Catalogue report

LUT School of Energy Systems

Master's Programme in Welded Metal Structures

Master’s Programme in Welded Metal Structures 2018-2019 (120 ECTS cr)

Facts

- Degree Master of Science in Technology (M.Sc. Tech.), (Diplomi-insinööri in Finnish)
- Higher university degree, gives eligibility to apply for scientific doctoral studies
- Extent 120 ECTS credits
- Duration two years, full-time studies of 60 ECTS per academic year.

Learning Outcomes of the MSc Programme in Welded Metal Structures

After completing Master’s Programme in Welded Metal Structures a student will learn about the design, analysis, fabrication and research of modern and competitive welded metal structures. A student will acquire a good understanding about the strength and ductility properties of metallic materials and their behaviour under long-term loading together with their weldability aspects. This will provide competencies to design different types of metal structures such as machine bodies, bridges, buildings, structural components and bodies for vehicles or supporting structures for different types of engineering applications.

A student will

- be able to demonstrate a comprehensive understanding of design and fabrication of welded metal structures for demanding applications
- have adopted principles of fatigue failure analysis of welded metal structures and metallurgical theories describing the behavior of metallic materials due to different welding processes
- be able to objectively compare different welding processes and analyse their advantanges and disadvantages for different types of industrial application areas
- have adopted the principles of innovative and critical thinking and purposeful problems solving
- be able to work with others in task-orientated groups and participate and interact in the group in a productive manner and lead and manage design projects
- be able to logically think through theoretical and practical problems and solve it
- be able to contribute to innovative thinking to improve the properties and lifetime expectations of welded metal structures

Degree Structure

The Master's degree (120 ECTS) consists of core studies, specialisation studies, minor studies and free elective studies. The Master's Thesis and Seminar is included in the specialisation studies.

See Uni-portal:
Welded Metal Structures

Degree structures

Degree Structure

The Master's degree (120 ECTS) consists of core studies, specialisation studies, minor studies and free elective studies. The Master's Thesis and Seminar is included in the specialisation studies, and the Thesis must be written in English in the programmes taught in English.

Students may choose any minor offered by LUT (check the required prerequisites, if any) or do the minor during exchange abroad (upon application).

Minors of Mechanical Engineering are:

KoDSaManu Modern Manufacturing
KoDSaMate Advanced Materials Engineering
KoDSaLate Laser Processing and
KoDSaSusta Sustainability

Please notice that the extent of the minors of Mechanical Engineering is 25 ECTS cr.

Free elective studies can be any courses offered by LUT if the required prerequisites are fulfilled. Studies in other universities/from abroad or a max. of 10 ECTS of internship (BK10A1400 Work Internship in Master's Degree, 2-10 ECTS) may be included upon application, too. Language studies are recommended, especially English courses and Finnish courses for international students.

See the degree structure for details.

Master's Programme in Welded Metal Structures 2018-2019

Degree structure status: accepted

Academic year: 2018-19

Beginning date of the academic year: 01.08.2018

Core Studies (min 34 cr)

KoDCore: Core Studies, 30 - 40 cr
- *Obligatory Studies 34-35 ECTS cr*
  - BK10A1200: Research Methods and Methodologies, 4 cr
  - BK10A3800: Principles of Industrial Manufacturing Processes, 5 cr
  - BK10A3900: Reliability Based Machine Element Design, 5 cr
  - BK10A4100: Management and Leadership Skills in Mechanical Engineering, 5 cr
  - BK10A5400: Digitised Design and Production in Welded and 3D-printed Structures, 5 cr
  - BK50A2701: Selection Criteria of Structural Materials, 5 cr
  - BK70A0001: Simulation of a Mechatronic Machine, 5 cr
- *Only for students coming outside LUT*
  - BH60A4600: Introduction to M.Sc. Studies, 1 cr

Specialisation Studies (min 55 cr)

KoDWelde: Welded Metal Structures, 30 - 50 cr
- *Choose either module Advanced Structural Design or module Sustainable Welding Production*

KoDWelde150: Advanced Structural Design, 10 - 30 cr
Obligatory Studies 55 ECTS cr
BK10A1501: Master's Thesis and Seminar, 30 cr
BK10A4000: Design of Advanced Plate and Shell Structures, 5 cr
BK80A1302: Applications for FE-method for Steel Structures, 5 cr
BK80A1402: Fatigue Design, 5 cr
BK80A2303: Steel Structures II, 5 cr
Alternative Studies. Students, who wish to focus their studies in business and industrial oriented structure design, should select the first of the following courses and students, who wish to focus their studies in scientific research, should select the latter of the following courses.
BK80A3000: Integrated Design and Fabrication of Welded Structures, 5 cr
BK80A3100: Scientific Research of Welding and Structures, 5 cr
KoDWelde160: Sustainable Welding Production, 10 - 30 cr
Obligatory Studies 55 ECTS cr
BK10A1501: Master's Thesis and Seminar, 30 cr
BK20A0403: Modern Welding Processes, 5 cr
BK20A2400: Materials and Welding Metallurgy, 5 cr
BK20A2500: Sustainable Welding Production, 5 cr
BK20A2600: Modelling and Simulation in Welding, 5 cr
Alternative Studies.Students, who wish to focus their studies in business and industrial oriented structure design, should select the first of the following courses and students, who wish to focus their studies in scientific research, should select the latter of the following courses.
BK80A3000: Integrated Design and Fabrication of Welded Structures, 5 cr
BK80A3100: Scientific Research of Welding and Structures, 5 cr

Minor Studies (min 20 cr)

Students may choose any minor studies taught at LUT if the required prerequisites are fulfilled. Minor studies of Mechanical Engineering are Modern Manufacturing (KoDSaManu), Laser Processing (KoDSaLate), Advanced Materials Engineering (KoDSaMate) and Sustainability (KoDSaSusta).

Free Elective Studies

Choose enough free elective studies to attain the full 120 ECTS cr. Free elective studies can include any courses offered by LUT if the required prerequisites are fulfilled. Students are recommended to include an internship that improves professional skills to elective studies. An internship may be worth a maximum of 10 ECTS credits. More information: BK10A1400 Work Internship in Master’s Degree 2-10 ECTS cr. Also language studies are recommended, especially English courses and Finnish courses for international students.

Courses and study modules not included in degree structures

Minor Studies

The extent of the minor is a min. of 20 ECTS. Students may choose any minor offered by LUT (check the required prerequisites, if any) or do the minor during exchange abroad (upon application).

Minors of Mechanical Engineering are:

Minors of Mechanical Engineering are:
KoDSaManu Modern Manufacturing
KoDSaMate Advanced Materials Engineering
KoDSaLate Laser Processing and
KoDSaSusta Sustainability

Please notice that the extent of the minors of Mechanical Engineering is 25 ECTS cr.

Other minors taught at LUT in the academic year 2018-2019 are:

Energy Technology:
EnSaM100 Energiatekniikka (in Finnish)
EnSaM150 Energiatekniikka, laaja (in Finnish)
EnDSaBT Bio-Energy Technology
EnDMES Modelling of Energy Systems

Environmental Technology:
YmKSaYmte Ympäristötekniikka (in Finnish)
YmDSaResp Environmental Responsibility

Electrical Engineering:
SaSaM100 Sähkötekniikka (in Finnish)
SaSaM101 Sähkötekniikka, laaja (in Finnish)
SaDREE Renewable Energy and Energy Efficiency

Industrial Engineering and Management:
TuKSOTekn Tuotantotalous, sivuopinnot muu tekniikka (in Finnish)
TuDSO Tuotantotalous, sivuopinnot laaja (in Finnish)
TuSOEntr Entrepreneurship, minor

Computer Science:
TikSOTite Tietotekniikka (in Finnish)

Business Administration:
KaSOLiik Liiketoimintaoaaminen (in Finnish)
KaSOIbm International Business and Management

Computational Engineering:
MaKSaM180 Teknillinen matematiikka (in Finnish)
FyKSaM110 Teknillinen fysiikka (in Finnish)
MaKSaHahmo Data-analytiikka (in Finnish)
MaDIntM300 Technomathematics
FyDInt300 Technical Physics
MaDSaCompu Computer Vision and Pattern Recognition

Chemical and Process Engineering:
KeSoM200 Kemia (in Finnish)
KeSoM300 Kemian prosessitekniikka (in Finnish)
KeSoD200 Advanced Water Treatment
KeSOD400 Biobased Chemical Engineering
KeSOD500 Advanced Chemistry

All minor subjects offered in academic year 2018-2019 can be found in the study guide "Minor Studies 2018-2019".

KoDSaMate: Advanced Materials Engineering, 20 - 30 cr
- *Obligatory Studies 25 ECTS cr*
  - BK90C1900: Introduction to Materials Engineering, 4 cr
  - BK90C2000: Hybrid Materials, 3 cr
  - BK90C2100: Functional Properties of Nanomaterials, 3 cr

BK90C2200: Sustainable Manufacturing of Advanced Materials, 5 cr
BK90C2300: High Performance Products, 5 cr
BK90C2400: Project course in Material Engineering, 5 cr

KoDSaLate: Laser Processing, 20 cr

Alternative Studies. Choose at least 20 ECTS cr from following courses.

BK30A0803: Digital Advanced Manufacturing with Lasers, 5 cr
BK30A0901: Additive Manufacturing - 3D Printing, 5 cr
BK30A1201: Laser Materials Processing, 5 cr
BK30A1301: Laser Based Manufacturing for Design, 5 cr
BK30A1400: Individual Project Work of Laser Technology, 5 cr

KoDSaManu: Modern Manufacturing, 20 - 30 cr

Obligatory Studies 25 ECTS cr

BK50A4000: Production Processes in Modern Job Shops, 5 cr
BK50A4100: Manufacturing Systems and Scheduling, 5 cr
BK50A4200: Product Flow in Job Shops, 5 cr
BK50A4300: Managing Job Shops, 5 cr
BK50A4401: Fabrication Laboratory, 5 - 10 cr

KoDSaSusta: Sustainability, 20 - 30 cr

Obligatory Studies 24-27 ECTS cr

BH60A2101: Advanced Course in Life Cycle Assessment, 7 cr
BJ02A4051: Development of New Sustainable Products and Solutions, 5 cr
CS30A1691: Social Sustainability, 6 cr
CT10A7004: Sustainability and IT, 6 cr

Students, who haven't done BH60A0001 Ympäristötekniikan perusteet in their earlier studies, are required to do Introduction to Sustainability.

BH60A4400: Introduction to Sustainability, 3 cr

Course descriptions

Descriptions of courses and study modules included in the degree structures

KoDCore: Core Studies, 30 - 40 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Study module
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F

No course descriptions.

Obligatory Studies 34-35 ECTS cr

BK10A1200: Research Methods and Methodologies, 4 cr

Validity: 01.08.2012 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Teachers: Harri Eskelinen

Note:

The course is arranged concurrently in face-to-face learning and distance learning environment. Replaces the course BK10A1700 Tutkimusmetodiikka JEDI.

Year:

M.Sc. (Tech.) 2

Period:

1-2

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Harri Eskelinen

Aims:

After having passed this course module the student is able to:
- plan, lead and organize the research project according to the established scientific practices and procedures
- compare, choose and utilize proper scientific practices to carry out research projects in industrial environments
- write and present a scientific research plan and research report.

