Østfold University College

Study Plan for Master in Green Energy Technology (120 ECTS) (2020–2022)

Facts about the program

ECTS Credits: 120
Study duration: 2 years
Teaching language: English
Campus: Østfold University College, campus Fredrikstad.

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Study information

The Master in Green Energy Technology focuses on a sustainable and environmentally friendly approach to energy technology.

The students will acquire knowledge and skills related to renewable energy sources and advanced materials needed to understand the principles of energy generation and storage. The students will also acquire knowledge related to how such energy sources and materials can be interconnected through smart grid and micro grid systems. They will learn how the concept of circular economy can be adapted to energy technology to achieve optimized resource efficiency. Throughout, project work in interdisciplinary groups provides collaboration skills and a better understanding of how each part of an energy system interact together to form an integrated unit.

After successfully completed four semesters, a Master in Green Energy Technology has the competence needed to implement appropriate innovation processes combined with specialized technological knowledge and skills in energy technology and thereby contribute to the development of a more sustainable society.

What do you learn?

Degree/title obtained

Master in Green Energy Technology.

Learning outcomes

A candidate who has completed his or her qualification should have the following learning outcomes defined in the terms of knowledge, skills and general competence:

Knowledge:
For the profile Smart Energy Technology the Candidate:

- has specialized insight into power systems, smart-grids and micro-grids and advanced knowledge regarding materials for energy technology, resource shortages and renewable energy sources
- has advanced knowledge of experimental and theoretical methods and modelling utilized in green energy technology for power systems, smart-grids and micro-grids, and is able to utilize his/her advanced and specialized knowledge in new areas.

For the profile Materials for Energy Technology the Candidate:

- has specialized insight into materials for green energy technology and advanced knowledge regarding renewable energy sources, power systems, smart-grids and micro-grids and challenges related to resource shortages
- has advanced knowledge of experimental and theoretical methods and modelling utilized in materials for green energy technology, and is able to utilize his/her advanced and specialized knowledge in new areas.

For both profiles the Candidate:

- is able to understand how societal, political and economic assumptions affect strategies and pathways chosen within debates and decisions regarding future energy technology

  is able to analyze scientific problems within energy technology, and relate this to the history of energy technology and its place in societal debates and strategies, both nationally and internationall.

Skills:

The Candidate:

- is able to critically analyze different sources of information and research methods, and use them to structure and develop academic arguments

  is able to analyze and apply different theories within energy technology, and utilize experimental and theoretical methods and modelling within energy technology, and can work independently with practical and theoretical problem solving

  can handle multiple analytical tools to influence politics and strategies and be a contributor in innovation processes, development and decision making related to future energy technology

  is able to independently conduct a defined research or development project under supervision, in agreement with existing ethical norms, and is able to analyze ethical problems related to green energy technology.

General Competence:

The Candidate:

- is able to utilize his/her knowledge and skills within new areas to accomplish advanced tasks and projects, and is able to find relevant scientific literature for new topics within energy technology
- is able to discuss and give oral and written presentations regarding research, and development projects related to energy technology
- is able to collaborate and contribute to team projects, and actively participate in innovation processes related to energy technology.

Admission

The minimum requirements for admission is one of the following:

1) Relevant bachelor's degree in engineering or equivalent education of at least 180 ECTS
or
2) Relevant natural science bachelor's degree or equivalent education of at least 180 ECTS

To be admitted, the applicant must have an average grade value from the qualifying education of at least 25 (according to ECTS standards).

Proof of English proficiency is also required.

For the profile choice with specialization in Smart Energy Technology, relevant degrees must be within the fields of energy technology, electrical engineering, mechatronics, cybernetics, physics, computer science or equivalent.

For the profile choice with specialization in Materials for Energy Technology, relevant degrees must be within the fields of energy technology, materials science, chemistry, chemical engineering, physics, mechanical engineering, civil engineering, or equivalent.

Applicants from countries outside the EU/EEA must submit proof of funding when submitting their application.

Structure and content

The structure and content of the programme

The Master in Green Energy Technology is a full-time study program for 2 years (4 semesters). The master program consists of a combination of compulsory and elective courses.

During the first semester, the students acquire an interdisciplinary basis and overview within the field of energy technology, preparing them for the more advanced compulsory courses and a specialization profile in the second semester. The selection of main disciplinary profile, either Smart Energy Technology or Materials for Energy Technology, in the second semester and a broad variation of elective courses in the third semester provides the opportunity for each student to choose their individual field of specialization.

The first three semesters provides the students with understanding, knowledge and skills related to societal issues such as policies and innovation processes, available resources and the use and development of materials and systems for improved energy use. In combination with knowledge and skills related to the logics of scientific work and thinking, this prepares the students for the fourth and final semester, culminating in a Master Thesis on the topic of the chosen specialization.

It is possible to exchange the elective courses with master courses that are relevant to energy technology from other universities/university colleges in Norway or abroad. More details on such exchange is included in the paragraph about the third semester below.

The first semester is fixed for all students, with three compulsory courses, each of 10 ECTS. These will provide the students with a general interdisciplinary background within green energy technology, teach the students to work in interdisciplinary groups, how to search for scientific literature, and how to present their work both orally and as a written report.

In the second semester, there are 15 ECTS points (5 +10) compulsory coursework. The 10 ECTS compulsory part will provide the students with knowledge and skills related to how social, political and cultural values affect science, and how more sustainable and lower carbon energy systems can be achieved by implementing innovation and new business models. The 5 ECTS compulsory part is the first part of the course Scientific Research and Methods, which is completed early in the third semester. This course provides the students with knowledge and skills related to the ethics and logics of academic thinking and writing. The students will also choose their Master Thesis topic and conduct a comprehensive literature study resulting in specific research questions for the Master Thesis, sufficiently framed and defined by state-of-the-art research literature related to their chosen field of interest. In addition to the compulsory part of the second semester, each student choose one of the two specialization profiles as a rule based on their prior bachelor level education, which provided the fulfillment of the admission requirement. Both profiles is constituted by two courses, counting totally 15 ECTS points (5+10), both compulsory for the chosen profile.

To enter the Smart Energy Technology profile, students are expected to possess basic knowledge and skills related to electrical circuits. Students with a bachelor degree in electrical engineering and/or computer science automatically fulfill this recommendation. Students with other bachelor level educations can acquire the recommended knowledge and skills related to electrical circuits by passing relevant exams at bachelor level. The students do not need to provide the program manager with formal documentation, but such relevant exams are highly recommended for students choosing this profile of specialization. The Smart Energy Technology profile focuses on the integration of renewable energy sources in power systems, in addition to the concept of micro grids, including modelling and simulations of such.

The Materials for Energy Technology profile does not have any specified recommended prior knowledge other than the ones provided by the compulsory courses of the first semester. The Materials for Energy Technology profile focuses on the use and understanding of advanced materials, and how such materials can provide development opportunities related to provident and sustainable technology applications for future energy use efficiency.

The third semester consist mainly on elective courses. There is a 5 ECTS compulsory part of the course Scientific Research and Methods finishing in September, allowing students to exchange to other institutions. Such exchange is facilitated by a comprehensive list of cooperation agreements with institutions outside Norway. Courses attended and passed in other institutions must be preapproved by the study program manager in collaboration with the student's supervisor and the office of international affairs at Østfold University College, to ensure sufficient learning outcome for each individual student. The elective courses cover a range of topics related to energy technology, allowing each student to pursue their individual interest. Any combination ensures sufficient learning outcome (except the partial combination Special Curriculum I and II, which is not possible due to course content overlap).

The fourth semester consists of a 30 ECTS Master Thesis, where the students will conduct a research/development project related to green energy technology.

Teaching, learning methods and forms of assessment

Forms of teaching and learning:

A combination of different teaching methods are used. Lectures, flipped classroom, seminars, workshops, various types of exercises, laboratory tasks, project work, supervision and self-study are combined to provide the students with the tools they need to obtain the knowledge and skills they will need for the future. Projects in interdisciplinary groups promote collaboration skills, and teach the students to communicate across disciplines. The students will practice both written and oral communication.

During the course of the four semesters, the students will meet guest lecturers from industry and collaborative universities abroad. The study plan provides the opportunity for project work in close collaboration with industry partners. In addition, the students can participate in ongoing research projects at the Faculty of Engineering. For more details, see heading Research and development work below.

The students are expected to work between 750 and 900 hours each semester. In addition to the organized tuition, the students are expected to work independently and in groups with assigned tasks, solve exercises, read the curriculum, find and read other relevant literature, and prepare for exams.

The students will learn how to search for scientific literature and to critically review what they find to acquire new knowledge. This will prepare them for a future where the field of energy technology is advancing towards new technological solutions. They will also obtain skills in various forms of academic writing, as well as in oral presentations.

Teaching materials

The students will work with analogue and relevant digital tools. The students are expected to pay for teaching materials such as textbooks and photocopies themselves. In addition, each student is expected to utilize their own laptop. Language The study is internationally oriented, and the tuition language is English. The students are expected to answer all exams in English, and deliver all written work and oral presentations in English. Coursework requirements and Assessment Most courses has some compulsory coursework requirements. The coursework requirements has to be approved before the student can take the exam or deliver the assessment requirements for the course. See the course descriptions for details. The students will be evaluated by a combination of coursework requirements, project reports and various forms of exams. The coursework requirements are evaluated on a approved/not approved basis, and should be approved before the student can take the exams or deliver the project work that will give the basis for the grade of the course. The coursework requirements and the bases for the assessment varies depending on the nature of each course. More details are given in the course descriptions. The course descriptions also give details about the possibilities for re-taking the assessment if the students fail. Generally, most written or oral exams can be re-taken maximum two times, while written reports can be revised one time. For each course grades are given from A to F, where A is the best grade, E is the lowest passed grade, and F is failed. Exams are graded by two sensors, for most of the courses one of these sensors will be external. An external sensor will always be used on the Master Thesis. The Master Theses is subject to electronic plagiarism control, as may also be the case with other courses and required coursework. Exam papers that are partly or entirely identical will not be approved and will be regarded as attempted cheating. For further information, please see Exam regulations for Østfold University College.

