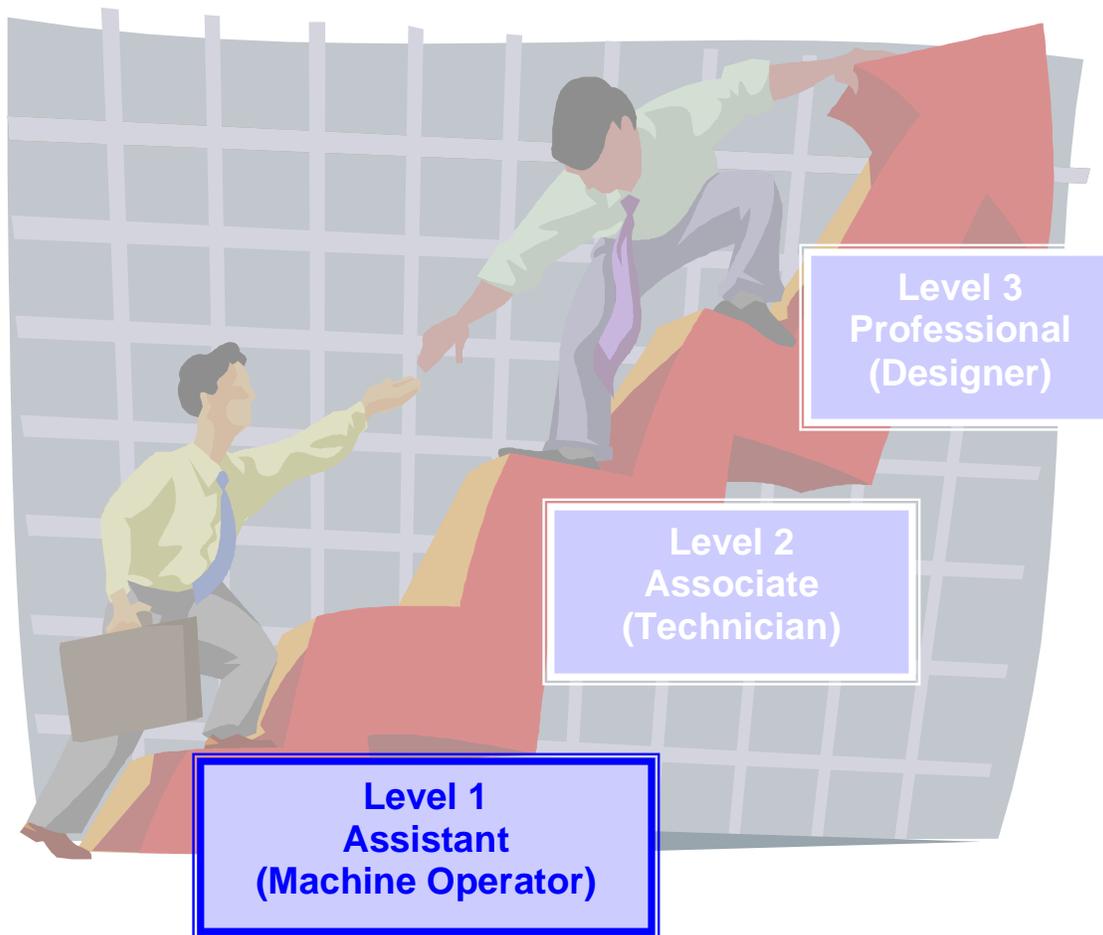


Siemens Mechatronic Systems Certification Program



Level 1 (Mechatronic Systems Assistant)

Overview Level 1 (Mechatronic System Assistant)

The Mechatronic Systems Assistant certification is the first of three certifications in a series. Each certification is based upon a specified, industry-driven job profile which helps an employer determine where this person can be best placed within the organization.

Job Profile

A Siemens Certified Mechatronic Systems Assistant will function as a well-grounded machine operator in a complex system, with responsibility for efficient operation of the equipment with minimal down-times. Normally a Siemens Certified Mechatronic Systems Assistant would carry out their work at plant assembly sites, workshops or in connections with service operation which utilize complex mechatronic systems.

