Industrial technological processes

The subject of industrial technological processes covers work in production processes, and how production equipment is connected to form production lines. It also covers the processing of raw materials in work processes. In addition, it covers working environment issues, communication and cooperation and how environmental regulations affect production.

Aim of the subject

Teaching in the subject of industrial technological processes should aim at helping students develop the ability to carry out common tasks in industrial technological processes in accordance with applicable safety regulations. Teaching should also give students the opportunity to develop knowledge about how to connect production equipment together to form production lines.

Teaching should give students the opportunity to develop a holistic approach to production processes where quality control, operating reliability, maintenance of equipment and understanding of individual responsibility in the work situation are crucial elements. Teaching should also give students the opportunity to develop knowledge to solve problems in the industrial technological process. Teaching should by this means help students develop their understanding of the importance of the individual for the final result. It should also give students the opportunity to develop knowledge of how to convert an idea into a finished product in production lines.

Teaching should give students the opportunity to develop the ability to determine their views on issues about the connections between sustainable development and technological processes. Teaching should also give students the opportunity to develop knowledge of terms and concepts used in the subject area, and the ability to communicate and cooperate with others in all stages of industrial technological processes.

Teaching should give students the opportunity to develop skills in handling production equipment in production lines, and thus practical exercises should be included in the teaching.

Teaching in the subject of industrial technological processes should give students the opportunities to develop the following:

1) The ability to plan tasks and to monitor, control and regulate equipment, and carry out other common tasks in industrial technological processes.
2) The ability to carry out simpler maintenance routines in industrial technological processing equipment.
3) The ability to work in accordance with safety regulations.
4) Understanding of quality and production processes, and also knowledge of sampling.
5) Knowledge of raw materials or materials, and how they are processed into final products in industrial technological processes.

6) Knowledge of how and why production equipment is linked together into production lines.
7) Understanding of how production impacts the environment, and how environmental regulation impacts production.
8) The ability to communicate with different target groups, cooperate with others, and evaluate their own work.

Courses in the subject

- Industrial technological processes 1, 100 credits, which builds on the course, production equipment 1.
- Industrial technological processes 2, 100 credits, which builds on the course, industrial technological processes 1.
- Industrial technological processes 3, 100 credits, which builds on the course, industrial technological processes 2.
- Industrial technological processes 4, 100 credits, which builds on the course, industrial technological processes 3.
- Laboratory technology 200 credits, which builds on the course, industrial technological processes 2.

Industrial technological processes 1

The course, industrial technological processes 1, covers points 1–8 under the heading Aim of the subject. The course covers basic knowledge in the subject.

Core content

Teaching in the course should cover the following core content:

- Basic monitoring, control and regulation of industrial technological processes and interpreting process charts.
- Operating reliability and the effect of simple remedial maintenance on industrial technological processes.
- Working environment issues and safety regulations.
- Definition of quality and its implications for industrial technological processes and production results.
- Where in industrial technological processes samples are taken, and approaches for sampling.
- Raw materials or processing materials into finished products in industrial technological processes.
- Structure, properties, handling and health risks of raw materials and finished products.
- Connecting production equipment to form production lines, different units and what functions they perform.
- The environmental impact of industrial technological processes. Measures to minimise environmental impact.
- Communication and cooperation between different roles and functions in industrial technological processes, e.g. employee groups, suppliers and customers.
- Simpler concepts in the area.

Knowledge requirements

Grade E

Students plan and organise **in consultation** with the supervisor monitoring, control and regulation of industrial technological processes. In their planning, students interpret **with some certainty** process charts, requirement specifications, instructions and safety regulations. Furthermore, students choose **in consultation** with the supervisor methods, tools, equipment and materials, taking into account desired results, health aspects, environmental factors and safety.

Students carry out with thoroughness and **in consultation** with the supervisor monitoring, control and regulation of industrial technological processes in accordance with process charts, safety regulations, instructions and requirement specifications. In addition, students carry out where necessary **in consultation** with supervisors remedial maintenance. The results of the work are **satisfactory** in relation to specific quality requirements. In their work, students use **with some certainty** instructions, process charts and requirement specifications. In addition, students carry out **with some certainty** procedures for sampling, and also interpret **with some certainty** the results. Students handle materials, equipment, tools and machines with **some** skills and keep the workplace well-organised. Students work ergonomically in a way that is safe both for themselves and others, and with due regard to the environment. During the work, students identify problems that occur and remedy them **in consultation** with the supervisor. After the task has been completed, students document **with some certainty** their work processes and results in accordance with specific instructions.

