Handling station

Exercise 1: Learning about components and their function

Learning objective

Upon completing this exercise, you should

- be familiar with the most important components used in the stacking magazine station

Problem description

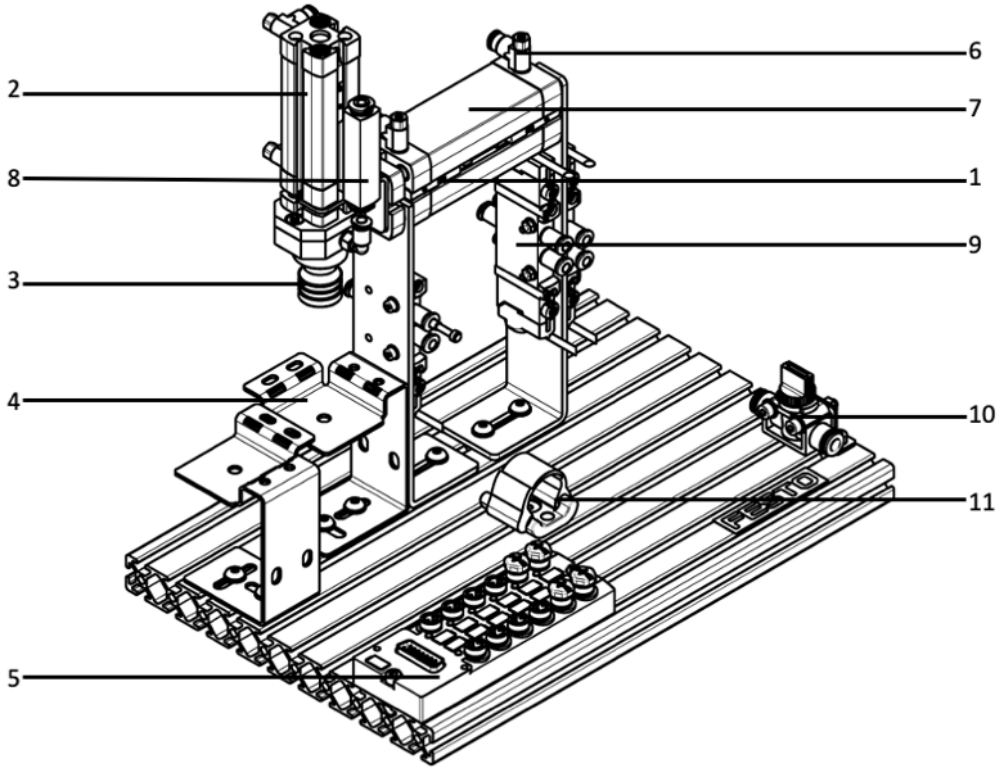
All automated systems use a range of components such as sensors, valves, motors, etc. It is important to be familiar with the function of the components in a system.

Task

1. Match the components with their correct designation and describe their purpose within the station.

Aids

- Theory book
- FluidSIM® online help
- Data sheets



Name: Class: Date:

1. Match the components with their correct designation and describe their purpose within the station.

No.	Designation	Function within the station
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		

Handling station

Exercise 2: Learning about components, symbols and designations

Learning objective

Upon completing this exercise, you should

- be familiar with the symbols and designations of key pneumatic components

Problem description

All automated systems use a range of components such as sensors, valves, motors, etc. It is important to describe the function of the system clearly and simply to all involved. This is done using, among other things, electrical, pneumatic and hydraulic circuit diagrams.
To understand these circuit diagrams, you must be familiar with the symbols used.

Task

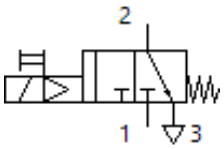
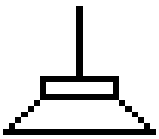
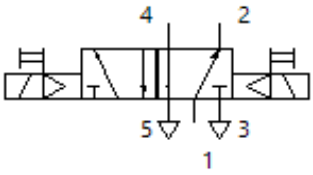
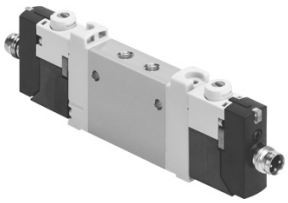
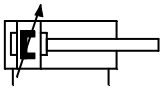
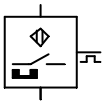
1. Match the components with the correct symbols and designations. Do this by entering the number assigned to the component in the correct fields in the "Symbol" and "Designation" columns.

Aids

- Theory book
- FluidSIM® online help
- Data sheets

Name: Class: Date:

1. Match the components with the correct symbols and designations. Do this by entering the number assigned to the component in the correct fields in the "Symbol" and "Designation" columns.

Component	Symbol	Designation
1 	[ ] 	[ ] One-way flow control valve
2 	[ ] 	[ ] Double-acting cylinder
3 	[ ] 	[ ] 3/2-way single solenoid valve
4 	[ ] 	[ ] Vacuum gripper
5 	[ ] 	[ ] Magnetic proximity sensor
6 	[ ] 	[ ] 5/2-way double solenoid valve

Handling station

Exercise 3: Learning about the function of components

Learning objective

Upon completing this exercise, you should

- be familiar with the function, use and classification of key components used in the stacking magazine station

Problem description

All automated systems use a range of components such as sensors, valves, motors, etc. It is important to be familiar with the function of these components.

