Chen, F., Chin, A.,T, Quagliga, R., Disc Brake Squeal. Mechanism, Analysis, Evaluation and Reduction/Prevetion, 2005. SAE; Wong, J., Y., Theory of Ground Vehicles. John Wiley&Sons, Inc., 2001. Automotive electrics and electronics. 3rd Edition,1999; Meskanen, J.,Mäkelä,T., Mäntynen, J., Rautatieliikenne. Tampereen teknillinen korkeakoulu, 1996; Esveld, C., Modern Railway Track, 2nd edition, 2001, MRT-Productions; Iwnicki, S., Handbook of Railway Vehicle Dynamics, 2006. CRC Press; Lichtberger, B., Handbuch Gleis, 2003 Tetzlaff Verlag; Östlund., S., Elektrisk Traktion, KTH Stockholm 2005.

460072S: Structural Systems in Automotive Vehicles II, 8,5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Haataja, Mauri Kalevi

Opintokohteen kielet: Finnish

Leikkaavuudet:

464125S Automotive development project 10.0 op

Learning outcomes:

The aim of this course it to familiarize the student with the product development of automotive vehicles and construction machines, dimension principles of vehicles and structural systems, driving stability of automotive vehicles, and railway vehicle technology. The student will learn how to perform measurements in automotive laboratories and based on road conditions.

Learning outcomes: The student is capable of applying the methods of life cycle design and product development of automotive vehicles and construction machines. The student is able to determine the structure loads of machinery and endurance and is capable of designing steering and power transmission systems of automotive vehicles as well as axle constructions of railway vehicles. The student is capable of dimensioning suspension and damping equipment for automotive vehicles and is capable of determining models of vehicle dynamics on road condition cases. Finally, the student is capable of determining driving stability.

Contents:

Suspension systems and basis of automotive vehicles and construction machines; Steering and power transmission systems of automotive vehicles; Railway vehicle technolog;. Modeling of vehicle dynamics t of automotives and vehicle combinations; Automotive technical measurements in automotive laboratories; An industry design exercise assignment

Learning activities and teaching methods:

This course consists of lectures and calculation exercises. There will also be practical exercises and laboratory experiments.. Automotive technical measurements will be performed at the OAMK automotive laboratory. A

designing assignment for automotive industry will be included in the course. Grades will be determined by an exam, exercises and laboratory experiments.

Recommended optional programme components:

460071A Structural Systems in Automotive Vehicles I

Recommended or required reading:

Lecture notes and the material will be handed out during the lectures.
Additional literature: Wong, J., Y., Theory of Ground Vehicles. John Wiley&Sons, Inc. 2001. Gillespie, T.D.: Fundamentals of Vehicle Dynamics. 1992. SAE. Mitschke, M.: Dynamik der Kraftfahrzeuge, Band B: Schwingungen, Springer Verlag, Berlin, 1997. Esveld, C., Modern Railway Track, 2nd edition, 2001 MRT-Productions. Lichtberger, B., Handbuch Gleis, 2003 Tetzlaff Verlag . Östlund, S., Elektrisk Traktion, KTH 2005. Johansson, A., Out-of-Round Railway Wheels Causes and Consequences. 2005. Chalmers University of Technology. Iwnicki,S., Handbook of Railway Vehicle Dynamics.2006.CRC Press. Wheels and Axles.Cost-effective Engineering.2000. IMechE Seminar Publication. Moyar,G,J., Punwani,S,K., Railroad Journal Roller Bearing Failure and Detection. SAE 1988. Stichel, S., Running behavior of railway freight wagons with single-axle running gear. Railway Technology .Department of Vehicle Engineering.KTH Stockholm 1998. Dixon, J.,C., Tires, Suspension and Handling. Second Edition. 1996. SAE. Genta,G., Motor Vehicle Dynamics. Modeling and Simulation. 1999.World Scientific.

477405S: Surfaces and Phase Boundaries in Pyrometallurgy, 4 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Fabritius, Timo Matti Juhani

Opintokohteen kielet: Finnish

Leikkaavuudet:

470613S Physical Chemistry of Pyrometallurgical Processes 10.0 op

Voidaan suorittaa useasti: Kyllä

Language of instruction:

Finnish

Learning outcomes:

The student will understand the properties of different phases and the interphases (gas-solid, gas-liquid, solid-solid, solid-liquid, liquid-liquid) in the high temperature 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 can explain the essential properties of the phases as well as phase boundaries and interfaces and recognizes their relevance in pyrometallurgical processes. Additionally, (s)he can evaluate the interfacial properties (e.g. wetting, interfacial tension, surface tension) based on their definitions and computational methods as well as estimate the relations between interfacial phenomena and process conditions.

Contents:

Properties of gas, molten and solid phases. The basics of surface chemistry. Especially the structure of solid and molten metals and slags and the effect of different phase interphases in high temperature phenomena.

Learning activities and teaching methods:

Lectures and exam in Finnish during the 5 th period. Please note that the course is not organised for the English speaking students.

Recommended optional programme components:

Education of thermodynamics and transport phenomena that are included in the B.Sc. -studies of the process engineering curriculum. Structure of solid materials.