He or she will be able to:

- Localize , identify causes and sources, correct where possible and/or document malfunctions to be passed on to the appropriate experts for resolution, or (where appropriate) exchange or replace defective components
- Recognize potential or impending malfunctions and contact expert assistance in order to keep the production line functioning and to prevent production loss
- Perform routine, preventive maintenance
- Understand and explain the principal operations of the mechatronic subsystems in a complex system
- Understand and explain how these subsystems work together
- Read and understand the technical documents, reports and outlines specific to the system and subsystems, and be able to consult with experts
- Work effectively as a team-member and coordinate the activities with upstream and downstream operations
- Understand and implement safety regulations required for operation of the system

Siemens Certified Mechatronic Systems Assistants understand the full system. In this certification level, they view the components or devices in terms of their roles within the system, and work to keep the system running at maximum capacity. Because the individual components or devices are viewed as “black boxes” in this certification level, they will not be responsible for carrying out repairs of defective devices. However, they will be able to identify correctly where malfunctions are occurring and be able to communicate with experts who can carry out the required repairs.

The Curriculum

Level 1 (Assistant) Certification consists of four standardized courses, designed to be integrated within a college curriculum or to be implemented as continuing education. Each course consists of roughly 60 hours of classroom instruction with additional laboratory work on a physical system located at the training institution, on PC- and web-based simulations, etc.

Each of the four courses has a main focus, although the “big picture” perspective is maintained throughout the program. The main foci of the four courses are:

Course 1: Electrical Components

Course 2: Mechanical Components and Electrical Drives

Course 3: (Electro) Pneumatic and Hydraulic Control Circuits

Course 4: Digital Fundamentals and PLCs

Once a student has successfully completed all four courses, he/she should be well-prepared to sit for the Level 1 certification examination. This will be administered through a neutral testing center. Only by successfully passing the Level 1 Certification Examination will the student be awarded the certification of Siemens Certified Mechatronic Systems Assistant.

System Approach in Level 1

These four courses prepare students for the certification as a Siemens Certified Mechatronic Systems Assistant. The job profile for which the Level 1 certification prepares students is that of a machine operator, who has a well-rounded understanding of the complex inter-relationships and inter-workings of a mechatronic system.

All courses within the Certification Program are based upon a System Approach. Students learn about individual components and system characteristics within the context of an actual mechatronic system. At the beginning of this course, students should first be presented with a complex system. This system should be physically available at the educational institution and within the first class meetings should be visited by the students. By focusing on an actual system, students understand clearly why they are learning the subject material. This increases significantly the learning effect and promotes a fuller understanding of the material being learned. By viewing the system as a whole, learning retention is also increased, as the student experiences the components as part of a whole, rather than in isolation.

Of great importance is that the student is able to transfer the knowledge learned to a new system and is able to quickly familiarize him-or herself with the new system. This understanding leads to a better informed employee who has sufficient knowledge to make well-informed decisions about the running of the system upon which he or she is working on.

Syllabus Level 1, Course 1 Electrical Components

Course Description

This course covers the basics of electrical components in a complex mechatronic system. Based upon a physical system, students will learn the basic functions and physical properties of electrical components, and the roles they play within the system. Technical documentation such as data sheets, schematics, timing diagrams and system specifications will also be covered. By understanding the complete system, the flow of energy through it and measurements on the components, students will learn and apply troubleshooting strategies to identify, localize and (where possible) correct malfunctions. Preventive maintenance and safety issues for electrical components within the system will be discussed.

Course Goals

Upon completion of the course, students should:

- Understand what a mechatronic system is, and the inter-relationships of components and modules with a system.
- Understand the flow of energy, mass and information in the system.
- Understand the role of electrical components in complex mechatronic system and subsystems.
- Understand troubleshooting, maintenance and safety issues within a mechatronic system.

