

SKELETON CURRICULUM

for the training occupation of

Electronics technician for industrial engineering

(Resolution of the Standing Conference of the Ministers of Education and Cultural Affairs of 16 May 2003)

Part I: Preliminary remarks

The present skeleton curriculum for occupationally related teaching at a vocational school has been passed by the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany (KMK).

The present skeleton curriculum has been agreed in conjunction with the corresponding training regulations promulgated by the Federal Government (issued by the Federal Ministry of Labour and Economics or by the otherwise responsible ministry in agreement with the Federal Ministry for Education and Research). The process for such agreement is regulated via the "Joint Results Protocol of 30 May 1972". The present skeleton curriculum takes the lower secondary school leaving certificate as its basis and describes minimum requirements.

In the case of allocated occupations, the present skeleton curriculum is structured to include basic training extending across all occupational fields and specialist training for which such basic training forms the foundation.

The training regulations and the skeleton curriculum stipulating the objectives and content of vocational education and training form the basis for the imparting of final qualifications in a recognised training occupation and of the qualification issued by the vocational school in conjunction with teaching in further subjects. This enables the essential prerequisites for qualified employment and entry into school based and vocational advanced and continuing training courses to be put into place.

The skeleton curriculum does not contain any methodological stipulations in respect of teaching. Autonomous and responsible thoughts and actions constitute the overarching objective of training, and the preferred course of action is for delivery of these aims to take place via such forms of teaching in which they represent part of the overall methodological concept. In principle, any methodological approach adopted may contribute to the achievement of this objective. Methods which directly foster occupational competence are particularly suited to purpose and appropriate consideration should be accorded to these within the structuring of the teaching.

The federal states either adopt the skeleton curriculum directly or else implement it via their own curricula. In the latter case, the federal states ensure that coordination of the result stipulated in the skeleton curriculum in terms of structure of specialist content and time remains intact.

Part II: Educational remit of the vocational school

Within the dual system of vocational education and training, the vocational school and the company providing training fulfil a joint educational remit.

Within this process, the vocational school constitutes an independent learning venue. The vocational school cooperates with other VET participants as an equal partner. The task of the vocational school is to impart vocational and general educational content to pupils according particular consideration to VET requirements.

The aim of the vocational school is to provide basic and specialist vocational training and to extend general education previously acquired. Within this process, the vocational school pursues the objective of enabling pupils to carry out occupational tasks and be involved in shaping the world of work and of society whilst fulfilling their social and ecological responsibility. It is guided by the regulations contained within the educational laws of the federal states as these apply to such schools. Vocationally related teaching is also guided by the national vocational regulatory instruments in respect of each individual recognised training occupation:

- the skeleton curriculum issued by the Standing Conference of the Ministers of Education and Cultural Affairs (KMK);
- training regulations promulgated by the Federal Government in respect of in-company training;

Pursuant to the Framework Agreement on Vocational Schools (Resolution of the KMK of 15 March 1991), the aims of vocational schools are:

- "to impart employability encompassing a combination of specialist competence and general skills of a human and social nature;
- to develop occupational flexibility enabling the changing requirements within the world of work including in respect of the convergence of Europe to be met;
- to stimulate readiness to engage in advanced and continuing vocational training;
- to foster the ability and readiness to act in a responsible manner in the way in which pupils organise their own lives and act within public life."

In order to achieve these aims, a vocational school must:

- structure teaching in such a way so that it is aligned to the specific educational purpose of the tasks it pursues and emphasises an employment oriented approach;
- impart vocational skills and skills which extend across occupational fields whilst according due consideration to necessary vocational specialisation;
- guarantee differentiated and flexible educational provision in order to accord full consideration to varying degrees of ability and talent whilst also fulfilling the needs of the world of work and of society;
- provide extensive support for and promotion of opportunities for the disabled and the disadvantaged insofar as possible;

- indicate environmental threats and accident risks in conjunction with the exercise of an occupation and in connection with pupils' private lives and highlight means by which such threats and risks may be avoided or reduced.

In addition to this, the vocational school should, within the general teaching it conducts and to the greatest possible extent within occupationally related teaching, address core contemporary problems such as:

- work and unemployment,
- the peaceful coexistence of people, peoples and cultures in the world whilst maintaining a sense of cultural identity,
- the preservation of the natural basis of life and
- The guarantee of human rights.