Task

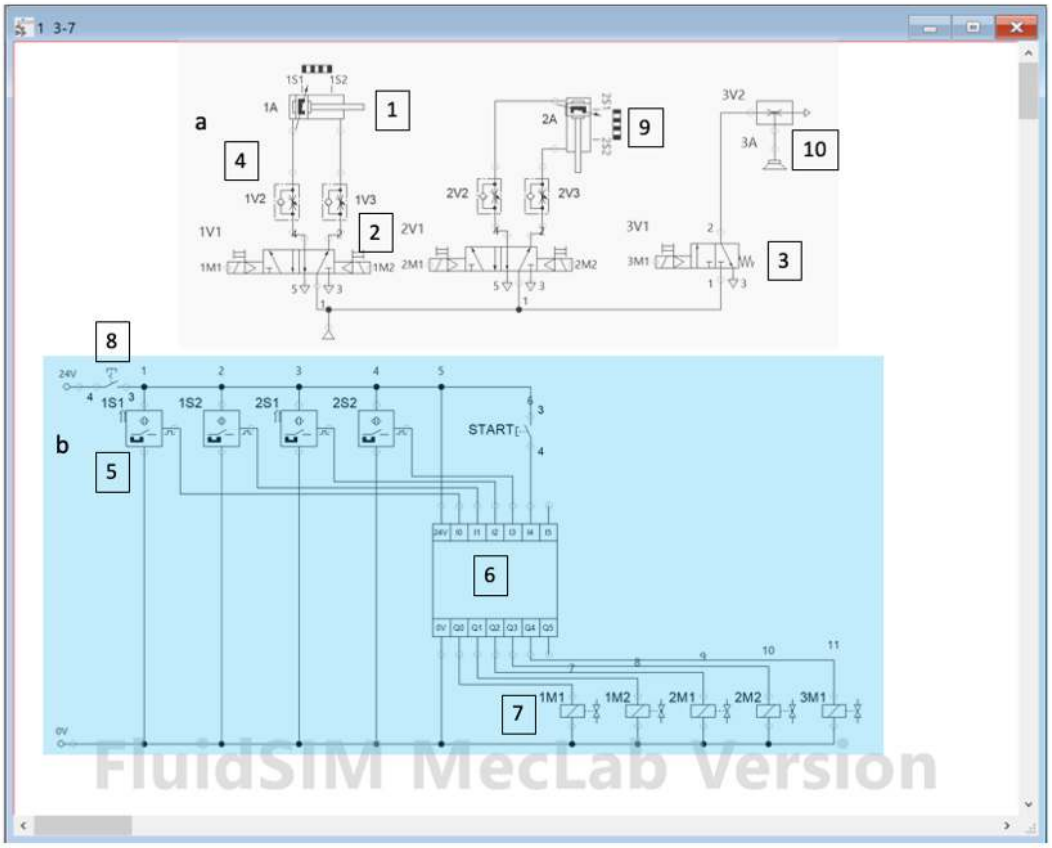
1. Complete the table.
2. Decide whether the component is a sensor or actuator, control component or mechanical component.
3. Describe this component's function within the stacking magazine station. Are you familiar with similar examples from your own environment?

Aids

- Theory book
- FluidSIM® online help
- Data sheets

Name:	Class:	Date:

1. The circuit diagram for the handling station is shown below. Describe the function of the numbered components.



Name: Class: Date:

Number	Function
a	
b	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Handling station

Exercise 4: Creating schematic and circuit diagrams

Learning objective

Upon completing this exercise, you should

- be able to create schematic diagrams, pneumatic circuit diagrams and allocation lists

Problem description

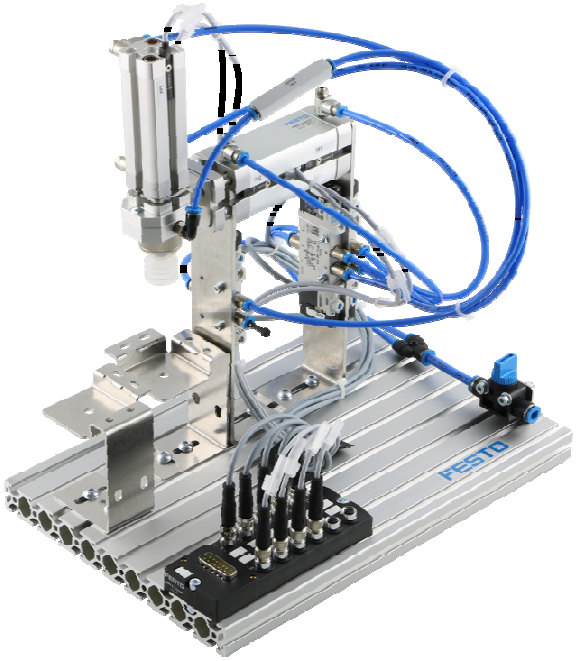
Engineers use schematic diagrams, technical drawings, part lists or circuit diagrams to represent machines or machine parts efficiently and clearly.

Task

1. Create a schematic diagram for the handling station pictured, showing the function and position of the key components.
2. Create an allocation list that specifies which sensor or actuator is plugged into which slot on the multi-pin plug distributor.
3. Create a pneumatic circuit diagram of the station using FluidSIM®.

Aids

- Theory book
- FluidSIM®
- Handling station



Picture of the station

Name: Class: Date:

1. Create a schematic diagram for the handling station pictured, showing the function and position of the key components.

2. Create an allocation list that specifies which sensor or actuator is plugged into which slot on the multi-pin plug distributor.

Slot	Designation	Description
0		
2		
4		
6		
1		
3		
5		
7		
9		

Name:	Class:	Date:

3. Create a pneumatic circuit diagram of the station using FluidSIM®.

Handling station

Exercise 5: Controlling a double-acting cylinder

Learning objective

Upon completing this exercise, you should

- be able to select the components of an electropneumatic circuit
- be able to design electropneumatic circuits
- be able to actuate a double-acting cylinder using FluidSIM®

Problem description

Workpieces are to be lifted using a pneumatic cylinder. A control system is to be designed for this purpose.

A vertically arranged double-acting cylinder equipped with one-way flow control valves is provided for lifting. This cylinder is to be supplied with air by means of a solenoid valve and controlled via PC. The cylinder should advance when a pushbutton is actuated and retract after a second pushbutton is actuated.

Tasks

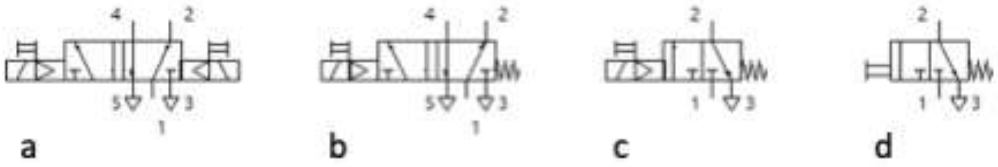
1. Select a suitable valve from the four available and explain the reasons for your choice.
2. Design a pneumatic circuit diagram for the components you selected and test its function via simulation.
3. Complete the electrical circuit diagram with the suitable actuating elements and transfer the solution to FluidSIM®. Carry out a functional test via simulation.
4. For safety reasons the cylinder should advance slowly, but retract quickly. How can this be achieved? Test your solution via simulation.
5. Extend the circuit so that the vertically arranged cylinder of the handling station can be controlled and test its operability. What do you have to do so that the actual cylinder also advances slowly and retracts quickly?
6. How can you arrange it so that the cylinder automatically retracts upwards after reaching the advanced (lower) end position? Modify the circuit and test the result.

Aids

- Theory book
- FluidSIM®
- Data sheets

Name:	Class:	Date:

1. Select a suitable valve from the four available and explain the reasons for your choice.
   a 5/2-way double solenoid valve
   b 5/2-way single solenoid valve
   c 3/2-way normally closed solenoid valve
   d 3/2-way normally closed valve, manually actuated



