






## Course description

# Basics of Pneumatics

	Level of difficulty	Beginner
	Learning time	18 h
	Additionally recommended learning media	
	Course type	eLab
	Theme category	Factory Automation

After completing the training, the learners know the function and structure of an overall mechatronic system. They learn which properties a handling device has and how different grippers function. The various sensors also play an essential role. The learners can independently carry out the commissioning of the components using the technical documentation. The material flow of the system and the representation of a flow chart in GRAFCET round off this training.

No.	Task	Method	Competency level	Content	Competencies	Learning time	HW/ SW dependent
<b>Learning unit 1: Pick&amp; Place Module</b>							
1	Structure and function of the Pick& Place module	Guidance text supported Method	Apply	<ul style="list-style-type: none"> <li>▪ pick and place</li> <li>▪ 2-axis handling device</li> <li>▪ Pressure regulating valve</li> <li>▪ Bellows suction cup</li> <li>▪ Pressure sensor</li> <li>▪ Workroom</li> <li>▪ Technical documentation</li> <li>▪ Reference marking</li> </ul>	<ul style="list-style-type: none"> <li>▪ Know the structure and function of a 2-axis handling device.</li> <li>▪ Know the function of a pressure control valve.</li> <li>▪ Can read and interpret technical documents.</li> <li>▪ Know the structure and function of a bellows suction cup.</li> <li>▪ Know the structure and function of a pressure sensor.</li> <li>▪ Can name the workspace of the 2-axis handling device used in the module.</li> <li>▪ Know the reference marking of the components.</li> <li>▪ Can reflect on the knowledge gained.</li> </ul>	90 min.	No
2	Selection of a suitable gripper	Technical analysis	Rate	<ul style="list-style-type: none"> <li>▪ pick and place</li> <li>▪ Vacuum suction pads</li> <li>▪ Influencing variables</li> <li>▪ Holding force</li> <li>▪ Assembly/disassembly</li> <li>▪ Commissioning</li> <li>▪ Function test</li> <li>▪ Interpretation</li> <li>▪ Parallel gripper</li> <li>▪ Gripper types</li> </ul>	<ul style="list-style-type: none"> <li>▪ Know the design and function of a vacuum gripper.</li> <li>▪ Know the influencing variables such as workpiece diameter/surface on the holding force of a vacuum gripper.</li> <li>▪ Can design a suction diameter under given general conditions.</li> <li>▪ Are able to carry out a gripper change in a professional manner.</li> <li>▪ Can put a parallel gripper into operation and carry out a function test.</li> <li>▪ Can design a type of gripper for a particular installation.</li> <li>▪ Know the reference marking of the components.</li> <li>▪ Can reflect on the knowledge gained.</li> </ul>	90 min.	Yes

No.	Task	Method	Competency level	Content	Competencies	Learning time	HW/ SW dependent
3	Valve terminal in the Pick& Place module	Guided text Method	Analyze	<ul style="list-style-type: none"> <li>pick and place</li> <li>5/2-way valve</li> <li>Technical documentation</li> <li>Interpretation</li> <li>Valve terminal</li> </ul>	<ul style="list-style-type: none"> <li>Know the design and function of a 5/2-way valve.</li> <li>Can use the technical documentation to design a valve terminal.</li> <li>Know the structure and functionality of the Pick&amp;Place module.</li> <li>Can name the individual components of the Pick&amp;Place module.</li> <li>Can test the function and the integrated valves on a valve terminal.</li> <li>Know the relevant criteria when selecting a valve terminal for a system.</li> <li>Can reflect the knowledge gained.</li> </ul>	60 min.	Yes
4	Commissioning of the Pick and Place module	Guided text Method	Apply	<ul style="list-style-type: none"> <li>pick and place</li> <li>Mechanical structure</li> <li>Electropneumatic assembly</li> <li>Vacuum generator</li> <li>Throttle check valve</li> <li>Magnetic proximity switch</li> <li>Pressure switch</li> <li>Adjustment</li> <li>Commissioning</li> <li>Visual inspection</li> <li>Function test</li> <li>Commissioning report</li> </ul>	<ul style="list-style-type: none"> <li>Can carry out a professional commissioning of a mechatronic subsystem.</li> <li>Can perform a visual inspection on a mechatronic subsystem.</li> <li>Can adjust the Pick&amp;Place module.</li> <li>Can adjust a magnetic proximity switch.</li> <li>Know how to properly set a pressure switch.</li> <li>Can check the electrical and pneumatic structure with the aid of technical documentation.</li> <li>Can create a commissioning report.</li> <li>Can adjust the speed of the mini-slide via the throttle check valve.</li> <li>Can check individual components such as the vacuum generator and the pressure regulating valve.</li> <li>Can reflect on the knowledge gained.</li> </ul>	90 min.	Yes

