

Systems knowledge

The subject of systems knowledge covers how HVAC, ventilation, refrigeration and heat pump systems function and are built up. This also covers the importance of maintaining systems. The subject covers energy efficiency in buildings, which media are used in systems, their physical properties and how energy conversion takes place.

Aim of the subject

Teaching in the subject of systems knowledge should aim at helping students develop knowledge of how HVAC, ventilation, refrigeration and heat pump systems function and their construction. Students should be given the opportunity to develop knowledge about systems individually and their multiple interaction. Teaching should also give students the opportunity to develop knowledge about the construction of buildings, and also understanding of how the climate shell and activities affect dimensioning of systems. By means of teaching, students should be given the opportunity to develop knowledge of the principles governing work, environmental impact, and conditions for production.

Teaching should lead to students developing skills in assessing and calculating power needs in heat and cooling processes, and also knowledge about how the use of energy affects health and the environment, and how this can take place in accordance with sustainable development. It should also contribute to students developing ergonomic and working environment oriented approaches. In addition, students should be given the opportunity to develop knowledge about the terms and concepts used in the area of installations and property.

Teaching should be organised so that students have opportunities to apply theoretical solutions in practice.

Teaching in the subject of systems knowledge should give students the opportunities to develop the following:

- 1) Knowledge of the functions and construction of energy technology systems, and the properties of energy bearing media.
- 2) Knowledge of thermodynamics and also skills in making calculations for heating, sanitary, ventilation, cooling and heat pump systems.
- 3) Knowledge of the effective and environmentally friendly use of energy.
- 4) Understanding of drawings, operating instructions, user manuals and instructions, and also skills in making drawings.
- 5) The ability to carry out operating controls.
- 6) Knowledge of laws and other regulations in the area.

7) The ability to work safely and ergonomically.

Courses in the subject

- Installation adjustments, 100 credits.
- Systems design, 100 credits.
- Thermodynamics, 100 credits.

Systems design

The course, systems design, covers points 1 and 3–7 under the heading Aim of the subject, with special emphasis on points 1 and 4.

Core content

Teaching in the course should cover the following core content:

- Overall view of heating, sanitary, ventilation, refrigeration and heat pump systems' functions and interaction in properties, buildings, and facilities.
- Structure and function of heating, sanitary, ventilation, cooling and heat pump systems, and how they are installed and maintained.
- Directional flows, pressure and temperature in different systems.
- How apparatuses and components in systems function individually and together.
- Simple systems drawings, symbols and terms and how they are used to describe systems.
- Flowcharts, operating instructions and user manuals to carry out operating controls on real or simulated systems.
- Installation standards, building and working environment regulations to meet society's requirements for the rational use of energy, health and safety.

Knowledge requirements

Grade E

Students describe **in basic terms** the functions and construction of different energy technology systems. In their descriptions, students give an account **in basic terms** of components and apparatuses in the system and their function and construction. Students refer in their descriptions to drawings, operating instructions, user manuals and instructions. In addition, students describe **in basic terms** effective and environmentally friendly use of energy in energy technology systems. In their descriptions, students use **simple** professional language.

Students make **with some certainty** simple drawings of energy systems with correct symbols and descriptions.

Students carry out **in consultation** with the supervisor operating controls by using drawings, operating instructions, user manuals and instructions in accordance with laws and other regulations.

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 describe **in detail** the functions and construction of different energy technology systems. In their descriptions, students give an account **in basic terms** of components and apparatuses in the systems and their function and construction. Students refer in their descriptions to drawings, operating instructions, user manuals and instructions. In addition, students describe **in detail** effective and environmentally friendly use of energy in energy technology systems. In their descriptions, students use professional language.

Students make **with some certainty** simple drawings of energy systems with correct symbols and descriptions.

Students carry out **after consultation** with the supervisor operating controls using drawings, operating instructions, user manuals and instructions, in accordance with laws and other regulations.

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 describe **in detail and in a balanced way** the functions and construction of different energy technology systems. In their descriptions, students give an account **in detail and in a balanced way** of the components and apparatuses in the system and their function and construction. Students refer in their descriptions to drawings, operating instructions, user manuals and instructions. In addition, students describe **in detail and in a balanced way** effective and environmentally friendly use of energy in energy technology systems. In their descriptions, students use **balanced** professional language.

Students make **with certainty** simple drawings of energy systems with correct symbols and descriptions.

Students carry out **after consultation** with the supervisor operating controls using drawings, operating instructions, user manuals and instructions, in accordance with laws and other regulations.

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

Thermodynamics

The course, thermodynamics, covers points 1–7 under the heading Aim of the subject, with special emphasis on points 2 and 6.