Students give an account **in basic terms** of how raw materials or materials are processed in industrial technological processes, and apply techniques, methods and tools used for tasks, and also apply **simple** relationships between production equipment and production lines. In addition, students give an account **in basic terms** based on examples of the importance of maintenance for operational safety. Students give an account in **basic terms** of how materials, techniques, methods of production equipment influence the work process, quality, final results and the environment. Students give an account **in basic terms** of possible deviations from the specifications.

Students cooperate in their work with others, and also give an account **in basic terms** of the importance of cooperation. In addition, students use **with some certainty** simpler terminology and professional language.

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 plan and organise **after consultation** with the supervisor monitoring, control and regulation of industrial technological processes. In their planning, students interpret **with some certainty** process charts, requirement specifications, instructions and safety regulations. Furthermore, students choose **after consultation** with the supervisor methods, tools, equipment and materials, taking into account desired results, health aspects, environmental factors and safety. **In addition, students give in detail the reasons for their choices**.

Students carry out with thoroughness and **after consultation** with the supervisor monitoring, control and regulation of industrial technological processes in accordance with process charts, safety regulations, instructions and requirement specifications. In addition, students carry out where necessary **after consultation** with the supervisor remedial maintenance. The results of the work are **satisfactory** in relation to specific quality requirements. In their work, students use **with some certainty** instructions, process charts and requirement specifications. In addition, students

carry out **with some certainty** procedures for sampling, and also interpret **with some certainty** the results. Students handle materials, equipment, tools and machines with **good** skills and keep the workplace well-organised. Students work ergonomically in a way that is safe both for themselves and others, and with due regard to the environment. During the work, students identify problems that occur and remedy them **after consultation** with the supervisor. After the task has been completed, students document **with some certainty** their work processes and results in accordance with specific instructions.

Students give an account **in detail** of how raw materials or materials are processed in industrial technological processes, and apply techniques, methods and tools used for tasks, and also apply relationships between production equipment and production lines. In addition, students give an account **in detail** based on examples of the importance of maintenance for operating safety. Students give an account **in detail** of how materials, techniques, methods of production and equipment influence **efficiency at work,** the work process, quality, final results and the environment. Students give an account **in detail** of possible deviations from the specifications.

Students cooperate in their work with others, and also give an account **in detail** of the importance of cooperation. In addition, students use **with some certainty** simpler terminology and professional language.

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 plan and organise **after consultation** with the supervisor monitoring, control and regulation of industrial technological processes. In their planning, students interpret **with certainty** process charts, requirement specifications, instructions and safety regulations. **Students also anticipate difficulties that can occur, and adapt their planning and organisation to this**. Furthermore, students choose **after consultation** with the supervisor methods, tools, equipment and materials, taking into account desired results, health aspects, environmental factors and safety. **In addition, students give reasons in detail and in a balanced way for their choices**.

Students carry out with thoroughness and **after consultation** with the supervisor monitoring, control and regulation of industrial technological processes in accordance with process charts, safety regulations, instructions and requirement specifications. In addition, students carry out where necessary **after consultation** with the supervisor remedial maintenance. The results of the work are **good** in relation to specific quality requirements. In their work, students use **with certainty** instructions, process charts and requirement specifications. In addition, students carry out **with certainty** procedures for sampling, and also interpret **with certainty** the results. Students handle materials, equipment, tools and machines with **very good** skills and keep the workplace well-organised. Students work ergonomically in a way that is safe both for themselves and others, and with due regard to the environment. During the work, students identify problems that occur and remedy them **after consultation** with the supervisor. When the task has been

completed, students document **with certainty** the work process and results in accordance with specific instructions.

Students give an account **in detail and in a balanced way** of how raw materials or materials are processed in industrial technological processes, and apply techniques, methods and tools used for tasks, and also apply **complex** relationships between production equipment and production lines. In addition, students give an account **in detail and in a balanced way** based on examples of the importance of maintenance for operating safety. Students give an account **in detail and in a balanced way** of how materials, techniques, methods of production equipment influence **efficiency at work**, the work process, quality, final results and the environment, **and also make proposals on how the work can be improved**. Students give an account **in detail and in a balanced way** of possible deviations from the specifications.

Students cooperate in their work with others, and also give an account **in detail and in a balanced way** of the importance of cooperation. In addition, students use **with certainty** simpler terminology and professional language.

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

Industrial technological processes 2

The course, industrial technological processes 2, covers points 1–8 under the heading Aim of the subject.

Core content

Teaching in the course should cover the following core content:

- Monitoring, control and regulation of industrial technological processes and interpreting process charts.
- Operating reliability and simpler prevention and remedial maintenance of industrial technological processes.
- Working environment issues and safety regulations.
- Definition of quality and its implications for industrial technological processes and production results.
- Where samples are taken in industrial technological processes, and approaches to sampling. Factors affecting choice and use of appropriate measuring methods. Different methods of analysis.
- Methods for correcting possible errors in production.
- Raw materials or processing materials into finished products by different processing stages in industrial technological processes.
- Structure, properties, handling and health risks of raw materials, finished and waste products.
- Connecting production equipment to form production lines, different units, what functions they perform, why different units are needed and why they come in a certain sequence.
- The environmental impact of industrial technological processes. Measures to minimise environmental impact.
- Communication and cooperation between different target groups in industrial technological processes, e.g. employee groups, suppliers and customers.
- Concepts in the subject area.

Knowledge requirements

Grade E

Students plan and organise **in consultation** with the supervisor monitoring, control and regulation of industrial technological processes. In addition, students plan and organise **in**

consultation with the supervisor preventive, remedial and corrective maintenance. In their planning, students interpret **with some certainty** process charts, requirement specifications, instructions and safety regulations. Furthermore, students choose **in consultation** with the supervisor methods, tools, equipment and materials, taking into account desired results, health aspects, environmental factors and safety.

Students carry out with thoroughness and **in consultation** with the supervisor monitoring, control and regulation of industrial technological processes in accordance with process charts, safety regulations, instructions and requirement specifications. In addition, students carry out **in consultation** with supervisors preventative and remedial maintenance. The results of the work are **satisfactory** in relation to specific quality requirements. In their work, students use **with some certainty** instructions, process charts and requirement specifications. In addition, students carry out **with some certainty** procedures for sampling, and also interpret **with some certainty** the results. Students handle materials, equipment, tools and machines with **some** skills and keep the workplace well-organised. Students work ergonomically in a way that is safe both for themselves and others, and with due regard to the environment. During the work, students make where necessary corrections in production based on process charts and requirement specifications. In addition, students identify possible problems that occur and remedy them **in consultation** with the supervisor. After the task has been completed, students document **with some certainty** their work processes and results in accordance with specific instructions.

Students give an account **in basic terms** of how raw materials or materials are processed in industrial technological processes, and apply techniques, methods and tools used for tasks, and also apply **simple** relationships between production equipment and production lines. In addition, students give an account **in basic terms** based on examples of the importance of maintenance for operational safety. Students give an account in **basic terms** of how materials, techniques, methods of production equipment influence the work process, quality, final results and the environment. Students give an account **in basic terms** of possible deviations from the specifications.

Students cooperate in their work with others, and also give an account **in basic terms** of the importance of cooperation. In addition, students use **with some certainty** terminology and the language of the profession.

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 plan and organise **after consultation** with the supervisor monitoring, control and regulation of industrial technological processes. In addition, students plan and organise **after consultation** with the supervisor preventative and remedial maintenance. In their planning, students interpret **with some certainty** process charts, requirement specifications, instructions and safety regulations. Furthermore, students choose **after consultation** with the supervisor methods, tools, equipment and materials, taking into account desired results, health aspects,

environmental factors and safety. **In addition, students give in detail the reasons for their choices**.

Students carry out with thoroughness and **after consultation** with the supervisor monitoring, control and regulation of industrial technological processes in accordance with process charts, safety regulations, instructions and requirement specifications. In addition, students carry out **after consultation** with the supervisor preventive and remedial maintenance. The results of the work are **satisfactory** in relation to specific quality requirements. In their work, students use **with some certainty** instructions, process charts and requirement specifications. In addition, students carry out **with some certainty** procedures for sampling, and also interpret **with some certainty** the results. Students handle materials, equipment, tools and machines with **good** skills and keep the workplace well-organised. Students work ergonomically in a way that is safe both for themselves and others, and with due regard to the environment. During the work, students make where necessary corrections in production based on process charts and requirement specifications. In addition, students identify possible problems that occur and remedy them **after consultation** with the supervisor. After the task has been completed, students document **with some certainty** their work processes and results in accordance with specific instructions.

Students give an account **in detail** of how raw materials or materials are processed in industrial technological processes, and apply techniques, methods and tools used for tasks, and also apply relationships between production equipment and production lines. In addition, students give an account **in detail** based on examples of the importance of maintenance for operating safety. Students also give an account **in detail** of how materials, techniques, methods of production and equipment influence **efficiency at work,** the work process, quality, final results and the environment. Students give an account **in detail** of possible deviations from the specifications.

Students cooperate in their work with others, and also give an account **in detail** of the importance of cooperation. In addition, students use **with some certainty** terminology and the language of the profession.