Research and development work

The Master in Green Energy Technology is located at the Faculty of Engineering, Østfold University College, where the employees carry out research related to various aspects of energy technology, such as smart grids, micro grids, materials, and innovation processes. Students are invited to participate with academic staff and guest researchers in professional research projects within and outside the institution. The diversity of the practical and theoretical research of the Faculty employees is one of the main sources of the education at all levels. The research of the academic staff takes place both inside and outside the institution, on a high national and international level. The students will have the opportunity to actively participate in the research projects of the academic staff in the Master Thesis, and to a lesser extent also in some of the other project-based courses. In addition, we have a close contact with the local industry, and the students will have the opportunity to participate in research and development project in collaboration with the industry. The active participation and contributions of the students may take various forms such as practical and theoretical contributions, and sometimes within publications.

Internationalisation

Faculty of Engineering consists of an international faculty with different expertise and experience in the international research projects, development and innovation activities and teaching. The Faculty has an international network with exchange opportunities and appointments with various research and educational institutions.

All courses are taught in English, using solely English literature. This facilitates applicants from outside Norway. Students can also exchange to institutions outside Norway (see "Study Abroad").

Programme evaluation

To be able to offer relevant education of good quality, we are dependent on feedback from the students and on their participation in evaluating the programs of study. Each individual academic environment is responsible for adopting evaluation procedures at course level. See the course descriptions for details.

In addition to course evaluations, Østfold University College conducts periodic evaluations of the study program as a whole. In addition, NOKUT (the Norwegian Agency for Quality Assurance in Education) conduct the annual Student Survey on student perceptions on the quality of study programs in Norway. All students in this study program are given the opportunity to participate in the survey.

Reading list

See the course descriptions.

Studies abroad

Voluntary exchange / study abroad should normally take place in the 3rd semester and will extend over varying periods of time. Any of the courses in the 3rd semester can be exchanged with other courses abroad, as long as the courses are relevant for the Master and secures sufficient learning outcome. It is also possible to take the Master Thesis abroad in the 4th semester. Exchange/study abroad must be discussed with and approved by supervisors and the program manager.

The Faculty of Engineering has agreements for internationalization and student exchanges at master's level with the following institutions:

- Universidad de Castilla-La Macha - Spain
- Hochschule Wismar - Germany
- Queensland University of Technology - Australia
- University of North Dakota - USA
- University of Pisa - Italy
- Högskolan Väst - Sweden
- Universidad Politecnica de Cartagena - Spain
- University of Vaasa - Finland
- Piraeus University of Applied Sciences - Greece

The international coordinator at the Faculty of Engineering can be contacted for further information.

Work and future studies

Graduates from the Master program form a new and unique generation of professionals who will be called upon to tackle critical issues in renewable and sustainable energy management systems. They are distinguished by their technical and management knowledge and the skills required to deal with a wide range of issues at the interface between energy, technology, innovation and science. With the increasing demand for environmentally friendly and sustainable energy solutions, the industry has a great need of professionals within this field, who are experienced in working in interdisciplinary groups to solve complex problems.

PhD-studies

The study will form the basis for PhD level research, and prepare the candidate for admission to relevant doctoral programs within energy technology. A completed master degree qualifies for admission to related PhD-studies. Examples of such are the PhD program in Mathematics and Natural Sciences at the University of Oslo, PhD in Energy and Process Engineering, or Materials Science and Engineering at Norwegian University of Science and Technology, the PhD program at the Faculty of Engineering and Science at the University of Agder, PhD in Science and Technology at Norwegian University of Life Sciences and the Doctoral Education at the Faculty of Mathematics and Natural Sciences, University of Bergen. Note that one need a B or better average on the Master degree for the admission to PhD-studies at some institutions.

Career prospects

The study focuses on the possibilities and challenges of green energy technology. The study provides competence needed to work within the energy technology sector in both commercial companies, specialized consultancy agencies, policy and regulation defining public bodies and public services. Energy suppliers, energy distributors, and companies manufacturing or supplying energy technology solutions, components, materials, etc. are possible future employers. It is also possible to go into research or teaching, or to start up a new company based on energy technology innovation.

The candidates can work as project engineers, project leaders, or product/concept developers within energy technology. They are attractive employees for a variety of companies and bodies within production, delivery, service, counselling, policy development and administration/management, both nationally and internationally.

The study plan is approved and revised

The study plan is approved

Dean Geir Torgersen 22 August, 2019 Accredited by The Norwegian Agency for Quality Assurance in Education (NOKUT), 28.8.2018.

The study plan is revised

Head of Studies, Annette Veberg Dahl, 22 August 2019

The study plan applies to

2020 (autumn)

Programme Coordinator

Faculty of Computer Science, Engineering and Economics.
Faculty of Engineering, program manager Shima Pilehvar.

Study model

This study model has a new design. Let us know what you thing about it

Autumn 2020

Core courses

IRMGR40118
Adapting Technology to the Circular Economy
stp

IRMGR40218
Renewable Energy
stp

IRMGR40318
Materials for Energy Technology
stp

Spring 2021

Core courses

IRMGR40518 · Part 1 of 2
Scientific Research and Methods

IRMGR40418
Energy Technology, Policy and Sustainability
stp

Profile choice: Smart Energy Technology

IRMGR41018
Wind, Solar and Hydro Power Integration in Power Systems
stp

IRMGR41118
Dynamic Modelling and Simulation of Micro Grids
stp

Profile choice: Materials for Energy Technology

IRMGR41518
Experimental Methods
stp

IRMGR41618
Solid State Physics and its Modern Industrial Applications
stp

Autumn 2021

Core courses

IRMGR40518 · Part 2 of 2
Scientific Research and Methods
stp

Elective courses (25 ECTS)

IRMGR42018
Power System Dynamic and Control
stp

IRMGR42118 Smart Grids Technology and Applications	stp
IRMGR42218 Advanced Control Engineering	stp
IRMGR42318 Project Development and Funding	stp
IRMGR42418 Entrepreneurial Leadership	stp
IRMGR42718 Materials for Energy Efficient Buildings	stp
IRMGR42518 Special Curriculum I	stp
IRMGR42618 Special Curriculum II	stp

Spring 2022

Core courses

IRMGR44018 Master Thesis	stp

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Østfold University College

IRMGR40118 Adapting Technology to the Circular Economy (Autumn 2020)

Facts about the course

ECTS Credits: 10
Responsible department: Faculty of Computer Science, Engineering and Economics
Campus: Fredrikstad.
Course Leader: Shima Pilehvar
Teaching language: English.
Duration: ½ year

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The course is connected to the following study programs

Master in Green Energy Technology (Compulsory).

Lecture Semester

First semester (autumn).

The student's learning outcomes after completing the course

Knowledge:

The student

- understands the background and consequences of the UN sustainability goals
- understands how social sustainability may impact social issues both nationally and internationally
- has knowledge of the EU strategy on Circular Economy
- understands the principals of performing a Life Cycle Assessment for products
- understands the basic principles of LEAN production
- has knowledge about EUs Candidate list (REACH) for avoiding hazardous substances
- has a theoretical knowledge on how to achieve optimal resource efficiency in a closed material loop
- has basic knowledge in writing as an engineer and reporting on a business level
- has basic knowledge of methods related to innovation and how to use these methods when working towards optimal resource efficiency in closed material loops.

Skills:

The student

- can perform a Life Cycle Assessment (LCA) using computer programs (SIMAPRO or similar)
- can plan and write a report as a feasibility study on improvements in LCA phases from an environmental standpoint and from a logistical standpoint
- can perform a LEAN analysis on material flows through the life span
- can perform an ethical analysis of possible consequences of material supply-chains in regard to the UN sustainability goals
- can analyze the business potential in identified possible improvements in the closed material loops
- can lead innovation workshop with an industry partner on closed circuit technology and possibilities suggested in reports
- can perform a substitution process to avoid hazardous substances in materials.

General competence:

The student

- has a solid understanding on the challenges connected to resource scarcity on a global level
- shows good cooperative skills in group work situations
- can work in close interaction with an industrial partner, and understands their business and challenges
- has an overall understanding on the ethical challenges regarding possible conflict between short term busyness goals and possible long term consequences of the lifecycle of new and innovative solutions.

Content

The subject introduces the student to the principals outlined in EU priority on the translation to a circular economy, and how this will be a key framework factor for future business. The subject offers theoretical education on basic tools, but will mainly be focusing on the business-report to the industry-partner, and the process leading to this report.

Keyword for content:

- Adapting the UN sustainability goals in technology and business
- LCA basic: Environmental indicators, phases in LCA (Life Cycle Assessment)
- LCA tools: Benchmarking performance for product-phases
- Ethical considerations regarding sustainability, utilization of hazardous substances, material supply-chains, and possible conflicts between short term busyness goals and possible long term consequences of the lifecycle of new and innovative solutions.
- LEAN basic: Logistics, optimizing resource use
- LEAN tools
- Innovation tools
- Writing business reports

Forms of teaching and learning

- Lectures and guest speakers
- Literature-study
- Group work
- Workshop with group members and supervisor
- On the job observation ¿ industry partner

Workload

250-300 hours.

Coursework requirements - conditions for taking the exam

- Approved pre-versions of business reports
- Web-based test before assessment-start: Good to go?

Examination

1. Individual written exam, 3 hours. All written aids and calculator are permitted. Counts 50% of the final grade.
2. Group (max. 5 students) or individual report from project assignment. Counts 50% of the final grade

The students will receive one final grade for the course as a whole; grades on sub-evaluations will not be shown.

