

# Catalogue report

LUT School of Energy Systems

## Master's Programme in Circular Economy

### Master's Programme in Circular Economy 2018-2019 (120 ECTS cr)

The Master's programme in Circular Economy is offered on the Lahti Campus. MSc programme in Circular Economy is also suitable for people living around in Finland or abroad. The intensive periods are organised in Lahti on Thursdays and Fridays.

#### 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 MSc programme in Circular Economy

Students who have completed their M.Sc. (Tech.) degree in Circular Economy are able to:

- understand the necessity of a circular economy
- understand the requirements of a systemic change
- apply theories how to enable the shift from linear model to circular economy
- apply theories based on circular economy approach to design more sustainable products
- apply theories how to integrate sharing economy in a society
- recognise the most significant environmental impacts of products and processes and their importance in terms of business
- assess the technical possibilities of industrial, service, community, and primary production processes and systems to minimise environmental impacts
- explain the complex interdependencies of both local and global environmental problems
- adopt and innovate new technical solutions to develop the environmental sector

#### 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:

[Circular Economy](#)

## 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.

BH60A5400 Introduction to Circular Economy will be taken in quantity of 5 ECTS cr.

BL20A0910 Technology and Society is recommended to take in academic year 2018-2019.

If the student is required to study BH60A5200 Introduction to Business, it is recommended to take in autumn 2018.

If the student is required to study BH60A5300 Introduction to Sustainable System Transition, it is recommended to take in academic year 2018-2019.

Students may choose any minor offered by LUT (check the required prerequisites, if any) or do the minor during exchange abroad (upon application). Students are recommended to choose one of the following minors:

EnDSOEDM Energiatekniikka digitaalisille maisteriohjelmille

Minor studies offered by University of Helsinki or degree programme in Industrial Engineering and Management, which are suitable for distance learning or they are organised in Lahti

Free elective studies can be any courses offered by LUT if the required prerequisites are fulfilled. Recommended elective studies are e.g.:

BH60A0451 Air Pollution Control

BH60A2101 Advanced Course in Life Cycle Assessment

BH60A5200 Introduction to Business and Sustainability or

BH60A5700 Business and Sustainability.

Studies in other universities/from abroad or a max. of 10 ECTS of internship (BH60A3700 Work Internship in Master's Degree, 2-10 ECTS) may be included upon application, too.

See the degree structure for details.

## Master's Programme in Circular Economy 2018-2019

Degree structure status: accepted

Academic year: 2018-19

Beginning date of the academic year: 01.08.2018

### Core Studies (min 28 cr)

YmCIRCore: Core Studies, 20 - 40 cr

*Obligatory Studies 28-34 ECTS cr. BL20A0910 Technology and Society is recommended to take in academic year 2018-2019. BH60A5400 Introduction to Circular Economy will be taken in quantity of 5 ECTS cr.*

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

BH60A5400: Introduction to Circular Economy, 3 - 5 cr

BH60A5800: Sustainable System Transition, 6 cr

BH60L1000: The Food-Energy-Water Nexus, 6 cr

BH60L2000: Grand Challenges of Sustainability, 6 cr

BL20A0910: Technology and Society, 4 cr

*Students, who haven't done BH60A5600 Kestävyysmuutos ja johtaminen (or equivalent knowledge), are required to take courses BH60A5200 Introduction to Business and Sustainability and BH60A5300 Introduction to Sustainable System Transition. The first course is recommended to take in autumn 2018 and the latter in academic year 2018-2019.*

BH60A5200: Introduction to Business and Sustainability, 3 cr

BH60A5300: Introduction to Sustainable System Transition, 3 cr

## Specialisation Studies (min 59 cr)

YmDCircu: Circular Economy, 50 - 70 cr

*Obligatory Studies 59 ECTS c*

BH60A5000: Master's Thesis, 30 cr

BH60A0252: Solid Waste Management Technology, 7 cr

BH60L3000: Biological Cycle in Circular Economy, 6 cr

BH60L4000: Technical Cycle in Circular Economy, 6 cr

BH60L5000: Energy in Traffic Systems, 6 cr

BH60L6000: Sustainability Challenge Project Work, 4 cr

## Minor Studies (min 20 cr)

Students may choose any minor studies taught at LUT if the required prerequisites are fulfilled. Students are recommended to choose minor studies Energiatekniikka digitaalisille maisteriohjelmille (code EnDSOEDM), minor studies offered by University of Helsinki or degree programme in Industrial Engineering and Management, which are suitable for distance learning.

## 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: BH60A3700 Work Internship in Master's Degree 2-10 ECTS cr. Students are recommended to include following studies in free elective studies.

YMCEVal: Free elective studies, 0 - 100 cr

*Choose enough free elective studies to attain 120 ECTS cr*

BH60A0451: Air Pollution Control, 6 cr

BH60A2101: Advanced Course in Life Cycle Assessment, 7 cr

BH60A5200: Introduction to Business and Sustainability, 3 cr

BH60A5700: Business and Sustainability, 6 cr

BH60A3700: Work internship in Master's degree, 2 - 10 cr

# 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).

Students may choose any minor studies taught at LUT if the required prerequisites are fulfilled.

Students are recommended to choose one of the following minors:

EnDSOEDM Energiatekniikka digitaalisille maisteriohjelmille

Minor studies offered by University of Helsinki or degree programme in Industrial Engineering and Management, which are suitable for distance learning or they are organised in Lahti.

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

Energy Technology:

EnSaM100 Energiatekniikka (in Finnish)  
 EnDSaBT Bio-Energy Technology  
 EnDMES Modelling of Energy Systems

Mechanical Engineering:

KoDSaKote Konetekniikka (in Finnish)  
 KoDSaManu Modern Manufacturing  
 KoDSaMate Advanced Materials Engineering

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)

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".