Course Objectives

At the conclusion of this course, students will be able to:

- Describe what comprises a mechatronic system or module.
- Explain the role of various electrical components within a given system or module.
- Trace and describe the flow of energy in a given mechatronic system or subsystem.
- Describe the basic physical properties of electrical components.
- Read, analyze and utilize the technical documents such as data sheets, timing diagrams, operation manuals, schematics, etc. for a mechatronic system.
- Carry out measurements on electrical components in a mechatronic system.
- Correctly localize, identify and document causes of malfunctions in electrical components, based upon the technical documentation.
- Where possible correct malfunctions, or correctly identify the expertise required to correct a malfunction.
- Apply safety rules while working on the system.
- Transfer the knowledge learned from one system to another system.

Course Content

Content to be covered within this course includes the following topics:

- Basic elements and quantities
- Circuit diagrams, data sheets, schematics
- Measurements
- Energy sources
- Actuators
- Sensors
- Overcurrent protection
- Safety issues, including local regulations
- Preventive and routine maintenance of components
- Troubleshooting of the electrical components within a module or system

NOTE: The order in which the content will be discussed is dependent upon the mechatronic system which is being used. In each case, the component and/or class of components will be discussed within the context of the system and the module in which the component is located. This means that the exact order of presentation will vary according to the system available for instruction. It is also important that all classes of electrical components be discussed, whether available in the training system or not.

Focus in all cases is on the role of the components within a module and system, identification of problems, routine maintenance, troubleshooting, and safety issues with the goal of preventing system downtime or reducing them to a minimum.

Course Prerequisites

Basic knowledge of algebra.

Course Materials

Recommended basic course materials are in digital form:

Course materials provided by SMSCP Partner Schools to their students are at the partner school's discretion, and may include special software such as SIMIT, Diagnostic Kit software, etc. If desired, a supporting textbook on electrical components may be required by the school or instructor.

Students must also have access to a mechatronic training system containing all or most of the basic component types covered in the course. Please see the SMSCP "Hardware Requirements" document for more information on system requirements for Level 1 instruction.

Syllabus Level 1, Course 2 Mechanical Components and Electrical Drives

Course Description

This course covers the basics of mechanical components and electrical drives in a complex mechatronic system. Based upon a physical system, students will learn the basic functions and physical properties of mechanical components as well as electrical drives (AC and DC), and the roles they play within the system. They will also learn about mechanical components which lead and support the energy through a mechanical system to increase efficiency and to reduce wear and tear. Materials, lubrication requirements and surface properties will be examined. Technical documentation such as data sheets and specifications of mechanical elements and electrical drives will also be covered. By understanding the interworkings of the complete system, students will learn and apply troubleshooting strategies to identify, localize and (where possible) correct malfunctions. Preventive maintenance of mechanical elements and electrical drives as well as safety issues within the system will be discussed.

Course Goals

Upon completion of the course, students should:

- Understand the role of mechanical components and electrical drives in complex mechatronic systems, modules and subsystems.
- Understand the flow of energy in the system.
- Understand troubleshooting, preventive maintenance and safety issues revolving around mechanical components and electrical drives within a mechatronic system.

Course Objectives

At the conclusion of this course, students will be able to:

- Explain the role of various mechanical components within a given system or module.
- Trace and describe the flow of energy in a given mechatronic system or subsystem.
- Describe the basic physical properties of mechanical components including materials, lubrication requirements and surface properties.
- Carry out adjustments on mechanical components in a mechatronic system.
- Read, analyze and utilize the technical data sheets for the mechanical components and electrical drives within a mechatronic system.
- Correctly localize, identify and document causes of malfunctions in mechanical components or electrical drives, based upon the technical documentation.
- Correct malfunctions where possible, or correctly identify the expertise required to correct a malfunction.
- Apply safety rules while working on the system.
- Transfer the knowledge learned from one system to another system.