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The aims listed address the development of **employability skills**. Employability skills within this context are defined as the readiness and ability of an individual person to conduct himself or herself in an appropriate, considered and individually and socially responsible manner in social, occupational and private situations.

Employability skills are contained within the dimensions of specialist competence, personal competence and social competence.

Specialist competence describes the readiness and ability to use specialist knowledge and ability as a basis to solve tasks and problems in a target oriented, appropriate, methodologically suitable and autonomous manner and to assess results.

Personal competence describes the readiness and ability to act as an individual personality in clarifying, considering and assessing development opportunities, requirements and restrictions within the family, within an occupation and within public life, to evolve individual talents and to make and further develop life plans. Personal competence encompasses such personal qualities as autonomy, critical ability, confidence, reliability and a sense of responsibility and duty. It also particularly includes the development of considered values and self-determined loyalty to values.

Social competence describes the readiness and ability to develop and live out social relationships, to detect and understand areas of affinity and conflict and to deal with and reach understanding with others in a rational and responsible manner. It also particularly includes the development of social responsibility and solidarity.

Methodological and learning competence arise from a balanced development of these three dimensions.

Competence describes successful learning in respect of the individual learner and the equipping of him or her with the ability to act autonomously in private, occupational and social situations. In contrast to this, **qualification** is defined as successful learning in respect of usefulness of competences within the context of the demand for such competences in private, occupational and social situations (cf. German Education Council, recommendations of the Educational Commission for the Reorganisation of Upper Secondary Education).

Part III: Didactic principles

The objectives of vocational education and training require teaching to be conducted in accordance with educational methods aligned to the tasks of the vocational school and to enable young people to plan, execute and evaluate work related tasks within the scope of their occupational activity.

Learning at vocational school essentially takes place with reference to specific occupational actions, a variety of mental operations and theoretical understanding of the actions of others. This learning is primarily linked to reflecting on the execution of actions (action plan, process, results). The fact that occupational work is pervaded by this thought process creates the preconditions for learning at and from work. As far as the skeleton curriculum is concerned, this means that the description of aims and the choice of content takes place in an occupationally related way.

Learning theory and didactic cognitions form the basis for the adoption of a pragmatic approach towards the structuring of employment oriented teaching in which the following points of reference apply.

- Situations which are usual for the execution of the occupation form the didactic points of reference (learning in order to be able to act).
- Actions which trainees can perform themselves wherever possible or understand in theory constitute the starting point for learning (learning via acting).
- Wherever possible, actions need to be autonomously planned, executed, checked, corrected where necessary and finally evaluated in writing by the learners themselves.
- Actions should foster a holistic understanding of occupational reality, incorporating technical, safety, economic, legal, ecological and social aspects amongst others.
- Actions need to be integrated into the experiences of the learners and be reflected upon with reference to their societal implications.
- Actions should also include social processes such as declaration of interest or conflict resolution.

Employment oriented teaching is a didactic concept bundling together specialist and action system structures and may be realised via a range of teaching methods.

Teaching provision at vocational schools is directed towards young people and adults who have different prior learning, cultural backgrounds and experiences gained from companies providing training. Vocational schools are only able to fulfil their educational remit if they accord due consideration to these differences and encourage pupils, including disadvantaged and particularly talented pupils, to develop in line with their individual potential.

Part IV Occupationally related preliminary remarks

The present skeleton curriculum for vocational education and training in the occupation of Electronics technician for industrial engineering has been harmonised with the Ordinance on Vocational Education and Training in the Industrial Electrical Occupations of 3 July 2003 (Federal Law Gazette, BGBl. I p. 1144).

The training occupation has been aligned to the occupational field of electro technology pursuant to the Basic Vocational Training Year Accreditation Directive issued by the Federal Ministry for Economics and Labour.

In respect of the first year of training, the skeleton curriculum corresponds to the vocationally related specialist theory area of the skeleton curriculum for the school based basic vocational training year. Insofar as the first year of training takes place within a school based basic vocational training year, the skeleton curriculum applies to the vocationally related learning area within such a basic vocational training year.

The skeleton curriculum for the training occupation of Energy electronics engineer (resolution of the KMK of 7 January 1987) is replaced by the present skeleton curriculum.

The principle vocational school curriculum content in the examination area of business and social studies is imparted on the basis of "Elements for teaching at vocational schools in the area of business and social studies for technical training occupations" (resolution of the KMK of 18 May 1984).

The aims and content of the skeleton curriculum relate to the vocational qualifications and the training occupation profile for the occupation of Electronics technician for industrial engineering.

Electronics technicians for industrial engineering assemble systems and plants for power supply, measurement and control, communications technology, signalling technology, drive technology and lighting. They put these systems and plants into operation, maintain and operate them.

The skeleton curriculum takes the following objectives as its starting point.

Pupils

- work predominantly in a team and within the scope of their occupational activity communicate with others inside and outside the company, including with persons from other cultural circles.
- advise customers and provide customer service, analyse customer requirements in respect of the design of electrical systems and plants.
- accord due consideration to standards and regulations, use technical regulations and stipulations, technical bulletins and descriptions, operating instructions and other information typical to the occupation, including English language information.
- use current information and communication systems to procure information, process orders and projects and document and present results.
- design modifications and extensions to electrical systems and plants, including computer aided design.
- also conduct software aided technical calculations for the design of electrical systems and plants and cost calculations.

- plan and steer work processes when setting up and decommissioning workplaces/construction sites; organise and monitor the work of other trades and service providers, document and evaluate work results.
- accord due consideration to ergonomic, economic, ecological and societal aspects when planning and executing work. minimise the negative impact of the work process on the environment by using appropriate materials, acting in a responsible manner and according due consideration to environmental regulations.
- programme and configure systems, check functionality and safety systems.
- install/assemble wiring systems, information and energy cables including general supply lines.
- install automation systems, machines and drive systems and set these up.
- use standards, regulations and rules relating to securing product quality, ensure the smooth operation of plants and systems and Make a contribution to continuous improvement of work processes.
- develop approaches to be adopted for the putting into operation of electrical systems and plants.
- check safety measures.
- take over and hand over plants, instruct users in their operation and provide services.
- monitor and maintain plants, conduct regular checks, analyse malfunctions, instigate immediate measures and repair plants.

The learning fields contained within the present skeleton curriculum are aligned to work and company operational processes. For this reason, customer oriented occupational actions and order processing are accorded particular significance and need to be given special consideration when implementing the learning fields within learning situations.

The imparting of competences and skills should take place using assignment of tasks typical to the occupation and should also be conducted in an order and project oriented manner involving cooperation with other learning venues.

Mathematical and scientific content, technical safety information and economic, business administration and ecological aspects should be imparted in an integrative manner within the learning fields.

Appropriate aims and content comprising 40 teaching hours have been integrated into the learning fields for the imparting of English language elements below the communication level.

The main focus in the learning fields for the first year of training is on the acquisition of basic knowledge across the occupational field within the context of typical, cross-vocational occupational action processes. Consideration should be accorded to occupationally specific aspects via the selection of appropriate examples and tasks.

The objects of the interim examination or of Part 1 of the final examination have been accorded consideration in the aims and content of learning fields 1 to 6.

The new form of final examination also requires vocational schools to adopt a new concept for integrative preparation for the examination situation. The holistic and integrative approach of the final examination is particularly reflected in the expansions

of competence in the seventh half year of training. The complex assignment of projects tasks in the learning fields of the seventh half year of training accord particular attention to occupational areas of deployment. These complex task assignments enable competences and skills which have already been imparted to be used and extended in a recapitulatory and project related manner as well as allowing additional aims and content specific to the area of deployment to be developed with the agreement of and in conjunction with the companies providing training.

The objective of all learning fields is the development of employability skills. In order to emphasise selected facts and circumstances relating to personal and social competence and methodological, learning and communication competence, such competences are expressly included as an integral part of some learning fields. In all other learning fields, these competences should be addressed situationally and individually according particular consideration to the typical main characteristics of the occupation and should be consolidated and extended.