Contents:

Learning outcomes: Criteria to evaluate the scientific contribution of research. Scientific research projects in engineering science. Principles of qualitative and quantitative analysis. Viewpoints on how to illustrate the results of quantitative analysis. Different means to carry out literature reviews, interviews and surveys. Utilisation of silent knowledge. Contents and structures of research plans and research structures based on the IMRAD principle. Viewpoints of writing scientific articles and conference papers. Practical advice about giving a conference presentation. Guidelines for acting as an opponent in a scientific conference or seminar.

Teaching Methods:

For face-to face learning (1-2 period): Introduction lecture 2 h, 1st period, Learning diary 26h 1st period, Personal guidance and literature search 28 h, 2nd period. Written research plan 48 h, 2nd period. Total workload 104 h.
For distance learning (non-stop): Independent study and literature search 54 h, Written research plan 48 h, Skype-exam and -meetings 2h, Total workload 104 h.
The course is suitable for distance learning.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

For face-to face learning, 0-5, Learning diary 50 %, Written research plan 50 %
For distance learning: 0-5, Written research plan 50 %, Skype-exam 50 %

Course Materials:

Lectures in Moodle. For Finnish students and distance learning: Eskelinen & Karsikas, Tutkimusmetodiikan
perusteet - Tekniikan alan oppikirja, Tammertekniikka, 2014.

Limitation for students? (Yes, number, priorities/Leave empty):

The possibility to pass the course via distance learning is meant only for students of LUT's distance learning programs (JEDI, MEC).

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

No

BK10A3800: Principles of Industrial Manufacturing Processes, 5 cr

Validity: 01.08.2016 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Teachers: Juho Ratava, Juha Varis

Year:

M.Sc. (Tech.) 1

Period:

1-2

Teaching Language:

English

Teacher(s) in Charge:

Postdoctoral Reseacher, D.Sc. (Tech.) Juho Ratava

Aims:

After having completed this course module the student should be able to describe the principles of machining products and production, sheet metal production and products, generally used welding processes, the extrusion process, packaging processes. The student is introduced to characteristics describing manufacturability aspects of different materials and quality measurement. The student will be able to write technical and scientific text, as well as search for scientific information, evaluate it critically and use it in their own text.

Contents:

The course focuses on the most typical and used processes in manufacturing technology, as detailed in course objectives. The course runs through the various processes having a strong connection to product design and Design for Manufacturing (DFM) aspects.

Teaching Methods:

Lectures 28 h, period 1
Seminar lecture 4 h, period 1
Seminars 4 h, period 2
Project work (groups) and working as an opponent 94 h, periods 1 - 2
Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

Yes

Assessment:

0-5, exam 40 %, seminar 60 %
Intermediate seminar presentation, final presentation and working as opponent. Participation in seminar.

Course Materials:

Course material is available on the Moodle.

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 5

BK10A3900: Reliability Based Machine Element Design, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Harri Eskelinen, Kimmo Kerkkänen

Year:

M.Sc. (Tech.) 2

Period:

1-2

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Harri Eskelinen
University Lecturer, D.Sc. (Tech.) Kimmo Kerkkänen

Aims:

After having passed this course, the student will be able to:
- utilize two reliability measures: safety index and probability of failure
- apply tools and techniques for risk analysis of a machine or mechanical system
- use principles, with which the designer can improve the geometries, shapes, sizes, material properties, and topology of a product to reduce the failure probability
- utilize statistical information to support reliability design
- apply failure mode analysis, especially in context of wear and corrosion phenomena
- choose an appropriate distribution to analyze reliability aspects of a component

Contents:

The importance of multidisciplinary optimization including reliability-based constraints in design is discussed. Two significant reliability measures, safety index and probability of failure, are compared and discussed. Tools and techniques for both qualitative and quantitative risk analysis of an assembly or any technical system are presented. Principles, with which the designer can modify the geometries, shapes, sizes, material properties, and topology of a product to reduce the failure probability are discussed. Possibilities to utilize statistical information to support reliability design are evaluated. Aspects, how uncertainties associated with statistical distributions and any insufficient information may lead to large errors in probability calculations in engineering, are clarified. Tools for analyzing failure modes of machine elements, machines and technical systems especially in context of wear

and corrosion phenomena, are taught. Guidelines to choose an appropriate distribution to analyze reliability aspects and lifetime of a component are presented. Team and project works deal with practical industrial applications of reliability based engineering.

Teaching Methods:

Lectures total 28 h, periods 1 - 2. Literature search 20 h, periods 1 - 2. Team and project work 73 h, periods 1 - 2. Seminar 9 h, period 2. Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, continuous and comprehensive evaluation of team and project work 70 %, seminar 30 %.

Course Materials:

Patrick O'Connor, Andre Kleyner, Practical Reliability Engineering, 5th Edition, 978-0-470-97982-2. Erdman, A.G., Mechanism Design. Norton, R.L., Design of Machinery. Lectures and exercises in Moodle.

Prerequisites:

B.Sc. (Mech.Eng.) Degree or equivalent knowledge.

Places for exchange-students? (Yes, number/No):

max 5

Places for Open University Students?(Yes, number/No):

No

BK10A4100: Management and Leadership Skills in Mechanical Engineering, 5 cr

Validity: 01.08.2016 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Teachers: Kimmo Kerkkänen, Harri Eskelinen, Tapio Saarelainen

Year:

M.Sc. (Tech.) 1

Period:

1-4

Teaching Language:

English

Teacher(s) in Charge:

Docent, Ph.D. (Mil.), Tapio Saarelainen
University Lecturer, D.Sc. (Tech.) Kimmo Kerkkänen
Docent, D.Sc. (Tech.) Harri Eskelinen

Aims:

After having passed this course, focusing on engineering tasks, the students will be able to:
- utilize basics of effective delegation and meeting management also in a networking environment

- employ effective communication techniques and apply both social and leadership skills to optimize end results and to manage possible conflicts in contexts of teamwork or projects
- set and achieve goals for the set work and projects and lead themselves
- identify opportunities to enhance cooperation among their colleagues
- manage day-to-day challenges of leading a team and manage time and prioritize work
- use effective strategies for organizing projects and negotiating resources
- apply problem-solving and decision-making skills to accomplish tasks
- assess their flexibility and openness to new ideas to inspire other team members and to create and sustain a positive, productive atmosphere
- create and implement changes as applicable to lead team work or projects
- understand the role of financial and business management in engineering projects.

Contents:

This course introduces fundamentals of leadership and management as regards contexts of engineering projects. The students gain experience in project work, develop team work skills, apply self-management and implement work discipline. Through interactive activities, self-assessments, discussions, and practical team and project work, the students learn how to lead either product design tasks, production or larger scale projects with the focus on the field of mechanical engineering in particular. The skills introduced include communicating effectively, solving problems, making decisions, working in teams, building relationships, creating and implementing changes in an organization, and aligning one's goals with the organization's mission, goals, and objectives. Depending on the given task within the course module, the students are advised to recognize the special skills and competences needed for leading design tasks, production or larger scale projects.

Teaching Methods:

Lectures and literature review 8 h, period 1, orientation meetings 6 h, period 2 and group discussions 10 h, periods 2-4. Participation in the board meetings of virtual companies 24 h, periods 1-4. Building of a networking environment for the teamwork and project management 10 h, period 1. Exercises and the utilization of a leadership journal to get practical experience in working as a project manager, production manager, design manager, workshop manager, engineering team leader etc. 72 h, periods 1-4. Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, continuous and comprehensive evaluation of success in teamwork and project work, peer review of management and leadership skills and the evaluation of a leadership journal.

Course Materials:

Lecture notes, books and articles used for the literature review.

Prerequisites:

B.Sc. (Tech.) Degree or equivalent knowledge

Places for exchange-students? (Yes, number/No):

Yes, 5

Places for Open University Students?(Yes, number/No):

Max 5

BK10A5400: Digitised Design and Production in Welded and 3D-printed Structures, 5 cr

Validity: 01.01.2018 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Year:

M.Sc. (Tech.) 1

Period:

3-4

Teaching Language:

English

Teacher(s) in Charge:

Timo Björk, D.Sc. (Tech.), Professor
Antti Salminen, D.Sc. (Tech.), Professor

Aims:

After completing the course students:
- have an overview about all production phases of platestructures (from design to end-using and recycling)
- can define the essential phenomena involved in eachprocess phase and can solve them
- understand how the digitalization can be utilized inorder to enhance the efficiency of production

Contents:

Introduction: examples of plated structures for demanding applications (ships, boats, cars, bridges, cranes, booms, beam and frame structures, vehicle frames, process equipment, silos, towers, pipes, chimneys, pressure vessels, shell structures, etc..
Material selection based on needs from end users, fabrication and recycling
Design for use and considering the requirements from fabrication, transportation, assembly, maintenance and recycling
Design for manufacturing including: pretreatment, cutting and forming processes of plates, preparing of joints considering welding processes and finishing processes considering the aspect of strength and quality
Lead time and cost control
Design and life cycle control of plate structures based on calculation and monitoring
Digitalization of the production including design, fabrication processes and life cycle control
Design of detail by using 3Dprinting
One personal homework/ guided exercise concerning design of plate structures with documented report:
Geometrical design based on life cycle (loading) control and material selection, fabrication plan incl. cutting, forming and joint preparing, design of bolted and welded joints for chosen process, finishing processes, quality and inspection plan.

Teaching Methods:

Lectures 28 h, writing the report/homework 70 h, additional individual work 32 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5. Grade is based on the quality of documented report.

Course Materials:

Lectures in Moodle.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

No

BK50A2701: Selection Criteria of Structural Materials, 5 cr

Validity: 01.08.2016 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Teachers: Jörg Wunderlich, Sari Pärssinen, Harri Eskelinen

Note:

The course is arranged concurrently in face-to-face learning and distance learning environment. Replaces the course BK10A2900 Konstruktiomateriaalit ja niiden valinta JEDI

Year:

M.Sc. (Tech.) 1

Period:

3-4

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Harri Eskelinen

Aims:

After having passed this course module the student is able to:
- apply and develop systematic and analytical means and tools of systematic material selection approaches into solving cross-technological material selection tasks
- define and analyse the properties, the strengths, the weaknesses and the application areas of the main groups of constructional materials for different types of applications
- is able to justify and build generalized models to take into a count both the functionality and the manufacturability aspects in addition to the total costs and environmental aspects of the product in solving the material selection task
- is able to evaluate and utilize recent results and documents of material science
- derive analytical models based on the principles of LCC's, LCA's and MIPS-factors in material selection.

Contents:

During the course the student will become familiar with the properties and application areas of different constructional materials. The recent scientific results dealing with material science and technology will be discussed. Aspects of selecting and comparing different materials are discussed from the viewpoints of functionality, manufacturing aspects, costs and environmental aspects of the product. Future trends in materials science are discussed briefly. Metals and their alloys, polymers, ceramics, composites, wood materials, adaptive materials, nanomaterials. Environmental aspects of material selection from the viewpoint of LCC and LCA and the basics of MIPS calculations. Innovative solutions of the material selection tasks will be discussed. Principles to formulate and solve the materials solution tasks based on analytical and systematic approaches and means to develop models to support the selection process staring from the product's requirement list will be discussed in details. Multi-language teaching environment will be utilized during the project work.
Project work focuses to selecting structural materials for industrial applications.