EnDSOEDM: Energiatekniikka digitaalisille maisteriohjelmille, 21 cr

*Sivuopintokokonaisuus 21 op. Tarkoitettu LESin ja LENSin digiohjelmien opiskelijoille.*

BH40A0010: Introduction to Energy Technology for EnTeDI Students, 4 cr

BH40A0210: Energy-efficient Pumps, Fans and Compressors, 4 cr

BH40A0220: Efficient Power Plants and Waste Heat Recovery, 5 cr

BH61A020E: Energy Economics for EnTeDI, 5 cr

BH61A060E: Bioenergy for EnTeDI, 3 cr

## Course descriptions

## Descriptions of courses and study modules included in the degree structures

### YmCIRCORE: Core Studies, 20 - 40 cr

**Validity:** 01.08.2018 -

**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 28-34 ECTS cr. BL20A0910 Technology and Society is recommended to take in academic year 2018-2019. BH60A5400 Introduction to Circular Economy will be taken in quantity of 5 ECTS cr.*

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

**Note:**

Lectures together with all 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 completion of the course the student is expected to be able to:

1. describe the content of the Degree Programme, interpret the study guide and also describe the research areas of School of Energy Systems,
2. prepare his/her individual study plan (ePSP) and follow the progress of his/her studies with the help of WebOodi's personal study plan,
3. observe the university's examination practices and degree programme practices (incl. instructions of the Master's Thesis),
4. use the services of the library, retrieve information independently and use the information sources in accordance with good practices, and also to observe the copyrights,

5. understand how to manage the studies and how to find help when needed during his/her studies,
6. use the Moodle learning environment,
7. know how to improve information security during his/her daily use of university networks,
8. understand the concept of career planning and use the services of career services,
9. understand the concept of cultural differences and how it might effect on his/her daily social intercourse.

**Contents:**

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

**Teaching Methods:**

1<sup>st</sup> and 2<sup>nd</sup> period: 15 h of obligatory lectures (incl. participation in an ePSP workshop. 1<sup>st</sup> period: Information security training and Information searching web courses (2+ 5 h). 2<sup>nd</sup> period: Individual discussion with a teacher tutor 1 h. Individual work 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

**BH60A5400: Introduction to Circular Economy, 3 - 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

**Note:**

This course is a pilot course in Autumn 2018 and will get the final form after publication date of the Study Guide. Thus some details given in this study guide might differ with the actual implementation. Final guidelines are given in the first lecture.

This course includes 3 ECTS cr web course and 2 ECTS cr blended learning (might involve attendance on lectures in Lahti). Lectures are held in LUT Lahti (at Friday on weeks 36, 38, 40, 42, 44, 46, 48 and 50).

**Year:**

M.Sc. (Tech.) 1

**Period:**

1-2

**Teaching Language:**

English

**Teacher(s) in Charge:**

Post doctoral researcher, D.Sc. (Tech.) Sanni Väisänen

**Aims:**

Upon completion of the 3 ECTS cr course the student is expected to be able to

1. explain the targets of circular economy and understand possibilities to implement circular economy in different sectors,

Upon completion of the 5 ECTS cr course the student is expected to be able to (in addition to the previous)

2. analyse capability of the selected products, production systems and services to fulfil the requirements of circular economy,

3. implement assessments to reveal development needs of selected products, production systems and services to fulfil the requirements of circular economy, and

4. compare different alternative ways to work towards circular economy targets.

**Contents:**

Introduction to circular economy: circular economy aspects related to food systems, forest systems, product design, transportation sector and sharing economy.

**Teaching Methods:**

3 ECTS cr course: The completion of the course consist of completing the learning tasks in open online course (MOOC) (approx. 65 h).

5 ECTS cr course: In addition to MOOC course 1st period: 8 h of lectures or group meetings. Individual and group tasks (approx. 26 h).

2nd period: 8 h of lectures or group meetings. Individual and group tasks (approx. 26 h).

Total workload 78-130 h.

**Examination in Examination schedule (Yes/No):**

No

**Examination in Moodle (Yes/No):**

No

**Examination in Exam (Yes/No):**

No

**Assessment:**

0 - 5. Continuous assessment. Evaluation of Individual and group tasks.

**Course Materials:**

Will be announced in the beginning of the course.

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

Max 10

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

Max 5

**BH60A5800: Sustainable System Transition, 6 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

**Note:**

Will be organised first time in academic year 2019-2020 in Lahti.

Replaces the course BH60A3501 Sustainable Innovation and System Transition.

**Year:**

M.Sc. (Tech.) 2

**Period:**

1-3

**Teaching Language:**

English

**Teacher(s) in Charge:**

Professor, D.Sc. (Econ. & Bus. Adm.), M.Sc. (Tech.) Lassi Linnanen

Associate Professor, D.Sc. (Agr.& For.) Mirja Mikkilä

**Aims:**

1. Upon completion of the course the student is expected to be able to:
  1. understand and analyze complex sustainability challenges,
  2. discuss the central concepts related to system transitions,
  3. develop solutions that fill all aspects of sustainability,
  4. learn to apply theoretical concepts to empirical cases,
  5. work in a multicultural group,
  6. produce a scientific written report and to present findings at a seminar.

**Contents:**

After completing the course the student is capable to understand and analyze complex sustainability challenges, and apply learned theoretical concepts in solution seeking. The central concepts related to system transitions are discussed in multicultural groups. Solutions for sustainability transition developed during the course are reported and presented orally in the seminar.

**Teaching Methods:**

9x2h lectures and 5x2h tutorials (28h); 3+6h mid-term and seminar (9h); independent work 120h. Total workload 157.

Independent work consists of group project work (70%), including seminar and mid-term presentation, and peer-evaluation. Individual learning (30%) is assessed on the basis of response papers.

**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):**

No

**Assessment:**

Evaluation 0 - 5. Project work and seminars 70 %, response papers 30 %.

**Course Materials:**

Course material will be announced during the lectures. Moodle.

**Prerequisites:**



Sustainability transition and sustainable business (Kestävyyssmuutos ja johtaminen) or Introduction to Sustainable System Transition passed or equivalent knowledge studied earlier.