_____

_____

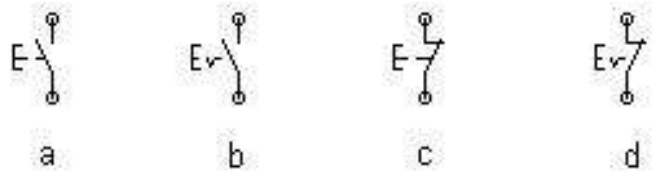
_____

_____

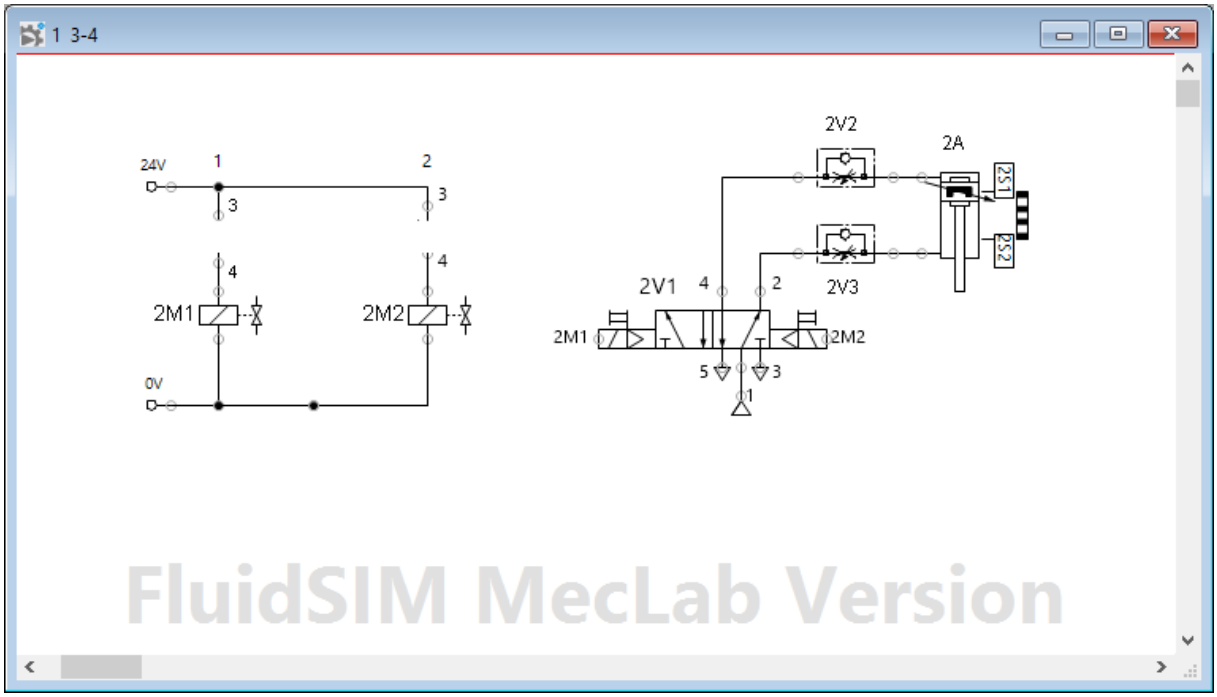
2. Design a pneumatic circuit diagram for the components you selected and test its function via simulation.
   Use FluidSIM® for this. The components required are the double-acting cylinder, the chosen valve, two one-way flow control valves and a compressed air source. Test the circuit in simulation mode by clicking on the valve manual override with the mouse.

Name:	Class:	Date:

3. Complete the electrical circuit diagram with a suitable actuating component. The actuating components available are (see illustration):



a) pushbutton (N/O contact),
b) detenting pushbutton (N/O contact),
c) pushbutton (N/C contact),
d) detenting pushbutton (N/C contact).



4. For safety reasons the cylinder should advance slowly, but retract quickly. How can this be achieved? Test your solution via simulation.

Name:	Class:	Date:

5. Extend the circuit so that the cylinder of the handling station can be controlled and test its operability.
   Do this by extending the circuit diagram to include the multi-pin plug symbol and assign the designation for the solenoid coil to the slot where the solenoid coil is actually plugged in.
   What do you have to do so that the actual cylinder also advances slowly and retracts quickly?

6. How can you arrange it so that the cylinder automatically retracts upwards after reaching the advanced (lower) end position? Modify the circuit and test the result.

Handling station

Exercise 6: Learning about logic operations

Learning objective

Upon completing this exercise, you should

- be familiar with the most important logic operations
- be able to create logic programs in FluidSIM®
- be able to solve simple control tasks using logic operations

Problem description

Logic operations are an important basis of control technology. In the FluidSIM® logic module, inputs and outputs are linked using logic operations. This exercise deals with the most important logic operations.

Task

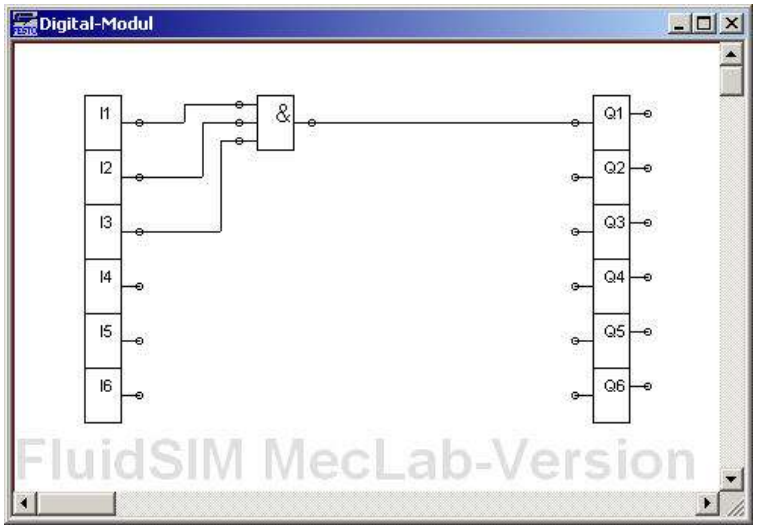
1. Transfer the following logic circuits to FluidSIM® and study the circuit's behaviour by setting the input channels I1 through I3 to the status 'high' by clicking on them. Complete the truth table. In each case specify an example of a control task that can be solved using this logic operation.
2. Create the logic circuit shown below in FluidSIM®, test its behaviour and describe it. What control tasks can this so-called latching element be used for?
3. Create the circuit shown below in FluidSIM®.
   Open the logic module and create a program with the following characteristics:
   - Lamp P1 should light up when the two pushbuttons T1 and T2 are pressed (and stay on after pushbuttons T1 and T2 have been released).
   - The lamp should switch off extinguished when pushbuttons T3 or T4 are actuated.
4. Extend the circuit from Exercise 3 so that an electric motor is switched on and off instead of the lamp.