Teaching Methods:

For face-to-face learning (3-4 period): Introduction lecture 2 h, 3rd period. Learning diary 36 h, 3rd-4th period. Exercises in small teams 28 h, 3rd-4th period. Project work and poster presentation 44 h, 3rd-4th period. Independent study 20
h. Total workload 130 h.
For distance learning (non-stop):Project work 60 h, Independent study 68 h, Skype-exam and-meetings 2 h.
The course is suitable for distance learning.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

For face-to-face learning, 0-5, comprehensive and continuous evaluation 50 %, project work 50 %
For distance learning: 0-5, Skype-exam 50 %, project work 50 %

Course Materials:

Mangohon, P., The Principles of Materials Selection for Engineering Design. Strong, A. B., Plastics, Materials and Processing. Kalpakjan, S. & Schmid, S., Manufacturing Engineering and Technology. Lectures and exercises in Moodle. For Finnish students and distance learning: Eskelinen &
Karsikas, Vihreän teknologian näkökulmat konstruktiomateriaalien valinnassa, ISBN 978-952-265-457-1.

Limitation for students? (Yes, number, priorities/Leave empty):

The possibility to pass the course via distance learning is meant only for students of LUT's distance learning programs.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

No

BK70A0001: Simulation of a Mechatronic Machine, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Aki Mikkola

Note:

Replaces the course BK10A3101 Simulation of a Mechatronic Machine JEDI

Year:

M.Sc. (Tech.) 1

Period:

1-2

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Aki Mikkola

Aims:

The student possesses the theories and practices of mathematical modeling and computer simulation of machine systems, which are hydraulically actuated. The
student is able to utilize simulations as an integrated tool of product design and he/she can utilize his/her skills to generalize the theories of engineering design to solve multidisciplinary design tasks and real-life problems. The student is able to compare and justify the use of different constructional solutions for linear and rotating motion mechanism based on their static, kinematic and dynamic analysis. The student is able to individual scientific work to simulate mechatronic machines.

Contents:

Principles of multibody dynamics, modelling of actuators, coupled simulation. Use of the concept of virtual work. Constraint equations and Lagrangian multipliers. Inertia of rigid bodies. Modelling of hydraulic components. Numerical integration of the equation of motion. Individual utilisation of simulation software, including the principles of how to apply previously mentioned mathematical theories to handling and solving abstract and multidisciplinary problems.

Teaching Methods:

Lectures 22 h, 1st-2nd period. Teamwork in multi-cultural working environment 32 h, 1st-2nd period.Supervised tutorials 24 h, 1st-2nd period. Independent study 52 h, 1st-2nd period. Total loading 130 h.
The course is suitable for distance learning.

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Number of mid-term examinations:

2 (mid-term examinations in Moodle)

Assessment:

0-5, examination and two mid-term exams, examinations 60 %, simulation work 20 %, in class quizzes 10 %, homework 10 %.

Course Materials:

Lecture notes. Shabana, A. A.: Computational Dynamics, John Wiley & Sons, Inc., 1st edition, 1994. ISBN 0-471-30551-0.

Prerequisites:

Students are recommended to have completed BK80A2600 Mekaniikka and BK60A0200 Mekatroniikka.

Places for exchange-students? (Yes, number/No):

15–

Places for Open University Students?(Yes, number/No):

max 15

Only for students coming outside LUT

BH60A4600: Introduction to M.Sc. Studies, 1 cr

Validity: 01.08.2013 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Teachers: Marjaana Lehtinen, Katja Hynynen, Aki-Pekka Grönman, Sanni Väisänen, Risto Soukka

Note:

Lectures together withall students of International Master's programs in Energy Technology, Electrical Engineering, Mechanical Engineering and Sustainability Science and Solutions.
Lectures for students of MSc programme in Circular Economy will be arranged in Lahti or online (announced in the beginning of the course).

Year:

M.Sc. (Tech.) 1

Period:

1-2

Teaching Language:

English

Teacher(s) in Charge:

Post-Doctoral Researcher, TkT Sanni Väisänen
Post-Doctoral Researcher, TkT Katja Hynynen
Associate Professor, TkT Ahti Jaatinen-Värri
University Lecturer, TkT Kimmo Kerkkänen

Aims:

Upon completionof the course the student is expected to be able to:
1. describe the content of the Degree Programme, interpret the study guide andalso describe the research areas of School of Energy Systems,
2. prepare his/her individual study plan (ePSP) and follow the progress ofhis/her studies with the help of WebOodi's personal study plan,
3. observe the university's examination practices and degree programmepractices (incl. instructions of the Master's Thesis),
4. use the services of the library, retrieve information independently and usethe information sources in accordance with good practices, and also toobserve the copyrights,
5. understand how to manage the studies and how to find help when needed duringhis/her studies,
6. use the Moodle learning environment,
7. knowshow to improve information security during his/her daily use ofuniversity networks,
8. understandthe concept of career planning and use the services of career services,
9. understand the concept of cultural differences and how it mighteffect on his/her daily social intercourse.

Contents:

Getting to know the School of EnergySystems and the Master's programs Studies (incl. Master's Thesis). Studyand exam culture in LUT. LUT library collections, databases,reference practices, and copyrights, information security, career planningand cultural difference related issues. Study Skills and Motivation. ePSPworkshop. Research areas of School of Energy Systems. The course is related to sustainability.

Teaching Methods:

1st and 2nd period: 15 hof obligatory lectures (incl. participation in an ePSP workshop. 1stperiod: Information security training and Information searchning web courses (2+ 5 h). 2nd period: Individual discussion with a teacher tutor 1 h. Individualwork 3 h. Total workload 26 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

Pass/fail. Passing the course requires attendance at the lectures, ePSP, passing individual Information security training and Information searching web courses, written assignment, and discussion with teacher tutor.

Course Materials:

Study Guide, Moodle, LUT library collections, and databases.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

No

KoDWelde: Welded Metal Structures, 30 - 50 cr

Validity: 01.08.2016 -
Form of study: Major studies
Type: Study module
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F

No course descriptions.

Choose either module Advanced Structural Design or module Sustainable Welding Production

KoDWelde150: Advanced Structural Design, 10 - 30 cr

Validity: 01.08.2016 -
Form of study: Major studies
Type: Study module
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F

No course descriptions.

Obligatory Studies 55 ECTS cr

BK10A1501: Master's Thesis and Seminar, 30 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Katriina Mielonen

Year:

M.Sc. (Tech.) 2

Period:

1-4

Teaching Language:

English

Teacher(s) in Charge:

Katriina Mielonen, University Lecturer, D.Sc.
Harri Eskelinen, Professor, D.Sc.

Aims:

The Master's thesis is the final project of the Master's degree, which demonstrates the student's knowledge of a topic of scientific or societal importance in the professional field in question. Student is able to combine theory and practice: he/she can exploit theory in solving problems in scientific research. The student must demonstrate the ability to carry out the project independently and following a plan and student, can set goals for him/her self-concerning results and time schedules. The student manages extensive and versatile data acquisition knowhow.

Contents:

The Master's thesis is a research project by nature, which requires approximately 6 months of work. It is related to the student's major subject and its topic is agreed on by the supervisor and the student together. During the work, student must show capability to work independently according to defined plans and goals. Course includes seminars.

Teaching Methods:

The Master's thesis is a written report on the research work involved, presenting the stages of the work, the methods, results and explanations.
1st-4th period. Elevator speech when thesis is ready.
Independent study 776 h. Total workload 780 h. Seminar listening points are valid till the student will graduate.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, Master's thesis 100 %. Elevator speech passed.

Course Materials:

LUT final thesis instructions. Seminar instructions in Moodle.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

No

BK10A4000: Design of Advanced Plate and Shell Structures, 5 cr

Validity: 01.08.2016 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Teachers: Ilkka Pöllänen, Timo Björk

Year:

M.Sc. (Tech.) 1

Period:

1-2

Teaching Language:

English

Teacher(s) in Charge:

Ilkka Pöllänen, M.Sc. (Tech.)
Timo Björk, D.Sc. (Tech.), Professor

Aims:

After having passed this course module the student is able to:
- recognize different type of plate and shell structures and their application in mechanical engineering
- understand the behavior of plates and shells in term of strength and capacity and can design simple structures and analyze fabrication processes
- choose purposeful solution in terms of design, fabrication and material (steels, other metals and composites) for certain application and can design simple constructions
- design the fabrication such as bending, forming and cutting of plate as a workshop processes
- understand and utilize the capability of FEA in design and fabrication on plate and shell structures
- design and fabrication of cell structures (laser, 2D-printing and extruding-processes)

Contents:

During the course the student will become familiar with:
- the basic theory of plate and shell structures
- design of plate and shell structures considering stiffness, vibrations, stability and simple plastic limit state
- simulation of fabrication, such as brake pressing, mechanical cutting and punching of plate
- fabrication possibilities of plate and shell structures
- laboratory tests of plate and shell structures to compare the results with analytical and FEA.

Teaching Methods:

Lectures 42 h, guided exercises 14 h, exercises and home works individually and in groups 74 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, Exercises (40 %), examination (60 %).

Course Materials:

Lectures on Moodle.

Prerequisites:

Book recommendation: Benham, Crawford & Armstrong, Mechanics of Engineering Materials. Recommended BK80A2701 Lujuusoppi

Limitation for students? (Yes, number, priorities/Leave empty):

Yes 20

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

No

BK80A1302: Applications for FE-method for Steel Structures, 5 cr

Validity: 01.08.2017 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Teachers: Niko Tuominen, Timo Björk, Ilkka Pöllänen

Year:

M.Sc. (Tech.) 1

Period:

3-4

Teaching Language:

English

Teacher(s) in Charge:

Ilkka Pöllänen, M.Sc. (Tech.) Timo Björk, D.Sc. (Tech.), Professor

Aims:

After having passed this course module, the student is able to:
-model the typical industrial structures
-choose an appropriate element type for the considered structure
-choose an appropriate analysis type for the considered structure
-verify the FE-analysis results by analytical computations

Contents:

During the course the student will become familiar with:
-linear analysis
-vibrations of the structure
-stability behaviors of the structures
-non-linear analysis
-sub-modelling techniques
-manufacturing requirements in the FE-analysis

Teaching Methods:

Lectures 28 h, period 3rd-4th. Exercises 28 h, period 3rd-4th. Independent study 74 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, Examination 60 %, written assignments 40 %.

Course Materials:

Lectures on Moodle. Hakala M.K., Lujuusopin elementtimenetelmä. Rao S., The Finite Element Method in Engineering. Weaver W., Johnston P., Structural Dynamics by Finite Elements.

Prerequisites:

Basic theory of FE-modelling, linear algebra and matrix operations are required.
Book recommendation: Bryan J. Mac Donald, Practical stress Analysis with Finite Elements.

Limitation for students? (Yes, number, priorities/Leave empty):

Yes, 30

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

No

BK80A1402: Fatigue Design, 5 cr

Validity: 01.08.2016 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Teachers: Mohammad Dabiri, Timo Björk

Year:

M.Sc. (Tech.) 2

Period:

1-2

Teaching Language:

English

Teacher(s) in Charge:

Mohammad Dabiri, M.Sc. (Tech.), Junior Researcher
Timo Björk, D.Sc. (Tech.), Professor

Aims:

After having passed the course the student is able to:
- learn fatigue as a material failure
- learn different approaches to analyze fatigue strength of components for mechanical engineering
- learn how to design fatigue loaded structures for demanding application
- learn how to avoid fatigue failure

Contents:

Design principals to avoid fatigue failure of mechanical engineering components and structures. Introduction to fatigue in micro and macro scale, deformation of structural materials, stress concentrations and fracture mechanics. Design of structures based on stress-life approach, strain-life approach and linear elastic fracture mechanics.