No.	Task	Method	Competency level	Content	Competencies	Learning time	HW/ SW dependent
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**Learning unit 2: Module Conveyor**

5	Structure and function of the conveyor module	Guidance text supported Method	Analyze	<ul style="list-style-type: none"> <li>▪ Conveyor module</li> <li>▪ Reference marking</li> <li>▪ DC motor</li> <li>▪ Diffuse reflection light scanner</li> <li>▪ Through-beam photoelectric sensor</li> </ul>	<ul style="list-style-type: none"> <li>▪ Know the structure and function of the module tape.</li> <li>▪ Can name the mechanical, pneumatic and electrical components.</li> <li>▪ Know the reference marking of the components.</li> <li>▪ Know the different tasks of the two modules and their characteristics.</li> <li>▪ Know the function of the DC motor and the motor controller.</li> <li>▪ Can reproduce the function of a diffuse reflection light scanner.</li> <li>▪ Can reproduce the function of a throughbeam photoelectric sensor on the module belt.</li> </ul>	30 min.	Yes
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6	Workpiece detection at the beginning of the belt	Guidance text supported Method	Analyze	<ul style="list-style-type: none"> <li>▪ Conveyor module</li> <li>▪ Reference marking</li> <li>▪ DC motor</li> <li>▪ Diffuse reflection light scanners with fibre optics</li> <li>▪ Through-beam photoelectric sensor</li> <li>▪ Scanning range</li> <li>▪ Adjustment</li> <li>▪ Areas of application</li> </ul>	<ul style="list-style-type: none"> <li>▪ Can reproduce the structure and function of a diffuse reflection light scanner with fibre optics.</li> <li>▪ Know the typical areas of application of a diffuse reflection light scanner with fibre optics.</li> <li>▪ Know the basic conditions for safe object detection with a diffuse sensor.</li> <li>▪ Can perform the adjustment of a diffuse sensor.</li> <li>▪ Know the terms tactile range.</li> <li>▪ Can contextualize the concept of touch distance and object color.</li> <li>▪ Can reflect on what they have learned.</li> </ul>	90 min.	Yes
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No.	Task	Method	Competency level	Content	Competencies	Learning time	HW/ SW de-pend
7	Controlling a DC motor with a motor controller	Guidance text supported Method	Apply	<ul style="list-style-type: none"> <li>▪ Conveyor module</li> <li>▪ Motor controller</li> <li>▪ DC motor</li> <li>▪ Technical documentation</li> <li>▪ Motor characteristic</li> <li>▪ Torque</li> <li>▪ Speed</li> <li>▪ Efficiency</li> <li>▪ Starting current</li> <li>▪ Creep</li> <li>▪ Analogue/ digital control</li> </ul>	<ul style="list-style-type: none"> <li>▪ Know the structure and operation of a DC motor.</li> <li>▪ Can interpret the operation of a DC motor using technical documentation.</li> <li>▪ Know the terms torque, speed, efficiency and starting current and their SI units.</li> <li>▪ Can determine the starting current of the DC motor.</li> <li>▪ Can reproduce the prerequisites for connection and commissioning of the DC motor.</li> <li>▪ Know the structure and function of a motor controller</li> <li>▪ Can implement the control of a DC motor with motor controller.</li> <li>▪ Can control the tape speed of the module tape.</li> <li>▪ Can explain the term creep feed in the context of DC motor.</li> <li>▪ Know the difference between digital and analog control of the motor.</li> <li>▪ Can control the motor analog.</li> </ul>	60 min.	Yes
8	Commissioning of the Conveyor module	Guidance text supported Method	Apply	<ul style="list-style-type: none"> <li>▪ Conveyor module</li> <li>▪ Reference marking</li> <li>▪ Mini I/O terminal</li> <li>▪ Through-beam photo-electric sensor</li> </ul>	<ul style="list-style-type: none"> <li>▪ Can perform commissioning on a mechatronic subsystem.</li> <li>▪ Can perform a mechanical, pneumatic and electrical test on the module.</li> <li>▪ Know the reference designation of the individual components.</li> <li>▪ Know the connection requirements for the Mini I-/O Terminal with the aid of the technical documentation.</li> </ul>	45 min.	Yes
9	Structure and function of the distance sensor	Guidance text supported Method	Apply	<ul style="list-style-type: none"> <li>▪ Distance sensor</li> <li>▪ Functional principle</li> <li>▪ Structure</li> <li>▪ Wavelength</li> <li>▪ Reflection types</li> <li>▪ Areas of application</li> <li>▪ Measuring principle</li> </ul>	<ul style="list-style-type: none"> <li>▪ Know the structure and function of a distance sensor.</li> <li>▪ Can reproduce the operating principle of a distance sensor.</li> <li>▪ Can classify and express terms such as wavelength of light.</li> <li>▪ Know the different categories and typical applications of distance sensors.</li> <li>▪ Can describe and classify the different types of reflection.</li> <li>▪ Know the measuring principle of distance sensors.</li> </ul>	30 min.	Yes