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 plan and organise **after consultation** with the supervisor monitoring, control and regulation of industrial technological processes. In addition, students plan and organise **after consultation** with the supervisor preventative and remedial maintenance. In their planning, students interpret **with certainty** process charts, requirement specifications, instructions and safety regulations. **Students also anticipate difficulties that can occur, and adapt their planning and organisation to this**. Furthermore, students choose **after consultation** with the supervisor methods, tools, equipment and materials, taking into account desired results, health aspects, environmental factors and safety. **In addition, students give reasons in detail and in a balanced way for their choices**.

Students carry out with thoroughness and **after consultation** with the supervisor monitoring, control and regulation of industrial technological processes in accordance with process charts, safety regulations, instructions and requirement specifications. In addition, students carry out **after consultation** with the supervisor preventive and remedial maintenance. The results of the work are **good** in relation to specific quality requirements. In their work, students use **with certainty** instructions, process charts and requirement specifications. In addition, students carry out **with certainty** procedures for sampling, and also interpret **with certainty** the results. Students handle materials, equipment, tools and machines with **very good** skills and keep the workplace well-organised. Students work ergonomically in a way that is safe both for themselves and others, and with due regard to the environment. During the work, students make where necessary corrections in production based on process charts and requirement specifications. In addition, students identify possible problems that occur and remedy them **after consultation** with the supervisor. When the task has been completed, students document **with certainty** the work process and results in accordance with specific instructions.

Students give an account **in detail and in a balanced way** of how raw materials or materials are processed in industrial technological processes, and apply techniques, methods and tools used for tasks, and also apply **complex** relationships between production equipment and production lines. In addition, students give an account **in detail and in a balanced way** based on examples of the importance of maintenance for operating safety. Students give an account **in detail and in a balanced way** of how materials, techniques, methods of production equipment influence **efficiency at work**, the work process, quality, final results and the environment, **and also make proposals on how the work can be improved**. Students give an account **in detail and in a balanced way** of possible deviations from the specifications.

Students cooperate in their work with others, and also give an account **in detail and in a balanced way** of the importance of cooperation. In addition, students use **with certainty** terminology and professional language.

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

Industrial technological processes 3

The course, industrial technological processes 3, covers points 1–8 under the heading Aim of the subject. The course covers advanced knowledge in the subject.

Core content

Teaching in the course should cover the following core content:

- Monitoring, control and regulation of industrial technological processes and interpreting process charts.
- Operating reliability and simpler preventative, remedial and corrective maintenance of industrial technological processes.
- Working environment issues and safety regulations.
- Quality work and its significance for industrial technological processes and production results.
- Where in industrial technological processes samples are taken, and approaches for sampling. Factors affecting choice and use of measuring methods. Different methods of analysis. Documentation requirements.
- Record-keeping, fault tracing, reporting of and correction of possible errors in production.
- Raw materials or materials into finished products by different processing stages. Sampling in the industrial technological process.
- Structure, properties, handling and health risks of raw materials, finished and waste products, and semi-manufactured products.
- Connecting production equipment to form production lines, different units, what functions they perform, why different units are needed, why they come in a certain sequence, how they are connected and how material is moved between them.
- Environmental regulations and how specific processes are affected by them.
- Communication and cooperation between different target groups in industrial technological processes, e.g. employee groups, suppliers and customers.
- Concepts in the subject area.

Knowledge requirements

Grade E

Students plan and organise **in consultation** with the supervisor monitoring, control and regulation of industrial technological processes. In addition, students plan and organise **in**

consultation with the supervisor preventive, remedial and corrective maintenance. In their planning, students interpret **with some certainty** process charts, requirement specifications, instructions and safety regulations. Furthermore, students choose **in consultation** with the supervisor methods, tools, equipment and materials, taking into account desired results, health aspects, environmental factors and safety.

Students carry out with thoroughness and **in consultation** with the supervisor monitoring, control and regulation of industrial technological processes in accordance with process charts, safety regulations, instructions and requirement specifications. In addition, students carry out **in consultation** with the supervisor fault tracing, and also preventative, remedial and corrective maintenance. The results of the work are **satisfactory** in relation to specific quality requirements. In their work, students use **with some certainty** instructions, process charts and requirement specifications. In addition, students carry out **with some certainty** procedures for sampling, and also interpret **with some certainty** the results. Students handle materials, equipment, tools and machines with **some** skills and keep the workplace well-organised. Students work ergonomically in a way that is safe both for themselves and others, and with due regard to the environment. During the work, students carry out where necessary and **in consultation with the supervisor** corrections based on process charts, requirement specifications and safety regulations. In addition, students identify possible problems that occur and remedy them **in consultation** with the supervisor. During the work, students use **with some certainty** journals, and also report possible errors in production in accordance with specific instructions. After the task has been completed, students document **with some certainty** their work processes and results in accordance with specific instructions.

Students give an account **in basic terms** of how raw materials or materials are processed in industrial technological processes, and apply techniques, methods and tools used for tasks, and also apply **simple** relationships between production equipment and production lines. In addition, students give an account **in basic terms** based on examples of the importance of maintenance for operational safety. Students also give an account **in basic terms** of how environmental legislation affects the production process, and also **in basic terms** of how materials, techniques, methods and production equipment influence the work process, quality, final results and the environment. Students give an account **in basic terms** of possible deviations from the specifications.

Students cooperate in their work with others, and also use **with some certainty** the terminology and language of the profession.

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 plan and organise **after consultation** with the supervisor monitoring, control and regulation of industrial technological processes. In addition, students plan and organise **after consultation** with the supervisor preventative, remedial and corrective maintenance. In their planning, students interpret **with some certainty** process charts, requirement specifications,

instructions and safety regulations. Furthermore, students choose **after consultation** with the supervisor methods, tools, equipment and materials, taking into account desired results, health aspects, environmental factors and safety. **In addition, students give in detail the reasons for their choices**.

Students carry out with thoroughness and **after consultation** with the supervisor monitoring, control and regulation of industrial technological processes in accordance with process charts, safety regulations, instructions and requirement specifications. In addition, students carry out **after consultation** with the supervisor fault tracing, and also preventative, remedial and corrective maintenance. The results of the work are **satisfactory** in relation to specific quality requirements. In their work, students use **with some certainty** instructions, process charts and requirement specifications. In addition, students carry out **with some certainty** procedures for sampling, and also interpret **with some certainty** the results. Students handle materials, equipment, tools and machines with **good** skills and keep the workplace well-organised. Students work ergonomically in a way that is safe both for themselves and others, and with due regard to the environment. During the work, students carry out where necessary and **after consultation** with the supervisor corrections to production based on process charts, requirement specifications and safety regulations. In addition, students identify possible problems that occur and remedy them **after consultation** with the supervisor. During the work, students use **with some certainty** journals, and also report possible errors in production in accordance with specific instructions. After the task has been completed, students document **with some certainty** their work processes and results in accordance with specific instructions.

Students give an account **in detail** of how raw materials or materials are processed in industrial technological processes, and apply techniques, methods and tools used for tasks, and also apply relationships between production equipment and production lines. In addition, students give an account **in detail** based on examples of the importance of maintenance for operating safety. Students also give an account **in detail** of how environmental legislation affects the production process, and also **in detail** of how materials, techniques, methods and production equipment influence **efficiency at work**, the work process, quality, final results and the environment. Students give an account **in detail** of possible deviations from the specifications.

Students cooperate in their work with others, and also use **with some certainty** the terminology and language of the profession.

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 plan and organise **after consultation** with the supervisor monitoring, control and regulation of industrial technological processes. In addition, students plan and organise **after consultation** with the supervisor preventative, remedial and corrective maintenance. In their planning, students interpret **with certainty** process charts, requirement specifications, instructions and safety regulations. **Students also anticipate difficulties that can occur, and**

adapt their planning and organisation to this. Furthermore, students choose **after consultation** with the supervisor methods, tools, equipment and materials, taking into account desired results, health aspects, environmental factors and safety. **In addition, students give reasons in detail and in a balanced way for their choices**.

Students carry out with thoroughness and **after consultation** with the supervisor monitoring, control and regulation of industrial technological processes in accordance with process charts, safety regulations, instructions and requirement specifications. In addition, students carry out **after consultation** with the supervisor fault tracing, and also preventative, remedial and corrective maintenance. The results of the work are **good** in relation to specific quality requirements. In their work, students use **with certainty** instructions, process charts and requirement specifications. In addition, students carry out **with certainty** procedures for sampling, and also interpret **with certainty** the results. Students handle materials, equipment, tools and machines with **very good** skills and keep the workplace well-organised. Students work ergonomically in a way that is safe both for themselves and others, and with due regard to the environment. During the work, students make where necessary corrections in production based on process charts and requirement specifications. In addition, students identify possible problems that occur and remedy them **after consultation** with the supervisor. During the work, students use **with certainty** journals, and also report possible errors in production in accordance with specific instructions. When the task has been completed, students document **with certainty** the work process and results in accordance with specific instructions.

