Automation Technician Certificate Program

Online self-paced, skills based training - when you want, where you want and at your own pace.

The Automation Technician program provides an introduction to industrial automation including digital electronic, process control and programming of PLCs, robotics and SCADA systems. The program examines applications and examples of automated manufacturing systems including both the theory and function of digital and industrial electronics, hydraulics and pneumatics, robotics systems, digital programming languages and alarm management. No background in Automation is required.

The Automation Technician Certificate contains the following modules:

Each of the 18 modules includes learning objectives, practical applications, technical tips, interactive labs, review questions and online final exams.

1. Introduction to Automation
2. Industrial Control Devices
3. Motors & Control Circuits
4. Digital Electronics
5. Analog & Digital Transducers
6. Industrial Process Control
7. Distributed Control Systems (DCS)
8. SCADA Systems
9. Introduction to PLCs
10. Ladder Logic Programming
11. PLC Timers
12. PLC Counters
13. PLC Data Handling
14. PLC Math Instructions
15. Introduction to Robotics
16. Robot Manipulators & End Effectors
17. Robot Vision, Touch, & Sound
18. Robot Programming

Learning with Laboratory Simulations

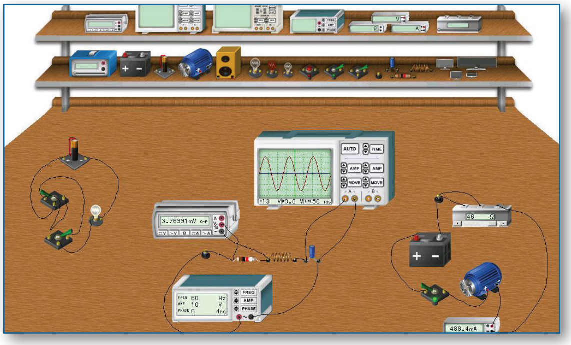
One of the main features of the Automation Technician program is the integration of theory with laboratory experiments and projects. Students who enrol in the program receive a licensed copy of LogixSim, which includes both 2D- and 3D-simulation software and features CircuitLogix, RoboLogix, PLCLogix, and 3DLab simulation products.

LogixSim Simulator

LogixSim is a suite of software products that provides "real world" laboratory simulation of electricity, electronics, robotics, and programmable logic controllers. It combines four simulators and offers unlimited possibilities for the design, testing, and debugging of control devices and automated equipment as well as circuit schematics and systems. From the simplest control circuits to the most complex, LogixSim has the versatility to suit almost any requirement for real-world simulation.

3DLab

3DLab is a simulated bench top, designed to closely replicate the appearance and functionality of actual electrical and electronic devices and instruments. 3DLab features a workbench and shelves containing over 30 realistic-looking devices which are interconnected to perform a wide range of DC/AC experiments and laboratory projects

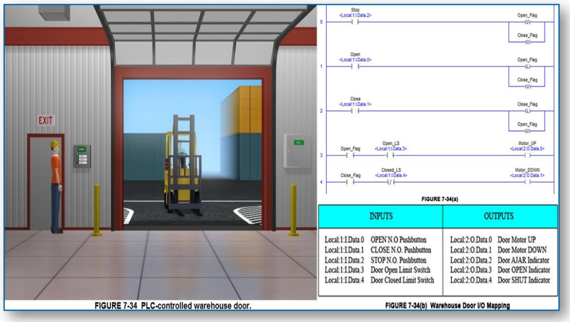


CircuitLogix

CircuitLogix is a software program that converts your computer into a fully-functioning electronics laboratory with thousands of components and devices that are easily interconnected. Circuit-Logix is a SPICE-based 2D-schematic editor, which provides simulation of analog, digital, and mixed-mode devices and circuits.

PLCLogix

PLCLogix is a PLC simulator that emulates the operation of an RSLogix 5000 PLC. It provides users with the ability to write, edit and debug programs written using the RSLogix 5000 tag-based format. PLCLogix also features 12 "real world" 3D control application environments including batch processing, elevators, traffic lights, car washes, etc.