Core content

Teaching in the course should cover the following core content:

- Relationships between heat and other forms of energy. Concepts in thermodynamics, e.g. heat transfer, temperature, energy transformation and pressure.
- Methods for and applying energy and power calculations.
- Dimensioning pipe and air duct systems, heaters and cooling agents, and also flow and pressure in these.
- Effective use of energy in buildings.
- Simple systems drawings, symbols and terms and how they are used to describe systems.
- Product information, calculation manuals, templates, quick reference guides, computer programs and calculation methods, and how these are used to carry out calculations for systems.
- Building legislation to fulfil society needs for economy in the use of energy, health and safety.

Knowledge requirements

Grade E

Students describe **in basic terms** the functions and construction of different energy technology systems. In their descriptions, students give an account **in basic terms** of the laws of thermodynamics. In addition, students describe **in basic terms** effective and environmentally friendly use of energy in energy technology systems.

Students **estimate** the need for heating and cooling in **simple** systems by using established standards and quick reference guides so that systems comply with building legislation. In addition, students evaluate their own **estimates** in **simple** assessments, and give an account **in detail** of how systems are dimensioned.

Grade D

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

Grade C

Students describe **in detail** the functions and construction of different energy technology systems. In their descriptions, students give an account **in detail** of the laws of thermodynamics. In addition, students describe **in detail** effective and environmentally friendly use of energy in energy technology systems.

Students **calculate** the need for heating and cooling in systems by using established standards and quick reference guides, **and also simple methods of calculation** so that systems comply with building legislation. In addition, students evaluate their own **calculations in balanced** assessments, and give an account **in detail** of how systems are dimensioned.

Grade B

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

Grade A

Students describe **in detail and in a balanced way** the functions and construction of different energy technology systems. In their descriptions, students give an account **in detail and in a balanced way** of the laws of thermodynamics. In addition, students describe **in detail and in a balanced way** effective and environmentally friendly use of energy in energy technology systems.

Students **calculate** the need for heating and cooling in **complex** systems by using established standards and quick reference guides, **and also complex methods of calculation** so that systems comply with building legislation. In addition, students evaluate their own **calculations in balanced** assessments, and **give proposals on how the system can be energy optimised**. Students give an account **in detail and in a balanced way** of how systems can be dimensioned.

Installation adjustments

The course, installation adjustments, covers points 1–6 under the heading Aim of the subject.

Core content

Teaching in the course should cover the following core content:

- Fundamental principles of pump technology, pump data and operating modes of circulation pumps, fans and regulators.
- Terminology and concepts, as well as functions of components in control technology.
- Units and quantities found in the installation and property industries.
- Methods for measuring pressure, temperature, flow, and flow rates in water and air.
- Measuring instruments for the purpose.
- Functional testing to assess the accuracy of the system in order to guarantee functional requirements.
- Equipment for regulating temperatures and flows.
- Installation and starting control loops.
- Installation standards, building and working environment regulations to meet society's requirements for the rational use of energy, health and safety.
- Methods of combustion analysis in boilers.

Knowledge requirements

Grade E

Students describe **in basic terms** the functions and construction of different energy technology systems. In their descriptions, students give an account **in basic terms** of the laws of thermodynamics. In addition, students describe **in basic terms** effective and environmentally friendly use of energy in energy technology systems.

Students carry out **in consultation** with the supervisor operating controls by using drawings, operating instructions, user manuals and instructions in accordance with laws and other regulations. In their operating controls, students carry out **simple** measurements and calculations, and also check results in relation to **predetermined parameters**. Students carry out **in consultation** with the supervisor necessary changes, and start the system.

Students use protective equipment, follow safety regulations for their own safety and that of others, and work ergonomically.

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 describe **in detail** the functions and construction of different energy technology systems. In their descriptions, students give an account **in detail** of the laws of thermodynamics. In addition, students describe **in detail** effective and environmentally friendly use of energy in energy technology systems.

Students carry out **after consultation** with the supervisor operating controls using drawings, operating instructions, user manuals and instructions, in accordance with laws and other regulations. In their operating controls, students carry out measurements and calculations, and also check results in relation to **predetermined parameters**. Students carry out **after consultation** with the supervisor necessary changes, **choosing installations** and start the system. **Thereafter students analyse with some certainty systems and optimise the use of energy where needed.**

Students use protective equipment, follow safety regulations for their own safety and that of others, and work ergonomically.

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 describe **in detail and in a balanced way** the functions and construction of different energy technology systems. In their descriptions, students give an account **in detail and in a balanced way** of the laws of thermodynamics, **and the hydraulic properties of systems**. In addition, students describe **in detail and in a balanced way** effective and environmentally friendly use of energy in energy technology systems.

Students carry out **after consultation** with the supervisor operating controls using drawings, operating instructions, user manuals and instructions, in accordance with laws and other regulations. In their operating controls, students carry out measurements and calculations, and also check results in relation to **tables and diagrams**. Students carry out **after consultation** with the supervisor necessary changes, **choosing installations** and start the system. **Thereafter students analyse with certainty systems and optimise the use of energy where needed.**

Students use protective equipment, follow safety regulations for their own safety and that of others, and work ergonomically.

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