Teaching Methods:

Lectures 42 h. Guided exercises 28 h. Home works individually 60 h. Total workload 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, mandatory exercises 40 % + examination 60 %.

Course Materials:

Lectures in Moodle
Dowling N.E., Mechanical Behavior of Materials 2nd, 3rd or 4th ed., Prentice Hall.
Stephens R. et al., Metal Fatigue in Engineering 2nd ed., John Wiley & Sons.
Schijve J., Fatigue of Structures and Materials 2nd ed., Springer.

Prerequisites:

BK80A2701 Lujuusoppi recommended
Familiarity with basics of mechanics of materials is required.

Places for exchange-students? (Yes, number/No):

15–

Places for Open University Students?(Yes, number/No):

No

BK80A2303: Steel Structures II, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Timo Björk, Antti Ahola

Year:

M.Sc. (Tech.) 1

Period:

3-4

Teaching Language:

English

Teacher(s) in Charge:

Timo Björk, D.Sc. (Tech.), Professor

Aims:

After completing the course, students can design of welded structures for demanding applications, considering also fabrication requirements, which means that they can:
- choose the purposeful analyzing method for fatigue design of welded joints
- design of the plated (welded and cold formed) structures considering stability
- design the structures and joints by using plastic limit state method
- evaluate the risk of brittle fracture, especially for arctic structures

- design of beams considering also torsion, warping, distortion, shear lag, etc.
- optimize structures, especially considering the potential of high and ultra high strength steels
- design of bolted connections

Contents:

The physical background for fatigue design of welded joints. Theoretical background and design (EC3) for buckling of plates, columns and beams. Plasticity theory of beams, frames and plates (yield line method). Numerical methods for analyzing of brittle fracture considering the material properties of welded joints. Theory of thin walled structures. Practical approach for design and multi-objective optimization of welded structures considering the global structural behavior and details and the potential of high strength materials. Failure modes of bolded joints.

Teaching Methods:

Lectures 42 h, laboratory work 4 h including e.g. fatigue failure demonstrations of welded constructions, guided exercises 14 h, exercises and homeworks individually and in groups 70 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, examination 60 %, exercises 40 %.

Course Materials:

Lecture material in Moodle, Eurocode 3, A. Hobbacher: Recommendations for Fatigue Design of Welded Joints and
Components.

Prerequisites:

Recommended BK80A2202 Teräsrakenteet I and BK80A2701 Lujuusoppi.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

No

Alternative Studies. Students, who wish to focus their studies in business and industrial oriented structure design, should select the first of the following courses and students, who wish to focus their studies in scientific research, should select the latter of the following courses.

BK80A3000: Integrated Design and Fabrication of Welded Structures, 5 cr

Validity: 01.08.2016 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Teachers: Timo Björk, Antti Salminen

Year:

M.Sc. (Tech.) 2

Period:

1-2

Teaching Language:

English

Teacher(s) in Charge:

Timo Björk, D.Sc. (Tech.), Professor
Harri Eskelinen, D.Sc. (Tech.), Professor
Antti Salminen, D.Sc. (Tech.), Professor

Aims:

After having passed this course module the student is able to:
- apply the skills comprehensively learned from previous courses for designing and production planning of welded structures or complete member of it
- apply the theoretical knowledge for practical design and fabrication of welded structure
- have skills to collect design data and use design tools to create a competitive and fabrication friendly construction based on requirements set by end-user
- design for fabrication (=,considering the potential and limitations of available fabrication processes) but also understand the background of quality requirements set for fabrication
- understand the consisting of fabrication costs and design impact on them
- have encouragement to design and make fabrication plans later in industry, unprompted
- move this experience to work out the integrated design & fabrication process in practice (=,in R&D and workshop)

Contents:

During the course the student will become familiar with the Design of real structure based on available load information, durability requirements and main boundary conditions given by end-user. Using of practical design tools (analytical and numerical) and optimization approaches to design energy efficient constructions. Working as a member of group, consisting of design and fabrication experts, for the common goal. Create a fabrication plan and especially welding process specifications (WPS) for a structure or a complete member of it Methods to take into consideration the available workshop facilities when choosing fabrication processes and evaluating fabrication costs. Practical interactive process between design and fabrication to find a compromising solution considering strength requirements and fabrication costs of critical structural details. Documentation of design and fabrication plan.

Teaching Methods:

Guiding lectures 8 h. Guided group working in teams 7 x 2h = 14 h. Design, calculation, and fabrication planning in teams 108 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

Design (drawing & calculations) 40 %, fabrication plan 30 % and report 30 %.

Course Materials:

Material from previous lectures, such as steel structures, welding technology and laser processing.

Prerequisites:

BK80A2303 Steel Structures II or BK20A2500 Sustainable Welding Production Completed.

Places for exchange-students? (Yes, number/No):

Max 5

Places for Open University Students?(Yes, number/No):

No

BK80A3100: Scientific Research of Welding and Structures, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Timo Björk, Antti Salminen, Harri Eskelinen

Year:

M.Sc. (Tech.) 2

Period:

3-4

Teaching Language:

English

Teacher(s) in Charge:

Timo Björk, D.Sc. (Tech.), Professor
Antti Salminen, D.Sc. (Tech.), Professor
Harri Eskelinen, D.Sc. (Tech.), Professor

Aims:

After having passed this course module the student is able to:
- work out welding procedures tests and metallographic investigations
- define the quality parameters for welded joints
- plan the capacity test by experimental investigation for welded joints and components
- write a scientific article about this kind of investigation

Contents:

During the course the student will become familiar with the welding processes in practice (MAG-manual/robotic and laser) and carry out metallurgical research (micro-macro level analyses, hardness measuring, etc.). Measure geometrical and residual stresses or strains (by strain gauges and ARAMIS) and deformations & loads. Reporting the presenting the research work.

Teaching Methods:

Demo lectures 4 h. Guided group working in teams 14 x 3 h =, 42 h. Writing the report 80 h. Seminar (presentation of the research work and contents of the article) 4 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

Article and presentation 100 %.

Course Materials:

Book about experimental testing (recommendation will be announced later).

Prerequisites:

BK80A3000 Integrated Design and Fabrication of Welded Structures completed.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

No

KoDWelde160: Sustainable Welding Production, 10 - 30 cr

Validity: 01.08.2016 -
Form of study: Major studies
Type: Study module
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F

No course descriptions.

Obligatory Studies 55 ECTS cr

BK10A1501: Master's Thesis and Seminar, 30 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Katriina Mielonen

Year:

M.Sc. (Tech.) 2

Period:

1-4

Teaching Language:

English

Teacher(s) in Charge:

Katriina Mielonen, University Lecturer, D.Sc.
Harri Eskelinen, Professor, D.Sc.

Aims:

The Master’s thesis is the final project of the Master’s degree, which demonstrates the student’s knowledge of a topic of scientific or societal importance in the professional field in question. Student is able to combine theory and practice: he/she can exploit theory in solving problems in scientific research. The student must demonstrate the ability to carry out the project independently and following a plan and student, can set goals for him/her self-concerning results and time schedules. The student manages extensive and versatile data acquisition knowhow.

Contents:

The Master's thesis is a research project by nature, which requires approximately 6 months of work. It is related to the student's major subject and its topic is agreed on by the supervisor and the student together. During the work, student must show capability to work independently according to defined plans and goals. Course includes seminars.

Teaching Methods:

The Master's thesis is a written report on the research work involved, presenting the stages of the work, the methods, results and explanations.
1st-4th period. Elevator speech when thesis is ready.
Independent study 776 h. Total workload 780 h. Seminar listening points are valid till the student will graduate.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, Master's thesis 100 %. Elevator speech passed.

Course Materials:

LUT final thesis instructions. Seminar instructions in Moodle.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

No

BK20A0403: Modern Welding Processes, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Paul Kah

Year:

M.Sc. (Tech.) 1

Period:

1-2

Teaching Language:

English

Teacher(s) in Charge:

Docent, D.Sc. (Tech.) Paul Kah

Aims:

The aim of the course is to educate students on various aspects of modern welding processes used in industry. Course laboratory works and exercises feature real examples of welding designer tasks. After having passed this course, the student:

- has a thorough knowledge of most important welding processes that are used in industry, knows their peculiarities and typical applications.

- knows operational principles of processes and understand how to selecting most suitable process to specified applications, taking into account usability, productivity, and economy aspects.
- understands the relationship between welding process, quality, cost-effective production, energy saving, and sustainability, when selecting proper welding process for different applications.
- has a general overview of utilizing standards like SFS-EN-ISO in welding production, and quality management, as far as they concern welding processes

Contents:

The course consists of lectures, exercises and an obligatory visit to an industrial company to make the student familiar with industrial welding processes and practices. Lecture topics are listed below:

- Major parameters, productivity, usability, and efficiency of major welding processes (Manual Metal Arc (MMA) welding; Gas Metal Arc Welding (GMAW); Metal Inert Gas, Metal Active Gas (MIG/MAG) welding; Submerged Arc Welding (SAW), Tungsten Inert Gas (TIG) welding, Plasma welding, Friction Stir Welding (FSW), Laser welding, Electron Beam welding, Hybrid welding, Resistance welding and other)
- The concept of materials weldability
- Mechanization/robotization/automation of welding processes
- Basics of welded structures design
- Welding grooves preparations: cutting and bevelling methods
- Quality, sustainability and safety aspects in a welding workshop

Each lecture has an exercise, which consists of multiple choice and open questions, and some practical assignments based on industrial tasks of a welding engineer, for instance:

- Compare welding processes by productivity and usability aspects
- Define weldability of a certain material
- Describe features of a certain automated welding process
- Evaluate proposed welding designs
- List features concerning welding quality and its control

Additionally, the course has obligatory exercise assignment, which is a report of 10-20 pages written by the student for the whole duration of the course, example topics are:

- Principle, operational parameters and novel developments of a certain welding process
- Weldability of a material group
- Benefits and concerns of welding mechanization/robotization/automation
- Welding quality control for a specific welding process

Teaching Methods:

The course is delivered in a form of lectures with interactive questions and discussions with students. The course also includes practical laboratory exercises. Material delivery and teaching methods:

- Lectures: 24 h
- Seminar presentations and acting as an opponent: 60 h
- Laboratory practice: 8 h including weldability analyses for different materials, products and processes
- Preparation for exam: 38 h

Total workload: 130 h
The course is suitable for distance learning.