RoboLogix

RoboLogix is a robotics simulation software package that is designed to emulate real-world robotics applications and employs the basic principles common to the vast majority of robots currently in use in the automation industry. RoboLogix allows you to write, test, and de-bug robotics programs and observe the robot's operation using a realistic-looking manipulator in a 3D simulation environment

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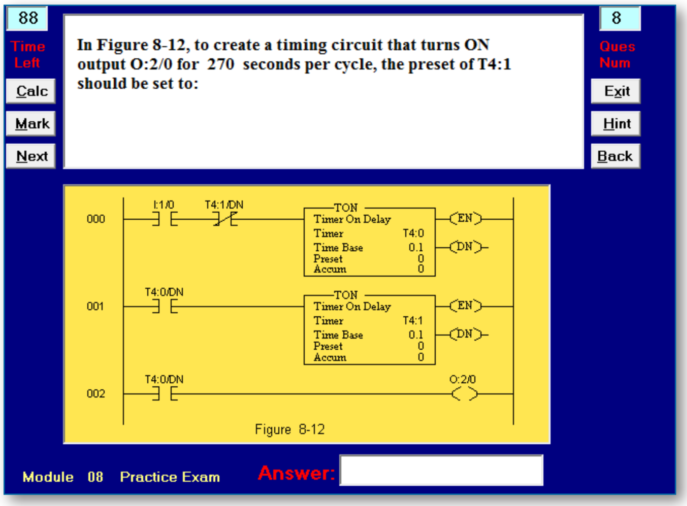
STUDENT SUPPORT

To fully support your distance education learning experience in our program, we provides a comprehensive student support system that gives our students every opportunity to get technical, tutorial or administrative help, when and how you need it.

Exams

Being tested is always a stressful and challenging part of your student experience. To help you prepare for testing, our program includes detailed review questions covering the program material in each module. If you complete these review questions and work with our program tutors to resolve any problem areas, you will be well prepared to excel on the online exams taken at the end of each module.



Online Forums

The Automation Discussion Forum provides our students with an online community in which to meet other students within the program and discuss topics of mutual interest. It is also where students access our online program tutor and a library of tutorial.

The Student Support Center

The Student Support Center is open Monday through Friday 9 am - 10 pm & Saturday & Sunday from 10 am - 5 pm (EST). Calling into the Support Center is free using our toll-free 1-800 long distance number. Technical, tutorial and administrative support is available to you by phone or email during these hours. Our Program Consultants and Tutorial Support Staff can assist you with any questions you might have, from installing the program, to solving content-based tutorial questions, to helping you register for more modules.

Online Resources

Our online student support website provides a wide range of resources, including access to your "Account", online forums, testing, videos, animations, images and additional supplementary learning materials.

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FOR MORE INFORMATION PLEASE CONTACT US AT :

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AUTOMATION TECHNICIAN PROGRAM DESCRIPTION

Table of Contents

Module 1 – INTRODUCTION TO AUTOMATION
This module provides a general overview of automation systems and the role of automation in industry. It also covers the basic principles of flexible automation and flexible manufacturing systems. The advantages of automation are outlined, and the main components associated with automation systems are explored. Automation safety is also discussed in detail. An introduction to automation simulation is presented with an emphasis on practical application.

Learning Outcomes:
• Define the term "automation".
• List three advantages of using automation systems.
• Name six factors affecting the original design of PLCs.
• Describe the role of automation in industry.
• Define flexible automation.
• Differentiate between economy of scale and economy of scope.
• List three examples of continuous flow processes.
• Describe the purpose of a flexible manufacturing system.
• Explain the difference between DCS, RCS and CCS.
• Define automation simulation and explain its advantages.
• Name three considerations for automation safety.

Module 2 - INDUSTRIAL CONTROL DEVICES
Industrial Control Devices provides an overview of devices such as switches, actuators, and relays and their industrial applications. The student will learn troubleshooting techniques and the principles of relay and ladder logic. This module also covers solenoids and control valves with an emphasis on practical applications.

Learning Outcomes:
• Define inductive arcing and explain how it can be prevented.
• Name three types of mechanical switches.
• Describe the basic operating principle of a control relay.
• Explain the purpose of overload relays.
• Define the term holding contract and its application in control circuits.
• Explain the difference between a control relay and a solenoid.
• List three applications of rotary actuators.
• Name three types of time-delay relays.

Module 3 - MOTORS & CONTROL CIRCUITS
This module will focus on the principles of DC motors and the various types used in industry. The student will learn the fundamentals of speed control including dynamic and regenerative braking. It also introduces the student to electronic speed control of DC motors. In addition, the fundamentals of alternating current motors and AC variable speed control systems are presented. The principles of variable frequency drives and their control circuits are discussed in detail.