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

max 5

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

max 5

### **BH60L1000: The Food-Energy-Water Nexus, 6 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

**Note:**

Will be organised in Lahti.

**Year:**

M.Sc. (Tech.) 1

**Period:**

3-4

**Teaching Language:**

English

**Teacher(s) in Charge:**

Miina Porkka, DSc (Tech), Post-Doctoral Researcher

**Aims:**

Upon completion of this course, students will be able to:

- Understand the importance of systems approaches to the food-energy-water nexus
- Understand and articulate cross-sectoral, ecological, social and economic linkages and processes within the FEW nexus
- Apply nexus thinking in different contexts and across local to global scales
- Apply quantitative methods to analyse nexus linkages and trade-offs

**Contents:**

Systems thinking and social-ecological systems approaches. Food, energy and water systems and their connectivity. Food security, energy security, water security.

**Teaching Methods:**

Lectures (20h), independent and group study (40h), assignments (30h), group work (70h). Total workload 160h.

**Examination in Examination schedule (Yes/No):**

No

**Examination in Moodle (Yes/No):**

No

**Examination in Exam (Yes/No):**

No

**Assessment:**

Numerical assessment (0-5). Grade based on assignments, group work and peer and self evaluation. Weights of different assessment elements will be specified in the first lecture.

**Course Materials:**

Lecture materials and (open access) journal articles. Some additions are possible and will be informed at the beginning of the course.

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

3

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

max 5

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

max 5

## **BH60L2000: Grand Challenges of Sustainability, 6 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

**Note:**

Will be organised in Lahti.

**Year:**

M.Sc. (Tech.) 1

**Period:**

3-4

**Teaching Language:**

English

**Teacher(s) in Charge:**

Professor, D.Sc. Helena Kahiluoto

**Aims:**

The student understands the grand challenges of the humanity and the threats and challenges due to transgressing the planetary boundaries. He/she understands, what sustainability is and knows the most important conceptual frameworks of sustainability and sustainability transformation. The student is able to analyse complex causes of practical situations and understands the inherent uncertainty of development pathways. He/she can cocreate synergic and robust solutions that combine various dimensions of sustainability utilizing science, technology and possibly private-public-civil society partnerships. The course starts with a situation of a family that exemplifies the wicked grand challenges and ends with one or several solutions cocreated, with potential to turn the vicious cycle to a virtuous circle.

**Contents:**

- Planetary boundaries
- Complex systems and uncertainty
- Resilience and transformability
- Co-creation for synergistic solutions
- Enabling sustainability transformation

**Teaching Methods:**

Teamwork, includes individual contributions

Lectures 14 h (4 h 3. period, 10 h 4. period)

Final panel 2 h

Learning diary 28 h.

Total workload 156 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:**

The tutorial contributes to the total scores by 40 %, half of them based on the joint entity, half of them on the individual contributions. The evaluation is performed as a peer review.

Active participation in the lectures contribute by 20 % of the scores.

40 % of the scores is based on the learning diary.

**Course Materials:**

Scientific and other articles selected and distributed by the teachers -contain alternatives.

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

Students of the Master Program in Circular Economy.

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

4

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

Max 5

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

Max 5

**Description and DL of the company assignment:**

Enterprises have the opportunity to make an order to, or participate in, a process where a group of three to five students with a different disciplinary or competence background co-create (using appr. 112 hours each) a solution to one or more topical grand challenges of the humanity (e.g., concerning food, energy or water security, climate change or water pollution) with entrepreneurship in a central role.

## **BL20A0910: Technology and Society, 4 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:** Johanna Naukkarinen

**Note:**

Course is taught fully on-line and continuously rolling (no tie to the LUT periods)  
Enrolment by e-mail to post-doctoral researcher Johanna Naukkarinen.

**Year:**

M.Sc. (Tech.) 1-2

**Period:**

1-4

**Teaching Language:**

English

**Teacher(s) in Charge:**

Johanna Naukkarinen, D.Sc. (Tech.), Post-doctoral researcher

**Aims:**

Upon completion of the course the student will be able to:

1. understand and explain the general interplay between technology and society
2. analyze the possible effects of different technologies on society
3. evaluate how the societal factors may affect the development and dissemination of different technologies.

**Contents:**

Social and economic factors affecting the development and adoption of technologies, mechanisms of interplay between society and technology, predicting the potential impact of technology.

**Teaching Methods:**

The completion of the course consist of completing the learning tasks in a topic related massive open online -course (MOOC) of teacher's choice and keeping a learning diary. The MOOC will be announced at the beginning of the academic year. Formal passing or a certificate on completion of the MOOC is not required, but student has to proof that all the required assignments have been sufficiently done. Total workload 104 h.

**Examination in Examination schedule (Yes/No):**

No

**Examination in Moodle (Yes/No):**

No

**Examination in Exam (Yes/No):**

No

**Assessment:**

Grading on a scale 0-5

50 % of the assessment is based on the quality of MOOC learning assignment and 50 % on the quality of the learning diary. More exact assessment matrix can be found on course Moodle-area.

**Course Materials:**

The content of the chosen MOOC, article(s) provided in the Moodle-area

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

Primarily for M.Sc students in electrical engineering, energy technology and circular economy.

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

No

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

No

*Students, who haven't done BH60A5600 Kestävyyksmuutos ja johtaminen (or equivalent knowledge), are required to take courses BH60A5200 Introduction to Business and Sustainability and BH60A5300 Introduction to Sustainable System Transition. The first course is recommended to take in autumn 2018 and the latter in academic year 2018-2019.*

**BH60A5200: Introduction to Business and Sustainability, 3 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

**Note:**

The course is intended for international students of MSc programmes in Sustainability Science and Solutions and Circular Economy, or Sustainability minor students. Literature examination in the electric exam system. Registration for the course in WebOodi during the academic year. Registration for the exam using the electric exam software (EXAM). The examination can be carried also during the vacations. Beyond the academic year the registration only for the electric exam software. Moodle is used as a communication platform.

