Electricity theory

The subject of electricity theory covers DC circuits, single-phase AC circuits, and three-phase systems with different kinds of loads. It also covers cable-borne interference and safety issues.

Aim of the subject

Teaching in the subject of electricity theory should aim at helping students develop skills in measuring and calculating electrical power in DC circuits, single-phase AC circuits, and three-phase systems with different kinds of loads. It should also help students develop the ability to localise and rectify faults in DC and single-phase AC circuits and in three-phase systems. In addition, teaching should help students develop their understanding of how cable-borne interference occurs and its impact on the electrical system.

Teaching should give students the opportunity to develop knowledge of safety issues and of requirements and standards in the area of electricity.

Teaching should give students the opportunity to practically measure and calculate electrical power in DC circuits, single-phase AC circuits and three-phase systems. It should also give students the opportunity to localise and rectify faults practically, using diagrams, drawings, measuring instruments and other equipment.

Teaching in the subject of electricity theory should give students the opportunities to develop the following:

1) Knowledge of the structure and functions of the electricity system.
2) Knowledge of the structure and functions of DC circuits, and single-phase AC circuits, and also skills in measuring and calculating electrical power in these under different kinds of loads.
3) Knowledge of the structure and functions of three-phase systems, and also skills in measuring and calculating electrical power in these under loads of different kinds.
4) Knowledge of the occurrence of disturbances in and their impact on the electrical system.
5) The ability to search for and rectify faults in DC circuits and single phase AC circuits.
6) The ability to search for and rectify faults in three-phase systems.
7) Knowledge of safety issues and of regulations and standards in the electricity area.

Courses in the subject

- Electricity theory 1, 100 credits.

- Electricity theory 2, 100 credits which builds on the course electricity theory 1.
- Practical electricity, 100 credits.

Practical electricity

The course practical electricity covers points 1–7 under the heading Aim of the subject.

Core content

Teaching in the course should cover the following core content:

- The electricity system's structure and function from transformer to loads.
- Electrical material e.g. conductors, semiconductors and insulators.
- Electrical power and relationships.
- Functions of DC circuits and single phase AC circuits.
- Differences between symmetrical and asymmetrical loading.
- The function of different voltage systems in distribution and industry.
- Structure, function and use of TN-C and TN-S systems.
- The occurrence and effect of electrical and magnetic fields.
- Occurrence and dissemination of side emissions.
- Functions and effects of protective conductors.
- Effect of overtones on the electricity network.
- Power electronic equipment's uses and effects on the network.

Knowledge requirements

Grade E

Students give an account **in basic terms** of the electricity system's DC circuits, single-phase AC circuits, and the structure and functions of three phase systems, and also the effect of different loadings on the electrical system. In addition, students give an account **in basic terms** of how disturbances to the electrical system occur, and what effect they have on the system.

Students carry out **in consultation** with the supervisor electrical measurements in electrical systems. Prior to their work, students choose **with some certainty** appropriate measuring methods and measuring instruments. In addition, students make a **simple** risk assessment and adapt where necessary their measurements accordingly. Students carry out **in consultation** with the supervisor **simple** calculations. Based on results of measurements and calculations, students propose **with some certainty** appropriate measures for rectifying faults in electrical systems. Students carry out **in consultation** with the supervisor these measures. The work is carried out in

a way that is safe for students themselves and others based on regulations and standards in the electricity area.

In consultation with the supervisor, students assess **with some certainty** their own ability and the requirements of the situation.

Grade D

Grade D means that the knowledge requirements for grade E and most of C are satisfied.

Grade C

Students give an account **in detail** of the electricity system's DC circuits, single-phase AC circuits, and the structure and functions of three phase systems, and also the effect of different loadings on the electrical system. In addition, students give an account **in detail** of how disturbances in the electrical system occur, and what effect they have on the system.

Students carry out **after consultation** with the supervisor electrical measurements in electrical systems. Prior to their work, students choose **with some certainty** appropriate measuring methods and measuring instruments. In addition, students make a risk assessment and adapt where necessary their measurements accordingly. Students carry out **after consultation** with the supervisor calculations. Based on results of measurements and calculations, students propose **with some certainty** appropriate measures for rectifying faults in electrical systems. Students carry out these measures **after consultation** with the supervisor. The work is carried out in a way that is safe for students themselves and others based on regulations and standards in the electricity area.