Students give an account **in detail and in a balanced way** of how raw materials or materials are processed in industrial technological processes, and apply techniques, methods and tools used for tasks, and also apply **complex** relationships between production equipment and production lines. In addition, students give an account **in detail and in a balanced way** based on examples of the importance of maintenance for operating safety. Students also give an account **in detail and in a balanced way** of how environmental legislation affects production processes, and also **in detail and in a balanced way** of how materials, techniques, methods of production and equipment influence **efficiency at work**, the work process, quality, final results and the environment**, and also make proposals on how the work can be improved**. Students give an account **in detail and in a balanced way** of possible deviations from the specifications.

Students cooperate in their work with others, and also use **with certainty** the terminology and language of the profession.

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

Industrial technological processes 4

The course, industrial technological processes 4, covers points 1–8 under the heading Aim of the subject. The course covers advanced knowledge in the subject.

Core content

Teaching in the course should cover the following core content:

- Monitoring, control and regulation of industrial technological processes and interpreting process charts.
- Operating reliability and simpler preventative, remedial and corrective maintenance of industrial technological processes. The importance of maintenance in industrial technological processes.
- Working environment issues and safety regulations.
- Systematic quality work and its implications for industrial technological processes and production results.
- Where samples are taken in industrial technological processes, and approaches to sampling. Factors affecting choice and use of measuring methods. Different methods of analysis. Documentation requirements.
- Handling and assessment of test results in accordance with regulations for tolerance values. Value added.
- Record-keeping, fault tracing, reporting of and correction of possible errors in production.
- Optimisation of processes.
- Raw materials or processing materials into finished products by different processing stages, sampling and possible reprocessing in industrial technological processes.
- Structure, properties, handling and health risks of raw materials, finished and waste products, and semi manufactured products, and also alternative raw materials.
- Connecting production equipment to form production lines, different units, what functions they perform, why different units are needed, why they come in a certain sequence, how they are connected, and how material is moved between them.
- Alternative methods of production.
- Measures to minimise the environmental impact of production processes.
- Communication and cooperation between different target groups in industrial technological processes, e.g. employee groups, suppliers and customers.
- Concepts in the subject area.

Knowledge requirements

Grade E

Students plan and organise **in consultation** with the supervisor monitoring, control and regulation of industrial technological processes. In addition, students plan and organise **in consultation** with the supervisor optimisation of processes, and also preventative, remedial and corrective maintenance. In their planning, students interpret **with some certainty** process charts, requirement specifications, instructions and safety regulations. Furthermore, students choose **in consultation** with the supervisor methods, tools, equipment and materials, taking into account desired results, health aspects, environmental factors and safety.

Students carry out with thoroughness and **in consultation** with the supervisor monitoring, control and regulation of industrial technological processes in accordance with process charts, safety regulations, instructions and requirement specifications. In addition, students carry out **in consultation** with the supervisor fault tracing, and also preventative, remedial and corrective maintenance. The results of the work are **satisfactory** in relation to specific quality requirements. In their work, students use **with some certainty** instructions, process charts and requirement specifications. In addition, students carry out **with some certainty** procedures for sampling, and also interpret **with some certainty** the results. Students handle materials, equipment, tools and machines with **some** skills and keep the workplace well-organised. Students work ergonomically in a way that is safe both for themselves and others, and with due regard to the environment. During the work, students carry out where necessary and **in consultation** with the supervisor optimisation of processes, and also corrections to production based on process charts, requirement specifications and safety regulations. In addition, students identify possible problems that occur and remedy them **in consultation** with the supervisor. During the work, students use **with some certainty** journals, and also report possible errors in production in accordance with specific instructions. After the task has been completed, students document **with some certainty** their work processes and results in accordance with specific instructions.

Students give an account **in basic terms** of how raw materials or materials are processed in industrial technological processes, and apply techniques, methods and tools used for tasks, and also apply **simple** relationships between production equipment and production lines. In addition, students give an account **in basic terms** based on examples of the importance of maintenance for operational safety. Students give an account in **basic terms** of how materials, techniques, methods of production equipment influence the work process, quality, final results and the environment. Students give an account **in basic terms** of possible deviations from the specifications.

Students cooperate in their work with others, and also use **with some certainty** the terminology and language of the profession.

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 plan and organise **after consultation** with the supervisor monitoring, control and regulation of industrial technological processes. In addition, students plan and organise **after consultation** with the supervisor preventative, remedial and corrective maintenance. In their planning, students interpret **with some certainty** process charts, requirement specifications, instructions and safety regulations. Furthermore, students choose **after consultation** with the supervisor methods, tools, equipment and materials, taking into account desired results, health aspects, environmental factors and safety. **In addition, students give in detail the reasons for their choices**.