Aids

- Theory book
- FluidSIM®
- FluidSIM® online help

Name:	Class:	Date:

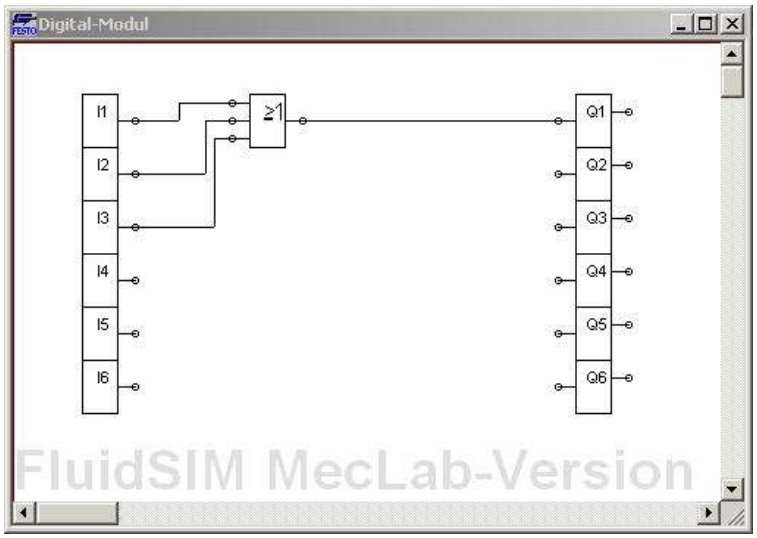
1. Transfer the following logic circuits to FluidSIM® and study the circuit's behaviour by setting the input channels I1 through I3 to the status 'high' by clicking on them. Complete the truth table. In each case specify an example of a control task that can be solved using this logic operation.



I1	I2	I3	Q1
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	1	1	
1	1	0	
1	0	1	
1	0	0	

Example of a control task:

_____

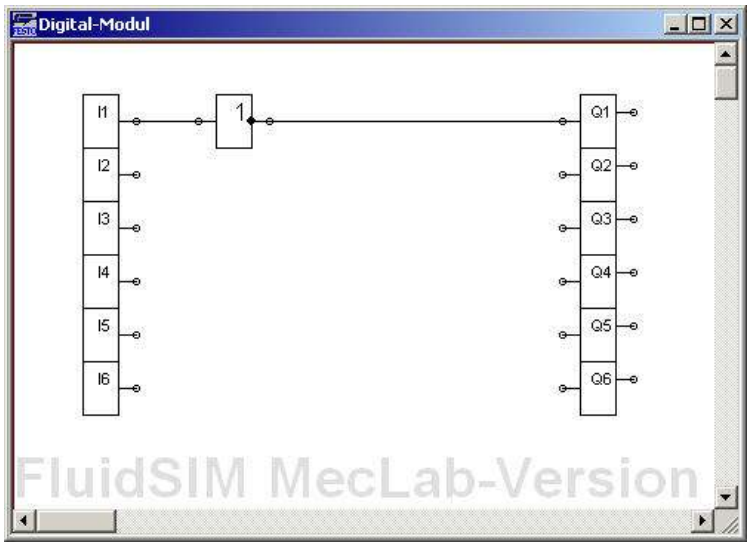


I1	I2	I3	Q1
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	1	1	
1	1	0	
1	0	1	
1	0	0	

Example of a control task:

_____

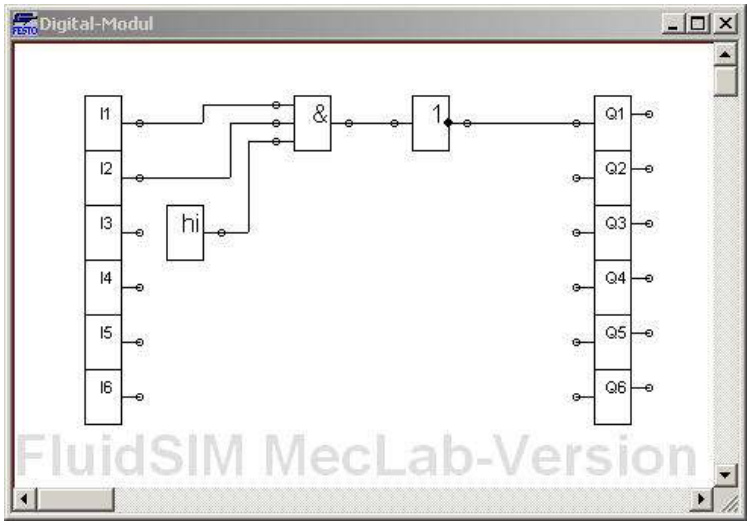
Name: Class: Date:



I1	Q1
0	
1	

Example of a control task:

_____



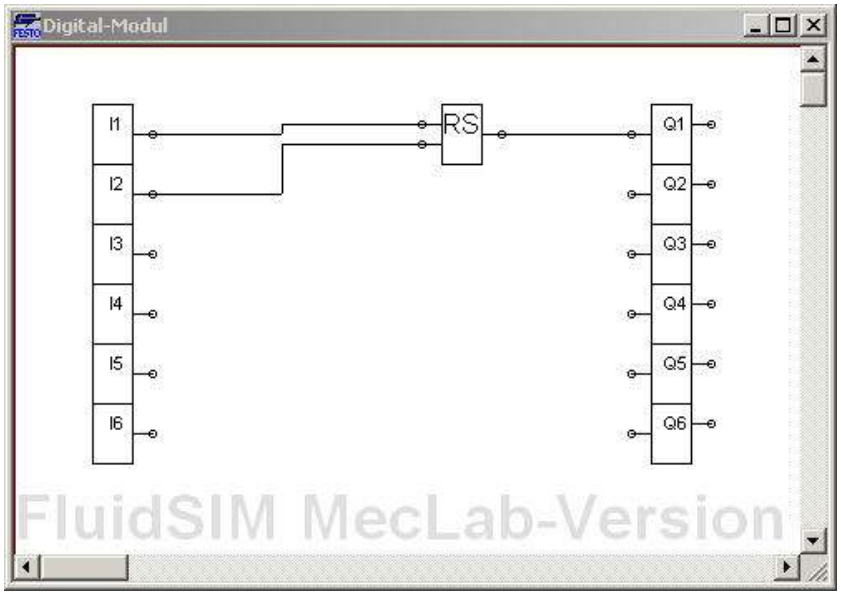
I1	I2	Q1
0	0	
0	1	
1	0	
1	1	

Example of a control task:

_____

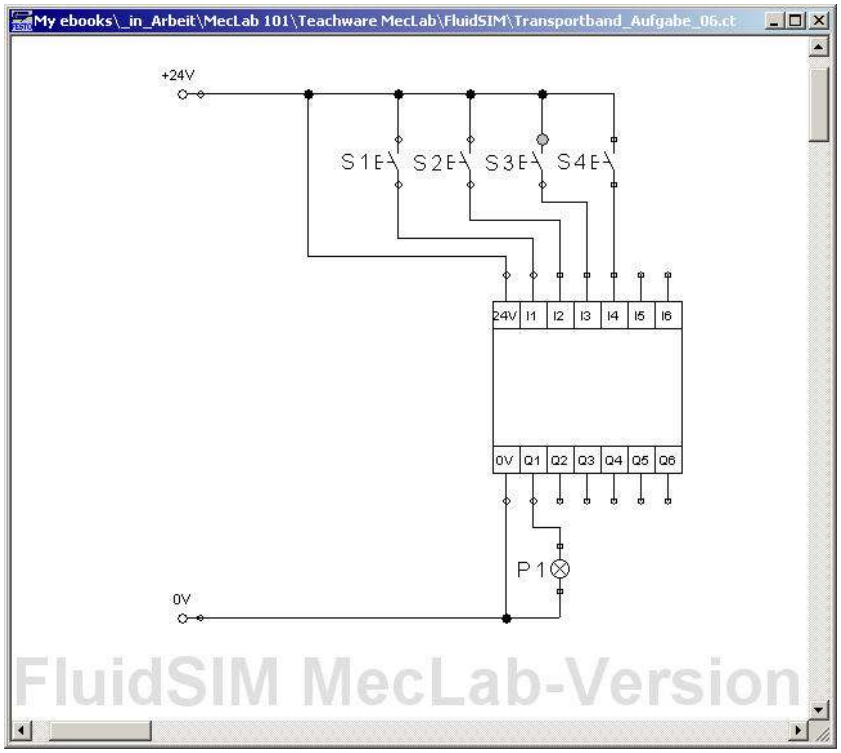
Name:	Class:	Date:

2. Create the logic circuit shown below in FluidSIM®, test its behaviour and describe it. What control tasks can this so-called latching element be used for?

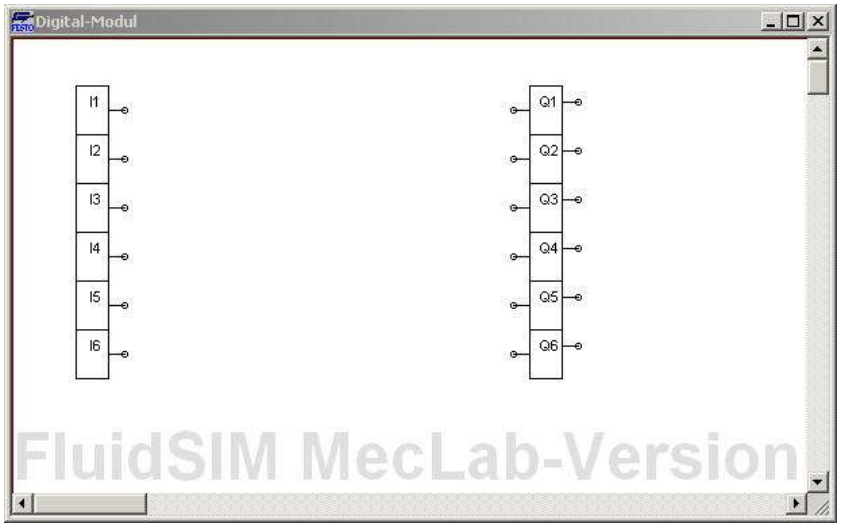


Name:	Class:	Date:

3. Create the circuit shown below in FluidSIM®.



– Open the logic module and create a program with the following characteristics:
  - Lamp P1 should light up when the two pushbuttons T1 and T2 are pressed (and stay on after pushbuttons T1 and T2 have been released).
  - The lamp should switch off when pushbuttons T3 or T4 are actuated.