Part V Learning fields

Summary of the learning fields for the training occupation of Electronics technician for industrial engineering					
Learning fields		Suggested time allocation in hours			
		1st year	2nd year	3rd year	4th year
1	Analyse electrical systems and check functions	80			
2	Plan and execute electrical installations	80			
3	Analyse and adjust control systems	80			
4	Make information technology systems available for use	80			
5	Ensure electrical energy supply and the safety of operating equipment		80		
6	Analyse and check equipment and sub-assemblies in plants		60		
7	Programme and realise control systems for plants		80		
8	Select and integrate drive systems		60		
9	Execute technical building services plants and put these into operation			80	
10	Set up and maintain energy plants			100	
11	Put into operation and maintain automated plants			100	
12	Plan and realise electrical plants				80
13	Maintain and adjust electrical plants				60
	Total	320	280	280	140

Learning field 1	Analyse electrical systems and check functions
1st year of training	Suggested time allocation: 80 hours
Formulation of objectives: Pupils find out about the tasks, work requirements, activities and sample work processes within their occupation. Pupils analyse electrical systems at the plant, device, sub-assembly and component level and the correlative effects between the individual levels. During this process, they read and draw up technical documentation. They determine the functions and operational characteristics of selected components and sub-assemblies and their tasks within electrical systems. For these purposes, the pupils obtain information independently which they then evaluate. They evaluate English language technical documentation with the assistance of tools. For the purposes of analysing and checking basic circuits and recognising the general laws of electro technology, the pupils determine electrical values by measurement technology and calculation and document and evaluate these. The pupils check the function of electrical connections and operating equipment. They analyse and correct errors. The pupils realise tasks within a team and communicate using correct specialist language. They deploy work, time and learning planning methods. They act in a responsible manner according due consideration to technical safety aspects.	
Contents: Company structures, work organisation, company communication Products, services Circuit diagrams, circuit symbols Electrical operating equipment, basic circuits, basic electrical values Performance and ratings of sample components and functional units Risks posed by electrical current, safety rules, health and safety at work Measurement procedures, functional checks, trouble shooting Team work Methods of obtaining and processing information	
Learning field 2	Plan and execute electrical installations
1st year of training	Suggested time allocation: 80 hours
Formulation of objectives:	

The pupils analyse orders for the installation of energy supply to plants and equipment.

The pupils plan installations according due attention to typical network systems and the required protective measures. They draw up circuit and installation plans, including using computer aided means. They assess components and select these in accordance with functional, economic and ecological aspects.

Pupils use specialist terminology from the field of electrical installation technology. They also evaluate English language information.

Pupils plan the typical processes for the setting up of plants. They determine the approach to be adopted in respect of fulfilment of order, materials requirements and coordination with other parties involved, select equipment and coordinate the work process. They calculate the costs involved in setting up the plant, draw up offers and explain these to customers.

The pupils set up plants according due consideration to safety rules and accident prevention stipulations relating to work in and on electrical plants. They recognise possible risks posed by electrical current and act in accordance with the relevant safety provisions and protective measures.

The pupils put plants into operation, record ratings and draw up documentation. They check the functionality of plants, find and eliminate errors. They hand over plants to customers, demonstrate the functions of the plants and provide introductory guidance on use.

The pupils evaluate their work results for the purposes of improving work organisation. They issue an invoice for the orders which have been processed.

Contents:

Order planning, execution of order

Energy requirements of a plant or piece of equipment

Safety regulations

Installation technology

Ratings of operational equipment

Types of circuit diagram

Dimensioning of cables

Work organisation

Calculation of costs, drawing up offers

Learning field 3

Analyse and adjust control systems

1st year of training

Suggested time allocation: 80 hours

Formulation of objectives:

The pupils plan modifications and adjustments to control systems in accordance with stipulations.

The pupils analyse plants and equipment and visualise structural composition and functional correlations. They determine control systems and differentiate between open and closed loop control systems.

The pupils differentiate techniques for the realisation of control systems and evaluate the benefits and drawbacks of these in accordance with economic and technical safety aspects.

The pupils alter control systems, selecting sub-assemblies and constituent components in accordance with requirements.

The put systems to which control systems have been applied into operation, check functionality, record ratings using measurement technology and carry out necessary adjustments. They document technical changes using standard and bespoke software.

The pupils organise their learning and work tasks autonomously and within the team. They analyse, reflect upon and evaluate the findings they have obtained within this process. They evaluate English language documentation with the assistance of tools and also use specialist English terminology for the written representation of facts and circumstances related to control technology.