Students carry out with thoroughness and **after consultation** with the supervisor monitoring, control and regulation of industrial technological processes in accordance with process charts, safety regulations, instructions and requirement specifications. In addition, students carry out **after consultation** with the supervisor fault tracing, and also preventative, remedial and corrective maintenance. The results of the work are **satisfactory** in relation to specific quality requirements. In their work, students use **with some certainty** instructions, process charts and requirement specifications. In addition, students carry out **with some certainty** procedures for sampling, and also interpret **with some certainty** the results. Students handle materials, equipment, tools and machines with **good** skills and keep the workplace well-organised. Students work ergonomically in a way that is safe both for themselves and others, and with due regard to the environment. During the work, students carry out where necessary and **after consultation** with the supervisor optimisation of processes, and also corrections in production based on process charts, requirement specifications and safety regulations. In addition, students identify possible problems that occur and remedy them **after consultation** with the supervisor. During the work, students use **with some certainty** journals, and also report possible errors in production in accordance with specific instructions. After the task has been completed, students document **with some certainty** their work processes and results in accordance with specific instructions.

Students give an account **in detail** of how raw materials or materials are processed in industrial technological processes, and apply techniques, methods and tools used for tasks, and also apply relationships between production equipment and production lines. In addition, students give an account **in detail** based on examples of the importance of maintenance for operating safety. Students give an account **in detail** of how materials, techniques, methods of production and equipment influence **efficiency at work,** the work process, quality, final results and the environment. Students give an account **in detail** of possible deviations from the specifications. In addition, students evaluate their own work processes in **balanced** assessments.

Students cooperate in their work with others, and also use **with some certainty** the terminology and language of the profession.

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 plan and organise **after consultation** with the supervisor monitoring, control and regulation of industrial technological processes. In addition, students plan and organise **after consultation** with the supervisor preventative, remedial and corrective maintenance. In their planning, students interpret **with certainty** process charts, requirement specifications, instructions and safety regulations. **Students also anticipate difficulties that can occur, and adapt their planning and organisation to this**. Furthermore, students choose **after consultation** with the supervisor methods, tools, equipment and materials, taking into account desired results, health aspects, environmental factors and safety. **In addition, students give reasons in detail and in a balanced way for their choices**.

Students carry out with thoroughness and **after consultation** with the supervisor monitoring, control and regulation of industrial technological processes in accordance with process charts, safety regulations, instructions and requirement specifications. In addition, students carry out **after consultation** with the supervisor fault tracing, and also preventative, remedial and corrective maintenance. The results of the work are **good** in relation to specific quality requirements. In their work, students use **with certainty** instructions, process charts and requirement specifications. In addition, students carry out **with certainty** procedures for sampling, and also interpret **with certainty** the results. Students handle materials, equipment, tools and machines with **very good** skills and keep the workplace well-organised. Students work ergonomically in a way that is safe both for themselves and others, and with due regard to the environment. During the work, students carry out where necessary and **after consultation** with the supervisor optimisation of processes, and also corrections in production based on process charts, requirement specifications and safety regulations. In addition, students identify possible problems that occur and remedy them **after consultation** with the supervisor. During the work, students use **with certainty** journals, and also report possible errors in production in accordance with specific instructions. When the task has been completed, students document **with certainty** the work process and results in accordance with specific instructions.

Students give an account **in detail and in a balanced way** of how raw materials or materials are processed in industrial technological processes, and apply the techniques, methods and tools used for tasks, and also apply **complex** relationships between production equipment and production lines. In addition, students give an account **in detail and in a balanced way** based on examples of the importance of maintenance for operating safety. Students give an account **in detail and in a balanced way** of how materials, techniques, methods of production equipment influence **efficiency at work**, the work process, quality, final results and the environment, **and also make proposals on how the work can be improved**. Students give an account **in detail and in a balanced way** of possible deviations from the specifications.

Students cooperate in their work with others, and also use **with certainty** the terminology and language of the profession.

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

Laboratory techniques

The course, laboratory techniques, covers points 1, 3, 5 and 7–8 under the heading Aim of the subject.

Core content

Teaching in the course should cover the following core content:

- Working duties in a laboratory in industrial technological processes, such as receiving samples, performing analyses, documentation and reporting.
- Procedures for sampling.
- Factors which affect selection of measurement and analysis for quality control and product development.
- Assessing, handling and documenting test results in accordance with rules for tolerance values.
- Value added.
- Systematic quality work and its implications for industrial technological processes and production results.
- Structure, properties, and health risks when handling chemicals and materials.
- Working environment issues and safety regulations.
- Communication and cooperation between different target groups in industrial technological processes, e.g. employee groups, suppliers and customers.
- Chemical concepts and formulae in technology.