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

Yes

Assessment:

- Grading: numerical assessment (0-5)
- Exam: 50 %

- Exercises: 50 %

Course Materials:

- Course lecture slides
- Howard & Gray: Modern Welding Technology 6th edition. AWS Welding Handbook, 9th edition.
- Welding production standards, e.g. EN ISO 2553, 3834, 4063, 5173 + A1, 5178, 5817, 6520, 6947, 9013, 9017, 9606, 9692, 9712, 13916, 13920, 14731, 14732, 15607, 15609, 15610, 15611, 15612, 15613, 15614, 17635, 17662, 17663; EN 1011, 1090 13479; and ISO/TR 15608, 20172
- Videos of industrial welding operations and processes given at lectures

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 10

BK20A2400: Materials and Welding Metallurgy, 5 cr

Validity: 01.08.2016 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Teachers: Paul Kah

Year:

M.Sc. (Tech.) 1

Period:

3-4

Teaching Language:

English

Teacher(s) in Charge:

Docent, D.Sc. (Tech.) Paul Kah
Post-Doctoral Researcher, D.Sc. (Tech.) Eric Mvola Belinga

Aims:

This course aims to provide the student with an understanding of the microstructures and metallurgical characteristics of welded joints in ferrous and non-ferrous alloys, the formation of weld defects and how the metal and heat source interaction affects microstructure and strengthening behaviour of different alloys. Course exercise features real example in welding engineering. On successful completion of this course, a student should be able to:

- Define the practical applications of metallurgy
- Identify fundamental principles and practices of welding metallurgy
- Predict and analyse the macro and microstructures of the welded joint
- Explain the causes of defects in welds and how they can be avoided
- Carry out weld joint characterization
- Identify the composition and classification of base metals
- Describe the principles of metal corrosion
- Explain the physical characteristics and mechanical properties of metals
- Identify grain structures and hard-facing of a weldment
- Demonstrate field identification methods for base metals
- Demonstrate preheat, inter-pass and post-weld heat treatment of metals
- Identify hydrogen cracking and the effects of welding on metals
- Identify metallurgical considerations for welding ferrous and non-ferrous metals

- Demonstrate heat treatment and its impact on metals
- Relate hardness to other properties including metals
- Recommend procedures and methods necessary to prevent the formation of undesirable phases and weld, defects for dissimilar metallic alloys
- Use software for welding metallurgy modelling

Contents:

The course consists of lectures, which topics are listed below:

- Welding Metallurgy principles
- Weldability of metals and non-metal materials
- Solidification of welds and factors imposing
- Welding energy/heat input and their effect on welding
- Heat treatments
- Cracks and fracture phenomenon
- Fundamentals of corrosion
- Weldability tests
- Metallurgical quality of weld and failure analyses
- Principles of metallographic examinations

Each lecture has an exercise, which consists of multiple choice and open questions, and some practical assignments are industry related tasks of a welding engineer, for assessing:

- Utilisation of software to predict and model phase transformation
- Characterization welded joint
- Sample preparation, micrograph analyses and quantification
- Understanding of the weld solidification principle
- Identification and avoiding the risk of premature failure
- Relating microstructure to the welded joint performance
- Adapting effective approach to WPS base on metallurgical knowledge

Teaching Methods:

The course is delivered in the form of lectures with interactive questions and discussions with students. Material delivery and teaching methods:

- Lectures and interactive exercises: 70 h
- Laboratory exercises: 14 h including sample preparation, micrograph analyses and quantification
- Preparation of exercises: 22 h
- Preparation for exam: 24 h

Total workload: 130 h

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

Yes

Assessment:

Grading: numerical assessment (0-5)
Exam: 50 %
Obligatory exercises: 50 %
Practical exercises are obligatory

Course Materials:

- Course lecture slides
- Welding: Principles and Applications; L. Jeffus, 2016, Cengage Learning
- Welding Metallurgy, Kou, S, 2003, Second Edition, Wiley
- Modern Welding Technology; Howard B. Cary, Scott Helzer, Sixth Edition, Pearson
- Welding Metallurgy and Weldability, John C. Lippold., 2015,
- Applied Welding Engineering; Processes Codes and Standards, Ramesh Singh, 1st Edition, Elsevier

Prerequisites:

Basic understanding of welding processes and materials sciences.

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 10

BK20A2500: Sustainable Welding Production, 5 cr

Validity: 01.08.2016 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Teachers: Paul Kah

Year:

M.Sc. (Tech.) 1

Period:

3-4

Teaching Language:

English

Teacher(s) in Charge:

Docent, D.Sc. (Tech.) Paul Kah
Post-Doctoral Researcher, D.Sc. (Tech.) Pavel Layus

Aims:

The aim of the course is to train the student to develop, manage, control and ensure quality and sustainability in welding production. Course exercises feature real examples of welding engineer tasks. After having passed this course, the student:

- understands the meaning of sustainability and quality in welding production
- knows how to implement quality assurance systems
- knows quality levels in welding
- familiar with the concept of Welding Procedure Specification (WPS), its development, approval, and implementation
- understands welding imperfections and various testing procedures (destructive and non-destructive) of weld joints
- knows basic concepts of repair welding
- understands economics, costs, and productivity of welding
- familiar with most important welding standards: EN ISO 2553, 3834, 4063, 5xxx, 6520, 6947, 9xxx, 139xx, 14731-2, 156xx, 176xx; EN 1011, 1090, and ISO/TR 15608, 20172.
- knows principles of mechanization and automation of welding
- understands welding networks and supply chains
- familiar with welding safety and health hazards

Contents:

The course consists of lectures, which topics are listed below:

- Concept of sustainability and quality
- Welding standards and coordination
- Welding procedure specification (WPS)
- Welding defects and imperfections
- Testing methods in welding production
- Repair welding

- Economics, costs, and productivity
- Mechanization and automation
- Welding networks and supply chains
- Welding safety

Each lecture has an exercise, which consists of multiple choice and open questions, and some practical assignments based on industrial tasks of a welding engineer, for instance:

- Designing Welding Procedure Specification (WPS) according to standards
- Identifying welding defects from real industrial cases
- Interpreting results of destructive and non-destructive welding tests, conducted for industrial cases
- Calculating the cost of welding operations
- Evaluating the safety risks of welding workplaces from real industrial cases

Additionally, the course has an obligatory seminar assignment, which is a 20-30 pages report written by students groups (2-3 students per group) for the whole duration of the course, example topics are:

- Towards sustainable production: Case study of shipbuilding industry
- Comparison of various Quality Management Control Systems for welding production
- Developments in welding defects testing, real-time welding defect monitoring, and prevention
- Welding safety: novel developments and risk analysis

Teaching Methods:

The course is delivered in a form of lectures with interactive questions and discussions with students. Material delivery and teaching methods:

- Lectures and interactive exercises: 28 h
- Group seminar report writing and preparation of exercises: 76 h
- Preparation for exam: 26 h

Total workload: 130 h

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

Yes

Assessment:

- Grading: numerical assessment (0-5)
- Exam: 50 %
- Obligatory exercises: 50 %
- Group seminar report and presentation: pass/fail

Course Materials:

- Course lecture slides
- Welding: Principles and Applications; L. Jeffus, 2016, Cengage Learning
- Manufacturing Technology; P.N. Rao, 2013, Tata McGraw-Hill Education
- The Welding Workplace; R. Boekholt, 2000, Woodhead Publishing
- Welding production standards: EN ISO 2553, 3834, 4063, 5173 + A1, 5178, 5817, 6520, 6947, 9013, 9017, 9606, 9692, 9712, 13916, 13920, 14731, 14732, 15607, 15609, 15610, 15611, 15612, 15613, 15614, 17635, 17662, 17663; EN 1011, 1090 13479; and ISO/TR 15608, 20172

Prerequisites:

Pass BK20A0403 Modern Welding Processes, or equivalent background in welding.

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 10

BK20A2600: Modelling and Simulation in Welding, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Esa Hiltunen

Note:

Replaces the course BK10A4800 Virtual Welding JEDI

Year:

M.Sc. (Tech.) 2

Period:

1-2

Teaching Language:

English

Teacher(s) in Charge:

M.Sc. (Tech.) Esa Hiltunen

Aims:

After completing this course the student is able to recognize the characteristics of welding arc and heat flow as well as estimate their effecton weld pool behavior and parent metal. In addition, the student will be ableto interpret the metallurgical effects in the parent metal and contraction andresidual stress in welded structure. The student will be aware of modern ITProducts available in development of workshop operations. The student will beable to use simulation software to model a robot welding station, simulate its operation and make offline programming.

Contents:

Heat flow in arc and in weld pool. Cooling rate, heat conductionand temperature distribution in welds. Weld pool solidification. Metallurgical effects in the parent metal. Contraction and residual stress in welded structures. Modeling of robot welding system and simulation of robot operation. Optimization of operation cycles. Weldability of welded products and accessibility of robot tools in welding performance.

Teaching Methods:

Lectures 14 h, exercises 56 h, home works 60 h. Preparation fore xamination and examination. Total workload 130 h.
The course is suitable for distance learning.

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5. Examination 30 %, exercises and home works 70 %.

Course Materials:

Lectures in Moodle.

Number of exercise groups where enrollment is in WebOodi (Number/Leave empty):

3

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 5

Alternative Studies.Students, who wish to focus their studies in business and industrial oriented structure design, should select the first of the following courses and students, who wish to focus their studies in scientific research, should select the latter of the following courses.

BK80A3000: Integrated Design and Fabrication of Welded Structures, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Timo Björk, Antti Salminen

Year:

M.Sc. (Tech.) 2

Period:

1-2

Teaching Language:

English

Teacher(s) in Charge:

Timo Björk, D.Sc. (Tech.), Professor
Harri Eskelinen, D.Sc. (Tech.), Professor
Antti Salminen, D.Sc. (Tech.), Professor

Aims:

After having passed this course module the student is able to:
- apply the skills comprehensively learned from previous courses for designing and production planning of welded structures or complete member of it
- apply the theoretical knowledge for practical design and fabrication of welded structure
- have skills to collect design data and use design tools to create a competitive and fabrication friendly construction based on requirements set by end-user
- design for fabrication (=,considering the potential and limitations of available fabrication processes) but also understand the background of quality requirements set for fabrication
- understand the consisting of fabrication costs and design impact on them
- have encouragement to design and make fabrication plans later in industry, unprompted
- move this experience to work out the integrated design & fabrication process in practice (=,in R&D and workshop)

Contents:

During the course the student will become familiar with the Design of real structure based on available load information, durability requirements and main boundary conditions given by end-user. Using of practical design tools (analytical and numerical) and optimization approaches to design energy efficient constructions. Working as a member of group, consisting of design and fabrication experts, for the common goal. Create a fabrication plan and especially welding process specifications (WPS) for a structure or a complete member of it Methods to take into consideration the available workshop facilities when choosing

fabrication processes and evaluating fabrication costs. Practical interactive process between design and fabrication to find a compromising solution considering strength requirements and fabrication costs of critical structural details. Documentation of design and fabrication plan.

Teaching Methods:

Guiding lectures 8 h. Guided group working in teams 7 x 2h = 14 h. Design, calculation, and fabrication planning in teams 108 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

Design (drawing & calculations) 40 %, fabrication plan 30 % and report 30 %.

Course Materials:

Material from previous lectures, such as steel structures, welding technology and laser processing.

Prerequisites:

BK80A2303 Steel Structures II or BK20A2500 Sustainable Welding Production Completed.

Places for exchange-students? (Yes, number/No):

Max 5

Places for Open University Students?(Yes, number/No):

No

BK80A3100: Scientific Research of Welding and Structures, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Timo Björk, Antti Salminen, Harri Eskelinen

Year:

M.Sc. (Tech.) 2

Period:

3-4

Teaching Language:

English

Teacher(s) in Charge:

Timo Björk, D.Sc. (Tech.), Professor
Antti Salminen, D.Sc. (Tech.), Professor
Harri Eskelinen, D.Sc. (Tech.), Professor

Aims:

After having passed this course module the student is able to:
- work out welding procedures tests and metallographic investigations

- define the quality parameters for welded joints
- plan the capacity test by experimental investigation for welded joints and components
- write a scientific article about this kind of investigation

Contents:

During the course the student will become familiar with the welding processes in practice (MAG-manual/robotic and laser) and carry out metallurgical research (micro-macro level analyses, hardness measuring, etc.). Measure geometrical and residual stresses or strains (by strain gauges and ARAMIS) and deformations & loads. Reporting the presenting the research work.