Contents:

Block diagram, IPO model, sensors, actuators, interfaces

Chain of effects, functional descriptions

Connective and stored programme signal processing

Logical basic interconnections, storage functions

Standards, regulations and rules

Technical documentation

Learning field 4	Make information technology systems available for use
1st year of training	Suggested time allocation: 80 hours
Formulation of objectives: <p>The pupils plan the provision and expansion of information technology systems in accordance with functional specifications. They analyse systems, check the technical and economic feasibility of orders and offer solutions. They research German and English language media by using networks.</p> <p>The pupils select hardware and software components according due consideration to function, performance, area of deployment, compatibility, economic efficiency and environmental sustainability and procure these components.</p> <p>The pupils install and configure information technology systems and task related standard and bespoke software and use these. They integrate information technology systems into existing networks and carry out the necessary configurations for this purpose. The pupils accord due attention to statutory regulations in respect of data protection, copyright law and media law. They deploy selected data back-up and data protection measures.</p> <p>The pupils document and present the work processes and results relating to the provision of information technology systems. For this purpose, they use word processing, spreadsheet, graphical representation and presentation software.</p>	
Contents: <p>Function and structure of functional specifications</p> <p>Hardware, operating systems, standard and bespoke software</p> <p>Procurement process</p> <p>Installation and configuration processes for hardware and software components</p> <p>Ergonomic workplace design</p> <p>Tools and methods for diagnostics and trouble shooting</p> <p>Local and global networks, data transmission protocols</p> <p>Data back-up and data protection, copyright and media law</p> <p>Presentation technologies and methods</p>	

Learning field 5	Ensure electrical energy supply and the safety of operating equipment
2nd year of training	Suggested time allocation: 80 hours
Formulation of objectives: <p>The pupils plan electrical energy supply for operating equipment and plants. They analyse and classify electrical energy supply possibilities in accordance with functional, economic and ecological aspects.</p> <p>The pupils dimension plants according due consideration to network systems and protective measures. For this purpose, they select and assess components from the plants and draw up circuit diagrams using specialist literature, technical bulletins and descriptions of equipment, including in English.</p> <p>The pupils check compliance with standards, regulations and rules relating to protection against electric shock, health and safety at work and prevention of accidents when setting up, putting into operation and maintaining electrical energy supply plants and when using operating equipment.</p> <p>The pupils check permanently sited and portable electric operating equipment and put such equipment into service. They record ratings and test results and classify these in document form.</p> <p>The pupils instruct users in how to operate the plants.</p>	
Contents: <p>Circuit and distribution systems</p> <p>Environmental sustainability</p> <p>Voltage levels</p> <p>Alternating and rotary current systems</p> <p>Network systems</p> <p>Protective systems</p> <p>Measurement and test equipment</p> <p>Test protocols</p> <p>Classes of protection, classes of insulation</p> <p>Types of protection</p> <p>User instructions</p>	

Learning field 6 2nd year of training	Analyse and check equipment and sub-assemblies in plants Suggested time allocation: 60 hours
<p>Formulation of objectives:</p> <p>The pupils plan and organise modification and repair orders to equipment and sub-assemblies in line with customer requirements and stipulate the stages for the execution of orders.</p> <p>The pupils analyse equipment, sub-assemblies and the correlative effects between the components constituting the plant. For this purpose, they use specialist literature and equipment descriptions, including in English. They determine the function and operational characteristics of sub-assemblies constituting the plant.</p> <p>The pupils record measurement values and signal processes and evaluate these in the light of secure operational functioning of the equipment and sub-assemblies.</p> <p>The pupils systematically isolate errors and eliminate malfunctions within the components constituting the plant. They carry out modifications and repair work to equipment and sub-assemblies and monitor and check these.</p> <p>The pupils use standards, regulations and rules applying to the modification and repair of equipment and sub-assemblies and comply with regulations in respect of health and safety at work and environmental protection.</p> <p>The pupils use computer aided methods to draw up technical paperwork to document the modification or repair work. They substantiate, present and evaluate the work results.</p>	
<p>Contents:</p> <p>Operating instructions and instructions for use</p> <p>Connection analysis methods</p> <p>Analogue and digital sub-assemblies</p> <p>Standard connection solutions</p> <p>Error isolation methods</p> <p>Simulation software</p> <p>Measurement and test procedures</p> <p>Test regulations, test protocols</p> <p>Technical connection documentation</p> <p>Health and safety at work, health protection</p> <p>Electromagnetic compatibility</p> <p>Conducting discussions, taking minutes</p>	
Learning field 7 2nd year of training	Programme and realise control systems for plants Suggested time allocation: 80 hours
<p>Formulation of objectives:</p> <p>The pupils plan control systems for plants. They analyse control systems in existing plants in order to adapt these to modified customer requirements.</p> <p>The pupils record and analyse control processes. They use programme development tools and configure and parameterise the necessary hardware and software components. During this process, they select forms of presentation in compliance with standards and regulations.</p> <p>The pupils put control systems into operation according due consideration to the functions of the plant. They undertake autonomous checks of the function of control systems, also including aspects relevant to safety, and use appropriate test and measurement procedures for the purposes of identifying errors. They eliminate errors in the control programmes they have developed.</p> <p>The pupils supplement or draw up technical documentation for control systems and present the results of their work. During the work process, the pupils use specialist language and terminology, including in English.</p> <p>The pupils work independently and assume responsibility within the team. They evaluate the experiences and findings they have obtained.</p>	
<p>Contents:</p> <p>Catalogue of requirements</p> <p>Computer aided procurement of information</p> <p>Sensors, actuators</p> <p>Functional groups within a control system</p> <p>Programme documentation</p> <p>Functions, function modules</p> <p>Storage, time and counting functions</p> <p>Sequences</p> <p>Programme test, error search</p> <p>Test protocols, technical documentation and programme archiving</p> <p>Standards, regulations and rules</p> <p>Presentation techniques using standard software</p> <p>Lead presentation techniques</p>	