Course Content

Content to be covered within this course includes the following topics:

- Mechanical systems and subsystems in support of flow of energy in the system
- Components for transmitting torque (e.g., gears)
- Support components (e.g., bearings)
- Fasteners
- Couplings and clutches
- Basics of electrical drives (AC and DC)
- Technical documentation
- Safety issues, including local regulations
- Preventive and routine maintenance of components including lubrication requirements, surface properties, and prevention of friction
- Troubleshooting of the mechanical components within a module or system

NOTE: The order in which the content will be discussed is dependent upon the mechatronic system which is being used. In each case, the component and/or class of components will be discussed within the context of the system and the module in which the component is located. This means that the exact order of presentation will vary according to the system available for instruction. It is also important that all classes of electrical components be discussed, whether available in the training system or not.

Focus in all cases is on the role of the components within a module and system, identification of problems, routine maintenance, troubleshooting, and safety issues with the goal of preventing system downtime or reducing them to a minimum.

Course Prerequisites

Basic knowledge of algebra.

Course Materials

Recommended basic course materials are in digital form:

Course materials provided by SMSCP Partner Schools to their students are at the partner school's discretion, and may include special software such as SIMIT, Diagnostic Kit software, etc. If desired, a supporting textbook on mechanical components and electric drives may be required by the school or instructor.

Students must also have access to a mechatronic training system containing all or most of the basic component types covered in the course. Please see the SMSCP "Hardware Requirements" document for more information on system requirements for Level 1 instruction.

Syllabus Level 1, Course 3 (Electro) Pneumatic and Hydraulic Control Circuits

Course Description

This course covers the basics of pneumatic, electropneumatic and hydraulic control circuits in a complex mechatronic system. Students will learn the functions and properties of control elements based upon physical principles, and the roles they play within the system. Technical documentation such as data sheets, circuit diagrams, displacement step diagrams and function charts will also be covered. By understanding and performing measurements on the pneumatic and hydraulic control circuits, students will learn and apply troubleshooting strategies to identify, localize and (where possible) correct malfunctions. Preventive maintenance of (electro) pneumatic and hydraulic components as well as safety issues within the system will be discussed.

Course Goals

Upon completion of the course, students should:

- Understand what a mechatronic system is, and the inter-relationships of components and modules within a complex mechatronic system with a focus on (electro)pneumatic and hydraulic control systems.
- Understand the role of (electro) pneumatic and hydraulic control systems in complex mechatronic system and subsystems.
- Understand troubleshooting, maintenance and safety issues revolving around (electro) pneumatic and hydraulic circuits within a mechatronic system.

Course Objectives

At the conclusion of this course, students will be able to:

- Explain the role of various (electro) pneumatic and hydraulic components within a given system or module.
- Trace and describe the flow of energy in a given mechatronic system or subsystem.
- Describe the basic physical properties of pneumatic and hydraulic components.
- Carry out measurements and adjustments on pneumatic and hydraulic components in a mechatronic system.
- Read, analyze and utilize the technical documents such as data sheets, circuit diagrams, displacement step diagrams, timing diagrams and function charts for the pneumatic and hydraulic components within a mechatronic system.
- Correctly localize, identify and document causes of malfunctions in pneumatic and hydraulic circuits, based upon the technical documentation.
- Correct malfunctions in pneumatic and hydraulic circuits, where possible, or correctly identify the expertise required to correct a malfunction.

- Apply safety rules while working on the system.
- Transfer the knowledge learned from one system to another system.

Course Content

Content to be covered within this course includes the following topics:

- Pneumatics and Electropneumatics
 - Introduction
 - Electropneumatic Control System
 - Signal Processing Structure
 - Function Diagram and Pneumatic Circuit Diagram
 - Actuation of Pneumatic Cylinders
 - Sequence Control Systems
 - Electrically Actuated Directional Control Valves (DCVs)
 - Displacement-Step Diagram
 - Pneumatic Actuators
 - Stroke Speed Regulation of Pneumatic Actuators
 - Basic Electropneumatic Control Circuits
 - Air Generation and Distribution
 - Terminal Connections
 - Electrical Control Devices
 - Safety Regulations
- Hydraulics
 - Overview
 - Circuit Symbols
 - Design of Circuit Symbols
 - Physical Principle
 - Transmissions
 - Pressure Transfer and Flow Rate
 - Solenoid Activated Directional Control Valves

NOTE: The order in which the content will be discussed is dependent upon the mechatronic system which is being used. In each case, the component and/or class of components will be discussed within the context of the system and the module in which the component is located. This means that the exact order of presentation will vary according to the system available for instruction. It is also important that all classes of electrical components be discussed, whether available in the training system or not.