Teaching Methods:

Demo lectures 4 h. Guided group working in teams 14 x 3 h =, 42 h. Writing the report 80 h. Seminar (presentation of the research work and contents of the article) 4 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

Article and presentation 100 %.

Course Materials:

Book about experimental testing (recommendation will be announced later).

Prerequisites:

BK80A3000 Integrated Design and Fabrication of Welded Structures completed.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

No

Descriptions of courses and study modules not included in the degree structures

KoDSaMate: Advanced Materials Engineering, 20 - 30 cr

Validity: 01.08.2016 -
Form of study:
Type: Study module
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F

Aims:
After completing this minor subject the student will be able to:
- understand the influence of material selection to the product design
- structure hybrid materials from separate raw material sources
- have the readiness to understand the usability of nanomaterials and ceramics in processes and products
- apply various manufacturing methods to advanced materials processing and define concepts and entities

related to high performance products
- ability to build up material selection route from end product and manufacturing methods to raw materials

Obligatory Studies 25 ECTS cr

BK90C1900: Introduction to Materials Engineering, 4 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Timo Kärki

Year:

M.Sc. (Tech.) 1-2

Period:

2

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) , D.Sc. (Agr. & For.) Timo Kärki

Aims:

Aim of the course is to introduce possibilities of Material Engineering to students. Diverse possibilities of different materials is taken into consideration when optimizing the variable possibilities in Product Designing. After having completed this course, the student should be able to: understand the influence of material selection to the product design recognize the variable possibilities of different materials show creative and innovative expertise in the field of Materials Engineering.

Contents:

Basics of Materials Engineering and Product Design. Principles of materials selection and introduction to materials selection procedures. Choice of fabrication techniques including case studies related to different materials. Selecting polymers and composites as raw materials: structure, properties, processing characteristics and applications for the commercially important polymers including general classes of polymers: commodity, engineering and specialty thermoplastics, thermosetting resins and rubbers. Introduction to specific metals, alloys and minerals: metallurgy, properties, applications and potentialities of metals, alloys and minerals in a wide variety of engineering environments. Wood materials. Introduction to engineering ceramics. Properties and manufacturing of carbon based materials. Recycled Materials as a raw material source.

Teaching Methods:

Lectures 21 h. Independent study 63 h. Seminar 20 h. Total workload 104 h.

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, examination 70 %, seminar 30 %

Course Materials:

Course material in Moodle. Other literature to be announced during lectures.

Prerequisites:

-

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 10

BK90C2000: Hybrid Materials, 3 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Ossi Martikka

Year:

M.Sc. (Tech.) 1-2

Period:

2

Teaching Language:

English

Teacher(s) in Charge:

Project Researcher, D.Sc. (Tech.) Ossi Martikka

Aims:

Organic–inorganic hybrids and composites have been playing a major role in research and society in recent years. This course aims to give the participants an understanding of the properties of the organic and inorganic components, preparation methods, characterisation techniques and also examples of functional hybrid materials. After having completed this course, the student should be able to: structure hybrid materials from separate raw material sources characterize hybrid materials with various testing methods can work in teams and solve problems related to hybrid materials

Contents:

Combinations of different materials. Various structures of hybrid materials. Properties of biopolymers and bionanomaterials. Different characterization methods: optical, morphological, surface, interfacial and mechanical characterization. Designing of Hybrid Materials. Performance of Hybrid Materials.

Teaching Methods:

Lectures 14 h. Exercises and individual guidance 20 h. Independent study 44 h. Total workload 78 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, oral examination in evaluation panel 50 %, exercises and seminar 50 %.

Course Materials:

Course material in Moodle. Other literature to be announced during lectures.

Prerequisites:

-

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 10

BK90C2100: Functional Properties of Nanomaterials, 3 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Irina Turku

Year:

M.Sc. (Tech.) 1-2

Period:

3

Teaching Language:

English

Teacher(s) in Charge:

D.Sc. (Tech.) Irina Turku

Aims:

Aim of the course is to get students familiar to different types of nanomaterials. Manufacturing processes of nanomaterials are also highlighted. After having completed this course, the student should be able to: understand the variety of nanomaterials and have the readiness to understand the usability of nanomaterials in processes and products, can work in
teams and solve problems.

Contents:

What is nanoscience about? Classification of nanomaterials. Nanomaterial structures, fundamentals and properties. Carbon based nanomaterials, liquid crystals properties and application, nanocellulose and 'smart" polymers. Analytical tools in nanoscience. Applications of nanomaterials. Synthesis of nanoscale materials. Bottom-up and top-down approaches. Safety of nanomaterials.

Teaching Methods:

14 h of lectures, 2 h of laboratory work, 14 h of tutorials, total workload 78 h, 3rd period

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

Yes

Assessment:

Numerical assessment, 0-5; Final grade will include: examination 60 %, essay 40 % and laboratory work (pass).

Course Materials:

M.F. Ashby et al. Nanomaterials, Nanotechnologies and Design, ELSIVIER Ltd, 2009; Lecture materials; Internet resources.

Places for exchange-students? (Yes, number/No):

15–

Places for Open University Students?(Yes, number/No):

max 10

BK90C2200: Sustainable Manufacturing of Advanced Materials, 5 cr

Validity: 01.08.2016 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Teachers: Marko Hyvärinen, Katriina Mielonen

Year:

M.Sc. (Tech.) 1-2

Period:

3

Teaching Language:

English

Teacher(s) in Charge:

Laboratory Engineer, D.Sc. (Tech.) Marko Hyvärinen

Aims:

Aim of the course is to demonstrate awareness of the range of modern manufacturing techniques for advanced materials and to select an appropriate manufacturing technique for a given component/use. After having completed this course, the student should be able to: apply various manufacturing methods to advanced materials processing define processing methods based on material selection can understand and identify possibilities of entrepreneurship in sustainable manufacturing.

Contents:

Introduction to processing technology and overview of manufacturing processes. Usable material forms: short fibers, non-woven mat, undirectional, bidirectional, multi-axial and braided weaves. Fundamentals of laminate construction: ply orientation, balance and symmetry. Manufacturing methods: wet layup, prepreg layup, filament winding, automated tape layup, automated fiber placement, resin infusion, press molding and pultrusion. Matrix resins: thermoset vs. thermoplastic polymers, process temperatures, service limits, storage requirements, shelf life limits and pot life/work life. Process equipment: oven, autoclave and platen press. Extrusion, injection moulding and moulding as manufacturing methods. Coating and laminations methods in packaging solutions. Future process developments.

Teaching Methods:

Lectures 28 h. Independent study 72 h. Seminar 30 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

Yes

Assessment:

0-5, examination 70 %, seminar 30 %.

Course Materials:

Course material in Moodle. Other literature to be announced during lectures.

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 10

BK90C2300: High Performance Products, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Timo Kärki

Year:

M.Sc. (Tech.) 1-2

Period:

4

Teaching Language:

English

Teacher(s) in Charge:

Laboratory Engineer, D.Sc. (Tech.) Marko Hyvärinen
Post-Doctoral Researcher, D.Sc. (Tech.) Sami-Seppo Ovaska

Aims:

Aim of the course is to highlight the developments in the design of energy systems, aircraft, cars, electronic equipment, constructions, packaging, etc., which depend critically upon the availability of novel materials. Of equal importance is an understanding of both advanced processing techniques, the latest computer based design procedures and environmental aspects essential for product commercialization from the concept phase. After having completed this course, the student should be able to: define concepts and entities related to high performance products have a good understanding about product range manufactured with various methods can solve real-life problems related to high performance products.

Contents:

Composite industry overview: applications for composites, history and current technologies. Health and safety and industry terminology in high performance products. Applications in energy systems, aeronautical industry, automotive industry, marine industry, construction industry and smart materials in packaging industry.

Teaching Methods:

Lectures 28 h. Independent study 72 h. Seminar 30 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

Yes

Assessment:

0-5, examination 70 %, seminar 30 %.

Course Materials:

Course material in Moodle. Other literature to be announced during lectures.

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 10

BK90C2400: Project course in Material Engineering, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Marko Hyvärinen

Year:

M.Sc. (Tech.) 1-2

Period:

4

Teaching Language:

English

Teacher(s) in Charge:

Laboratory Engineer, D.Sc. (Tech.) Marko Hyvärinen

Aims:

Aim of the course is to get the students familiar to the project type working in materials engineering. Typical project will start with selection of materials and manufacturing method for a certain end product. After having completed this course, the student should be able to: ability to build up material selection route from end product and manufacturing methods to raw materials ability to work in a project organisation in certain role can act and communicate in groups and networks.

Contents:

Projects are completed across the full spectrum of manufacturing, including energy systems, automotive, construction industry, packaging etc. Project titles are varied and cover areas of operational improvement, strategic decision-making and organizational management. Sub-areas for project can be following: material optimization, selection of manufacturing method, testing, production planning, scheduling and inventory optimization, capacity utilization, lead time reduction, quality improvement and control, new product development process, effective maintenance, energy usage, layout floor planning, inter-departmental effectiveness, feasibility study in to a new technology, market approval, sales, marketing and business strategy, new markets, products, company strategies, competitors and routes to market.

Teaching Methods:

Lectures 6 h, exercises and individual guidance 28 h, project work 96 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, project work 70 %, exercises 30 %.

Course Materials:

Course material in Moodle. Other literature to be announced during lectures.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

max 10

KoDSaLate: Laser Processing, 20 cr

Validity: 01.08.2017 -
Form of study:
Type: Study module
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F

Aims:
After completing this minor subject the student will be able to:
- understand the principles of material processing lasers and laser based manufacturing systems and components
- understand the principles of laser materials processing in various processes for different materials
- utilize the advantages of digital photonic production in product design
- utilize additive manufacturing and 3D printing in product development and production
- apply the information to utilize laser for development of new manufacturing processes
- realizes and is able handle the occupational safety issues of industrial lasers

Alternative Studies. Choose at least 20 ECTS cr from following courses.

BK30A0803: Digital Advanced Manufacturing with Lasers, 5 cr

Validity: 01.08.2017 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Ilkka Poutiainen, Antti Salminen

Note:

Replaces the course BK10A2401 Digital Advanced Manufacturing with Lasers JEDI

Year:

M.Sc. (Tech.) 1

Period:

1-2

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Antti Salminen
M.Sc. (Tech.) Marika Hirvimäki

Aims:

After having passed the course, the student will:
- understand how laser beams are generated in a laser resonator and what kind of optical arrangements are required for a laser materials processing system
- be able to compare and generalize the special features of laser processing systems in production
- understand the risks, hazards and regulations involved in laser materials processing and procedures how these risks are handled in practice
- understand the practical aspects of laser materials processing of different materials
- have skills that are needed in the work life

Contents:

Knowledge on different laser equipment, resonator types, accessories and processing systems and requirements of different ways to process material with a laser beam. The principles of systems used for production. Optical components used for laser processing, safety and quality assurance. Tools for beam forming, guiding and modification. Practical use of laser processes. Participation in laser processing demonstrations.

Teaching Methods:

Lectures 28 h, 1st and 2nd period. Guided individual working (5x2h) 10 h.
Design, execution and reporting seminar work 92 h. Total work load 130 h.
The course is suitable for distance learning.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Number of mid-term examinations:

2 (online mid-term examinations)

Assessment:

Written individual report 50 %. Evaluation of learning 50%.