Grades from A to F, where A is the best grade, E is the lowest passed grade, and F is failed.

Examiners

One internal and one external examiner.

Conditions for resit/rescheduled exams

If the student fails the written exam, they can re-take this exam maximum two more times. A resit will be arranged in January the following semester. The student do not need to deliver a new report in order to re-take the written exam.

If the project report is graded as failed, the student will be given one more chance to improve the report.

Course evaluation

The course will be evaluated by a standardized electronic form.

Literature

Last updated 05.10.2018. The reading list may be subject to change before the semester starts.

Life Cycle Assessment:

- Baumann, H., & Tillman, A. M. (2004). The Hitch Hiker's Guide to LCA. An orientation in life cycle assessment methodology and application. External organization.

Circular Economy:

Selected parts of

- Webster, K. (2017). The circular economy: A wealth of flows. Ellen MacArthur Foundation Publishing.

- McKinsey&Company (2016). The circular economy: Moving from theory to practice. Online resource: https://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/the-circular-economy-moving-from-theory-to-practice

- Wijkman, A., & Skånberg, K. (2015). The circular economy and benefits for society. Club of Rome.

- Krarup, M., Kiørboe, N., & Sramkova, H. (2015). Moving towards a circular economy: successful Nordic business models. Nordic Council of Ministers.

- SB Insight. THE NORDIC MARKET FOR CIRCULAR ECONOMY.

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Østfold University College

IRMGR40218 Renewable Energy (Autumn 2020)

Facts about the course

ECTS Credits: 10
Responsible department: Faculty of Computer Science, Engineering and Economics
Campus: Fredrikstad.
Course Leader: Olav Aaker
Teaching language: English.
Duration: ½ year

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The course is connected to the following study programs

Master in Green Energy Technology (Compulsory).

Lecture Semester

First semester (autumn).

The student's learning outcomes after completing the course

Knowledge:

The student

- has advanced knowledge of current renewable energy sources, their current use and potential for future use

- has knowledge of the basic physical principles on which the energy sources rely, and the economic potential by using the various energy sources
- has advanced knowledge of mathematical modelling of renewable energy processes
- is able to analyze the principles of renewable energy and relate this to the history of energy technology and renewable energy and its place in modern society.
- can quantify the environmental and economic impact of various alternative energy sources
- has knowledge of smart grids and micro grids.

Skills:

The student

- can calculate the economic potential of a suggested renewable energy plant
- can calculate the feasibility of a suggested renewable energy process
- can calculate the necessary dimensions and equipment to build a powerplant with a specified energy source, and specified power output.

General competence:

The student

- can write a scientific project report.

Content

- Sources of renewable energy, such as:
    - Sun
    - Wind
    - Ocean waves and tidal forces
    - Hydropower
    - Biomass
    - Garbage and waste materials
- CO_2 capture and related issues
- Mathematical models and dimensioning related to renewable energy plants
- Introduction to smart grids and micro grids that utilize renewable energy sources
- Throughout the course, all topics will be covered in a historical perspective, emphasizing the historical development of renewable energy and energy technology.

Forms of teaching and learning

- Lectures
- Laboratory work, including mathematical modelling
- Project work: Prepare a report where an alternative energy powerplant is planned and proper dimensions are suggested. The economy of the project should also be considered.

Workload

250-300 hours.

Coursework requirements - conditions for taking the exam

- Four minor assignments.
- One major project work, group assignment.

Examination

Individual written exam 5 hours.

Permitted aids: Table of formulas and approved calculator

Grades from A to F, where A is the best grade, E is the lowest passed grade, and F is failed.

Examiners

One internal and one external examiner.

Conditions for resit/rescheduled exams

If the student fails the written exam, they can re-take this exam maximum two more times. A resit will be arranged in January the following semester. The students do not need to do the coursework assignments again to be allowed a re-take of the written exam.

Course evaluation

The course will be evaluated by a standardized electronic form.

Literature

Last updated 05.10.2018. The reading list may be subject to change before the semester starts.

- Da Rosa (2012), Fundamentals of Renewable Energy Processes, Academic Press, 3rd edition
- Duffy, Rogers, Ayompe (2015): Renewable Energy and Energy Efficiency: Assessment of Projects and Policies, Wiley-Blackwell, 1st edition
- Handouts.

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Østfold University College

IRMGR40318 Materials for Energy Technology (Autumn 2020)

Facts about the course

ECTS Credits: 10
Responsible department: Faculty of Computer Science, Engineering and Economics
Campus: Fredrikstad.
Course Leader: Anna-Lena Kjøniksen
Teaching language: English.
Duration: ½ year

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The course is connected to the following study programs

Master in Green Energy Technology (Compulsory).

Lecture Semester

First semester (autumn).

The student's learning outcomes after completing the course

Knowledge:

The student

- has advanced knowledge regarding materials for energy technology applications
- is able to analyze scientific problems regarding materials for energy technolog.

Skills:

The student

- is able to analyze and critically examine different sources of information
- is able to analyze theories regarding materials for energy technology.

General competence:

The student

- is able to contribute to an interdisciplinary project in collaboration with other students
- is able to present a scientific topic orally
- knows how to search for scientific literature
- is able to write a scientific report.

Content

The course will provide the students with an overview of some selected materials that can be used for energy technology applications, and in-depth knowledge regarding one of these types of materials.

Advanced materials, such as phase change materials, can be used to reduce the energy needed to heat and cool buildings. Solar cells and solar collectors can convert solar energy to electricity/heat. Nanofluids have a great potential as heat transfer liquids. These are only some examples of the utilization of materials for energy technology applications. Understanding the mechanisms for how these materials work is essential for the development of new and improved materials.

Forms of teaching and learning

The first part of the course will be based on lectures, presenting some examples of advanced materials for energy technology applications. The examples will focus on new research in the field, both from our own research and from the scientific research literature.

The second part of the course will be based on interdisciplinary project group work, where the students will find new research literature and write a report about a selected application of materials for energy technology. The report should be in the form of a scientific review article, and clearly illustrate the current state-of-the-art and discuss the most important challenges that needs to be resolved in the future. This work will be supervised by the lecturer.

A seminar regarding presentation techniques will prepare the students for giving an oral presentation of their project work.

A seminar regarding search for scientific literature will prepare the students for finding relevant literature for the project.

Workload

250-300 hours.

Coursework requirements - conditions for taking the exam

- Project outline (group work)
- Preliminary report (group work)
- Oral group presentation of project.
- Attendance at Presentation Techniques Seminar
- Attendance at Search for Scientific Literature Seminar
- Attendance at oral group presentation of all projects

Examination

- Individual written exam 3 hours. All written aids and calculator are permitted. 50% of the evaluation
- Group project report. 50% of the evaluation

The students will receive one final grade for the course as a whole; grades on sub-evaluations will not be shown.

Grades from A to F, where A is the best grade, E is the lowest passed grade, and F is failed.

Examiners

One internal and one external examiner.

Conditions for resit/rescheduled exams

If the student fails the written exam, they can re-take this exam maximum two more times. A resit will be arranged in January the following semester. The students do not need to deliver a new report in order to re-take the written exam.

If the project report is graded as failed, the students will be given one more chance to improve the report.

Course evaluation

The course will be evaluated by a standardized electronic form.

Literature

Last updated 05.10.2018. The reading list may be subject to change before the semester starts.

Compendium - Materials for Energy Technology (by Anna-Lena Kjøniksen). The compendium is primarily based on her own research within this field.

The students will also conduct a literature search to find research literature that is relevant for the project.

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Østfold University College

IRMGR40518 Scientific Research and Methods (Spring 2021–Autumn 2021)

Facts about the course

ECTS Credits: 10
Responsible department: Faculty of Computer Science, Engineering and Economics
Campus: Fredrikstad.
Course Leader: Shima Pilehvar
Teaching language: English.
Duration: 1 year

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The course is connected to the following study programs

Master in Green Energy Technology (Compulsory).

Lecture Semester

Second semester (spring) and third semester (autumn), from March to September.

The student's learning outcomes after completing the course

Knowledge:

The student

- has specialized insight into one topic within energy technology
- is able to utilize knowledge within new fields of energy technology
- has developed insight and understanding of the logic of scientific thinking and writing, as well as the ethical considerations related to a research project.

Skills:

The student

- can analyze and critically examine scientific literature
- can structure and formulate technical arguments and reasoning
- is able to plan a research project, in agreement with existing ethical norms
- can analyze relevant ethical research problems within energy technolog.

General competence:

The student

- is able to write a scientific report
- knows how to search for scientific literature
- is able to orally present a scientific project for both specialists within the field and the general public
- can acquire new knowledge within a field by self-tuition.

Content

Through the course, the students will learn about the logic, ethics and techniques of scientific writing and thinking. In the course, the students will also learn about scientific research design. This insight will be the knowledge base and the basis for independent reflections when the students perform a literature search to find current research literature related to the planned topic of their Master Thesis. Based on this literature, they will write a report that outlines the state-of-the-art within this topic.

Based on the state-of-the-art report, the students will:

- define the objective(s) of their Master Thesis
- clarify how the objective(s) are progressing beyond the state-of-the-art
- determine how to meet the objective(s), within the framework of both research design and ethics
- decide which methods and experimental techniques they will use
- make a first assessment of which experiments should be conducted
- put up a realistic progress plan for the Master Thesis
- write a project planning report that clarifies all these points including explanations for the choices that are made.

Forms of teaching and learning

The scientific writing and thinking, ethical considerations related to research projects and the research design topics will be taught through lectures. The lectures will include dialogue with the students, to closely link the general ideas of the logics of science to the Master thesis each individual student is planning. On the literature search and state-of-the-art report, the students will work under supervision of their Master Thesis supervisor. The project can either be an individual project, or if the Master Thesis is planned as a team work, conducted in an interdisciplinary team. For the team projects, the contributions of each student should be clearly specified.

Each project should deliver a state-of-the-art report, a project planning report and give oral presentations of the planned Master Thesis.

Workload

250-300 hours.

Coursework requirements - conditions for taking the exam

Oral presentation of the planned Master Thesis (individual or as a group), including a state-of-the-art literature review.

Examination

- State-of-the art report (counts as 50 % of the mark)
- Project planning report (counts as 50 % of the mark)

For group projects:

- State-of-the art report (counts as 50 % of the mark)

One report for the whole group, together with a specification of the contribution of each student.

- Project planning report (counts as 50 % of the mark)

One report for the whole group, together with a specification of the contribution of each student.

The specified contribution of the individual student counts as 50% of each report and the report as a whole counts as 50% of each report. Each student will receive an individual grade.
The students will receive one final grade for the course as a whole; grades on sub-evaluations will not be shown.

Grades from A to F, where A is the best grade, E is the lowest passed grade, and F is failed.

Examiners

The Master Thesis supervisor and one additional internal examiner.

Conditions for resit/rescheduled exams

If a report is graded as failed, the student will be given one more chance to improve the report. The improved report must be handed in for evaluation at a deadline specified by the Master Thesis supervisor.
For group projects:

If the specified contribution of an individual student is graded as failed, while the total report is not graded as failed, this student will have to deliver an individual report. In this case, the rest of the group can choose if they wish to deliver a modified report without the contribution of the student that failed, or if they wish to be evaluated based on the original report.

Course evaluation

The course will be evaluated by continuous dialogue with the students in lectures, to ensure that the link between the student¿s planned thesis and the lectures is close throughout.

Literature

Last updated 05.10.2018. The reading list may be subject to change before the semester starts.

Literature for the scientific writing, thinking and research design part:

- Kothari, Chakravanti Rajagopalachari (2004). Research methodology: Methods and techniques. New Age International.
- Cheek, Julianne (coming) Research Design, Sage

In addition, the students will conduct a literature review on their chosen subject for the Master Thesis.

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Østfold University College

IRMGR40418 Energy Technology, Policy and Sustainability (Spring 2021)

Facts about the course

ECTS Credits: 10
Responsible department: Faculty of Computer Science, Engineering and Economics
Campus: Fredrikstad.
Course Leader: Gunnar Andersson
Teaching language: English.
Duration: ½ year

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The course is connected to the following study programs

Master in Green Energy Technology (Compulsory).

Lecture Semester

Second semester (spring).

The student's learning outcomes after completing the course

Knowledge:

The student

- understands relevant concepts and frameworks from Science, Technology and Innovation Studies and their application to energy technology transformation
- can identify and evaluate relevant technologies
- is able to analyze key policy and societal debates shaping transition pathways to low carbon and sustainable energy systems.

Skills:

The student

- can find and use arguments and information on different energy technology options and can critically evaluate such material
- can critically evaluate new business models and innovation in shaping transition pathways to low carbon and sustainable energy systems.

General competence:

The student

- can critically evaluate contributions to debates on energy technology issues, and decisions on them
- can contribute to innovation processes
- is able to find information on different energy technology options, and critically evaluate such material.

Content

Energy technology, policy and sustainability provides students with an understanding of contemporary societal and policy debates around key energy technologies in the context of the transition towards more sustainable and lower carbon energy systems.

The course will take a distinctive Science technology and innovation studies (STIS) approach which will equip students with the analytical tools necessary to critically evaluate key energy technology and policy debates in Norway, Europe and globally. STIS is the study of how social, political, and cultural values affect science, technology and innovation, and how these, in turn, affect society, politics and culture.

Forms of teaching and learning

The lecture series is divided into four parts:

- Part 1 introduces historical case studies and relevant concepts and frameworks from the STIS field
- Part 2 introduces key debates around a range of relevant technologies
- Part 3 discusses the transition towards sustainable and lower carbon energy systems, new business models and innovation

- Part 4 explores key debates seen from an industry perspective

Parts 1-3 are organized as a combination of introductory lectures, seminars and workshops. Part 4 is organized as a project with regional industry.

Workload

250-300 hours.

Practical training/internship

Part 4 as a project with regional industry.

Coursework requirements - conditions for taking the exam

Plenary presentations of four (4) assignments. Group or individual.

Examination

72 hours individual written home assignment.

Grades from A to F, where A is the best grade, E is the lowest passed grade, and F is failed.

Examiners

One internal and one external examiner.

Conditions for resit/rescheduled exams

If the student fails the home assignment, they can re-take this assignment maximum two more times. A re-take will be arranged in August the following semester.

Course evaluation

The course will be evaluated by a standardized electronic form.

Literature

Last updated 05.10.2018. The reading list may be subject to change before the semester starts.

- Bijker, W. E., Hughes, T. P., & Pinch, T. (Red.). (2012). The social construction of technological systems: new directions in the sociology and history of technology (Anniversary ed). Cambridge, Mass: MIT Press.
- Hinrichs-Rahlwes, R. (Red.). (2013). Sustainable energy policies for Europe: towards 100% renewable energy. Leiden, The Netherlands: CRC Press/Balkema.

- International Energy Agency. (2017). Energy technology perspectives. 2017.
- Karnøe, P., & Garud, R. (2012). Path Creation: Co-creation of Heterogeneous Resources in the Emergence of the Danish Wind Turbine Cluster. European Planning Studies, 20(5), 733-752. https://doi.org/10.1080/09654313.2012.667923

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Østfold University College

IRMGR41018 Wind, Solar and Hydro Power Integration in Power Systems (Spring 2021)

Facts about the course

ECTS Credits: 5
Responsible department: Faculty of Computer Science, Engineering and Economics
Campus: Fredrikstad.
Course Leader: Kamil Dursun
Teaching language: English.
Duration: ½ year

Due to Covid-19 there can be changes to the course descriptions during the spring semester of 2021. Any changes in work requirements and examination form are published continuously in Studentweb. Other changes related to teaching will be communicated via other official channels.

Table of contents

The course is connected to the following study programs

Master in Green Energy Technology (Compulsory in Smart Energy Technology profile).

Recommended requirements

Basic knowledge of electric circuits. Previous knowledge of the fundamental area within energy technology or the subject Renewable energy (10 ECTS) from the 1st semester courses.

Lecture Semester

Second semester (spring).

The student's learning outcomes after completing the course

Knowledge:

The student

- has advanced knowledge of electrical machines and prime movers
- can implement voltage and frequency control in a power system
- is able to develop a simulation model based on block diagrams and/or a mathematical model
- is able to analyze the role of smart grids in the integration of wind and solar power.

Skills:

The student

- can formulate and implement a model for an integrated power system, and can analyze the results
- can utilize stationary and dynamic models of wind turbines, photovoltaic (PV) systems and hydropower plants
- can create wind power and power systems models with the help of dedicated software.

General competence:

The student

- can conduct a project in collaboration with other students
- can present a scientific topic orally
- can apply acquired knowledge and skills to solve advanced tasks and projects.

Content

- Wind power and voltage control; active and reactive power control
- Photovoltaic (PV) inverter topologies, configurations and control strategies
- Grid codes and technical regulations of wind power plants

- Wind power, solar power, hydropower and smart grid. Active management of distribution systems

The following topics will also be covered:

- Power system parameters of electrical machines and prime movers
- Effect of various energy sources in the power system
- Advantages and drawbacks of wind, solar and hydropower generation
- Energy storage

Forms of teaching and learning

A variety of teaching and learning methods will be used, from regular lectures with basic teaching using video-projection and other interactive devices (dialogue-based teaching) but also using individual and group modelling and simulation exercises.

The group work based teaching will force students to develop not only computer simulation skills but also to use their social skills in cooperation and communication. The course will also include the laboratory exercises and project work to develop project-based learning method, which will highlight the student¿s abilities in solving practical problems and team work.

New topics and simulation tools will be introduced by presenting concrete examples and problems using teaching methods with an inductive approach.

Workload

125-150 hours.

Coursework requirements - conditions for taking the exam

- Attendance at 1 workshop
- 1 oral presentation
- 1 project report

Examination

Individual written exam 3 hours. All written aids and calculator are permitted.

Grades from A to F, where A is the best grade, E is the lowest passed grade, and F is failed.

Examiners

One internal and one external examiner.

Conditions for resit/rescheduled exams

If the student fails the written exam, they can re-take this exam maximum two more times. A resit will be arranged in August the following semester. The students do not need to do the coursework assignments again to be allowed a re-take of the written exam.

Course evaluation

The course will be evaluated by a standardized electronic form.

Literature

Last updated 05.10.2018. The reading list may be subject to change before the semester starts.

Thomas Ackermann (2012), Wind power in power systems, John Willey, 2nd edition

Additional literature will be specified at the start of the semester.

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Østfold University College

IRMGR41118 Dynamic Modelling and Simulation of Micro Grids (Spring 2021)

Facts about the course

ECTS Credits: 10
Responsible department: Faculty of Computer Science, Engineering and Economics
Campus: Fredrikstad.
Course Leader: Nicolae Lucian Mihet
Teaching language: English.
Duration: ½ year

Due to Covid-19 there can be changes to the course descriptions during the spring semester of 2021. Any changes in work requirements and examination form are published continuously in Studentweb. Other changes related to teaching will be communicated via other official channels.

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The course is connected to the following study programs

Master in Green Energy Technology (Compulsory in Smart Energy Technology profile).

Recommended requirements

Basic knowledge of modelling and simulation tools and of implementation simple mathematical models of energy systems. Previous knowledge of the fundamental area within energy technology or the subject Renewable energy (10 ECTS) from the 1st semester courses.

Lecture Semester

Second semester (spring).

The student's learning outcomes after completing the course

Knowledge:

The student

- has advanced knowledge of energy conversion systems modelling, and state-of-the-art simulation tools
- has advance knowledge of distributed energy resources for Smart Grids and Microgrids.