Recommended or required reading:

Material used during the course. Supplementary literary material: T o the appropriate extent of Heikkinen, E-P.: Metallurgin hyvä tietää, moniste 58: Pyrometallurgisten prosessien teoria (in Finnish). Other possible materials will be announched during the course

900060A: Technical Communication, 2 op

Voimassaolo: 01.08.2005 - 31.07.2021
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Language Centre
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay900060A Technical Communication (OPEN UNI) 2.0 op
470218P Written and Oral Communication 3.0 op

Ei opintojaksokuvauksia.

464061A: Techniques of Creative Working, 3 op

Voimassaolo: - 31.07.2021
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Mechanical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Niskanen, Juhani
Opintokohteen kielet: Finnish
Leikkaavuudet:

464104A Product innovations 5.0 op

Learning outcomes:
The objective of the course for the student to learn to find problems in a familiar environment, analyze them and implement mechanical engineering to solve the problems.
Learning outcomes: Upon completion of the course, the student is able to convert a familiar condition to a problem requiring a technical solution and question existing solutions. The student is able to apply the most important methods of systematic creative working.
Contents:
Analyzing and abstracting of a problem; Connecting a problem to a larger context or its division to minor problems; Applying systematic methods to a defined problem
Learning activities and teaching methods:
The course includes an introductory lesson and guided exercises during lessons. The course also includes a separate group work from a topic that has come up during lessons. This course will have an exam and group work. The final grade is the average of exam and group work. Those who have done the exercises during the lessons are required to answer only half of the questions in the exam.
Recommended or required reading:
Jorma Tuomaala: Luovan työn tekniikka.

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 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.

477404S: Thermodynamics of Hydrometallurgical Solutions, 3 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Eetu-Pekka Heikkinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

470612A Metallurgical Thermodynamics 7.0 op

Language of instruction:

Finnish

Learning outcomes:

To give students an ability to use computational thermodynamics, phase diagrams and solution models in the consideration of hydrometallurgical 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 can examine hydrometallurgical systems including non-ideal solutions using computational thermodynamics, solution models (e.g. Debye-Hückel) and phase diagrams. In addition to actual computational determination of chemical equilibria, student should be able to recognize the role of thermodynamics among the other tools that can be used in process engineering and extractive metallurgy. Finally, (s)he should be able to create computationally solvable problems based on technical problems that in themselves are not solvable computationally as well as interpret and evaluate the computational results from the perspective of the original problem.

Contents:

Fundamentals of hydrometallurgical processes. Solution models that are relevant in the consideration of hyrometallurgical solutions. Phase diagrams. Use of CTD in hydrometallurgy. Fundamentals of corrosion.

Learning activities and teaching methods:

The course is lectured in Finnish during the 3 rd period during which the students are required to make a portfolio consisting of a learning diary and exercices. Please note that the course is not organised for the English speaking students.

Recommended optional programme components:

Education of thermodynamics that is included in the B.Sc. -studies of the process engineering curriculum.

Recommended or required reading:

Material used during the course.

Supplementary literary material: Fletcher, P.: Chemical Thermodynamics for Earth Scientists; Pitzer, K. S., Breewer, L.: Thermodynamics.

Person responsible:

University teacher Eetu-Pekka Heikkinen

477403S: Thermodynamics of Pyrometallurgical Solutions, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Eetu-Pekka Heikkinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

470612A	Metallurgical Thermodynamics	7.0 op

Language of instruction:

Finnish

Learning outcomes:

To give students an ability to use computational thermodynamics, phase diagrams and solution models in the consideration of pyrometallurgical 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 can examine pyrometallurgical systems including non-ideal solutions using computational thermodynamics, solution models (e.g. WLE-formalism) and phase diagrams. In addition to actual computational determination of chemical equilibria, student should be able to recognize the role of thermodynamics among the other tools that can be used in process engineering and extractive metallurgy. Finally, (s)he should be able to create computationally solvable problems based on technical problems that in themselves are not solvable computationally as well as interpret and evaluate the computational results from the perspective of the original problem.

Contents:

Standard states and solution models that are relevant in the consideration of pyrometallurgical solutions. Phase diagrams. Use of CTD in pyrometallurgy.

Learning activities and teaching methods:
The course is lectured in Finnish during the 1 st period during which the students are required to make a portfolio consisting of a learning diary and exercices. Please note that the course is not organised for the English speaking students.
Recommended optional programme components:
Education of thermodynamics that is included in the B.Sc. -studies of the process engineering curriculum.
Recommended or required reading:
Material used during the course.
Supplementary literary material: Gaskell, D.R.: Introduction to Metallurgical Thermodynamics; Biswas, A. K., Bashforth, G.R.: The Physical Chemistry of Iron and Steel Manufacture; Fletcher, P.: Chemical Thermodynamics for Earth Scientists.

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, Otatieto 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).