Course Materials:

Lecture notes. Steen, W., Laser Material Processing.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

max 5

BK30A0901: Additive Manufacturing - 3D Printing, 5 cr

Validity: 01.08.2015 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Teachers: Antti Salminen, Heidi Piili

Note:

Replaces the course BK10A2500 Additive Manufacturing - 3D Printing JEDI

Year:

M.Sc. (Tech.) 2 (M.Sc. (Tech.) 1-2 is also possible in academic year 2018-2019)

Period:

3-4

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Antti Salminen
Researcher, D.Sc. (Tech.) Heidi Piili

Aims:

After having passed the course, the student will:
- know all of the different technologies of additive manufacturing (AM, aka 3D printing)
- be able to compare different AM processes and select suitable processes for different applications
- know the basics about product design for additive manufacturing
- be familiar with the possibilities of additive manufacturing in product development, prototyping and part manufacturing
- have the latest knowledge of additive manufacturing technologies and processes.

Contents:

Additive manufacturing (AM, aka 3D printing) processes, materials and equipment. Utilization of the potential of additive manufacturing in product design. Practical cases and applications. Future trends and potential of additive manufacturing. First-hand demonstrations on how to design parts for additive manufacturing. Practical demonstrations on manufacturing of parts with AM processes. Economic aspects of additive manufacturing.

Teaching Methods:

Lectures 28 h, periods 3-4. Tutorials 14 h, periods 3-4. Individual work 88 h. Total workload 130 h.
The course is suitable for distance learning.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

Yes

Examination in Exam (Yes/No):

No

Assessment:

Grade 0-5, written project report 80 %, seminar 20 %. Volunteer Moodle exam 20%.

Course Materials:

Gibson, I., Rosen, D. W., Stucker, B.: Additive Manufacturing Technologies. Other study material will be listed in Moodle.

Places for exchange-students? (Yes, number/No):

max 5

Places for Open University Students?(Yes, number/No):

max 5

BK30A1201: Laser Materials Processing, 5 cr

Validity: 01.08.2017 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Teachers: Antti Salminen, Ilkka Poutiainen

Note:

Replaces the course BK10A2300 Laser Materials Processing JEDI

Year:

M.Sc. (Tech.) 2 (M.Sc. (Tech.) 1-2 is also possible in academic year 2018-2019)

Period:

3-4

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Antti Salminen

Aims:

After having passed the course module the student is able:
- to compare laser materials processing processes and knows different processes special features
- identify what are the theoretical basis affecting in different processes and how they affect the possible applications based on them
- to know how to select and optimize proper process and processing procedure for different materials
- understanding how processing parameters affect the quality of the process / part
- to define what kind of lasers and laser systems can be applied in various processes and applications and how they could be applied
- is able to develop processes for different applications
- is able to work as expert to develop laser based processes for industrial applications

Contents:

- laser beam material interaction, transmission, reflection, absorption
- the features of different materials and laser beams affecting on phenomena
- the effect of laser based heating, melting, vaporization and ablation on material
- behavior of molten material and heat transfer mechanisms.
- formation of keyhole and phenomena connected
- knowledge on existing ways to process material with laser beam and the effect of laser beam material interaction on that
- knowledge on most common laser processes like laser welding, laser hybrid welding, cutting, marking, drilling, engraving, micro processing additive manufacturing and surface treatment and the lasers and laser systems used for carrying them out
- practical cases, applications will be combined to theory

Teaching Methods:

Lectures 28 h, 3rd and 4th period. Guided team working 3x2 h. Design, execution and reporting of project work in team's 96 h. Total workload 130 h.
The course is suitable for distance learning.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

Yes

Assessment:

0-5, written project work report 50 %, oral seminar presentation 30 %, and voluntary exam 20 %.

Course Materials:

Steen W., Laser Material Processing. Ion, J., Laser Processing of Engineering Materials.
Course material in Moodle.

Prerequisites:

BK20A1300 Laser Based Manufacturing for Design passed or equal level of understanding shown with oral exam.

Places for exchange-students? (Yes, number/No):

Yes, 1-3

Places for Open University Students?(Yes, number/No):

This course has 1-5 places for open university students. More information on the web site for open university instructions.

BK30A1301: Laser Based Manufacturing for Design, 5 cr

Validity: 01.08.2017 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Teachers: Matti Manninen, Joonas Pekkarinen, Antti Salminen, Ilkka Poutiainen

Note:

Replaces the course BK10A2201 Laser Based Manufacturing for Design JEDI

Year:

M.Sc. (Tech.) 1

Period:

3-4

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Antti Salminen

Aims:

After having passed the course, the student will:
- understand how laser beams and systems are used in materials processing
- realize how these processes can be utilized to full in product development of a company

- be able to compare and generalize the special features gained with creative use of different laser based processes and the impact and utilization of the special features of these processes on product design
- understand what kind of properties can be gained with use of laser based processes and how does this effect on design flow of a product
- understand how the real total cost analysis and sustainability studies can be carried out and how they compete with conventional manufacturing technologies
- Realizes what kind of quality can be reached and how these technologies can be used for increasing energy efficiency and save material.

Contents:

The possibilities and limitations of laser processing on the product design. The utilization of laser based processes into design routines and philosophies, together with mechanical properties in comparison with conventional manufacturing technologies. Practical case examples. Economic aspects of laser materials processing. The features of most common laser based processes i.e. various different versions and applications of e.g. laser marking, cutting, welding and surface treatment processes.

Teaching Methods:

Lectures 28 h. Guided group working in teams (5x2h), 10 h. Design, execution and reporting of project work in teams 92 h. Total workload 130 h.
The course is suitable for distance learning.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

Grade 0-5, written report 70 %, seminar 30 %. Voluntary learning diary.

Course Materials:

Course material in Moodle.

Places for exchange-students? (Yes, number/No):

max 5

Places for Open University Students?(Yes, number/No):

max 5

BK30A1400: Individual Project Work of Laser Technology, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Antti Salminen, Joonas Pekkarinen

Note:

This is a self-study course so it is recommended that student full fills the prerequisites

Year:

M.Sc. (Tech.) 2

Period:

1-2

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Antti Salminen, D.Sc. (Tech.) Heidi Piili, D.Sc. (Tech.) Ilkka Poutiainen

Aims:

After having passed the course module the student:
- apply comprehensively the learned skills of previous courses for laser based processes, systems and products
- understand how to perform research project in field of laser engineering / processing
- apply theoretical knowledge in practical R&D work
- have skills to collect existing data and use it for determining solutions
- know how to design and run experiments in field of laser processing
- select and design a laser system for industrial case.
- knows how to select right laser process and optimize the process for different materials
- is able to develop processes for different applications

Contents:

During the course student will become familiar with:
- basic phenomena of laser - material interaction in specific case i.e. transmission, reflection, absorption
- the features affecting on performing the experimental work to define the limitations and potential of ways to apply laser for manufacturing
- the effect of potential of laser in design and how to apply that into product and its manufacturing.
- reporting the tests carried out in an efficient effective way both in writing and orally.
- principles how to design and run a research project
- principles in writing scientific peer review publication

Teaching Methods:

Lectures 2 h. Guiding discussion with supervisor 15 h. Design, execution and reporting of project work 113 h. Total workload 130 h.
The course is suitable for distance learning.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

Project plan 15 %, Written report 55 %, Oral presentation 30 %

Course Materials:

Steen W., Laser Material Processing.
Ion, J., Laser Processing of Engineering Materials. Course material in Moodle.

Prerequisites:

BK30A1301 Laser Based Manufacturing for Design or BK30A1201 Laser Materials Processing passed or equivalent understanding shown in oral exam.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

No

KoDSaManu: Modern Manufacturing, 20 - 30 cr

Validity: 01.08.2016 -
Form of study:
Type: Study module
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F

Aims:
After completing this minor subject the student will be able to:
- calculate manufacturing process parameter to metallic products to achieve successfully production in technically manner but also economically wise
- design total manufacturing order and overall process to achieve efficient production rate with old and new machines
- create total manufacturing chain from original distributor to end user
- listen, discuss, understand and negotiate with different people with different organizational level
- find and create new production solutions for rapidly changing world
After the studies, students:
- have a theoretical or practical capability to work international environment.
- will understand the importance of the production for the national economy.
- have a theoretical or practical understanding of overall manufacturing and supply chain process to understand deeply different workers role in production.
- have a theoretical or practical understanding of a queque, mathematical distribution and simulation theory used in job shops.
- have a theoretical or practical understanding of a normally used manufacturing process.

Obligatory Studies 25 ECTS cr

BK50A4000: Production Processes in Modern Job Shops, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Mika Lohtander, Juho Ratava

Year:
M.Sc. (Tech.) 1
Period:
1-2
Teaching Language:
English
Teacher(s) in Charge:
Researcher, D.Sc. (Tech.) Mika Lohtander
Aims:
After completing the course, the students:
1. can choose the manufacturing processes for the most common products

2. are able to design a manufacturing order for a modern product
3. are able to evaluate manufacturing time and manufacturing costs based on basic mathematics.

Contents:

The course focuses production processes, material handling and storage methods needed in modern job shops. During the course, students become familiar with the basic metal industry processes as well as manual and automatic assembly processes. Individual works allows students to familiarize themselves to different kind of manufacturing processes. Students presents case-tasks to other students.

Teaching Methods:

Lectures 24 h, lecture exercises 12 h. Independent work like assignments and learning diary 94 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, Lecture assignments 60 %, learning diary 40 %.

Course Materials:

Literature to be announced during lectures. Course material is available in the Moodle.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

max 5

BK50A4100: Manufacturing Systems and Scheduling, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Esko Niemi, Mika Lohtander

Year:

M.Sc. (Tech.) 1

Period:

3-4

Teaching Language:

English

Teacher(s) in Charge:

Reseacrher, D.Sc. (Tech.) Mika Lohtander

Aims:

After completing the course, the student:
1. is able to evaluate the most important production parameters like lead time and bottlenecks by means of simulation

2. is able to design fundamentals of the manufacturing systems
3. is able to evaluate manufacturing time and manufacturing costs based on manufacturing simulation
4. is able to make optimization for most common manufacturing environments.

Contents:

The course focus on production management and analysis methods needed in modern job shops. Production was analyzed by computational methods and manufacturing simulation is introduced and some case studies will analyzed. Example tasks are calculated and discussed in small groups. Every lecture includes its own exercise.

Teaching Methods:

Lectures 24 h, lecture exercise 24 h. Individual work 82 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, activity during course 40 %, individual assigments 60 %.

Course Materials:

Literature to be announced during lectures. Course material is available in the Moodle.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

No

BK50A4200: Product Flow in Job Shops, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Mika Lohtander

Lectured every other academic year (Yes, next realization year/Leave empty):

Yes, lecturing every socond year, next time in period 1. and 2. in year 2018-2019.

Year:

M.Sc. (Tech.) 2

Period:

1-2

Teaching Language:

English

Teacher(s) in Charge:

Researcher, D.Sc. (Tech.) Mika Lohtander

Aims:

After having passed the course, the student will:
1. is able to act as a product manager in a manufacturing plant
2. is able to analyze production capacity and to make improvement for production
3. is able to take responsibility for the daily operations of a production plant
4. is able to respond plant investments

Contents:

The course lectures will discuss the meaning of an overall function of a manufacturing flow. The course focuses to the strategy and methods of the production. Student will prepare and present during lectures, key factors and most common issues of production. In assignment, the students will plan and design factory lay-out commonly used in metal industry and present product flowin subcontracting network.