**Year:**

B.Sc. (Tech.) 3

**Period:**

1-4

**Teaching Language:**

English

**Teacher(s) in Charge:**

Professor, D.Sc. (Econ. & Bus. Adm.), M.Sc. (Tech.) Lassi Linnanen  
Associate Professor, D.Sc. (Agr. & For.) Mirja Mikkilä

**Aims:**

Upon completion of the course the student is expected to be able to:

1. recognize the relationship between the company and society,
2. explain the connection between corporate responsibility and business strategies,
3. recognize organizational, economic, and social issues related to corporate social responsibility,
4. identify tools and mechanism sof corporate responsibility,
5. name dimensions and stakeholders related to corporate responsibility,
6. explain the importance of stakeholders in his/her ownwords.

**Contents:**

Corporate environmental strategies and application of the methods of environmental management. Identifying the sectors of responsible business operations. Basics of corporate ethics. Informing of and reporting on corporate responsibility issues to the stakeholders. Reporting of corporate social responsibility. Thecourse is related to sustainability.

**Teaching Methods:**

Literature examination in the exam aquarium. All the exams done during one calendar month are to be reviewed by the 15th of the following month except for the period 1 June – 31 July when the examination swill be evaluated by 15 August. Total workload 78h. See Moodle for further instructions and contact information. Electronic EXAM.

**Examination in Examination schedule (Yes/No):**

No

**Examination in Moodle (Yes/No):**

No

**Examination in Exam (Yes/No):**

Yes

**Assessment:**

Evaluation 0 - 5. Examination 100 %.

**Course Materials:**

Chandler,David: Strategic Corporate Social Responsibility: Sustainable Value Creation,2017. Other material and literature specified in MOODLE course overview.

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

15-

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

15-

**BH60A5300: Introduction to Sustainable System Transition, 3 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**Note:**

The course is intended for international students of MSc programmes in Sustainability Science and Solutions and Circular Economy, or Sustainability minor students. Literature examination in the electric exam system. Registration for the course in WebOodi during the academic year. Registration for the exam using the electric exam software (Exam). The examination can be carried also during the vacations. Beyond the academic year the registration only for the electric exam software. Moodle is used as a communication platform.

**Year:**

B.Sc. (Tech.) 3

**Period:**

1-4

**Teaching Language:**

English

**Teacher(s) in Charge:**

Professor, D.Sc. (Econ. & Bus. Adm.), M.Sc. (Tech.) Lassi Linnanen  
Associate Professor, D.Sc. (Agr. & For.) Mirja Mikkilä

**Aims:**

Upon completion of the course the student is expected to be able to:

1. recognize the dimensions of sustainable transition,
2. explain the connection sustainable transition and sustainable business strategies,
3. recognize organizational, economic, and social issues related to sustainable transition,
4. identify tools and mechanisms of sustainability governance,
5. name dimensions and agents related to sustainable transition.

**Contents:**

Upon completion of the course student is expected to be able to name and recognize connections between global environmental change and sustainability, to understand and explain the basic ideas of systems thinking and how it has changed environmental management approach, and to describe the main premises of socio-technical transitions.

**Teaching Methods:**

Literature examination in the exam aquarium. All the exams done during one calendar month are to be reviewed by the 15th of the following month except for the period 1 June – 31 July when the examinations will be evaluated by 15 August. Total workload 78h. See Moodle for further instructions and contact information. Electronic Exam.

**Examination in Examination schedule (Yes/No):**

No

**Examination in Moodle (Yes/No):**

No

**Examination in Exam (Yes/No):**

Yes

**Assessment:**

Evaluation 0 - 5. Examination 100 %.

**Course Materials:**

The applicable parts of the following textbooks, the examination material specified in Moodle course overview:

Boelie Elzen, Frank W. Geels, Kenneth Green (Editors): System Innovation and the Transition to Sustainability: Theory, Evidence and Policy. 2004.

Labanca (Ed.). Complex systems and social practices in energy transitions. 2017

Other material and literature specified in Moodle course overview.

Tukker et al. (Eds.). System innovation for sustainability 1: Perspectives on radical changes to sustainable consumption and production. 2008.

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

15-

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

15-

## **YmDCircu: Circular Economy, 50 - 70 cr**

**Validity:** 01.08.2018 -

**Form of study:**

**Type:** Study module

**Unit:** LUT School of Energy Systems

**Grading:** Study modules 0-5, P/F

No course descriptions.

*Obligatory Studies 59 ECTS c*

### **BH60A5000: Master's Thesis, 30 cr**

**Validity:** 01.08.2015 -

**Form of study:** Basic studies

**Type:** Master's Thesis

**Unit:** LUT School of Energy Systems

**Teachers:** Risto Soukka

**Year:**

M.Sc. (Tech.) 2

**Period:**

1-4

**Teaching Language:**

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. define a research problem,
2. choose and apply research methods relevant to the research problem,
3. search for suitable reference material, and assess the quality and reliability of the material and the information it contains,
4. use and interpret reference material correctly and diversely,
5. report on his or her work in writing, taking into account language and layout requirements, and
6. give a concise oral presentation on the content and results of the work.

**Contents:**

The thesis is a research or a planning project. Students must demonstrate the ability to complete the project independently and following a plan. A report is prepared following the instructions for the Master's thesis.

**Teaching Methods:**

The presentation of the thesis will be arranged with the supervising professor. There will not be a separate seminar. Total workload approx. 780 h.

**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 %.

**Course Materials:**

-

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

No

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

No

**BH60A0252: Solid Waste Management Technology, 7 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 Horttanainen, Jouni Havukainen, Mika Luoranen

**Year:**

M.Sc. (Tech.) 1

**Period:**

1-2

**Teaching Language:**

English

**Teacher(s) in Charge:**

Professor, D.Sc. (Tech.) Mika Horttanainen

**Aims:**

Upon completion of the course the student is expected to be able to

1. explain the most important generation mechanisms, properties, and collection and treatment systems of solid waste,
2. explain the operation of essential process technology and equipment,
3. compare and give grounded proposals for treatment methods and processes applicable to different situations,
4. calculate process parameters related to composting, digestion and energy utilization,
5. apply waste management legislation,



6. apply what he/she has learned to the environmental treatment and utilization of waste, and
7. describe the operation of regional waste management.

