Standardised description of qualifications in electrical engineering/electronics and mechatronics

Name of institution issuing the qualification:

Country in which the qualification is awarded:

Masthead

Date (Month/Year):

Editorial

Name of institution:

Address:

Author/s:

Introduction

This template comprises categories for a structured description of a qualification in mechatronics or electrical engineering/ electronics. The information provided was collected in order to **describe** qualifications in mechatronics or electrical engineering/ electronics in a standardised and transparent manner based on learning outcomes.

Following the recommendation of the European Commission on the EQF, the description of the learning outcomes (LOs) of a qualification forms the basis for the classification. Besides a comprehensive LO description, this report provides further details on the qualification in order to increase the understanding of technical qualifications and enable transnational analysis and comparison of qualifications.

The report provides, first, some basic information about the qualification (cf. point 1) before the qualifications profile is described (cf. point 2). In the third point, detailed information about the evaluation process is provided, followed by statistical indicators.

1. Information about the Qualification

TITLE OF THE QUALIFICATION *(in original language and in English)*	
FOCUS OF THE QUALIFICATION	❍ vocational education/training
TRAINING PROGRAMME	attendance ❍ obligatory ❍ non-obligatory
LENGTH OF TRAINING PROGRAMME *(if obligatory)*	
ISCED LEVEL *(1997)*1	
EQF LEVEL *(if appropriate due to referencing report)*	
PLACE(S) OF LEARNING	
ACCESS REQUIREMENTS FOR THE EVALUATION	

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1 As long as ISCED 2011 is not available.

PROCESS	
USUAL AGE RANGE OF THE LEARNERS WHEN PARTICIPATING IN THE EVALUATION PROCESS	
ACCESS TO NEXT LEVEL OF EDUCATION/TRAINING	
SECTORS/ WORKING AREAS	

2. Qualification Profile

SHORT DESCRIPTION OF THE QUALIFICATION (SCOPE)	

2a: Units of Learning Outcomes

Please describe the contents of the qualification "in a nutshell". List all units connected to the qualification. Please use the table below to list the units and the respective learning outcomes.

Try to contextualise/specify the active verbs you use!

The description should comprise one page at the most (i.e. approx. 400 words). Bear in mind that it should be understood by people who are not familiar with this qualification!

Recommended table for describing knowledge skills and competences: 1st option

Unit of qualifications	Knowledge	Skills	Competence
TEXT (Verdana 10 pt)	TEXT (Verdana 10 pt)	TEXT (Verdana 10 pt)	TEXT (Verdana 10 pt)

Recommended table for describing knowledge skills and competences: 2nd option

Unit of qualifications	Contextualised description of the application of knowledge, skills and competence in execution of work processes and functions typical for the unit of

	qualification
TEXT (Verdana 10 pt)	*TEXT (Verdana 10 pt)*

2b: Knowledge, skills and competences

Please describe the contents of the qualification "in a nutshell". List all knowledge, skills and competences connected to the qualification. You can give a short version (a summary) of the learning outcome description (either in text-form or as bullet points) and annex the detailed description. However, the summary should give readers a fair idea of the qualification and show its main focus points.

Try to contextualise/specify the active verbs you use!

The description should comprise one page at the most (i.e. approx. 400 words). Bear in mind that it should be understood by people who are not familiar with this qualification!

TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT (Verdana 10 pt)

2c: Work processes

Please describe the relevant work processes related to the qualification "in a nutshell". However, the summary should give readers a fair idea of the relevant work processes related to the qualification and show its main focus points.
The description should comprise one page at the most (i.e. approx. 400 words). Bear in mind that it should be understood by people who are not familiar with this qualification!

TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT (Verdana 10 pt)

2c: Work processes

2d: Competence profile based on the VQTS matrix in the field of mechatronics and electrical engineering/electronics

Please map the units of your qualification with the competence area and steps of competence development.

TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT (Verdana 10 pt)

Competence Matrix 'Mechatronics'
Based on the results of the VQTS I project. For further information see www.vocationalqualification.net;

VQTS II Competence Matrix 'Mechatronics'					
Competence Areas (core work tasks)	**Steps of Competence Development**				
1 **Maintaining and assuring the reliability of mechatronic systems**	He/She can perform the basic scheduled maintenance on mechatronic machines and systems and adhere to the equipment maintenance plans.	He/She can master the maintenance procedures for mechatronic systems such as the use of service documents and maintenance plans and, if faced with new challenges, can make the necessary adaptations.	He/She can use preventive maintenance to assure the trouble-free operation of mechatronic systems. In addition, he/she can modify operational sequences to implement quality-assurance measures	He/She can develop the necessary procedures for maintenance of mechatronic devices and systems, and can schedule the maintenance and quality-assurance procedures.	
2 **Installing and dismantling mechatronic systems and facilities**	He/She can use written instructions to install and dismantle individual components (sensors, actuators, drives, motors, transport systems, racks) that form a functional group of mechatronic systems.		He/She can master the installation and dismantling of mechatronic systems that use several technologies (mechanics, hydraulics, pneumatics, electrical-mechanics, electronics), set up the connexion technology, and check the efficiency of the overall system.	He/She can provide independent mechatronic solutions for the construction of production lines, assure their overall ability to function, and, in addition, can use both existing and modified standard components.	
3 **Installing and adjusting mechatronic components in systems and production lines**	He/She is able to install and adjust standardized mechatronic components, e.g. individual electro-pneumatic valves, sensor and actuator units.		He/She can install and adjust components of mechatronic subsystems (e.g., linear drives, measuring systems, transport systems).	He/She can install and adjust complex mechatronic facilities that include diverse technologies and instrumentation and control (I&C) equipment, adjust the associated parameters, test the facilities overall functions, and assure their reliability	
4 **Designing, adapting, and building mechatronic systems and facilities on the basis of client needs and site plans**	He/She can use machine tools controlled either manually or via computer-program to fabricate (according to production designs and customer requirements) the individual components for mechatronic systems. He/she can provide simple designs and descriptions of mechatronic subsystems and can use basic CAD applications.	He/She can build simple mechatronic subsystems by using engineering drawing and can install the devices according to specific production needs. He/She can act on extensive knowledge of standards and regulations (e.g. on surface treatments) and is able to use CAD's more advanced functions (e.g. interference check).	He/She can build mechatronic systems by using both original construction techniques and previously designed parts. He/She fully understands CAD functions and can document system developments (parts lists, descriptions of function, operating instructions).	He/She can design and build autonomous mechatronic subsystems and, with suitable measuring and testing facilities, can assess the necessary production accuracy. He/She can document the results with quality-control systems.	He/She can make independent adaptations to the various devices (including selection of drives, sensors, PLC) and can use CNC programs for building the system. He/She can, through a digital mock up, assemble and simulate the functioning system and use computer-aided computations (e.g. FEM). He/She can perform cost-benefit analyses (e.g. as a basis for deciding whether components should be bought or individually constructed.)	He/She can independently develop complex mechatronic systems and can calculate the economic usefulness of the system. He/She can optimise CNC programs for the manufacturing of complex mechatronic devices and systems and monitor the automated quantity of an open loop control system.

5 **Putting mechatronic systems into operation and providing clients with technical and economic support**	He/She can, according to specifications and blueprints, put mechatronic devices into operation and provide support to the client in the hand-over phase.	He/She, after considering the enterprise's needs and basic conditions, can put the mechatronic systems into operation, create the necessary documentation, advise the customer on safe operations of the devices, and advise on future technology selection.	He/She, after considering all basic conditions, can master the start-up of interconnected mechatronic systems and machines, and can provide the necessary documentation including a manual. He/She can review client needs and configure machines that provide solutions. He/She can train the customer where necessary and provide support for safe operating procedures.	He/She can evaluate customer requirements for mechatronic facilities, develop solutions, and can plan the system's implementation and operation.	He/She can direct, including scheduling and time management, the start-up of the project from the creation of a proposal to the client's acceptance.
6 **Supervising and evaluating both the process sequences of mechatronic systems and facilities and the operational sequence (including quality assurance)**	He/She can supervise process sequences according to specifications as well as implement any requested quality-control measures.	He/She can independently supervise the process sequences, evaluate the results, operate an accompanying statistic process control (SPC) for the quality control plan, and prepare simple work schedules, including production schedule and time management.	He/She can operate and supervise mechatronic facilities, choose testing and monitoring plans, set up the accompanying SPC, seek the optimal results of the production line according to material-flow, and provide work schedules including standard production times.	He/She can master the monitoring of complex mechatronic systems using virtual instruments and PPS systems as well as open loop control for the optimisation of machinery arrangement, material flow analysis, and scheduling.	He/She can optimise the process cycles of mechatronic production lines, provide instructions on modifying the PPS systems (e.g. adjustment to SAP systems) and introduce quality systems for continuous improvement processes (CIP/KVP).
7 **Installing, configuring, programming and testing hardware and software components for control and regulation of mechatronic systems and facilities**	He/She is able to install and configure programs for hardware and software components as well as set up simple programmable logic control programs (PLC).	He/She can master the selection of hardware and software for mechatronic systems (sensors, actuators, interfaces, communication procedures) and can provide and test simple programmable logic control programs (PLC) according to production process requirements.	He/She can integrate and configure program-, control-, and regulation-mechanisms in mechatronic systems, program simple devices (in co-operation with developers), and simulate the program sequence before start-up.	He/She can develop, test, and configure hardware and software solutions for networked mechatronic systems; and can monitor system conditions with suitable measuring and visualisation tools.	
8 **Preparing and distributing the technical information for adjustment of each enterprise's mechatronic systems**	He/She can provide descriptions and designs of mechatronic subsystems and is familiar with the basic CAD applications.		He/She can fully understand the management of technical information documents for mechatronic systems and can prepare and adapt these documents according to an enterprise's specific operating requirements.	He/She is able to analyse complex operational sequences separately in order to understand the connections and draw up maintenance and production procedures. He/She can understand that the system parameters are important for the equipments' functions and can independently assess and document the wear and general conditions of the mechatronic equipment.	
9 **Diagnosing and repairing malfunctions with mechatronic systems and facilities, advising clients on avoiding malfunctions, and modifying and expanding mechatronic systems**	He/She can diagnose and repair errors and malfunctions on the simple components and devices in the mechatronic systems. He/She can use the necessary checking, measuring, and diagnostic tools.	He/She can independently correct problems in mechatronic production equipment with the help of (computer-aided) diagnostic systems and the use of expert systems, databases, and error documentations.	He/She can diagnose and repair errors and disturbances in complex mechatronic equipment and is able to advise clients on how to avoid sources of malfunctions through changes or upgrades in the equipment and system.	He/She can develop, through analyses of malfunctions in the mechatronic equipment, a monitoring and diagnostic system	