Skills:

The student

- can combine theory and practice of modelling, optimization and simulation, addressing challenges on different time-scales involved in operation, optimization and design of Microgrids
- can implement a simple mathematical model of intelligent Distributed Energy Resources in a Microgrid at different time-scales
- is able to develop a simulation model based on a block diagrams and/or a mathematical model.

General competence:

The student

- can conduct project based learning using model based design in collaboration with other students
- can present a scientific topic orally
- can apply acquired knowledge and skills to solve advanced project tasks.

Content

- Introduction to simulation tools (MATLAB & Simulink, DiGSILENT Power Factory, NEPLAN)
- Concepts in modelling and simulation
- Theory and practice of modelling and analysis of distributed energy resources (DER) components (wind turbines (WT), photovoltaic (PV), Hydro Power, Smart Homes, Energy Storage Systems, Electric Vehicles (EVs))
- Control strategies methods for distributed energy resources (DER) components and systems;

- Dynamic properties and optimization models & techniques of electric generators and power electronic converters, used as main components of a Microgrid
- Analyzing of different dynamic system models suitable for Advanced Microgrids and Smart Grid Integration.

The course includes lectures with interactive models based design and simulation tools, labs with practical implementation of the models and with simulation exercises and an internal seminar on topic of modelling of renewable energy sources and energy conversion systems, with professors from other universities

The objectives of the course are to introduce the students to the fundamentals of energy conversion systems modelling, using state-of-the-art simulation tools. Combine theory and practice of modelling, optimization and simulation, addressing challenges on different time-scales involved in operation, optimization and design. Implementing a simple mathematical model of intelligent energy systems at different time-scale

The aim of the seminar is to practice connecting the topic to their own research through different perspectives from the field.

Forms of teaching and learning

A variety of teaching and learning methods will be used, from regular lectures with basic teaching using video-projection and other interactive devices (dialogue-based teaching) but also using individual and group modelling and simulation exercises. The group work based teaching will force students to develop not only computer simulation skills but also to use their social skills in cooperation and communication. The course will also include the laboratory exercises and project work to develop project-based learning method, which will highlight the student¿s abilities in solving practical problems and team work. New topics and simulation tools will be introduced by presenting concrete examples and problems using teaching methods with an inductive approach.

Workload

250-300 hours.

Coursework requirements - conditions for taking the exam

- Individual oral presentation
- 6 labs with simulation exercises based on written reports

Examination

Individual written exam 3 hours. All written aids and calculator are permitted.

Grades from A to F, where A is the best grade, E is the lowest passed grade, and F is failed.

Examiners

One internal and one external examiner.

Conditions for resit/rescheduled exams

If the student fails the written exam, they can re-take this exam maximum two more times. A resit will be arranged in August the following semester. The students do not need to do the coursework assignments again to be allowed a re-take of the written exam.

Course evaluation

The course will be evaluated through a standardized electronic form.

Literature

Last updated 05.10.2018. The reading list may be subject to change before the semester starts.

PowerPoint presentation with interactive simulation models based software tools with user-friendly Graphical User Interfaces (GUI).

Recommended literature:

- Mihet-Popa, L. (2015), Modelling and Simulation in MATLAB/Simulink with applications in Electrical Engineering, Editura Politehnica
- Mihet-Popa, L. (2014), Development of Simulation Tools for Distributed Energy Conversion Systems towards Smart Grids, Editura Politehnica
- Manassah, J. T. (2001) Elementary Mathematical and Computational Tools for Electrical and Computer Engineers using MATLAB, CRC Press

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Østfold University College

IRMGR41518 Experimental Methods (Spring 2021)

Facts about the course

ECTS Credits: 5
Responsible department: Faculty of Computer Science, Engineering and Economics
Campus: Fredrikstad.
Course Leader: Anna-Lena Kjøniksen
Teaching language: English.
Duration: ½ year

Due to Covid-19 there can be changes to the course descriptions during the spring semester of 2021. Any changes in work requirements and examination form are published continuously in Studentweb. Other changes related to teaching will be communicated via other official channels.

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The course is connected to the following study programs

Master in Green Energy Technology (Compulsory in Materials for Energy Technology profile).

Lecture Semester

Second semester (spring).

The student's learning outcomes after completing the course

Knowledge:

The student

- has advanced knowledge of two experimental methods within energy technology
- can analyze experimental limitations and possible artefacts.

Skills:

The student

- can utilize two experimental methods for research and development in an independent manner
- can critically analyze data obtained by two experimental research methods.

General competence:

The student can solve problems related to experimental work.

Content

The students will learn how to use two different experimental research techniques, and how to critically analyze and interpret the data obtained with these techniques. The experimental techniques should be relevant for the student's planned Master Thesis. The course is module-based, where each module teaches one experimental technique. The student should select two relevant modules for the course.

The course is research based, and each student should therefore conduct measurements that results in new knowledge of the measured systems. The students should preferably conduct measurements on samples that are relevant for their planned master project, e.g., a small pre-study. The project reports should include a discussion regarding analysis and interpretation of the data (including relevant references to scientific research literature), and a discussion of possible errors and artefacts of both the measurements and interpretations.

Available modules:

- Rheology - Viscoelastic properties of liquids and gels
- Dynamic light scattering and electrophoretic mobility - Determining hydrodynamic radius and zeta potentials
- Isothermal calorimetry - Heat flow rate of a sample due to chemical or physical changes in the sample
- Guarded hot plate system - Heat flux and heat conductivity of solids under the influence of various temperature changes.

Forms of teaching and learning

The teaching will be a combination of supervision and screencasts.

Workload

125-150 hours.

Coursework requirements - conditions for taking the exam

Laboratory assignments according to the two chosen modules.

Examination

Two partial exams, each count as 50 % of the evaluation.

Partial exam 1:

Project report from chosen module number 1

Partial exam 2:

Project report from chosen module number 2

Both partial exam must be evaluated as passed to pass the course.

The students will receive one final grade for the course as a whole; grades on sub-evaluations will not be shown.

Grades from A to F, where A is the best grade, E is the lowest passed grade, and F is failed.

Examiners

One internal and one external examiner.

Conditions for resit/rescheduled exams

If a project report is graded as failed, the students will be given one more chance to improve this report. A re-take will be arranged in August the following semester.

Course evaluation

The course will be evaluated by a standardized electronic form.

Literature

Last updated 05.10.2018. The reading list may be subject to change before the semester starts.

- Compendia covering theory on and experimental usage of Rheology, Dynamic light scattering and electrophoretic mobility, Isothermal calorimetry and Guarded hot plate system (by Anna-Lena Kjøniksen).
- Screencasts showing usage of the relevant instruments.

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Østfold University College

IRMGR41618 Solid State Physics and its Modern Industrial Applications (Spring 2021)

Facts about the course

ECTS Credits: 10
Responsible department: Faculty of Computer Science, Engineering and Economics
Campus: Fredrikstad.
Course Leader: Litian Wang
Teaching language: English.
Duration: ½ year

Due to Covid-19 there can be changes to the course descriptions during the spring semester of 2021. Any changes in work requirements and examination form are published continuously in Studentweb. Other changes related to teaching will be communicated via other official channels.

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The course is connected to the following study programs

Master in Green Energy Technology (Compulsory in Materials for Energy Technology profile).

Recommended requirements

An advanced knowledge and skills in physics and advanced mathematics.

Lecture Semester

Second semester (spring).

The student's learning outcomes after completing the course

Knowledge:

The student

- has advanced knowledge of some central topics of solid state physics
- has a broad overview of application and contemporary development related to energy technologies.

Skills:

The student

- can disseminate main ideas and principles related to materials associated with energy technologies
- can use advanced methods for material choice using the material database GRANTA
- can analyze and evaluate materials with various sets of criteria or material indexes
- can conduct preliminary scientific analysis and technical evaluation of materials associated with energy technologies
- can make proper evaluation of technical constructions/instrumentations associated with energy technologies
- is capable to participate actively in scientific research and development.

General competence:

The student can communicate and disseminate in their independent practice in research and development.

Content

The course provides an introduction to solid state physics and its application to the modern energy technologies. The emphasis is placed on the understanding of the fundamental phenomena and corresponding principles related to the contemporary development in materials science.

The course will focus on following subjects:

Part I: Fundamentals

- periodic structure, and associated reciprocal space, and its application in diffraction experiment
- lattices/defects in real materials and their roles in thermo-/electrical conductivity
- free Fermi electron gas theory. State density and Fermi level and their relation to electrical conductivity
- electron in periodic potentials: Energy band, band-gap and classification of materials
- semiconductors: Band-gap, Charge carrier, doping, p-n joint and photovoltage effect
- reciprocal lattices and its determination and the concept Brillouin-zones
- equilibrium concentration of point defects and its relationship with temperature and pressure
- diffusion processes and Ficks laws
- heat capacity originated from lattice vibration and thermo-conductivity
- periodic potential and formation of energy band structure
- Brillouin zone boundary and band-gap
- classification of metals, semiconductors and insulator. In terms of band structure
- charged carrier distribution in intrinsic and doped semiconductors. Electron holes and their roles in diodes p-n joint
- phenomena in low dimension materials
- phenomena in nanomaterials.

Part II: Specific application areas

- superconductor
- solar cell technology
- LED technology
- battery storage technology
- functional nanomaterials.

Part III: Methodology for industrial applications:

- Material indexes method associated with concrete applications
- Material choice and production process
- Material choice and security and health
- Material choice and environment
- GRANTA material database and material choices.

Forms of teaching and learning

The first part of the course (Fundamentals) will be given by a combination of lectures, exercises and home assignments.

The second part of the course (Applications) will be group work where students will conduct intensive literature search on a self-chosen application field. A technical report will be written, and the report will provide a proper review of the literature together with an analysis or evaluation for national technological development in the field. This work will be supervised by the lecturer.