Focus in all cases is on the role of the components within a module and system, identification of problems, routine maintenance, troubleshooting, and safety issues with the goal of preventing system downtime or reducing them to a minimum.

Course Prerequisites

Basic knowledge of algebra.

Course Materials

Recommended basic course materials are in digital form:

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Course materials provided by SMSCP Partner Schools to their students are at the partner school's discretion, and may include special software such as SIMIT, Diagnostic Kit software, etc. If desired, a supporting textbook on pneumatic and hydraulic systems may required by the school or instructor.

Students must also have access to a mechatronic training system containing all or most of the basic component types covered in the course. Please see the SMSCP "Hardware Requirements" document for more information on system requirements for Level 1 instruction.

Syllabus Level 1, Course 4 Digital Fundamentals and Programmable Logic Controllers

Course Description

This course covers the fundamentals of digital logic and an introduction to programmable logic controllers (PLCs) in a complex mechatronic system with a focus on the automation system SIMATIC S7-300 and the appropriate programming software STEP7. Using computer simulation, students will learn the role PLCs play within a mechatronic system or subsystem. They will also learn basic elements of PLC functions by writing small programs and testing these programs on an actual system. Students will learn to identify malfunctioning PLCs, as well as to apply troubleshooting strategies to identify and localize problems caused by PLC hardware.

Course Goals

Upon completion of the course, students should:

- Understand the role of programmable logic controllers in complex mechatronic systems, modules and subsystems.
- Understand the flow of information in the system.
- Understand and apply troubleshooting, maintenance and safety rules.

Course Objectives

At the conclusion of this course, students will be able to:

- Explain the role of programmable logic controllers within a given system or module.
- Trace and describe the flow of information in a given mechatronic system or subsystem with a focus on the control function of PLCs in the system.
- Describe the basic functions and design of PLCs.
- Read, analyze and utilize the technical documents such as data sheets, timing diagrams, operation manuals, schematics, and ladder diagrams.
- Correctly localize, identify and document system malfunctions in or caused by PLC hardware, based upon the technical documentation.
- Apply safety rules while working on the system.
- Transfer the knowledge learned from one system to another system.

Course Content

Content to be covered within this course includes the following topics:

- Function and design of a programmable logic controller (PLC)
- Types of signals in control systems

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- Number systems and digital logic
- Configuration of a PLC
- Basic function modules of PLC
- Program processing
- Basic fundamentals of the programming language STEP7
- Testing and simulation of a PLC program
- Safety issues, including local regulations
- Preventive and routine maintenance of PLCs
- Troubleshooting of the PLC hardware within a module or system

NOTE: The order in which the content will be discussed is dependent upon the mechatronic system which is being used. In each case, the component and/or class of components will be discussed within the context of the system and the module in which the component is located. This means that the exact order of presentation will vary according to the system available for instruction. It is also important that all classes of electrical components be discussed, whether available in the training system or not.

Focus in all cases is on the role of the components within a module and system, identification of problems, routine maintenance, troubleshooting, and safety issues with the goal of preventing system downtime or reducing them to a minimum.

Course Prerequisites

Basic knowledge of algebra. Successful completion of, or parallel enrollment in Courses 1, 2, and 3 of the certification program is recommended but not required.

Course Materials

Recommended basic course materials are in digital form:

Course materials provided by SMSCP Partner Schools to their students are at the partner school's discretion, and may include special software such as SIMIT, Diagnostic Kit software, etc. If desired, a supporting textbook on basic PLC topics may be required by the school or instructor.

Students must also have access to a mechatronic training system containing all or most of the basic component types covered in the course. Please see the SMSCP "Hardware Requirements" document for more information on system requirements for Level 1 instruction.