Competence Matrix 'Electrical Engineering/Electronics'

Based on the results of the VQTS II project. For further information see www.vocationalqualification.net;

VQTS II Competence Matrix 'Electronics/Electrical Engineering'				
Competence Areas (core work tasks)	**Steps of Competence Development**			
1. Preparing, planning, mounting and installing electrical and/or electronic systems for buildings and industrial applications	He/She can prepare and carry out simple electrical and electronic installations (e.g. cables, electrical outlets, connection and distribution systems, modular electronic components, computer components) as well as carry out and check the necessary wirings and mountings.	He/She can plan, prepare and connect electrical and modular electronic installations. (e.g. energy supply in private and business premises, incl. lighting; alternating and three-phase current; electronic systems as units, wireless LAN, multimedia systems). He/She can advice the costumer and select the best implementation according to customer specifications.	He/She can plan complex electrical and/or electronically networked installations (e.g. systems of energy distribution, building management systems / KNX, regulation and monitoring systems, building access systems, RFID-systems etc.) and fully wire them. He/She can configure, service and diagnose the functionality of the installation according to customer requirements and for this purpose can use computer-assisted tools.	
2. Inspecting, maintaining and servicing electrical and/or electronic systems and machinery	He/She can carry out basic and scheduled maintenance tasks, inspections and checks at electrical and/or electronic equipment according to maintenance schedules and predefined instructions (e.g. checking voltage tolerances, changing wearing parts in industrial plants, switching and control systems, electrical machinery, computer systems). He/She can use the measuring and testing tools necessary for it.	He/She can carry out and document preventative maintenance and alignment tasks at electrical and/or electronic industrial appliances and systems according to established methods of the quality assurance (e.g. continuous monitoring of a CNC machine tool).	He/She can analyse and determine availability and condition of electrical and/or electronic systems. He/She can analyse influencing factors on reliability and performance of electrical/electronic systems and find causes of malfunctions (e.g. leakage current analysis, power factor correction, EMC analysis).	He/She can develop and document maintenance and inspection methods for electrical/electronic systems based on production and service process analysis as well as on quality management and customer requirements. He/She is able to develop related maintenance, inspection and quality assurance plans (e.g. optimizing MTBF of a production line, planning reserve power supply).
3. Setting up, putting into operation and adjusting electrical and/or electronic systems	He/She can set up, adjust and put into operation electrical and/or electronic systems (e.g. allocating frequency channels for a TV set, basic settings of a frequency converter or a thermo relay for a motor) following customer requirements and instructions from the technical documentation.	He/She can obtain and set system test parameters for set up and operation of electrical and electronic systems and select and carry out test procedures for installation and adjustment (e.g. adjusting interfaces in multimedia system, sensitivity setting of alarm equipment, elevator control unit).	He/She can select, set up and adjust electrical and/or electronic systems and their control including accompanying sensors and actuators according to requirement analysis (e.g. energy supply systems, drive systems, electrical machinery, radio relay systems).	
4. Designing, modifying and adapting wirings and circuit boards for electrical and/or electronic systems including their interfaces	He/She can modify, plan and build up simple electrical/electronic circuits according to standards and guidelines (e.g. wiring for rooms, connection diagram of basic motor circuits, simple operational amplifier applications, small programmable control units).	He/She can modify, plan and build up standard electrical/electronic appliances according to customer requirements and official regulations (e.g. fire-warning devices, layouts for electrical/electronic wirings with the help of CAD programmes, energy supply in private and business premises).	He/She can design, build up and improve electrical/electronic applications and its interfaces together with experts working in interdisciplinary teams according to emc standards and confirming test (e.g. electronic control circuits and equipment, microcontroller applications, PLC and related software).	He/She can design, build up and configure devices and facilities, units for process control systems including related programming and considering complex system requirements (e.g. controlled drive systems, process monitoring, automated production line, real time microcontroller applications for car control, GSM data transmission for monitoring and remote control).