**Contents:**

Generation of solid waste and waste management in different parts of the world, properties of waste, legislation concerning waste management, source separation, collection and transport, pretreatment, composting, anaerobic digestion, waste-to-energy, landfilling, regional waste management, treatment of polluted soil.

**Teaching Methods:**

1st period: 14 h of lectures, 10 h of tutorials. 2nd period: 12 h of lectures, 8 h of tutorials. Assignment with literature and calculation part, presentation, individual work approx. 82 h. Field trip approx. 12 h. Lecture assignments approx. 10 h. Examination and preparation for it approx. 30 h. Total workload 182 h.

**Examination in Examination schedule (Yes/No):**

Yes

**Examination in Moodle (Yes/No):**

No

**Examination in Exam (Yes/No):**

No

**Assessment:**

0 - 5. Examination 50 %, assignment 40 %, lecture assignments 10 %.

**Course Materials:**

Tchobanoglous, Theisen, Vigil: Integrated Solid Waste Management, 1993. Handouts provided by the lecturer, course environment on Moodle.

**Prerequisites:**

BH60A0001 Ympäristötekniikan perusteet, BH60A0901 Ympäristömittaukset or equivalent knowledge

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

max 15

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

max 10

**BH60L3000: Biological Cycle in Circular Economy, 6 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

**Note:**

Will be organised first time in academic year 2019-2020 in Lahti.

**Year:**

M.Sc. (Tech.) 2

**Period:**

1-2

**Teaching Language:**

English

**Teacher(s) in Charge:**

Hanna Mäkinen, Dr. (Agriculture & Forestry), Post-doctoral researcher

**Aims:**

Upon the completion of the course the student is expected to be able to:

1. understand biological cycles (food, forest)
2. is able to analyze the volume/ quantity of the cycles
3. is able to develop solutions (and business concepts) to waste minimization, surplus management, and recycle

**Contents:**

Circular economy, food system, forest system, waste minimization, recycle, surplus management. The students produce a large project work in groups.

**Teaching Methods:**

42h lectures (35 digi- teaching, contact teaching 7h). Compulsory attendance on the contact teaching; 1h opening of the course, forming groups and brainstorming group works 3h, presenting and evaluating group works 3h.

Independent work (approx. 114 h): Group work, approx. 60 h, Examination and preparation, approx. 54 h. Total workload 156 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):**

Yes

**Examination in Exam (Yes/No):**

No

**Number of mid-term examinations:**

2

**Assessment:**

Exams (50 %) (Continues evaluation, Moodle-quiz) and group work (50%).

**Course Materials:**

material informed in lectures

**Prerequisites:**

BH60A5400 Introductionto Circular Economy

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

max 5

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

max 5

**BH60L4000: Technical Cycle in Circular Economy, 6 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

**Note:**

Will be organized first time 2019-2020 in Lahti.

**Year:**

M.Sc. (Tech.) 2

**Period:**

1-2

**Teaching Language:**

English

**Teacher(s) in Charge:**

Will be announced later.

**Aims:**

Will be announced later.

**Contents:**

Will be announced later.

**Teaching Methods:**

Will be announced later.

**Examination in Examination schedule (Yes/No):**

No

**Examination in Moodle (Yes/No):**

No

**Examination in Exam (Yes/No):**

No

**Assessment:**

Will be announced later.

**Course Materials:**

Will be announced later.

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

No

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

No

**BH60L5000: Energy in Traffic Systems, 6 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

**Note:**

Will be organised in Lahti.

**Year:**

M.Sc. (Tech.) 1

**Period:**

3-4

**Teaching Language:**

English

**Teacher(s) in Charge:**

Professor, D.Sc. (Econ. & Bus. Adm.), M.Sc. (Tech.) Lassi Linnanen  
 Postdoctoral Researcher, Ville Uusitalo

**Aims:**

Upon completion of the course the student is expected to be able to

1. comprehend basic vehicle and transportation systems and technologies
2. comprehend aspects that impact on transportation energy consumption
3. comprehend energy production methods for the transportation sector
4. apply methods for assessing energy production for the transportation sector
5. apply methods for reducing energy consumption in the transportation sector
3. apply methods to assess sustainability of transportation systems and transportation energy production

**Contents:**

Energy production for transportation, vehicle and transportation systems and technologies, possibilities to reduce energy consumption in the transportation sector, sustainability perspectives of transportation systems and transportation energy consumption.

**Teaching Methods:**

20 h of lectures and exercises, 3st - 4nd period. Independent work (approx. 114 h): Assignment, approx. 80 h, Examination and preparation for the examination, approx. 56 h. Total workload 156 h.

**Examination in Examination schedule (Yes/No):**

No

**Examination in Moodle (Yes/No):**

No

**Examination in Exam (Yes/No):**

Yes

**Assessment:**

0 - 5. Examination 50 %, assignment(s) 50 %.

**Course Materials:**

Course materials will be delivered via Moodle.

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

No

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

max 5

**BH60L6000: Sustainability Challenge Project Work, 4 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

**Note:**

Will be organised in Lahti.

**Year:**

M.Sc. (Tech.) 1

**Period:**

1-2

**Teaching Language:**

English

**Teacher(s) in Charge:**

Ville Uusitalo D. Sc. Postdoctoral researcher

**Aims:**

Upon completion of the course the student will be able to act as an active member of an interdisciplinary project team in different roles. Depending on her/his role in the project, the student can:

1. describe the outline of the project plan and apply different methods to divide the project into subtasks and to schedule the project,
2. prepare a budget for the project and monitor it,
3. document the group's and her/his project work results both orally and in writing,
4. reflect her/his actions as a member of the team and assess the outcome of the project and the other team members' work,
5. recognize the key elements in project risk management,
6. apply knowledge and skills acquired in other courses to complete the project

**Contents:**

Varying themes according to the project.