The third part of the course (Methodology) will be given as a workshop or seminar where various methods for defining material indexes in each application area will be discussed and be implement/tested. The results and discussions will be documented by a short but highly specialized technical report.

Workload

250-300 hours.

Coursework requirements - conditions for taking the exam

Three home assignments, evaluated as passed no later than 2 weeks before submission deadline for Partial exam 2.

Examination

- Partial exam 1: Individual written mid-term exam 3 hours. 50% of the evaluation.

Allowed materials under examination: Personal assignment file.

- Partial exam 2:

  Group scientific review report: 30% of the evaluation
  Group technical analysis report: 20% of the evaluation

The students will receive one grade for each partial exam and one final grade for the course as a whole.

Grades from A to F, where A is the best grade, E is the lowest passed grade, and F is failed.

Examiners

One internal and one external examiner.

Conditions for resit/rescheduled exams

If the student fails Partial exam 1, they can re-take this exam in the same semester.

If the student fails Partial exam 2, they can revise both reports one time.

In this case, a second evaluation and final grading will be arranged in August the following semester.

Course evaluation

The course will be evaluated by a standardized electronic form.

Literature

Last updated 05.10.2018. The reading list may be subject to change before the semester starts.

- Hook, Hall, (1991) Solid State Physics (Manchester Physics Series), John Wiley, 2nd edition
- Quinn John J., Yi Kyung-Soo (2018) Solid State Physics. Principles and Modern Applications, Second Edition, Springer
- Lucian Mihet-Popa (2015), Development of Simulation Models for DER Components & Systems. Modeling, Control and Testing of Distributed Energy Resources Components with a particular focus on Smart Grids, pp. 270, Publishing House: LAP Lambert Academic Publishing, Germany, ISBN: 978-3-659-75235-3.

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Østfold University College

IRMGR42018 Power System Dynamic and Control (Autumn 2021)

Facts about the course

ECTS Credits: 5
Responsible department: Faculty of Computer Science, Engineering and Economics
Campus: Fredrikstad.
Course Leader: Nand Kishor
Teaching language: English.
Duration: ½ year

Table of contents

The course is connected to the following study programs

Master in Green Energy Technology (Elective).

Recommended requirements

Basic knowledge of electric circuits. Fundamental knowledge about steady state and dynamic behavior of electrical machines and prime movers (course Wind, Solar and Hydro Power Integration in Power Systems (5 ECTS) or equivalent).

Lecture Semester

Third semester (autumn).

The student's learning outcomes after completing the course

Knowledge:

The student

- has advanced knowledge of power systems dynamics and control
- has advanced knowledge of control systems
- has advanced knowledge of, and is able to analyze the influences of wind and solar power in the power system
- can model and implement a dynamic model in a dedicated simulation tool
- has a good understanding of price mechanisms in the power market.

Skills:

The student

- can design control strategies applied on modern power systems
- is able to plan the execution of a technical project by establishing a time schedule of the project.

General competence:

The student can conduct a project in collaboration with other students.

Content

Following topics will be covered:

- Power system stability
- Active and reactive power oscillations in the system
- Power quality: characteristics, requirements
- Effects of distributed generation on stability
- Power market: Introduction, operation of wind energy in the power market
- Control of distributed power systems.

Forms of teaching and learning

- Lectures, exercises and laboratory training
- Flipped classroom and digital learning platforms will be used extensively
- Simulation techniques using Matlab and Simulink
- Individual and/or group training in form of home assignments.

Workload

125-150 hours.

Coursework requirements - conditions for taking the exam

One compulsory home assignment

Examination

Individual written exam 3 hours. All written aids and calculator are permitted.

Grades from A to F, where A is the best grade, E is the lowest passed grade, and F is failed.

Examiners

One internal and one external examiner.

Conditions for resit/rescheduled exams

If the student fails the written exam, they can re-take this exam maximum two more times. A resit will be arranged in January the following semester. The students do not need to redo the home assignment in order to re-take the written exam.

Course evaluation

The course will be evaluated by a standardized electronic form.

Literature

Last updated 05.10.2018. The reading list may be subject to change before the semester starts.

Machowski, Bialek, Bumby (2009), Power System Dynamics: Stability and Control, Wiley, 2nd edition

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Østfold University College

IRMGR42118 Smart Grids Technology and Applications (Autumn 2021)

Facts about the course

ECTS Credits: 10
Responsible department: Faculty of Computer Science, Engineering and Economics
Campus: Fredrikstad.
Course Leader: Nicolae Lucian Mihet
Teaching language: English.
Duration: ½ year

Table of contents

The course is connected to the following study programs

Master in Green Energy Technology (Elective).

Recommended requirements

Basic knowledge of power systems, power electronics and Information and Communication Technologies. Previous knowledge of the fundamental area within energy technology or the subject Renewable energy (10 ECTS) from the 1st semester courses and Dynamic Modelling and Simulation of Microgrids (10 ECTS) and Wind, Solar and Hydropower in Power Systems (5 ECTS) from the second semester.

Lecture Semester

Third semester (autumn).

The student's learning outcomes after completing the course

Knowledge:

The student

- has advanced knowledge about Smart Grid distribution systems, distributed generation & storage systems, energy management and communication technology
- has advanced knowledge about Smart Grids components and architectures
- has advanced knowledge about modelling and simulation of smart energy systems
- has advanced knowledge about important aspects of the Norwegian and international energy systems, including state of the art and future trends.

Skills:

The student

- can design, model, simulate and control Smart Grids components and systems
- can formulate overall mathematical models for a smart energy system and apply these skills to outline the system characteristics.

General competence:

The student

- can conduct a project in collaboration with other students
- know how to search for scientific literature
- can write, document and orally present a scientific report/project.

Content

The course will give an outline of the classic power systems and power system operations, smart grids with grid integration of distributed generation & storage systems, including Electric Vehicles (EVs) and flexible active loads. Energy storage technology, energy management and hierarchical and distributed control architectures including Information and Communication Technology (ICT) and Internet of things (IoT) will be pointed out. Smart meters, demand response and demand side management concepts will also be highlighted. Overview of modern and advanced Smart Grid systems with operational centers like SCADA system and operational tasks will be given.

Forms of teaching and learning

- Regular lectures with basic teaching using video-projection and other interactive devices (dialogue-based teaching).
- Individual and group modelling and simulation exercises

- The course will also include laboratory exercises and project work to develop project-based learning methods, which will highlight the student¿s abilities in solving practical problems and team work.
- New topics and simulation tools will be introduced by presenting concrete examples and problems using teaching methods with an inductive approach.

Workload

250-300 hours.

Coursework requirements - conditions for taking the exam

- Individual oral presentation
- 6 labs based simulation exercises with a written report

Examination

Individual written exam 3 hours. All written aids and calculator are permitted.

Grades from A to F, where A is the best grade, E is the lowest passed grade, and F is failed.

Examiners

One internal and one external examiner.

Conditions for resit/rescheduled exams

If the student fails the written exam, they can re-take this exam maximum two more times. A resit will be arranged in January the following semester. The students do not need to redo the coursework requirements in order to re-take the written exam.

Course evaluation

The course will be evaluated by a standardized electronic form.

Literature

Last updated 05.10.2018. The reading list may be subject to change before the semester starts.

The students will conduct a literature search to find relevant literature.

Recommended references:

- Mihet-Popa,L. (2015) Development of simulation tools for energy conversion systems toward Smart Grids, Editura Politehnica

- Eissa, M.M (2015), Energy efficiency improvements in Smart Grid Components, InTech
- Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, Nick Jenkins (2012), Smart Grid: Technology and Applications, John Wiley

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Østfold University College

IRMGR42218 Advanced Control Engineering (Autumn 2021)

Facts about the course

ECTS Credits: 10
Responsible department: Faculty of Computer Science, Engineering and Economics
Campus: Fredrikstad.
Course Leader: Bjørn Gitle Hauge
Teaching language: English.
Duration: ½ year

Table of contents

The course is connected to the following study programs

Master in Green Energy Technology (Elective).

Recommended requirements

General knowledge of physics and differential equations, Fourier and Laplace transform.

Lecture Semester

Third semester (autumn).

The student's learning outcomes after completing the course

Knowledge:

The student

- has advanced knowledge of mathematical models of dynamic systems described by differential equations
- has advanced knowledge of stability in linear systems, and methods for analyzing stability in feedback systems with a regulator
- has advanced knowledge of digital signal processing, Shannons sampling theorem, Z-transformation, inverstransformations, stability in the Z.plane, digital filters, and Root locus analysis
- has knowledge regarding regulators that are most commonly used in industry.

Skills:

The student

- can model time discrete systems, analyze and regulate
- can optimize the regulation of multivariate systems
- can design/synthesize regulators for use on processes with known models
- can conduct independent development projects and control of processes with the aid of regulators/PLS
- can analyze interdisciplinary control engineering problems.

General competence:

The student can work in interdisciplinary teams.

Content

The course will provide the student with an advanced insight in how to use differential equations to model different physical processes in mechanical, chemical and electrical systems. These systems transfer energy through the motion of mechanical parts, by fluids, gasses and electrical charge. The laws of energy conservation govern all these systems. This demands advanced interdisciplinary knowledge from different engineering disciplines. After being taught how to model different advanced control systems, the students will learn how to simulate the behavior of control systems when they are subjected to different signal inputs, and to predict the conditions that makes these systems stable and unstable. An unstable system may, through positive feedback of output signals start to oscillate violently, causing bridges to be ripped apart and electrical power systems to burn down. Predicting such behavior is vital for the survival of buildings and bridges and is done by analyzing the frequency response of the system with the help of Laplace and Fourier transforms. Learning about mathematical block diagrams makes us able to build complex control systems that will suppress interference and act in predicted ways. The students will also learn digital signal processing and the use of control systems computers called PLS, and the implementation of the PID regulator.