Teaching Methods:

Lectures 24 h, Group assignment and individual work 106 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, lecture activity 40 %, assignment and individual work 60 %.

Course Materials:

Literature to be announced during lectures. Course material is available in the Moodle.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

No

BK50A4300: Managing Job Shops, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Mika Lohtander

Note:

The course will be lectured for the next time during the academic year 2019-2020.

Lectured every other academic year (Yes, next realization year/Leave empty):

Yes, 2019-2020.

Year:

M.Sc. (Tech.) 2

Period:

1-2

Teaching Language:

English

Teacher(s) in Charge:

Researcher, D.Sc. (Tech.) Mika Lohtander

Aims:

After having passed the course, the student will:
1. know the factory management duty and responsibility
2. is able to take responsibility for the daily operations of a production plant
3. know the stakeholders role for production

Contents:

The course lectures will discuss the meaning of overall function of manufacturing and stakeholder's point of view. The topics cover everyday information technology, stakeholder cooperation and internal operation of the plant. A personal work will dealt more in-depth point of view to management.

Teaching Methods:

Lectures 24 h, individual work 106 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, Activity during lectures and exercises 20 %, individual work 80 %.

Course Materials:

Literature to be announced during lectures. Course material is available in the Moodle.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

No

BK50A4401: Fabrication Laboratory, 5 - 10 cr

Validity: 01.08.2017 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Mika Lohtander

Note:

Suitable also for doctoral studies.

Year:

M.Sc. (Tech.) 1-2

Period:

1-4

Teaching Language:

English

Teacher(s) in Charge:

Researcher, D.Sc. (Tech.) Mika Lohtander

Aims:

After having passed the course, the student will:
1. get touch some important research topics in field of manufacturing
2. be familiar how to transfer research result to practice
3. is capable to create or build simple and practical solutions.

Contents:

The course lectures will discuss the annually changing research themes. During the course the students will plan, design and in some cases built industrial systems. Students will present their Project Work results to a public audience.

Teaching Methods:

Lectures 12 h, project work 118 h. Total workload 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, practical part of project work 50 %, theoretical part of project work 50 %.

Course Materials:

Literature to be announced during lectures. Course material is available in the Moodle.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

max 5

Description and DL of the company assignment:

During this particular course, industrial manufacturing related problems could be solved, as an engineering student assignments. Industrial cases could relate to an assembly, processes, automation, product flow, subcontracting or storage. Students can practice production related skill with simulation and optimization software.
Contact:
Mika Lohtander. mika.lohtander@lut.fi, +358 400 579 455

KoDSaSusta: Sustainability, 20 - 30 cr

Validity: 01.08.2016 -

Form of study:

Type: Study module

Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Aims:

After completing this minor subject the student will be able to:
- understand the different sustainability aspects, sustainability challenges and their importance for a business

- recognize sustainability challenges related to different products
- apply life cycle assessment for evaluating environmental impacts of products and for searching environmentally best solutions

Obligatory Studies 24-27 ECTS cr

BH60A2101: Advanced Course in Life Cycle Assessment, 7 cr

Validity: 01.08.2010 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Teachers: Risto Soukka, Ivan Deviatkin, Sanni Väisänen

Note:

Suitable also for doctoral studies.
In order to take the course, the student should have own laptor computer with Windows

Year:

M.Sc. (Tech.) 1

Period:

3-4

Teaching Language:

Finnish and English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Risto Soukka

Aims:

Upon completion of the course the student is expected to be able to
1. explain the basic life cycle concepts,
2. plan, implement and analyse assessments to select products and services which fulfil the requirements of sustainable development,
3. plan, implement and analyse assessments to reveal development needs of products and services,
4. recognise the most inexpensive ways to reduce the environmental impact, and
5. perform life cycle assessments using software
6. apply theories to find and develop the most sustainable product, process or system design.

Contents:

Introduction to life cycle assessment, carrying out life cycle assessment, aspects related to inventory analysis, aspects related to impact assessment, calculating a carbon footprint, introduction to life cycle costing, aspects related to life cycle costing, LCA and LCC examples. This course is also suitable for postgraduate students.

Teaching Methods:

3rd period: 10 h of lectures, 3 h of computer training. Assignment 1 with a Quiz, literature and computational part, individual and pair work (approx. 38 h).
4th period: 4 h of lectures, 4 h of computer training. Assignment 2 with Life cycle modelling task, final report and result presentation meeting, group work (approx. 82 h).
Examination and preparation for it (approx. 41 h). Total workload 182 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Doctoral School course where enrollment is in WebOodi (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

Yes

Assessment:

0 - 5. Assignments 75 %, examination 25 %.

Course Materials:

Walter Klöpffer, Birgit Grahl Life Cycle Assessment (LCA), A Guide to Best Practice. Moodle. Standards ISO 14040 and ISO 14044.

Prerequisites:

Recommended: BH60A2401 Energy Recovery from Solid Waste and BH60A0252 Solid Waste Management Technology and BH60A1600 Basic Course on Environmental Management and Economics.

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 5

BJ02A4051: Development of New Sustainable Products and Solutions, 5 cr

Validity: 01.08.2016 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Teachers: Sami-Seppo Ovaska, Katriina Mielonen

Year:

M.Sc. (Tech.) 1

Period:

3

Teaching Language:

English

Teacher(s) in Charge:

D.Sc. (Tech.) Katriina Mielonen

Aims:

To give an overview about the use of modern biochemicals such as nanocellulose, hemicellulose lignin in various applications.
After the completing the module, the student ought to:
- describe how various renewable resources is utilized in various applications.
- have an insight into material and molecular design and its role for the end product performance
- describe how biomaterials, and in particular wood derived, are used for example in food, pharmaceuticals, composites, and smart materials.

Contents:

Use of fibers, cellulose (derivatives), lignin in various non-paper applications. Fundamentals about biomaterial design, modification, synthesis and use in various products. Chemical and mechanical modification, separation methods, mixing and drying methods. Product specification requirements and characterization methods.

Teaching Methods:

Lectures 28 h, self studies 42 h, project work 40 h. Total workload 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

Yes

Assessment:

0-5. 70% written examination 30% project work.

Course Materials:

Lecture material will be distributed via Moodle.

Places for exchange-students? (Yes, number/No):

max 5

Places for Open University Students?(Yes, number/No):

max 5

CS30A1691: Social Sustainability, 6 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Business and Management
Grading: Study modules 0-5,P/F
Teachers: Suvi Konsti-Laakso, Rakhshanda Khan, Satu Pekkarinen, Suvi-Jonna Martikainen, Helinä Melkas

Year:

B.Sc. (Tech.) 3

Period:

4

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Helinä Melkas
Rakhshanda Khan, PhD, Senior Researcher
Satu Pekkarinen, PhD, Senior Researcher
Suvi Konsti-Laakso, M.Sc., Researcher
Suvi-Jonna Martikainen, MA, Researcher

Aims:

After completion of the course, students will be able to
- explain and analyze the significance and meaning of social sustainability in development of business, organization and product and service processes

- discuss both theoretical and practice-based viewpoints as well as the kinds of tools and methods that enable social sustainability to become part of business, management and product and service development
- determine and compare appropriate situations for applying these methods
- differentiate between elements for critical thinking concerning social sustainability.

Contents:

Core content: social sustainability at different levels (global, societal and organizational), social innovation, frugal innovation, social enterprise, end-user involvement, employee involvement. Supplementary content: practical cases, methods and Living Lab activities.

Teaching Methods:

Lectures (intensive teaching) and small group assignments during the lectures 5 h, case exercise to be given during the lectures 60 h, independent and/or group studies 60 h, presentation of case exercises in a closing seminar 10 h, personal learning diary 21 h = total 156 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0 - 5. Case exercise 70%, learning diary 30%.

Course Materials:

The study materials consist of course slides and selected articles (will be announced later).

Prerequisites:

None.

Places for exchange-students? (Yes, number/No):

max 15

Places for Open University Students?(Yes, number/No):

max 5

CT10A7004: Sustainability and IT, 6 cr

Validity: 01.08.2018 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Business and Management
Grading: Study modules 0-5,P/F
Teachers: Jari Porras

Note:

This course is meant only for the fulltime students of the software engineering programme.

Year:

M. Sc. 1

Period:

3-4

Teaching Language:

English

Teacher(s) in Charge:

Prof., D.Sc. (Tech.) Jari Porras

Aims:

At the end of this course students will be able to:
1. Identify various sustainable development challenges in the surrounding society
2. Demonstrate the critical thinking and argumentation skills in the discussions of sustainable development challenges
3. Identify the possibilities of IT and especially software engineering in the sustainable development challenges
4. Apply IT and especially software engineering for sustainable development challenges

Contents:

The course emphasizes the role and impact of IT field and especially software engineering in the sustainable development. The topic is covered through selected books and scientific articles. Students may be divided into small groups that will each study the topic.

Teaching Methods:

This course follows flipped classroom approach. Introductory lectures are used for introducing the lecture material and dividing students into smaller groups.
Lectures 2 h, Mandatory classroom discussions 8 h, Homeworks 16 h, Reading assignments 24h, Period 3.
Lectures 6h, Mandatory classroom discussions 8h, Homeworks 16 h, Reading assignments 24 h, Project work 52 h, Period 4
Total 156 h.

Assessment:

0-5 continuous evaluation (no exam)
Presentation(s) 10%
Discussions 20%
Individual homeworks (x2) 20%
Group based homeworks (x2) 20%
Project 30%

Course Materials:

Murugesan S. & Gangadharan G.R.: Harnessing Green IT - Principles and practices, Wiley, 2012, 433 p
Tomlinson B.: Greening through IT - Information Technology for Environmental Sustainability, MIT Press, 2010, 221 p
A set of yearly changing scientific articles that will be announces at the moodle pages of the course.

Limitation for students? (Yes, number, priorities/Leave empty):

This course is meant only for the full time students of the software engineering programme

Places for exchange-students? (Yes, number/No):

max 10

Students, who haven't done BH60A0001 Ympäristötekniikan perusteet in their earlier studies, are required to do Introduction to Sustainability.

BH60A4400: Introduction to Sustainability, 3 cr

Validity: 01.08.2013 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Teachers: Mirja Mikkilä, Virgilio Panapanaan, Risto Soukka

Year:

M.Sc. (Tech.) 1

Period:

1

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Risto Soukka

Aims:

Upon completion of the course the students are expected to be able to:
1) explain the interaction between the environment, society and business and understand the relationships of various actors in these fields and their impacts on the society and the environment,
2) understand the core idea and thinking behind sustainability and its importance in order to limit or decelerate environmental damages and improve our quality of life while pursuing a more sustainable lifestyle and business within the planetary boundaries,
3) understand and apply practically the learned principles and concepts of sustainability in relation to current production and consumption habits,
4) know and be guided about the different value-adding activities and tools that promote sustainability

Contents:

The idea is to learn and understand sustainability challenges and their interconnectedness, and find out how we could move or transit towards a more sustainable world.

Teaching Methods:

1st period: 14 h of lectures. Independent study (approx. 64 h): assignment (group work) and seminar (approx. 26 h). Preparation for the examination and the exam (approx. 38 h). Total workload 78 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

Yes

Examination in Exam (Yes/No):

No

Assessment:

0 - 5. Examination 60 %, assignment 40 %.

Course Materials:

Will be announced during lectures. Moodle.

Places for exchange-students? (Yes, number/No):

max 5

Places for Open University Students?(Yes, number/No):

max 5