Name:	Class:	Date:

4. Extend the circuit so that a double-acting cylinder retracts and advances instead of the lamp lighting up.

Handling station

Exercise 7: Creating control systems via sequencing programs

Learning objective

Upon completing this exercise, you should

- be familiar with the mode of operation and fields of application of sequencing
- be able to create simple control systems via sequencing programs

Problem description

Many sequences in automation technology are characterised by one process step having to take place after another. Sensors check whether one step has been successfully completed before the next step starts. This is referred to as sequencing. There is a special programming technique available for user-friendly sequencing.
A simple sequence is to be programmed that lifts a workpiece in the handling station from the holder using the vertically arranged cylinder. The workpiece should then be released again when a pushbutton is actuated.

Task

1. Read up about the programming technique for sequencing in the theory section. Describe the basic idea in your own words.
2. Create a schematic diagram of the setup as well as an allocation list that shows which electrical components are plugged into which slots on the multi-pin plug distributor. Also create the pneumatic and electrical circuit diagrams in FluidSIM® (using the logic module, still without a program).
3. Describe in detail the sequence outlined in the problem description. Use the prepared form on the worksheet.
4. Open the logic module in FluidSIM® by clicking on it with the mouse and create the program to accomplish the sequence described in Exercise 3. Test the program via simulation.
5. Test the program using the handling station. Ensure that the wiring and the tubing correspond to the circuit diagram and assignment list.

Aids

- Theory book
- FluidSIM®
- Handling station

Name:	Class:	Date:

1. Read up about the sequencing programming technique in the theory section. Describe the basic idea in your own words.

_____

_____

_____

_____

2. Create a schematic diagram of the setup as well as an allocation list that shows which electrical components are plugged into which slots on the multi-pin plug distributor. Also create the pneumatic and electrical circuit diagrams in FluidSIM® (using the logic module, still without a program).

Schematic diagram

Name: Class: Date:

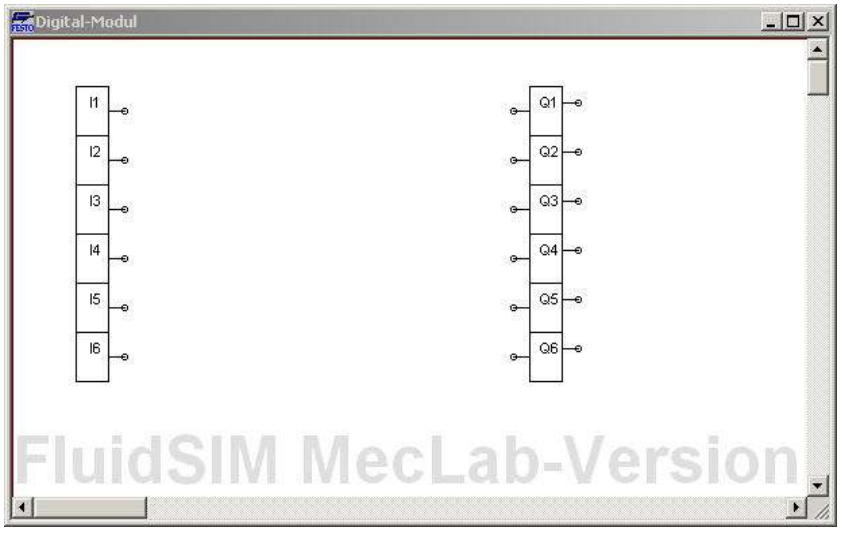
Slot	Designation	Explanation
4		
6		
5		
7		

Name: Class: Date:

3. Describe in detail the sequence outlined in the problem description. Use the prepared form on the worksheet.

Schritt	Aktion	Ausgang	Bedingung
0			
1			
2			
3			

4. Open the logic module in FluidSIM® by clicking on it with the mouse and create the program to accomplish the sequence described in Exercise 3. Test the program via simulation.



Name:	Class:	Date:

5. Test the program using the handling station. Ensure that the wiring and the tubing correspond to the circuit diagram and allocation list.

Handling station

Exercise 8: Handling workpieces

Learning objective

Upon completing this exercise, you should

- be familiar with the mode of operation and fields of application of sequencing
- be able to create complex control systems via sequencing programs

Problem description

Handling tasks are frequently encountered in production. Not all of these tasks require industrial robots;
so-called 2-axis handling systems are used for simple motion sequences. Handling scenarios where a workpiece is moved from one location to another are frequently called pick and place tasks. Examples of these include

- retrieving a workpiece from a conveyor
- placing one workpiece in another (assembly)
- placing a workpiece in packaging

This exercise deals with a pick and place task using the handling station.