**Teaching Methods:**

Project management lectures (a few intensive days). Working in a project as a member of a project team in different roles and tasks e.g. related to generating ideas, planning, dimensioning, construction, manufacturing, measuring and testing documentation, management and negotiations. Continuous self-assessment, evaluation of the project group work and the outcome of the project e.g. with a learning and /or project diary.

**Examination in Examination schedule (Yes/No):**

No

**Examination in Moodle (Yes/No):**

No

**Examination in Exam (Yes/No):**

No

**Assessment:**

1-5. The course is evaluated based on the work done in the project and its appropriate documentation, by student self-assessment and by teachers and peers. Comprehensive documentation, monitoring and reporting on the project are key elements in the evaluation.

**Course Materials:**

Case-specific

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

30, Students in Lahti circular economy Master's Program in Circular Economy are prioritized.

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

No

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

No

**YMCEVal: Free elective studies, 0 - 100 cr**

**Validity:** 01.08.2018 -

**Form of study:** Elective studies

**Type:** Study module

**Unit:** LUT School of Energy Systems

**Grading:** Study modules 0-5,P/F

No course descriptions.

*Choose enough free elective studies to attain 120 ECTS cr*

**BH60A0451: Air Pollution Control, 6 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:** Risto Soukka, Ville Uusitalo

**Year:**

M.Sc. (Tech.) 1-2

**Period:**

1-2

**Teaching Language:**

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. comprehend the air pollution control terminology,
2. apply methods for improving air quality in cities,
3. apply methods for decreasing the carbon footprint of products and services,
4. control air pollution treatment methods economically in changing conditions,
5. calculate reduction costs for air pollution,
6. apply different risk assessment methods,
7. comprehend the formation and treatment methods of air pollution,
8. comprehend air pollution control technologies and processing systems, and
9. comprehend sustainability aspect of air pollution control

**Contents:**

Control of particulates, sulphur and nitrogen oxides, greenhouse gas emissions, and of other gaseous emissions. Risk assessment methods. Sustainability aspects.

**Teaching Methods:**

14 h of lectures, 1st - 2nd period. 20 h of lectures, 1st - 2nd period. Option for study trip 8 h. Independent work (approx. 114 h): Assignment, approx. 60 h, Examination and preparation for it, approx. 54 h. Total workload 156 h.

**Examination in Examination schedule (Yes/No):**

No

**Examination in Moodle (Yes/No):**

No

**Examination in Exam (Yes/No):**

Yes

**Assessment:**

0 - 5. Examination 50 %, assignment 50 %.

**Course Materials:**

De Nevers Noel: Air Pollution Control Engineering, Cooper: Air Pollution Control - A Design Approach. Moodle.

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

max 5

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

max 5

### **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:** Ivan Deviatkin, Sanni Väisänen, Risto Soukka

**Note:**

Suitable also for doctoral studies.

In order to take the course, the student should have own laptop 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

**BH60A5200: Introduction to Business and Sustainability, 3 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**Note:**

The course is intended for international students of MSc programmes in Sustainability Science and Solutions and Circular Economy, or Sustainability minor students. Literature examination in the electric exam system. Registration for the course in WebOodi during the academic year. Registration for the exam using the electric exam software (EXAM). The examination can be carried also during the vacations. Beyond the academic year the registration only for the electric exam software. Moodle is used as a communication platform.

**Year:**

B.Sc. (Tech.) 3

**Period:**

1-4

**Teaching Language:**

English

**Teacher(s) in Charge:**

Professor, D.Sc. (Econ. & Bus. Adm.), M.Sc. (Tech.) Lassi Linnanen  
Associate Professor, D.Sc. (Agr. & For.) Mirja Mikkilä

**Aims:**

Upon completion of the course the student is expected to be able to:



1. recognize the relationship between the company and society,
2. explain the connection between corporate responsibility and business strategies,
3. recognize organizational, economic, and social issues related to corporate social responsibility,
4. identify tools and mechanism sof corporate responsibility,
5. name dimensions and stakeholders related to corporate responsibility,
6. explain the importance of stakeholders in his/her ownwords.

**Contents:**

Corporate environmental strategies and application of the methods of environmental management. Identifying the sectors of responsible business operations. Basics of corporate ethics. Informing of and reporting on corporate responsibility issues to the stakeholders. Reporting of corporate social responsibility. Thecourse is related to sustainability.

**Teaching Methods:**

Literature examination in the exam aquarium. All the exams done during one calendar month are to be reviewed by the 15th of the following month except for the period 1 June – 31 July when the examination swill be evaluated by 15 August. Total workload 78h. See Moodle for further instructions and contact information. Electronic EXAM.

**Examination in Examination schedule (Yes/No):**

No

**Examination in Moodle (Yes/No):**

No

**Examination in Exam (Yes/No):**

Yes

**Assessment:**

Evaluation 0 - 5. Examination 100 %.

**Course Materials:**

Chandler,David: Strategic Corporate Social Responsibility: Sustainable Value Creation,2017. Other material and literature specified in MOODLE course overview.

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

15-

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

15-

**BH60A5700: Business and Sustainability, 6 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

**Note:**

Replaces the course BH60A3001 Corporate Responsibility and Management 2.

**Year:**

M.Sc. (Tech.) 1

**Period:**

3-4

**Teaching Language:**

English

**Teacher(s) in Charge:**

Professor, D.Sc. (Econ. & Bus. Adm.), M.Sc. (Tech.) Lassi Linnanen  
Associate Professor, D.Sc. (Agr. & For.) Mirja Mikkilä

**Aims:**

Upon the completion of the course the student is expected to be able to:

1. analyze decision making situations related to sustainable business,
2. propose solutions to challenging business situation within sustainable business,
3. understand various sustainable business and enterprise models,
4. evaluate critically responsible corporate communication,
5. discuss and argument on various perspectives of sustainable business based on the learned issues and on-going societal debate.
6. carry out self- and peer evaluations

**Contents:**

Familiarization with the sustainable business models and the strategic responsibility framework of a firm. Reorganization of dimensions of responsible business. Deepening the application skills of mechanisms and tools of sustainable management. Analysis of business and financial consequences of responsibility governance. Familiarization of basics of business ethics. Communication and reporting of goals and implementation of corporate responsibility to stakeholders. Learning of corporate responsibility reporting guidelines.