465088S: Utilization of Electron Optical Methods, 3,5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Karjalainen, Pentti

Opintokohteen kielet: Finnish

Language of instruction:
Finnish
Learning outcomes:
The aim of the course is to deepen the student’s knowledge on electron microscopic techniques and especially their practical applications in examining the microstructure and elemental distribution in metals and alloys.
Learning outcomes: Upon completing of the required coursework, the student is able to make a rational choice of

the electron optical research method and technique to solve a given task. He/she can explain the factors affecting the accuracy of techniques and procedures. The student can also write short reports describing the methods utilized in exercises carried out, interpret and discuss the message of the photos and measured data obtained, and make comparisons of results published in the relevant literature.
Contents:
Contrast and image formation in STEM, SEM/EDS/WDS and SEM-EBSD and EPMA/WDS electron microscopes; Image analysis; Preparation of specimens; Exercises including preparation of specimens and supervised operation of microscopes; Report describing the results and data obtained
Learning activities and teaching methods:
The course is comprised of lectures during the 2nd period and a laboratory exercise work. The assessment is given in the form of a final exam.
Recommended or required reading:
Lecture notes
Other information:
The course is given every other year

031026A: Variational Methods, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Hamina, Martti Aulis

Opintokohteen kielet: Finnish

Language of instruction:
Finnish
Timing:
Period 4-6
Learning outcomes:
Introduction to calculus of variations.
Learning Outcomes **:** The student will be able to identify and solve analytically variational problems by forming and solving the corresponding Euler equation. He can transform a boundary value problem into the variational form. The student can construct approximate solutions by using the Galerkin method.
Contents:
Calculus of variations, Euler equation, generalized coordinates. Variational formulation of a boundary value problem. Hilbert space, Galerkin method
Learning activities and teaching methods:
Lectures and classroom exercices.
Recommended optional programme components:
Calculus I and II, matrix algebra and differential equations.
Recommended or required reading:
Rektorys K.: Variational Methods in Mathematics. Gelfand I. , Fomin S.: Calculus of Variations.

462055S: Virtual Engineering of Mechatronic Products, 5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

462109S Simulation and modelling of machines 8.0 op

Language of instruction:
Finnish

Learning outcomes:
Learning outcomes: Upon completion of the course, the student can use main computer programs used in virtual engineering of mechatronic products.
Contents:
Basics of virtual engineering; modeling and simulation of mechanics, actuators and control; Visualization of working models and dynamic analysis; Virtual management of product families and working principles
Learning activities and teaching methods:
The course consists of lectures and exercise assignments. Exercises include guided working with computer programs.
Recommended optional programme components:
Mechatronics
Recommended or required reading:
Lecture notes

761104P: Wave Motion, 3 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

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

ECTS Credits:
3 credits
Language of instruction:
Lectures and exercises in Finnish. Material in English.
Timing:
Spring
Learning outcomes:
The student can classify different types of wave motions and knows the characterizing quantities (wavelength, period, wave speed), can apply geometrical optics to simple mirror and lens systems, knows the meaning of interference and diffraction and can apply these in simple cases.
Contents:
Basic course on wave motion, and geometric and wave optics.
Wave motion and propagation. Acoustics. Geometric optics: basic principles, mirrors and lenses. Electromagnetic waves. Wave optics: interference, diffraction, and polarization. Optical instruments. Photometry. Laser.
Learning activities and teaching methods:
Lectures 32 h, exercises 10 h, four mini examinations and one end examination or a final examination.
Target group:
For students of minor subject.
Recommended optional programme components:
Upper secondary school physics and mathematics.
Person responsible:
Sami Heinäsmäki
Other information:
https://wiki.oulu.fi/display/761104P/

465080S: Welding Metallurgy, 8,5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

465111S Welding metallurgy 8.0 op

Language of instruction:
Finnish
Learning outcomes:
The course gives essential background information on the phenomena taking place in welding and their influence on microstructures and mechanical properties and also provides skills in select materials and welding methods.
Learning outcomes: Upon completing of the required coursework, student is able to:
-explain the influence of welding conditions on temperature distribution and solidification morphology of a welded joint,
-classify typical microstructures present in the heat-affected zone of low carbon steel weldments,
-compare the importance of microstructure on mechanical properties of the joint, and
-explain the microstructure changes occurring in welding of alloyed steels, cast irons and non-ferrous metals and their influence on properties.
After the course the student also has skills to select a proper weldability test for estimating the risk of cold and hot cracking.
Contents:
Heat distribution in welded joints; Solidification and segregation; Microstructures of the heat-affected zone; Weldability: structural steels, low-alloyed steels, stainless steels, cast irons, nonferrous metals; Welding defects and weldability testing
Learning activities and teaching methods:
This course consists of 40 hours of lectures during the 4th period, a seminar and a laboratory exercise with reporting. The final grade is based on a final exam and an exercise report.
Recommended optional programme components:
465061A Materials Engineering and 465077A Welding Technology
Recommended or required reading:
Lecture notes (mainly in Finnish)
Kou, S.: Welding Metallurgy, Wiley Co, New York, 1987.
Easterling K.: Introduction to the Physical Metallurgy of Welding, Butterworths & Co Ltd: London, 1983 Kyröläinen A. ja Lukkari J.: Ruostumattomat tereäkset ja näiden hitsaus, MET, 1999.

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

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.