Forms of teaching and learning

The course will be taught as a combination of lectures, seminars and project/laboratory work.

Workload

250-300 hours.

Coursework requirements - conditions for taking the exam

4 Laboratory group exercises/projects in control engineering.

Examination

Individual written exam 3 hours. All written aids and calculator are permitted.

Grades from A to F, where A is the best grade, E is the lowest passed grade, and F is failed.

Examiners

One internal and one external examiner.

Conditions for resit/rescheduled exams

If the student fails the written exam, they can re-take this exam maximum two more times. A resit will be arranged in January the following semester. The students do not need to redo the coursework requirements in order to re-take the written exam.

Course evaluation

The course will be evaluated by a standardized electronic form.

Literature

Last updated 05.10.2018. The reading list may be subject to change before the semester starts.

- Bolton (2003), Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Pearson Education
- Burns (2001), Advanced control engineering, Butterworth-Heinemann

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Østfold University College

IRMGR42318 Project Development and Funding (Autumn 2021)

Facts about the course

ECTS Credits: 10
Responsible department: Faculty of Computer Science, Engineering and Economics
Campus: Fredrikstad.
Course Leader: Bjørn Gitle Hauge
Teaching language: English.
Duration: ½ year

Table of contents

The course is connected to the following study programs

Master in Green Energy Technology (Elective).

Recommended requirements

Basic knowledge of Project Management.

Lecture Semester

Third semester (autumn).

The student's learning outcomes after completing the course

Knowledge:

The student

- has knowledge of different funding sources
- has knowledge of evaluation of different funding applications
- has knowledge of the bureaucratic hierarchy that governs funding programs
- can analyze the political processes connected to various funding sources.

Skills:

The student

- knows how to budget a project for funding purposes
- knows how to get political support for funding
- knows how to conduct a funding process towards success.

General competence:

The student

- can conduct an interdisciplinary project funding process
- can understand the political basis for different governmental funding programs
- is able to write an application for project funding.

Content

The course will provide the students with an overview of different sources of project funding, and how different applications are evaluated.

The students will learn how to write an application for project funding, practicing on real cases. The application can be written for an external industrial or public partner or for a project where HiØ is the main applicant. Applications that are considered to have high quality might be submitted as an actual application.

Forms of teaching and learning

The course will be taught as a combination of lectures, seminars and project work.

The students learn about various sources of project funding, practice on evaluating funding applications, and write an application for external funding in interdisciplinary teams.

Workload

250-300 hours.

Coursework requirements - conditions for taking the exam

Attendance at 4 seminars.

Examination

- Funding application (group work). A preliminary grade will be awarded on the basis of this report
- Individual oral examination, which may adjust the preliminary grade maximum two grades up or down. A final, individual grade will be awarded after the oral examination

The funding application has to be evaluated as passed before the oral examination.

Grades from A to F, where A is the best grade, E is the lowest passed grade, and F is failed.

Examiners

One internal and one external examiner.

Conditions for resit/rescheduled exams

If the funding application is graded as failed, the student will be given one more chance to improve the application.

If the student fails the oral examination, the student will have to prepare a new individual funding application, which must be evaluated as passed in order to re-take the oral exam.

A re-take of the oral exam will be arranged in January or February the following semester, providing students sufficient time to prepare a new funding application.

Course evaluation

The course will be evaluated by a standardized electronic form.

Literature

Last updated 05.10.2018. The reading list may be subject to change before the semester starts.

The Norwegian Research Council:

https://www.forskningsradet.no/servlet/Satellite?c=Page&cid=1184159007037&pagename=ForskningsradetEngelsk%2FHovedsidemal

INTERREG Europe:

https://www.interregeurope.eu/

US Embassy Small Grants Programme:

https://no.usembassy.gov/education-culture/grants/

Partnership Program with North America and others:

https://www.siu.no/eng/Programme-information/Cooperation-outside-the-EU/partnership-program-with-north-america

Norwegian Centre for international cooperation, SIU:

https://www.siu.no/eng

European comission Horizon 2020 programme, The EU Framework Programme for Research and Innovation:

http://ec.europa.eu/programmes/horizon2020/en/h2020-section/science-and-society

European Comission, Research and Innovation:

http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/swafs-01-2018-2019.html

European commission ERASMUS+

http://ec.europa.eu/programmes/erasmus-plus/node_en

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Østfold University College

IRMGR42418 Entrepreneurial Leadership (Autumn 2021)

Facts about the course

ECTS Credits: 10
Responsible department: Faculty of Computer Science, Engineering and Economics
Campus: Fredrikstad.
Course Leader: Gunnar Andersson
Teaching language: English.
Duration: ½ year

Table of contents

The course is connected to the following study programs

Master in Green Energy Technology (Elective).

Lecture Semester

Third semester (autumn).

The student's learning outcomes after completing the course

Knowledge:

The student

- has advanced technical knowledge and understanding of entrepreneurship

- has advanced insight into entrepreneurship and entrepreneurial leadership from a strategic perspective.

Skills:

The student

- is able to plan, establish, run and liquidate a small enterprise, utilizing relevant methods, IT tools, and models
- understands ethical aspects related to starting, running, and liquidating an enterprise, both with respect to employees and the societ.

General competence:

The student is able to systematic and effectively resolve innovation and development problem.

Content

The students will develop a business plan, implement the plan, and analyze and discuss the results in a report.

The students will learn about the following topics:

- Opportunity identification and idea evaluation
- Rapid prototyping and development of business ideas
- Customer value orientation and idea testing
- Registration of a business
- Organization of the enterprise
- Lean startup and scrum methodologies
- Leadership and management of a small enterprise
- Contact with suppliers and customers
- Competition, promotion, marketing.

Forms of teaching and learning

The course will be taught as a combination of lectures, seminars and project work in groups. Students will be taught to evaluate their ideas through running small tests to validate their value propositions. Students will rapidly prototype their business and aim to monetize their ideas as early as possible.

The course will draw on leading methodologies for learning entrepreneurship through a combination of experiential learning, project based work and mentoring by experienced entrepreneurs.

Along the way students will learn theory through practice. The overall aim is to introduce students to the different aspects of starting a small enterprise.

Workload

250-300 hours.

Coursework requirements - conditions for taking the exam

- Team work log demonstrating the efforts
- Hand-in of individual reflections based on regular entries

Examination

- Project report (group work). 50% of the evaluation
- Individual reflection based on weekly entries. 50% of the evaluation

The students will receive one final grade for the course as a whole; grades on sub-evaluations will not be shown.

Grades from A to F, where A is the best grade, E is the lowest passed grade, and F is failed.

Examiners

One internal and one external examiner.

Conditions for resit/rescheduled exams

If the project report is graded as failed, the students will be given one more chance to improve the report. The improved report will be evaluated in January the following semester.

Course evaluation

The course will be evaluated by a standardized electronic form.

Literature

Last updated 05.10.2018. The reading list may be subject to change before the semester starts.

- Ries, E., The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses. 2011: Crown Books.
- Osterwalder, A., et al., Value Proposition Design: How to Create Products and Services Customers Want. 2015: John Wiley & Sons.

- Bygrave, W.D. and A. Zacharakis, The portable MBA in entrepreneurship. Vol. 35. 2009: John Wiley & Sons.
- Guillebeau, C., The $100 startup: Reinvent the way you make a living, do what you love, and create a new future. 2012: Crown Pub.

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Østfold University College

IRMGR42718 Materials for Energy Efficient Buildings (Autumn 2021)

Facts about the course

ECTS Credits: 10
Responsible department: Faculty of Computer Science, Engineering and Economics
Campus: Fredrikstad.
Course Leader: Anna-Lena Kjøniksen
Teaching language: English.
Duration: ½ year

Table of contents

The course is connected to the following study programs

Master in Green Energy Technology (Elective).

Recommended requirements

Passed the courses Adapting Technology to the Circular Economy (10 ECTS) and Materials for Energy Technology (10 ECTS).

Lecture Semester

Third semester (autumn).

The student's learning outcomes after completing the course

Knowledge:

The student

- has advanced knowledge regarding materials for energy efficient buildings
- is able to analyze scientific problems of materials for energy efficient buildings
- has advanced knowledge regarding the energy efficiency of buildings from a life cycle perspective

Skills:

The student

- is able to conduct computer simulations to evaluate how different material strategies influence the embodied energy of the building
- is able to conduct computer simulations of buildings containing use phase materials
- is able to plan and conduct a limited research project under supervision

General competence:

The student

- is able to collaborate and contribute to team projects
- is able to present results from a research project in writing and discuss the project orally.

Content

The students will learn about how different materials can be utilized to enhance the energy efficiency of buildings, keeping in mind the life cycle assessment of the building and environmental considerations. The students will learn how to utilize models and simulations to predict the energy efficiency of buildings and building materials.

The following topics will be covered:

- Energy efficiency in buildings from a life cycle perspective
- Utilization of the Environmental Product Declaration (EPD) for choosing materials with low embodied energy
- Optimizing the choice of heat insulating materials in a lifecycle perspective
- New materials with extremely good heat insulation properties based on nanotechnology
- Materials for airtight structures in buildings for reducing heat loss
- Reduction of building temperature fluctuations by utilization of materials with high thermal mass and with phase change materials

- Computer simulations of the energy efficiency in buildings, including the use of phase change materials (PCM) as one of the components
- Utilization of BIM (building information models) to register and control the use of different building materials.

Forms of teaching and learning

- Lectures
- Project work in groups
- Screencasts
- Supervision

The students will conduct three projects working in the same groups.

Project 1. Computer simulation of the energy saved during the operative phase by including phase change materials (PCM) in a building material. Simulation of only this material, without taking the rest of the building envelope into account. The computer simulations will be conducted utilizing measured parameters of the material. The project is research-based, and accordingly each group will conduct simulations that should result in new knowledge. The groups will conduct several computer simulations, either varying different aspects of the material, or examining the effects of different outdoor conditions (daily temperature variations, seasonal temperature variations, different climatic zones, variations in solar radiation, etc).