**Teaching Methods:**

Lectures 6 h, 3 period. Written report on Corporate Responsibility communication and preparation of seminar presentation, groupwork approximately 30 h, written report 3 period.  
Seminar presentation 4. period. Case-assignments, group work, approximately 120 h, 3-4 period. The student must participate in the case-assignments.  
Total workload 156 h, of which independent work approximately 118 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):**

No

**Assessment:**

Evaluation 0 - 5. Written report 30 %, case-assignments 70 %.

**Course Materials:**

Caset: Hamschmidt, Jost (toim.): Case studies in sustainability management and strategy: the Oikos collection, 2007,  
Pirson, Michael (toim.): Case studies in social entrepreneurship: the Oikos collection, 2015,  
GRI yhteiskuntavastuun raportointiohjeisto, versiot 3.1 ja 4. Further course material will be announced during the lectures,  
Course material in Moodle

**Prerequisites:**

Sustainability transition and sustainable business (Kestävyysmuutos ja johtaminen) or Introduction to Sustainable Business  
passed or equivalent knowledge studied earlier.

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

Max 5

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

Max 5

**BH60A3700: Work internship in Master's degree, 2 - 10 cr****Validity:** 01.08.2012 -**Form of study:** Basic studies**Type:** Practical training**Unit:** LUT School of Energy Systems**Grading:** Study modules 0-5,P/F**Teachers:** Lassi Linnanen, Simo Hammo**Year:**

M.Sc. (Tech.) 1-2

**Period:**

1-4

**Teaching Language:**

Finnish

**Teacher(s) in Charge:**

Laboratory Engineer, Lic.Sc. (Tech.) Simo Hammo

**Aims:**

After the work environment internship, the student will have the basic knowledge of work, working environment and working community in his/her own field. The student will be able to apply the knowledge and skills acquired during the course of studies to work in his/her own field.

**Contents:**

The student obtains a (summer) job from the company, works there as a paid employee, requests for a certificate of employment and applies for the approval of the work as an internship for the Master's degree. Full-time employment relationships of at least four weeks can be approved as internships. The completion of the Master's thesis is not accepted as an internship. An employment relationship preceding the studies can be approved as an internship, provided that it has not been accepted and included in any other previous degree.

**Teaching Methods:**

The first 2 ECTS credits: applying for a job and recruiting 10 h, tasks connected to beginning of an employment relationship (e.g. orientation, the rules of the employment relationship and the workplace) 15 h, observing (while working) how the working community operates (e.g. how work/production is organized, supervision, the working manners of the working community/teams, the social environment of the workplace) 22 h, a written internship report 5 h (2 - 3 pages), total workload 52 h. 3 - 10 ECTS credits: having different tasks in a company 26 - 208 h (1 ECTS credit/26 h). The number of ECTS credits of compulsory internship varies depending on the degree programme in question, further information is available in the degree structures in the study guide.

**Examination in Examination schedule (Yes/No):**

No

**Examination in Moodle (Yes/No):**

No

**Examination in Exam (Yes/No):**

No

**Assessment:**

Pass/Fail. Internship report 100 %.

**Course Materials:**

Instructions: <https://uni.lut.fi/en/web/lut.fi-eng/internship6>

**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

### EnDSOEDM: Energiatekniikka digitaalisille maisteriohjelmille, 21 cr

**Validity:** 01.08.2018 -

**Form of study:**

**Type:** Study module

**Unit:** LUT School of Energy Systems

**Grading:** Study modules 0-5,P/F

**Aims:**

Energiatekniikka digitaalisille maisteriohjelmille sivuopintokokonaisuuden suoritettuaan opiskelija:

- ymmärtää energiantuotannon perusteet Suomessa ja maailmalla
- ymmärtää voimalaitostekniikan perusteet
- ymmärtää energiatalouden ja energiatehokkuuden perusteet.

Sivuopintokokonaisuus soveltuu etäopiskeluun.

*Sivuopintokokonaisuus 21 op. Tarkoitettu LESin ja LENSin digiohjelmien opiskelijoille.*

### BH40A0010: Introduction to Energy Technology for EnTeDI Students, 4 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

**Note:**

The course is only for EnTeDI students or those studying in in so called digital master's programmes (DIODI, JEDI etc.).

**Year:**

M.Sc. (Tech.) 1

**Period:**

1-2

**Teaching Language:**

Finnish

**Teacher(s) in Charge:**

D.Sc. (Tech.) Ahti Jaatinen-Värri, D.Sc. (Tech.) Kari Myöhänen

**Aims:**

- Understands the basics of power plant engineering, and how the most common power plants work.
- Is able to calculate the most common power plant process and operating parameters.
- Is able to describe the Finnish power system.
- Understands how electricity is produced in Finland and elsewhere.
- Is able to interpret energy scenarios and compare them.

**Contents:**

Fundamentals of power plant engineering, energy production in Finland and elsewhere, energy scenarios.

**Teaching Methods:**

On-line lectures, lectures and exercises, independent studies, group assignments, personal assignments, homework, 1 and 2 period.

Total workload 104 h.

**Examination in Examination schedule (Yes/No):**

No

**Examination in Moodle (Yes/No):**

No

**Examination in Exam (Yes/No):**

No

**Assessment:**

0-5, homework, assignments, group assignments.

**Course Materials:**

Course material is announced in Moodle.

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

No

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

No

**BH40A0210: Energy-efficient Pumps, Fans and Compressors, 4 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

**Note:**

The course is only for EnTeDI students or those studying in so called digital master's programmes (e.g. DIODI, JEDI).

It is lectured first time in the academic year 2019-2020.