In consultation with the supervisor, students assess **with some certainty** their own ability and the requirements of the situation.

Grade B

Grade B means that the knowledge requirements for grade C and most of A are satisfied.

Grade A

Students give an account **in detail and in a balanced way** of the electricity system's DC circuits, single-phase AC circuits, and the structure and functions of three phase systems, and also the effect of different loadings on the electrical system. In addition, students give an account **in detail and in a balanced way** of how disturbances to the electrical system occur, and what effect they have on the system.

Students carry out **after consultation** with the supervisor electrical measurements in electrical systems. Prior to their work, students choose **with certainty** appropriate measuring methods and instruments, **and also give reasons for their choices**. In addition, students make a **well grounded** risk assessment and adapt where necessary measurements accordingly. Students carry out **after consultation** with the supervisor **advanced** calculations. Based on results of measurements and calculations, students propose **with certainty** appropriate measures for rectifying faults in electrical systems. Students carry out these measures **after consultation** with

the supervisor. The work is carried out in a way that is safe for students themselves and others based on regulations and standards in the electricity area.

In consultation with the supervisor, students assess **with certainty** their own ability and the requirements of the situation.

Electricity theory 1

The course electricity theory 1 covers points 2, 4–5 and 7 under the heading Aim of the subject.

Core content

Teaching in the course should cover the following core content:

- Conductors, semiconductors and insulators.
- Electrical power in DC circuits, and single-phase AC circuits.
- Basic principles for motors, generators and transformers, and also for the transfer of electrical energy.
- Electrical series and parallel connections.
- DC circuits and single phase AC circuits.
- Electrical and magnetic fields.
- Electromagnetic compatibility (EMC), overtones and power correction.
- Resistive, inductive and capacitive circuits.
- Different measurement techniques, and also methods for analysing values and carrying out fault tracing and repairs.

Knowledge requirements

Grade E

Students give an account **in basic terms** of the structure and function of DC circuits, single-phase AC circuits, and also the effect of different loadings on circuits and the electrical system. In addition, students give an account **in basic terms** of how disturbances to the electrical system occur, and what effect they have on the system.

Students carry out **in consultation** with the supervisor electrical measurements in DC circuits and single-phase AC circuits. Prior to their work, students choose **with some certainty** appropriate measuring methods and measuring instruments. In addition, students make a **simple** risk assessment and adapt where necessary their measurements accordingly. Students carry out **in consultation** with the supervisor **simple** calculations. Based on results of measurements and calculations, students propose **with some certainty** appropriate measures for rectifying faults in electrical systems. Students carry out **in consultation** with the supervisor these measures. The work is carried out in a way that is safe for students themselves and others based on regulations and standards in the electricity area.

In consultation with the supervisor, students assess **with some certainty** their own ability and the requirements of the situation.

Grade D

Grade D means that the knowledge requirements for grade E and most of C are satisfied.

Grade C

Students give an account **in detail** of the structure and function of DC circuits, single-phase AC circuits, and also the effect of different loadings on circuits and the electrical system. In addition, students give an account **in detail** of how disturbances in the electrical system occur, and what effect they have on the system.

Students carry out **after consultation** with the supervisor electrical measurements in DC circuits and single-phase AC circuits. Prior to their work, students choose **with some certainty** appropriate measuring methods and measuring instruments. In addition, students make a risk assessment and adapt where necessary their measurements accordingly. Students carry out **after consultation** with the supervisor calculations. Based on results of measurements and calculations, students propose **with some certainty** appropriate measures for rectifying faults in electrical systems. Students carry out these measures **after consultation** with the supervisor. The work is carried out in a way that is safe for students themselves and others based on regulations and standards in the electricity area.

In consultation with the supervisor, students assess **with some certainty** their own ability and the requirements of the situation.

Grade B

Grade B means that the knowledge requirements for grade C and most of A are satisfied.

Grade A

Students give an account **in detail and in a balanced way** of the structure and function of DC circuits, single-phase AC circuits, and also the effect of different loadings on circuits and the electrical system. In addition, students give an account **in detail and in a balanced way** of how disturbances to the electrical system occur, and what effect they have on the system.

