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BILDUNG FÜR EUROPA
Nationale Agentur beim BIBB

GD Bildung und Kultur
Programm für lebenslanges Lernen

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

Technische Universität München

Hydraulic

Competence area	Steps of competence development			
1. Maintaining and assuring the reliability of mechatronic systems	She/he can perform the basic scheduled maintenance on mechatronic machines and systems and adhere to the equipment maintenance plans	She/he 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.	She/he 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.	She/he 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	She/he 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	She/he 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	She/he 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	She/he is able to install and adjust standardized mechatronic components, e.g. individual electro-pneumatic valves, sensor and actuator units.	She/he can install and adjust components of mechatronic subsystems (e.g., linear drives, measuring systems, transport systems).	She/he can install and adjust complex mechatronic facilities that include diverse technologies such as 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	She/he 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.	She/he can build simple mechatronic subsystems by using engineering drawing and can install the devices according to specific production needs. She/he 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).	She/he can build mechatronic systems by using both original construction techniques and previously designed parts. She/he fully understands CAD functions and can document system developments (parts lists, descriptions of function, operating instructions).	She/he can design and build autonomous mechatronic subsystems and, with suitable measuring and testing facilities, can assess the necessary production accuracy. She/he can document the results with quality-control systems.	She/he can make independent adaptations to the various devices (including selection of drives, sensors, SPS) and can use CNC programs for building the system. She/he can, through a digital mock up, assemble and simulate the functioning system and use computer-aided computations (e.g. FEM). She/he can perform cost-benefit analyses (e.g. as a basis for deciding whether components should be bought or individually constructed.)	She/he can independently develop complex mechatronic systems and can calculate the economic usefulness of the system. She/he 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	She/he can, according to specifications and blueprints, put mechatronic devices into operation and provide support to the client in the hand-over phase.	She/he, 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.	She/he, 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. She/he can review client needs and configure machines that provide solutions. She/he can train the customer where necessary and provide support for safe operating procedures.	She/he can evaluate customer requirements for mechatronic facilities, develop solutions, and can plan the system's implementation and operation.	She/he 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)	She/he can supervise process sequences according to specifications as well as implement any requested quality-control measures.	She/he 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.	She/he 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.	She/he 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.	She/he 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	She/he is able to install and configure programs for hardware and software components as well as set up simple software control programs (PLC).	She/he can master the selection of hardware and software for mechatronic systems (sensors, actuators, interfaces, communication procedures) and can provide and test simple software control programs (PLC) according to production process requirements.	She/he 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.	She/he 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.	She/he can provide descriptions and designs of mechatronic subsystems and is familiar with the basic CAD applications.	She/he 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.	She/he is able to analyse complex operational sequences separately in order to understand the connections and draw up maintenance and production procedures. She/he 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 and facilities	She/he can diagnose and repair errors and malfunctions on the simple components and devices in the mechatronic systems. She/he can use the necessary checking, measuring, and diagnostic tools.	She/he 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.	She/he 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.	She/he can develop, through analyses of malfunctions in the mechatronic equipment, a monitoring and diagnostic system.

Time Hours	Content	Learning Outcome What can the Student (S) do
	Physics of hydraulics. Calculation of Piston force, speed and flow. Handling and precaution of hydraulic oil. Principle diagrams of hydraulics. Basic hydraulic components. Pumps. Tank, cooler and filters. Cylinders. Valves for control of hydraulics directions flow and pressure. Electrical controlled valves. Build up of hydraulics circuits according diagrams on work bench. Adjusting flow, pressure and speed. Safety in hydraulics.	The apprentice/student is able to carry out$_{3\text{-}FP}$ (1) minor changes or expansions of the existing hydraulics and electrohydraulic equipment from documentation, as well as being able to differentiate and select $_{4\text{-}CaCo}$ (2) components for this. The apprentice/student is able to implement$_{3\text{-}FPCo}$ (3) and checks $_{5\text{-}FCaPCo}$ (4) hydraulics and electrohydraulic equipment according to specifications i.e. do control measurement; adjust documentation for the equipment according normal standards. The apprentice/student is able to summarize$_{2\text{-}FCa}$ (5) documentation being used to instruction of the operators. The apprentice/student is able to organize$_{4\text{-}FCaPCo}$ (6) preventive maintenance on hydraulics and electrohydraulic equipment in use. The apprentice/student is able to differentiate between$_{4\text{-}FaP}$ (7) instruments. The apprentice/student is able to generate$_{6\text{-}FaP}$(8) systematically, methodic faultfinding and fault correcting until component level. The apprentice/student is able to carry out$_{3\text{-}FP}$ (9) exchange of components according to documentation. The apprentice/student is able to produce$_{6\text{-}FCaP}$ (10) documentation and manuals to minor new contructions or minor modificated equipment. The apprentice/student is able to interpret$_{2\text{-}F}$ (11) the specific demands with regard to safety and enviremetal hydraulics and electrohydraulic equipment.

Cognitive Process / Knowledge	Re-member [1]		Understand [2]							Apply [3]		Analyze [4]			Evaluate [5]		Create [6]		
	Recognizing	Recalling	Interpreting	Exemplifying	Classifying	Summarizing	Inferring	Comparing, Contrast	Explaining	Carrying out, Execute	Implementing	Differentiating	Organizing	Attributing	Checking	Critiquing	Generating	Planning	Producing
factual knowledge (knowing **WHAT**) [F]			11			5				19	3	7	6		4		8		10
causal knowledge (knowing **WHY**) [Ca]						5						27	6		4		8		10
procedural knowledge (knowing **HOW**) [P]										19	3	7	6		4		8		10
conditional knowledge (knowing **WHEN**) [Co]											3	2	6		4				