**Year:**

D.Sc. (Tech.) 2

**Period:**

1-2

**Teaching Language:**

Finnish

**Teacher(s) in Charge:**

Associate professor, D.Sc. (Tech.) Pekka Punnonen

**Aims:**

Upon completion of the course the students will be able to: 1. define the operational principle and structure of pumps, blowers, fans and compressors, 2. choose the appropriate type of pumps, blowers, fans and compressors for different applications, 3. demonstrate sufficient knowledge of pumps, blowers, fans and compressors for economical optimization and for sale or purchase meetings, and 4. design their principal dimensions.

**Contents:**

Different types of pumps and their operating principles, calculation of centrifugal pumps and their characteristics in pipe network. Cavitation. Different types of compressors and their operating principles, calculation of radial compressors. Different types of blowers and their operating principles. Process applications, selection criteria and control.

**Teaching Methods:**

Lectures, on-line, lectures, independent studies. EXAM-eletrical exam. Home assignments, quizzes, dimensioning assignment.

Total workload 104 h.

**Examination in Examination schedule (Yes/No):**

No

**Examination in Moodle (Yes/No):**

No

**Examination in Exam (Yes/No):**

Yes

**Assessment:**

0-5, quizzes, home assignments and dimensioning assignment 60%, EXAM examination 40%.

**Course Materials:**

Lecture material in Moodle.

Additionally: Gülich, J.F. 2010: Centrifugal pumps.

Airila, Mauri et al.: Kompessorikirja.

Wirzenius, A.: Keskipakopumput.

Larjola, Jaakko: Radiaalikompressorit.

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

No

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

No

**BH40A0220: Efficient Power Plants and Waste Heat Recovery, 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

**Note:**

The course is only for EnTeDIstudents or those studying in so called digital master's programmes (DIODI, JEDI, etc.)

**Year:**

M.Sc. (Tech.) 1

**Period:**

3-4

**Teaching Language:**

English

**Teacher(s) in Charge:**

Antti Uusitalo, D.Sc. (Tech.), Post-doctoral researcher

**Aims:**

Upon completion of the course student: 1. Has knowledge on different waste heat recovery technologies and knowledge on the principles of waste heat recovery 2. Understands the principles of dimensioning and optimizing of efficient power systems 3. Is able to estimate waste heat recovery potential in different applications and to evaluate the most suitable waste heat recovery technology for different applications.

**Contents:**

Principles of waste heat recovery and the main factors affecting on waste heat recovery potential and opportunities. Operational principles of high efficiency power plants and different waste heat recovery technologies and their typical applications. Principles of dimensioning of the heat recovery devices.

**Teaching Methods:**

On-line lectures, quizz, homework, assignments, and independent studies.  
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

**Course Materials:**

Material informed later

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

Yes, the course is only for EnTeDI students or those studying in so called digital master's programmes (DIODI, JEDI, etc.)

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

No

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

No

**BH61A020E: Energy Economics for EnTeDI, 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

**Note:**

Only for the EnTeDI students.

**Year:**

M.Sc. (Tech.) 1

**Period:**

3-4

**Teaching Language:**

English

**Teacher(s) in Charge:**

Professor, D.Sc. (Tech.) Tapio Ranta

**Aims:**

Upon completion of the course the students will be able to utilise energy economic calculation methods and to calculate the additional cost in the energy production costs caused by emission trading. Students will be able to describe the basic concepts of Finnish energy economics and explain the structure of energy taxation in Finland, and calculate the energy taxes of fuels. Students will understand the structure of energy tariffs, and will be able to compile a duration curve of the consumption curve of energy.

**Contents:**

Use of energy statistics. The variation in energy demand and duration curves. Calculation methods for energy production costs. Profitability calculations of energy projects. Environmental impacts in energy production, especially carbon dioxide emissions. Energy and fuel markets. The effect of emission trading on the price of electricity, and energy tariffs. Energy taxation and the pricing system of natural gas. Energy economics in Finland and EU. The need for investments in electricity production. National energy and climate strategy. Fuel economics. Energy scenarios.

**Teaching Methods:**

Independent studies in Moodle, Homework based on lectures and exercises in Moodle.  
Total workload 130 h.

**Examination in Examination schedule (Yes/No):**

No

**Examination in Moodle (Yes/No):**

No

**Examination in Exam (Yes/No):**

No

**Assessment:**

Evaluation is based on exercises and homework in Moodle 100%, Pass/Fail.

**Course Materials:**

Study materials, including the lecture material, will be listed in Moodle.

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

No

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

No

**BH61A060E: Bioenergy for EnTeDI, 3 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



**Note:**

Only for the students of EnTeDI and Biorefineries M.Sc. programmes.

**Year:**

M.Sc. (Tech.) 1

**Period:**

1

**Teaching Language:**

English

**Teacher(s) in Charge:**

Tapio Ranta, D.Sc. (Tech.), Professor

**Aims:**

Upon completion of the course the student will be able to understand the meaning of bioenergy, alternative biomass resources, supply methods, refining and end-user applications; describe the quality properties of solid biofuels and how they are measured and evaluated by using standards; and explain the meaning of sustainability in bioenergy systems.

**Contents:**

The role of bioenergy in the EU energy policy, incentive programmes and future plans. Raw-material sources of bioenergy, potential resources and current use. Biomass supply systems and logistics. Refined biofuel commodities, biogas and liquid biofuels. Biomass international trade. Quality properties of solid biofuels, quality measurement and standards. Sustainable bioenergy.

**Teaching Methods:**

Independent studies in Moodle, Exercises in Moodle.  
Total workload 78 h.

**Examination in Examination schedule (Yes/No):**

No

**Examination in Moodle (Yes/No):**

No

**Examination in Exam (Yes/No):**

No

**Assessment:**

Evaluation is based on exercises in Moodle 100%, Pass/Fail.

**Course Materials:**

Study materials, including the lecture material, will be listed in Moodle.

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

Yes, only for the students of EnTeDI and Biorefineries M.Sc. programmes.

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

No

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

No