Learning field 8 2nd year of training	Select and integrate drive systems Suggested time allocation: 60 hours
<p>Formulation of objectives:</p> <p>The pupils plan the order processing of technical drive tasks in accordance with customer requirements. They analyse orders for drive systems and plan the technical realisation of the drive system.</p> <p>The pupils coordinate the procurement of order related information within the team, including English language information. For this purpose, they conduct specialist discussions and evaluate their findings.</p> <p>The pupils select the required equipment, sub-assemblies and protective systems according due consideration to functional, economic and ecological aspects and dimension these.</p> <p>The pupils set up electrical and pneumatic drive systems, check and put these into operation having parameterised the components. They measure and document ratings, draw up technical documentation and connection documentation using computer aided means, present these to users and instruct users.</p> <p>The pupils use standards, regulations and rules applying to the setting up and operation of electrical drive systems and comply with regulations in respect of health and safety at work and environmental protection. They check compliance with and document the above in a professional manner.</p> <p>The pupils conduct a holistic analysis of work results.</p> <p>Contents:</p> <ul style="list-style-type: none"> Structure of drive systems Actuators Direct and alternating current machines Protective systems Construction forms, types of operation, types of protection and cooling of machines Equipment and sub-assemblies for switching and steering drive systems Starting and braking processes Revolution speed control Test procedures Specialist discussions Technical documentation 	
Learning field 9 3rd year of training	Execute technical building services plants and put these into operation Suggested time allocation: 80 hours
<p>Formulation of objectives:</p> <p>The pupils plan order processing for electrical building services plants in accordance with technical and time stipulations. They coordinate their time and work planning within the team and in agreement with other trades. The pupils check their decisions to ensure that they are feasible, economical and environmentally sustainable.</p> <p>The pupils analyse, expand, set up and configure technical building services systems including communication systems and integrate visualisation into the project planning process.</p> <p>The pupils check the technical building services plants when these have been completed, put them into operation and instruct users.</p> <p>The pupils monitor technical building services systems, systematically isolate error in the event of malfunctions and initiate measures to eliminate such errors. During this process, they deploy diagnostic systems and interpret function and error protocols. They use complaints to improve plants and services.</p> <p>The pupils comply with safety and fire prevention regulations and stipulate measures to ensure compliance with these.</p> <p>The pupils process and draw up the necessary service documentation for the operation of plants. They use software which is usually deployed within the branch for this purpose.</p> <p>The pupils use specialist literature, product databases and equipment and plant descriptions, including in English.</p> <p>Contents:</p> <ul style="list-style-type: none"> Customer advice Materials management and calculation Light and lighting technology Risks and fire alarm systems Communication systems Protection against lightning Building services systems technology and its constituent components Load management Visualisation software Standards, regulations and rules 	
Learning field 10 3rd year of training	Set up and maintain energy plants Suggested time allocation: 100 hours
Formulation of objectives:	

The pupils analyse customer orders relating to the setting up of energy plants and plan the processing of orders in agreement with all of those involved in the process.

The pupils obtain order related information on the structure and operational characteristics of low voltage switch gears and evaluate the combined effects of the components. They plan stages of the work and make decisions on work organisation in order to execute assembly and installation in a target oriented and time efficient manner. During this process, they accord particular consideration to compliance with safety rules, accident prevention regulations and environmental protection provisions.