No.	Task	Method	Competency level	Content	Competencies	Learning time	HW/ SW dependent
10	Commissioning and adjustment of the distance sensor	Guidance text supported Method	Apply	<ul style="list-style-type: none"> <li>▪ Distance sensor</li> <li>▪ El. connections</li> <li>▪ Analog signal</li> <li>▪ Mini I/O terminal</li> <li>▪ Adjustment</li> <li>▪ Commissioning</li> <li>▪ Measuring range</li> <li>▪ Analog output</li> </ul>	<ul style="list-style-type: none"> <li>▪ Know the connections of a distance sensor.</li> <li>▪ Can properly connect the distance sensor to a mini-I/O terminal.</li> <li>▪ Can detect the characteristics of a distance sensor.</li> <li>▪ Can interpret the characteristic curve of a distance sensor.</li> <li>▪ Can adjust and commission a distance sensor.</li> <li>▪ Can determine the measuring range of a distance sensor.</li> <li>▪ Can perform an analog value measurement.</li> <li>▪ Can reflect on and classify the knowledge gained.</li> </ul>	60 min.	Yes

No.	Task	Method	Competency level	Content	Competencies	Learning time	HW/ SW de-pend
<b>Learning unit 3: Fügen station</b>							
11	Material flow and assembly of workpieces at the MPS station Joining	Guidance text supported Method	Apply	<ul style="list-style-type: none"> <li>Production engineering - Joining</li> <li>Handling technology</li> <li>Material flow</li> <li>Symbols</li> </ul>	<ul style="list-style-type: none"> <li>Know the material flow of the Fügen station.</li> <li>Know the common joining processes.</li> <li>Can compare and classify the different joining processes.</li> <li>Know the basics of handling technology.</li> <li>Know the symbols of the material flow.</li> <li>Can match the symbols of the material flow to the station.</li> <li>Can reflect and classify the results.</li> </ul>	45 min.	Yes
12	Creation of a GRAFCET for the process of the MPS station Joining	Guidance text supported Method	Apply	<ul style="list-style-type: none"> <li>Station Joining</li> <li>Sequence control</li> <li>GRAFCET</li> <li>Simulation</li> </ul>	<ul style="list-style-type: none"> <li>Know the basic features of a sequence control.</li> <li>Are able to reproduce the essential characteristics of a sequence control.</li> <li>Can describe a sequence control for the station.</li> <li>Know the functions and possibilities of GRAFCET.</li> <li>Can create a process description in GRAFCET for a mechatronic subsystem.</li> <li>Can simulate a sequence control for the station.</li> </ul>	90 min.	Yes
13	Commissioning of the Joining station	Guidance text supported Method	Apply	<ul style="list-style-type: none"> <li>Commissioning</li> <li>Visual inspection</li> <li>Functional test</li> <li>Technical documentation</li> <li>Signal check</li> </ul>	<ul style="list-style-type: none"> <li>Know the procedure for systematic commissioning of a complete mechatronic system.</li> <li>Can check a mechanical test of the components.</li> <li>Can perform electrical and pneumatic testing of components.</li> <li>Can check connection stations with the aid of technical documentation.</li> <li>Can check signals from sensors using the simulation box.</li> <li>Can commission a complete mechatronic system.</li> </ul>	90 min.	Yes