Students carry out **after consultation** with the supervisor electrical measurements in DC circuits and single-phase AC circuits. Prior to their work, students choose **with certainty** appropriate measuring methods and measuring instruments. In addition, students make a **well grounded** risk assessment and adapt where necessary measurements accordingly. Students carry out **after consultation** with the supervisor **advanced** calculations. Based on results of measurements and calculations, students propose **with certainty** appropriate measures for rectifying faults in electrical systems. Students carry out these measures **after consultation** with the supervisor. The work is carried out in a way that is safe for students themselves and others based on regulations and standards in the electricity area.

In consultation with the supervisor, students assess **with certainty** their own ability and the requirements of the situation.

Electricity theory 2

The course electricity theory 2 covers points 3–4 and 6–7 under the heading Aim of the subject.

Core content

Teaching in the course should cover the following core content:

- The structure and function of three-phase systems from transformers to loading.
- Resistive, inductive and capacitive circuits in three-phase networks.
- Differences between symmetrical and asymmetrical loading.
- The function and effect of three-phase motors and three-phase transformers in three-phase systems.
- The function of different voltage systems in distribution and industry.
- Structure, function and use of TN-C systems and TN-S systems.
- The occurrence and effect of electrical and magnetic fields.
- Occurrence and dissemination of side emissions.
- Functions and effects of protective conductors.
- The effect of linear and non-linear loads on the occurrence of overtones.
- Power electronic equipment's uses and functions.
- Filtering, stabilisation and other measures for reducing cable-related disturbances.

Knowledge requirements

Grade E

Students give an account **in basic terms** of the structure and function of three-phase systems, and also the effect of different loadings on the electrical system. In addition, students give an account **in basic terms** of how disturbances to the electrical system occur, and what effect they have on the system.

Students carry out **in consultation** with the supervisor electrical measurements in three-phase systems. Prior to their work, students choose **with some certainty** appropriate measuring methods and measuring instruments. In addition, students make a **simple** risk assessment and adapt where necessary their measurements accordingly. Students carry out **in consultation** with the supervisor **simple** calculations. Based on results of measurements and calculations, students propose **with some certainty** appropriate measures for rectifying faults in electrical systems. Students carry out **in consultation** with the supervisor these measures. The work is carried out in

a way that is safe for students themselves and others based on regulations and standards in the electricity area.

In consultation with the supervisor, students assess **with some certainty** their own ability and the requirements of the situation.

Grade D

Grade D means that the knowledge requirements for grade E and most of C are satisfied.

Grade C

Students give an account **in detail** of the structure and function of three-phase systems, and also the effect of different loadings on the electrical system. In addition, students give an account **in detail** of how disturbances in the electrical system occur, and what effect they have on the system.

Students carry out **after consultation** with the supervisor electrical measurements in three-phase systems. Prior to their work, students choose **with some certainty** appropriate measuring methods and measuring instruments. In addition, students make a risk assessment and adapt where necessary their measurements accordingly. Students carry out **after consultation** with the supervisor calculations. Based on results of measurements and calculations, students propose **with some certainty** appropriate measures for rectifying faults in electrical systems. Students carry out these measures **after consultation** with the supervisor. The work is carried out in a way that is safe for students themselves and others based on regulations and standards in the electricity area.

In consultation with the supervisor, students assess **with some certainty** their own ability and the requirements of the situation.

Grade B

Grade B means that the knowledge requirements for grade C and most of A are satisfied.

Grade A

Students give an account **in detail and in a balanced way** of the structure and function of three-phase systems, and also the effect of different loadings on the electrical system. In addition, students give an account **in detail and in a balanced way** of how disturbances to the electrical system occur, and what effect they have on the system.

Students carry out **after consultation** with the supervisor electrical measurements in three-phase systems. Prior to their work, students choose **with certainty** appropriate measuring methods and measuring instruments. In addition, students make a **well grounded** risk assessment and adapt where necessary measurements accordingly. Students carry out **after consultation** with the supervisor **advanced** calculations. Based on results of measurements and calculations, students propose **with certainty** appropriate measures for rectifying faults in electrical systems. Students carry out these measures **after consultation** with the supervisor. The work is carried out in a way that is safe for students themselves and others based on regulations and standards in the electricity area.

In consultation with the supervisor, students assess **with certainty** their own ability and the requirements of the situation.