VQTS II Competence Matrix
'Electronics/Electrical Engineering'

Competence Areas (core work tasks)	Steps of Competence Development			
5. Developing custom designed electrical and/or electronic projects	He/She can develop and propose solutions for simple electrical/electronic system based on customer requirements (e.g. lighting installations, power supply unit, basic automation and control systems).	He/She can design electrical/electronic systems (e.g. PLC program for industrial applications, microcontroller application, ensuring expansion capability) and provide the necessary documentation (operational, maintenance, safety instructions, function, integration and acceptance tests)		He/She can develop technical solutions for electrical and/or electronic systems and applications (e.g. microcontroller board for heating and air condition, RFID access system, new production line...) and provide appropriate documentation and customer training.
6. Supervising and supporting work and business processes including quality management	He/She can check process steps in the production with suitable process tools (e.g. PPS, ERP, MRP) and carry out quality controls.	He/She can evaluate results of the process monitoring with software tools and determine quality assurance actions (work, production and time schedules).		He/She can develop controlling methods in the production (PPS, MRP, ERP) and process planning/control and supervision (CAP) and implement these with the help of software supported systems.
7. Installing, configuring modifying and testing of application software for setup and operation of electrical and/or electronic systems	He/She can install programmes for hardware and software environments and carry out simple configuration tasks as well as updates (e.g. starter software, graphical programming for measurement and automation).	He/She can select hardware and software for production systems following the business requirements and test programmes.	He/She can integrate hardware and software into existing system environments and use simulation and diagnostic programs (e.g. implement and adapt a driver for a CAD/CAM interface).	He/She can combine hardware and software to networked system environments and carry out network specific checks of all signals and adapt by means of software (e.g. OPC-Server, process control system).
8. Diagnosing and repairing of electrical/electronic systems and equipment	He/She can carry out standardized test procedures and diagnostic methods using wiring diagrams and test tools and carry out simple repairs at electrical/electronic systems (e.g. power measurement, level measurement).	He/She can use testing and diagnostic tools as well as expert systems for the fault diagnosis at electrical/electronic systems up to the component level and carry out the necessary repairs (e.g. software control test, spectrum analyzer).	He/She can select and use diagnostic methods for complex electrical/electronic systems and carry out preventative measures for the avoidance of disturbances and malfunctions in arrangement with customers (e.g. detection of bit error rate, overvoltage protection analyse).	He/She can carry out system analyses (FMEA, FTA etc.) of electrical /electronic systems, determine error types and develop suitable diagnosis and repair methods including preventative measures.

3. Information about the Evaluation Process

LEGAL BASIS FOR EVALUATION PROCESS *(if available)*	
NAME OF THE QUALIFICATION AWARDING BODY	
TYPE OF INSTITUTION	○ public ○ private
TASKS OF INSTITUTION IN RELATION TO THE QUALIFICATION DESCRIBED	
OTHER INSTITUTIONS RELEVANT FOR THE QUALIFICATION DESCRIBED	
DESCRIPTION OF EVALUATION PROCESS	
EVALUATION CRITERIA	
EXAMINERS	
POSSIBILITIES OF OBJECTIONS (possibility to appeal the results of evaluation)	
REPETITION OF (PARTS OF) THE EVALUATION PROCESS	
EVALUATION METHODS	*Please explain which methods of evaluation are used.*

4. Statistical Indications

Please provide statistics (if available) that support the level classification. Such statistics can comprise data on tasks holders of the qualification usually hold on the labour market, unemployment rate of holders of the qualification, numbers of start-ups, status of qualification holders on the labour market etc. Please interpret the statistics/explain the context.

5. Annexes to the template

Annex 1: …………………………………………………
Annex 2: …………………………………………………
Annex 3: …………………………………………………
Annex 4: …………………………………………………
Annex x: …………………………………………………