Project 2. LCA analysis of the materials utilized in Project 1, including the energy efficiency aspects.

Project 3. Computer simulation of the energy efficiency of buildings (the whole building envelope) during the operative phase, where the effect of the materials studied in Project 1 and 2 is included in the simulation. The project is research-based, and accordingly each group will conduct simulations that should result in new knowledge. When possible, variations of the same parameters as in Project 1 should be included.

The results from the three projects should be combined into one report, which clearly illustrates the connection between the three projects. The students can choose whether they deliver a classical project report, or a report in the form of a research article. This combined report is part of the exam in the course.

Workload

250-300 hours.

Coursework requirements - conditions for taking the exam

- Approved results from computer simulation of Project 1
- Approved results from LCA analysis of Project 2
- Approved results from computer simulation of Project 3

Examination

1. The group project report on the combined results from the three projects.
2. Individual oral exam, 0.5 hours. The students will be examined in both the theoretical part of the curriculum and regarding the content of the project report.

In order to take the oral exam, the group project must be passed.

The students will receive one final grade for the course as a whole; grades on sub-evaluations will not be shown.

Grades from A to F, where A is the best grade, E is the lowest passed grade, and F is failed.

Examiners

Two internal examiners.

Conditions for resit/rescheduled exams

If the student fails the oral exam, they can re-take this exam maximum two more times. The students do not need to deliver a new report in order to re-take the oral exam.

If the project report is graded as failed, the students will be given one more chance to improve the report.

Course evaluation

The course will be evaluated by a standardized electronic form.

Literature

Last updated 05.10.2018. The reading list may be subject to change before the semester starts.

- Shukla and Sharma, ed. (2018), Sustainability through Energy-Efficient Buildings, CRC Press. ISBN 9781138066755
- Woods and Samdal, ed. (2017), ZEB Zero Emission Buildings - Final report, ISBN 978-82-690808-0-3. Including references within the report.
- Vinh Duy Cao, Shima Pilehvar, Carlos Salas-Bringas, Anna M. Szczotok, Tri Quang Bui, Manuel Carmona, Juan F. Rodriguez, and Anna-Lena Kjøniksen. "Thermal analysis of geopolymer concrete walls containing microencapsulated phase change materials for building applications", Submitted Manuscript.
- Vinh Duy Cao, Shima Pilehvar, Carlos Salas-Bringas, Anna M. Szczotok, Tri Quang Bui, Manuel Carmona, Juan F. Rodriguez, Anna-Lena Kjøniksen. "Thermal performance and numerical simulation of geopolymer concrete containing different types of thermoregulating materials for passive building applications." Energy and Buildings, (2018), 173, 678-688.
- Screencasts showing usage of computer simulation software.

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Østfold University College

IRMGR42518 Special Curriculum I (Autumn 2021)

Facts about the course

ECTS Credits: 10
Responsible department: Faculty of Computer Science, Engineering and Economics
Campus: Fredrikstad.
Course Leader: Shima Pilehvar
Teaching language: English.
Duration: ½ year

Table of contents

The course is connected to the following study programs

Master in Green Energy Technology (Elective).

Lecture Semester

Third semester (autumn).

The student's learning outcomes after completing the course

Knowledge:

The student has specialized insight into one topic within energy technology.

Skills:

The student can analyze and critically examine scientific research literature.

General competence:

The student can acquire new knowledge within a field by self-tuition.

Content

This is a self-study course where the student will read a curriculum consisting of scientific research literature (books, articles, etc) of 300-350 pages, depending on the complexity of the subject. The literature should be related to the subject of the student's planned Master Thesis. The literature is defined by the Master Thesis supervisor, and approved by the program manager.

The supervisor will provide up to 5 hours of supervision, to help the student understand the literature.

Forms of teaching and learning

Self-study with supervision.

Workload

250-300 hours.

Coursework requirements - conditions for taking the exam

None.

Examination

Individual oral exam. Approximately 1 hour duration.

Grades from A to F, where A is the best grade, E is the lowest passed grade, and F is failed.

Examiners

Supervisor and one internal or external examiner.

Conditions for resit/rescheduled exams

If the student fails the oral exam, he/she can re-take this exam maximum two more times. A re-take will be arranged in January the following semester.

Course evaluation

The course will be evaluated by a standardized electronic form.

Literature

Specified individually for each student.

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Østfold University College

IRMGR42618 Special Curriculum II (Autumn 2021)

Facts about the course

ECTS Credits: 5
Responsible department: Faculty of Computer Science, Engineering and Economics
Campus: Fredrikstad.
Course Leader: Shima Pilehvar
Teaching language: English.
Duration: ½ year

Table of contents

The course is connected to the following study programs

Master in Green Energy Technology (Elective).

Lecture Semester

Third semester (autumn).

The student's learning outcomes after completing the course

Knowledge:

The student has specialized insight into one topic within energy technology.

Skills:

The student can analyze and critically examine scientific research literature.

General competence:

The student can acquire new knowledge within a field by self-tuition.

Content

This is a self-study course where the student will read a curriculum consisting of scientific research literature (books, articles, etc) of 150-175 pages, depending on the complexity of the subject. The literature should be related to the subject of the student's planned Master Thesis. The literature is defined by the Master Thesis supervisor, and approved by the program manager.

The supervisor will provide up to 3 hours of supervision, to help the student understand the literature.

Forms of teaching and learning

Self-study with supervision.

Workload

125-150 hours.

Coursework requirements - conditions for taking the exam

None.

Examination

Individual oral exam. Approximately 1 hour duration.

Grades from A to F, where A is the best grade, E is the lowest passed grade, and F is failed.

Examiners

Supervisor and one internal or external examiner.

Conditions for resit/rescheduled exams

If the student fails the oral exam, he/she can re-take this exam maximum two more times. A re-take will be arranged in January the following semester.

Course evaluation

The course will be evaluated by a standardized electronic form.

Literature

Specified individually for each student.

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Østfold University College

IRMGR44018 Master Thesis (Spring 2022)

Facts about the course

ECTS Credits: 30
Responsible department: Faculty of Computer Science, Engineering and Economics
Campus: Fredrikstad.
Course Leader: Shima Pilehvar
Teaching language: English.
Duration: ½ year

Table of contents

The course is connected to the following study programs

Master in Green Energy Technology (Compulsory).

Absolute requirements

Passed at least 70 ECTS of the previous Master courses.

Passed the course Scientific Research and Methods (10 ECTS).

Lecture Semester

Fourth semester (spring).
It is possible to apply for following this course in the autumn semester.

The student's learning outcomes after completing the course

Knowledge:

The student

- has specialized insight into one topic within energy technology
- has thorough knowledge of scientific methods and ethical considerations within energy technology
- is able to utilize knowledge within new fields of energy technology
- Is able to analyze scientific problems within energy technology.

Skills:

The student

- is able to critically analyze different sources of information, and use them to structure and develop academic arguments
- is able to analyze and apply different theories within energy technology
- can utilize relevant methods for research development
- can work independently with practical and theoretical problem solving
- is able to plan and conduct a research project, including ethical reflections related to energy technology and future implications of technological advances.

General Competence:

The student

- can utilize his/her knowledge and skills within new areas to accomplish advanced tasks and projects
- knows how to search for scientific literature
- can write a comprehensive thesis regarding a specialized subject within energy technology
- is able to orally present a scientific project for both specialists within the fields and the general public.

Content

The student will perform a research project under supervision. The project can be connected to the research of one of the lecturers, or be a project in collaboration with an industry partner or one of the collaboration institutions abroad. The student is expected to apply previously acquired knowledge and skills related to their chosen specialized topic in addition to previously acquired knowledge and skills related to research design, the logics of scientific thinking and writing and ethical considerations in a research project.

Forms of teaching and learning

The students will work on a research project under supervision of one of the lecturers. The project either can be an individual project, or conducted in interdisciplinary teams. For the team projects, the tasks and contributions of each student must be clearly specified.

Workload

750-900 hours.

Coursework requirements - conditions for taking the exam

None.

Examination

Three component exam, consisting of project report, oral presentation and oral examination.

For individual projects:

Project report combined with an oral presentation of approximately 45 minutes duration aimed at the general public directly followed by an oral examination of approximately 45 minutes duration.

The examination committee will grade the written report before the oral presentation and examination. The written report must be passed in order to be allowed an oral presentation and examination. The committee will adjust the grade maximum two grades up or down based on the oral presentation and examination.

For group projects:

Project report. One report for the whole group, together with a specification of the contribution of each student. Combined with individual oral presentations aimed at the general public directly followed by an individual oral examination.

The examination committee will grade the written report before the oral presentation and examination. The specified contribution of the individual student counts as 50 % and the report as a whole counts as 50%. The committee will adjust the grade based on the oral presentation and examination.

For both individual and group projects:

Only the final grade will be given as the grade of the course. Grading presupposes that all preceding study plan courses are passed.

Grades from A to F, where A is the best grade, E is the lowest passed grade, and F is failed.

Examiners

Examination committee of one internal and one external examiner.

Conditions for resit/rescheduled exams

If the written report is not passed, the student can hand in a revised report one time, at a deadline specified by the Master Thesis supervisor. If the revised report is passed, the student is allowed an oral presentation and examination.

In case of a final grade complaint, the written report will be re-examined by a complaint committee. If the grade from the complaint committee differs from the grade the examination committee gave on the written report, the student must re-take the oral presentation and examination and receive a new grade from the complaint committee. If the complaint committee agrees with the examination committee on the grade of the written report, the student will keep the original grade.

Course evaluation

The course will be evaluated by a standardized electronic form.

Literature

The students will conduct a literature search to find literature that is relevant for the project.

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