Task

1. Create a schematic diagram, an allocation list and an electropneumatic circuit diagram for the handling station. The logic module is to serve as the controller.
2. The handling system is to move a workpiece from the rear tray to the front tray. Describe this sequence in detail. Use the prepared worksheet. Specify which input and output signals have to be received and transmitted. The program should start when a pushbutton is pressed.
3. Open the logic module in FluidSIM® by clicking on it with the mouse and create the program to accomplish the sequence described in Exercise 2. Test the program via simulation.
4. Test the program using the handling station. Ensure that the wiring and the tubing correspond to the circuit diagram and allocation list. Adjust the holders so the gripper can securely grip the workpiece.

Aids

- Theory book
- FluidSIM®
- Handling station

Name:	Klasse:	Datum:

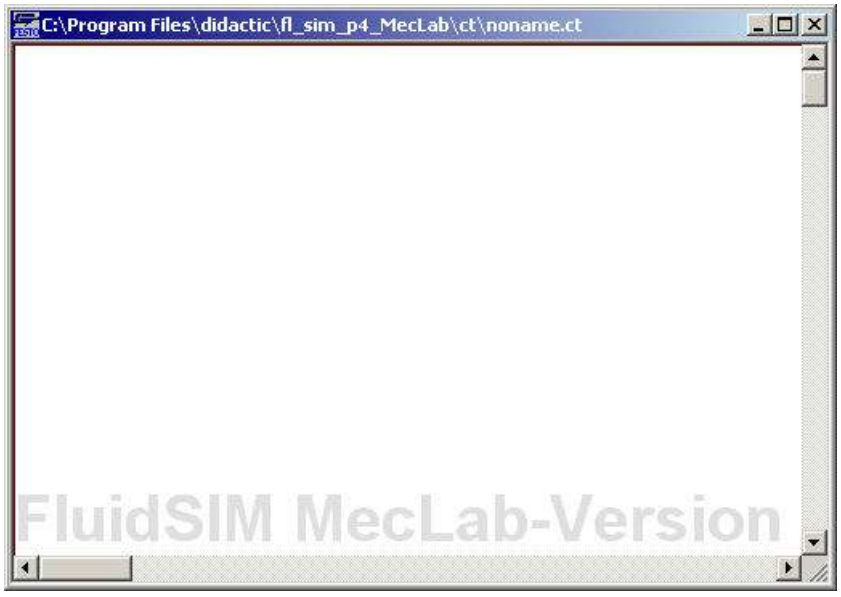
1. Create a schematic diagram, an allocation list and an electropneumatic circuit diagram for the handling station. The logic module is to serve as the controller.

Schematic diagram

Name: Class: Date:

Slot	Designation	Explanation
0		
1		
2		
3		
4		
5		
6		
7		
9		

Allocation list



Electro-pneumatic circuit diagram

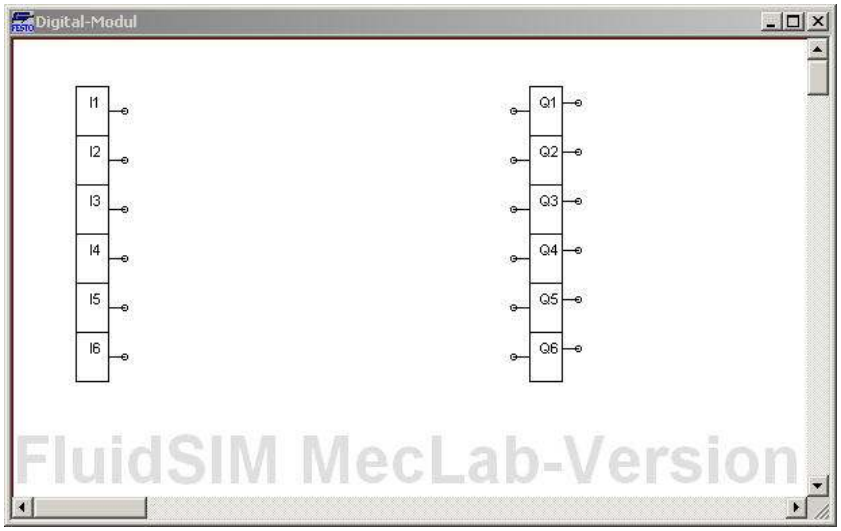
Name: Class: Date:

2. The handling system is to move a workpiece from the rear tray to the front tray. Describe this sequence in detail. Use the prepared worksheet. Specify which input and output signals have to be received and transmitted. The program should start when a pushbutton is pressed.

Step	Action	Output	Condition
1			
2			
3			
4			
5			
6			
7			
8			

Name:	Class:	Date:

3. Open the logic module in FluidSIM® by clicking on it with the mouse and create the program to accomplish the sequence described in Exercise 2. Test the program via simulation.



Name:	Class:	Date:

4. Test the program using the handling station. Ensure that the wiring and the tubing correspond to the circuit diagram and allocation list.