The pupils check and evaluate stages and results of work in accordance with economic, ecological and technical safety aspects.

When setting up plants, they deploy measurement and test procedures and initiate the necessary adjustments and modifications.

The pupils conduct regularly scheduled testing in a timely manner and localise and evaluate operational malfunctions.

They discuss possible solutions for elimination of errors with involved parties and repair malfunctions in a targeted way.

The pupils document all work processes and modifications made to the plants.

Contents:

Cables and cable networks

Switch gears

Protective systems for electrical networks

Types of network

Decentralised energy supply systems

Energy plants in buildings, in special premises and outside

Compensation

Recording, processing and evaluating metered values

Types of error and methods of trouble shooting

Recycling and disposal

Learning field 11

Put into operation and maintain automated plants

3rd year of training

Suggested time allocation: 100 hours

Formulation of objectives:

The pupils plan control systems for complex automated plants. They analyse the control systems within existing plants and install automated plants. They use industrial communication systems to integrate components into superordinate automated systems.

The pupils organise and optimise their work processes based on a system of division of labour. They use predictive analysis to prevent possible sources of error in the planning of plants. They record the effects of sources of error on the plants and services and initiate preventative measures.

The pupils configure and parameterise automated plants and the drive systems integrated into these. During this process, they accord due consideration to the topology and structures of automated systems. They record and analyse the data exchange between these systems and deploy programme development and programme visualisation instruments.

The pupils use standards, regulations and rules applying to the setting up and operation of automated plants, communication electric drive systems and health and safety at work regulations. They document compliance with these in a professional manner.

The pupils conduct independent checks on the functionality and safety of automated plants and put these into operation.

The pupils carry out maintenance and diagnostic works on automated plants and drive systems, including remote diagnoses. For these purposes, they deploy strategies for systematic identification and elimination of errors.

The pupils draw up and modify documentation, also use English language documentation and present their results. They use standard and bespoke software for these purposes.

Contents:

Levels of automation technology

Ratings and norms of bus systems

Configuration of networks and bus systems

Digital software control systems

Types of operation of automated plants

Value processing, analogue value processing

Open and closed loop control systems for communication drive systems

Inverter fed drive systems

Network perturbation and electromagnetic compatibility measures

Potential error and error influence analysis

Continuous improvement process

Conflict resolution strategies

Learning field 12

Plan and realise electrical plants

4th year of training

Suggested time allocation: 80 hours

Formulation of objectives:

The pupils plan control systems for electrical plants. They define targets, analyse and structure tasks in respect of their feasibility and accord due consideration to areas of deployment in the project selection process.

The pupils plan, develop and realise practice oriented solutions. During this process, they assume responsibility for project organisation and coordination of the learning and work processes. The pupils document project progress and analyse and evaluate the process. They comply with basic quality management standards and processes thus securing the quality of products and processes.

The pupils set up the electrical plants or plant components, put these into operation and test partial and overall functions. They demonstrate the structure and function of the plants or plant components.

During the project realisation process, the pupils accord due consideration to recycling opportunities and environmental compatibility issues.

They draw up and modify documentation, also use English language documentation and present their results. They use current information and communication media in order to do this.

The pupils evaluate project results in accordance with learning organisation, work organisation, technical and economic aspects.

Contents:

Project description

Time and work planning

Economic efficiency

Plant and product design

Standards, regulations and rules

Quality assurance

Project evaluation

Learning field 13

Maintain and adjust electrical plants

4th year of training

Suggested time allocation: 60 hours

Formulation of objectives:

The pupils plan maintenance and adjustment measures in electrical plants.

The pupils analyse malfunctions and deploy strategies for systematic identification and elimination of errors in electrical plants or plant components. They adjust electrical plants or plant components in accordance with customer wishes and document this in a professional manner.

The pupils instruct customers in the operation of the adjusted plants, provide information about statutory stipulations applying in respect of maintenance and explain the revised maintenance conditions.

The pupils also use English language documentation for project documentation and present their results.

The pupils reflect upon their vocational learning and work processes. They use appropriate training opportunities and a variety of learning techniques and learning media to develop their competences and skills further.

Contents:

Time and work planning

Maintenance concepts

Standards, regulations and rules

Customer advice and instruction

Process documentation

Knowledge management