Learning Outcomes:
• Explain the purpose of a commutator in DC motors.
• Differentiate between a stator and an armature.
• Define torque and counter emf.
• Name three typical dynamo configurations.
• Explain the basic operating principle of servomotors.
• Explain how Pulse Width Modulation is used in speed control.
• Define the terms dynamic and regenerative braking.
• Describe the operating principles of an AC induction motor.
• List three advantages of universal motors over induction motors.
• Differentiate between a cycloconverter and an inverter.
• Explain the basic operation of a variable frequency drive.

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Module 4 - DIGITAL ELECTRONICS
This module covers a wide variety of topics relating to digital electronics including number systems, logic gates, flip flops and counters. Boolean algebra and DeMorgan's theorem is also introduced as well as troubleshooting and problem solving techniques for digital logic circuits. The logic gates presented in the course include AND, OR, NOR, NAND and inverters.

Learning Outcomes:
- Explain the binary number system.
- Convert binary numbers to decimal and decimal numbers to binary.
- Explain the hexadecimal number system.
- Convert hexadecimal numbers to binary and binary numbers to hexadecimal.
- Differentiate between natural binary and Binary Coded Decimal (BCD).
- Understand the ASCII code.
- Apply truth tables to troubleshooting digital circuits.
- List five logic gates.
- Describe the basic operation of an inverter.
- Explain the purpose of Boolean algebra.
- Understand logic gate combinations.
- Name eight Boolean theorems.
- Apply basic troubleshooting techniques to digital circuits.

Module 5 - ANALOG & DIGITAL TRANSDUCERS
This module will build on previous topics by presenting an introduction to transducers used in both analog and digital applications. It also covers temperature, pressure, and flow transducers as well as other detection devices such as optical encoders and Hall-effect sensors. Capacitive, ultrasonic, and thickness sensors are also presented using practical and theoretical examples of industrial applications of these devices.

Learning Outcomes:
- Differentiate between a thermocouple and a thermopile.
- Explain the advantages of using pyrometers for temperature measurement.
- Define the terms RTD and thermistor.
- Name two types of pressure transducers.
- Describe how load cells are used for flow measurement.
- Name three types of photoelectric devices.
- Briefly describe the components used in fibre optic systems.
- Define lasers and explain why they are used in industrial electronic controls.
- Explain the basic operating principle of an optical shaft encoder.

Module 6 - INDUSTRIAL PROCESS CONTROL
It is in this module that the student learns the principles of industrial control systems including open- and closed-loop control. Proportional, Integral, and Derivative control are covered with an emphasis on practical application and design. An introduction to algorithms, flow charts and fuzzy logic is also presented in this course.

Learning Outcomes:
- Define the terms process, process variable and controlled variable.
- Name four applications for control systems.
- Explain the advantage of using block diagrams.
- Describe the relationship between the set point, error signal and measured value.
- Differentiate between open-loop control and closed-loop control.
- List the five basic components in a closed-loop control system.
- Name the four variables that are generally used to evaluate the performance of a closed-loop control system.
- Define dead time.
- Explain the basic operating principles of on off, proportional, integral, derivative and PID control.
- Describe the purpose of feedforward control in process systems.

Module 7 - DISTRIBUTED CONTROL SYSTEMS (DCS)
This module is intended to familiarize the student with the most important aspects of Distributed Control Systems. Topics covered in the module include remote terminal units (RTUs), HMIs and an introduction to LANs. The student will also learn the differences between star, bus, and ring topology and their applications in automation systems. In addition to covering system architecture and algorithms, the course also provides detailed information on practical applications for DCS. Emphasis is placed on design, problem solving and analysis of industrial automation systems.

Learning Outcomes:
- Differentiate between DCS and SCADA.
- List the three main elements in a DCS.
- Identify the difference between uptime and system latency.
- Explain the purpose of a remote terminal unit (RTU).
- Define task architecture and hardware architecture.
- Describe the reason why algorithms are popular in DCS.
- Name four common uses for HMI in DCS applications.
- Explain the function of a local area network (LAN).
- Identify three components of quality of use in HMI.
- Define the terms topology and Ethernet.
- Compare software-based alarms with hardware-based alarms.
- List five applications for DCS.
- Name the four elements in a typical OTS.

Module 8 - SCADA SYSTEMS
This module is intended to provide the student with an introduction to SCADA using automation systems and peripherals. The principles of alarm management are presented along with an overview of the alarm management lifecycle and an introduction to Six Sigma. SCADA security and authentication methodologies are also discussed in detail. Practical examples of SCADA applications are presented and include a discussion of SCADA simulation techniques.

Learning Outcomes:
- