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| --- | --- | --- | --- | --- | --- | --- |
|  | Gyldig fra: | 02.02.2015 | Version nr. | 01 | Dokument nr. | 1135 |
| Studieordning | 1101 Studieordning for maskinmesteruddannelsen med studiestart 1. og 4. semester januar 2013 og senere. Version 3 |
| **Energy – Technology and Management****Attendance** |

**Part 1**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Indhold | Skema | ECTS | Eva. | Eks. | Bedøm. | Navn DK/GB |
| 38901 A | CEP | 5 | MDT | EP | 7TRIN | Culture and Energy Policy |
| 38902 A | BIO | 4 | PRO | IP | BE/IB | Bioenergy |
| 38902 B | OG | 4 | RAP | IP | BE/IB | Oil and Gas Production |
| 38902 C | CHP | 2 | LB | IP | BE/IB | Combined Heat and Power |

**Part 2**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Indhold | Skema | ECTS | Eva. | Eks. | Bedøm. | Navn DK/GB |
| 38904 A | OP | 5 | RAP | IP | 7TRIN | Optimization of an Energy system |
| 38903 A | EE | 4 | LB | IP | BE/IB | Energy efficiency |
| 38903 B | RES | 4 | LB | IP | BE/IB | Renewable Energy Systems |
| 38903 C | DH | 2 | LB | IP | BE/IB | District Heating |

Reference for godkendelse ved Studienævnet:

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# Energy – Technology and Management

# General Description

## Aim

The aim of the elective is to give the students an insight into and perspective on energy technologies and energy systems. The emphasis is on Danish energy policies and solutions, but these are also seen in an international context.

The international aspect of the semester is underlined by the fact that the programme is open to international as well as Danish students and an essential purpose of the course is to practice communication and cooperation between students from different countries and cultures. As a consequence all lectures, all educational material and all assignments will be in English.

## Structure of the course

The course consists of two parts of a duration of approximately 8 weeks each, corresponding to 15 ECTS. Each part can be taken separately.

|  |  |
| --- | --- |
| **Part 1** | **Part 2** |
| Culture and Energy Policy5 ECTS | Exam | Optimization of an Energy System5 ECTS | Common Exam |
| Bioenergy4ECTS | Energy Efficiency4 ECTS |
| Oil and Gas Production4 ECTS | Renewable Energy Systems4 ECTS |
| Combined Heat and Power2 ECTS | District Heating2 ECTS |

All the subjects shown in a part are compulsory. For a more detailed description, see the curriculum for the specific part and subject.

The subject *Culture and Energy Policy* substitutes the language and culture part of the cross-curricular element (document no. 1132) compulsory for Danish students.

The subject *Optimization of an Energy System* substitutes the methodology part of the cross-curricular element (document no. 1132) compulsory for Danish students.

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|  | Gyldig fra: |  | Version nr. |  | Dokument nr. |  |
| Studieordning | 1101 Studieordning maskinmester studiestart januar 2013 Version 2, dateret den 02.02.2014  |
| **Curriculum****Energy – Technology and Management****Part 1** |

# Content of Part 1

Part 1 of the elective *Energy – Technology and Management* at Aarhus School of Marine and Technical Engineering consists of the following 4 subjects

* Culture and Energy Policy 5 ECTS
* Bioenergy 4 ECTS
* Oil and Gas Production 4 ECTS
* Combined Heat and Power (CHP) 2 ECTS

# Prerequisites

**International students:** High school diploma followed by at least one year of university studies in the natural sciences, engineering, management or economics.

**Danish students:** Passed 7th semester exam.

# Credit

15 ECTS.

# Duration

8 - 9 weeks (Beginning February – End March or Mid August – Mid October).

# Aim

The student shall acquire fundamental knowledge of energy from oil, gas, and biomass and how these fuels are used in combined heat and power plants in a Danish as well as an international context. The student shall also acquire general knowledge of energy policies and strategies. Furthermore, the student shall acquire knowledge of cultural analysis and cross-cultural communication.

# Learning Outcomes

Taxonomy: SOLO multistructural level unless otherwise stated.

## Competencies

Theoretical foundation for employment within energy production. The student is able to outline and discuss national strategies for energy supply. Furthermore, the student is able to relate in an analytical and critical way to the cultural differences present in an international work situation.

## Knowledge

**Culture and Energy Policy**

The student has knowledge of:

* Danish energy supply in general
* Danish energy policy
* Energy supply and policy of other countries
* Different theories and models relating to cultural understanding and cultural analysis
* Intercultural communication and cooperation

**Bioenergy**

The student has knowledge of:

* Energy content of biomass as it relates to chemical composition
* Pre-treatment techniques of biomass
* Operating methods of different biogas reactor types
* Different biological processes and process kinetics
* Simple models to simulate anaerobic processes
* Technologies for purification and upgrading of biogas
* Basic principles of biodiesel and bioethanol production (SOLO unistructural level)

**Oil and Gas Production**

The student has knowledge of:

* Offshore oil exploration
* Offshore oil well drilling technology
* Oil and gas production from oil well to refinery
* Technologies for transportation of gas (LNG)

**Combined Heat and Power**

The student has knowledge of:

* Relevant thermodynamics, e.g. energy balances and work cycles
* Plant design of biomass-, and waste fired CHP plants
* Combustion techniques used in CHP plants
* Heat pumps and Heat storage

## Skills

**Culture and Energy Policy**

The student is able to:

* Present the Danish strategies for energy supply
* Present the national strategies for energy supply
* Describe cultural aspects of an international work situation
* Analyze cultural aspects of an international work situation

**Bioenergy**

The student is able to:

* Calculate the dimensions of a biogas plant
* Calculate the impact on the greenhouse gas balance
* Quantify the energy production from a given amount of biomass

**Oil and Gas Production**

The student is able to:

* Read technical literature on oil and gas production
* Participate in discussions on related subjects

**Combined Heat and Power**

The student is able to:

* Calculate plant efficiencies
* Analyze the effect of adding heat pumps and heat storage to a CHP plant
* Discuss pros and cons of CHP plants and condensing power plants

# Exam

The subject *Culture and Energy Policy* is evaluated through a two-part oral exam. The duration of the exam is 30 minutes including marking. The first part of the exam includes a presentation of the results of a cultural case study. Prior to the oral exam, the student is given 24 hours to study the case and prepare his/her presentation. The first part lasts 12-14 minutes. The second part is a presentation of the findings from the student’s project report from the subject *Oil and Gas Production*. The focus in this presentation is on conveying the contents of the report in such a way that it can be understood by laypeople. The second part lasts 12-14 minutes. Mark: One mark from the Danish scale (consisting of the marks -3, 00, 02, 4, 7, 10, 12, where 02 is the passing mark).

The subject *Bio Energy* is evaluated through a group project work. The group size is max 5 students. The group hands in a report of 8 standard pages. (A standard page is 2400 characters including blanks). Additionally the group in common makes an oral presentation of their project (10 minutes per participant) followed by an individual examination of approximately 10 minutes in total for the group. Mark: passed/failed.

The subject *Oil and Gas Production* is evaluated through a group project work. The group size is max 5 students. On the last day of the second last week of Part 1 the group hands in a report of 4 standard pages per student. (A standard page is 2400 characters including blanks). Additionally, each student writes a single page in which he describes his contribution to the report and his outcome of the project. Mark: passed/failed.

The subject *Combined Heat and Power* is evaluated through a number of individual compulsory assignments which must be approved to pass the course.

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| Studieordning | 1101 Studieordning maskinmester studiestart januar 2013 Version 2, dateret den 02.02.2014  |
| **Curriculum****Energy – Technology and Management****Part 2** |

# Content of Part 2

Part 2 of the elective *Energy – Technology and Management* at Aarhus School of Marine and Technical Engineering can be taken separately or in combination with part 1, to make up a full semester. Part two consists of the following 4 subjects

* Optimization of an Energy System 5 ECTS
* Energy Efficiency 4 ECTS
* Renewable Energy Systems 4 ECTS
* District Heating (DH) 2 ECTS

# Prerequisites

**International students:** High school diploma followed by at least one year of university studies in the natural sciences, engineering, management or economics.

**Danish students:** Passed 7th semester exam.

# Credit

15 ECTS.

# Duration

8 - 9 weeks (Beginning April – End May or End October – Mid December).

# Aim

The students shall acquire a theoretical basis for optimizing energy systems towards a higher degree of sustainability, and be able to document their results in a professional report according to document no. 1132.

# Learning Outcomes

Taxonomy: SOLO multistructural level unless otherwise stated.

## Competencies

The student is able to participate in teams working with energy savings or within sustainable energy technology and can take part in development of sustainable energy systems.

## Knowledge

**Optimization of an Energy System**

The student has knowledge of:

* Tools to balance energy systems
* Excess electricity production
* Different technologies that can be used in the development of an energy system
* Scientific methodology in a project work

**Energy Efficiency**

The student has knowledge of:

* Tools for setting up a baseline for energy consumption
* Tools for calculations on heat loss from buildings
* Methods for calculating and assessing energy consumption in industrial processes
* Relevant legislation concerning energy consumption
* DS/EN ISO 50001, international standard for Energy Management Systems

**Renewable Energy Systems**

The student has knowledge of:

* Tools for modeling and developing energy systems
* Mechanical and electrical components of wind turbines
* Principles of solar thermal and solar photovoltaic energy plants
* Energy content in solar radiation and wind
* Methods of energy storage

**District Heating**

The student has knowledge of:

* Layout of a district heating system
* Properties for efficient district heating supply and consumption
* General socioeconomic advantages of district heating

## Skills

**Optimization of an Energy System**

The student is able to:

* Use the software tool EnergyPLAN to develop and balance an energy system
* Use the software tool EnergyPLAN to calculate socioeconomic aspects of developing sustainable energy systems
* Discuss possibilities for development of energy systems towards a higher degree of sustainability
* Use correct methodology in a project work.

**Energy Efficiency**

The student is able to:

* Set up a baseline for energy consumption
* Identify and assess optimization actions in buildings and industrial processes
* Set up action plans for energy optimization activities
* Prepare procedures for an Energy Management System

**Renewable Energy Systems**

The student is able to:

* Conduct basic dimensioning of solar and wind energy plants
* Calculate the energy output from solar and wind based energy plants
* Plan maintenance routines for renewable plants

**District Heating**

The student is able to:

* Evaluate the function of a district heating consumer installation
* Discuss advantages and disadvantages of district heating compared to individually heated buildings

# Exam

The subject *Optimization of an Energy System* is evaluated through a project work in which a future energy system of a limited area is modeled in EnergyPLAN. The project work must encompass all the other subjects of *Energy – Technology and Management* Part 2 including methodology. The group size is max 5 students. On the last day of the course the group hands in a project report of typically 10 and max 15 standard pages. (A standard page is 2400 characters including blanks). Additionally, each student writes a single page in which he describes his contribution to the report and his outcome of the project. Mark: One mark from the Danish scale (consisting of the marks -3, 00, 02, 4, 7, 10, 12, where 02 is the passing mark).

In the subjects *Energy Efficiency*, *Renewable Energy Systems* and *District Heating* there will further be a number of compulsory assignments and exercises that must be handed in and approved.