Knowledge requirements

Grade E

Students plan and organise **in consultation** with the supervisor laboratory work related to industrial technological processes. In their planning, students interpret **with some certainty** requirement specifications, instructions and safety regulations. Furthermore, students choose **in consultation** with the supervisor methods, techniques, equipment, materials and chemicals, taking into account desired results, health aspects, environmental factors and safety.

Students carry out with thoroughness and **in consultation** with the supervisor laboratory work related to industrial technological processes in accordance with safety regulations, instructions and requirement specifications. The results of the work are **satisfactory** in relation to specific quality requirements. In their work, students interpret **with some certainty** instructions, test

results and other information. Students handle materials, chemicals, equipment and machines with **some** skills and keep the workplace well-organised. Students work ergonomically in a way that is safe both for themselves and others, and with due regard to the environment. During the work, students identify problems that occur and remedy them **in consultation** with the supervisor. After the task has been completed, students document **with some certainty** their work processes and results in accordance with specific instructions.

Students give an account **in basic terms** of the build-up, properties, handling, and health risks associated with chemicals and materials. In addition, students give an account **in basic terms** of work processes, and also how choice of measuring and analytical methods affects results and the environment. Students give an account **in basic terms** of results and possible deviations from the specifications.

Students cooperate in their work with others, and also use **with some certainty** the terminology and language of the profession.

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 plan and organise **after consultation** with the supervisor laboratory work related to industrial technological processes. In their planning, students interpret **with some certainty** requirement specifications, instructions and safety regulations. Furthermore, students choose **after consultation** with the supervisor methods, techniques, equipment, materials and chemicals, taking into account desired results, health aspects, environmental factors and safety. **In addition, students give in detail the reasons for their choices**.

Students carry out with thoroughness and **after consultation** with the supervisor laboratory work related to industrial technological processes in accordance with safety regulations, instructions and requirement specifications. The results of the work are **satisfactory** in relation to specific quality requirements. In their work, students interpret **with some certainty** instructions, test results and other information. Students handle materials, chemicals, equipment and machines with **good** skills and keep the workplace well-organised. Students work ergonomically in a way that is safe both for themselves and others, and with due regard to the environment. During the work, students identify problems that occur and remedy them **after consultation** with the supervisor. After the task has been completed, students document **with some certainty** their work processes and results in accordance with specific instructions.

Students give an account **in detail** of the build-up, properties, handling, and health risks associated with chemicals and materials. In addition, students give an account **in detail** of work processes, and also how choice of measuring and analytical methods affect results and the environment. Students also give an account **in detail** of results and possible deviations from the specifications.

Students cooperate in their work with others, and also use **with some certainty** the terminology and language of the profession.

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

Students use with some certainty terminology and professional language, and also cooperate with others to solve work tasks. In addition, students give an account in detail of the importance of cooperation.

Grade B

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

Grade A

Students plan and organise **after consultation** with the supervisor laboratory work related to industrial technological processes. In their planning, students interpret **with certainty** requirement specifications, instructions and safety regulations. **Students also anticipate difficulties that can occur, and adapt their planning and organisation to this**. Furthermore, students choose **after consultation** with the supervisor methods, techniques, equipment, materials and chemicals, taking into account desired results, health aspects, environmental factors and safety. **In addition, students give reasons in detail and in a balanced way for their choices**.

Students carry out with thoroughness and **after consultation** with the supervisor laboratory work related to industrial technological processes in accordance with safety regulations, instructions and requirement specifications. The results of the work are **good** in relation to specific quality requirements. In their work, students interpret **with certainty** instructions, test results and other information. Students handle materials, chemicals, equipment and machines with **very good** skills and keep the workplace well-organised. Students work ergonomically in a way that is safe both for themselves and others, and with due regard to the environment. During the work, students identify problems that occur and remedy them **after consultation** with the supervisor. When the task has been completed, students document **with certainty** the work process and results in accordance with specific instructions.

Students give an account **in detail and in a balanced way** of the build-up, properties, handling, and health risks associated with chemicals and materials. In addition, students give an account **in detail and in a balanced way** of work processes, and also how choice of measuring and analytical methods affect results and the environment. Students also give an account **in detail and in a balanced way** of results and possible deviations from the specifications, **and also make proposals on how the work can be improved**.

Students cooperate in their work with others, and also use **with certainty** the terminology and language of the profession.

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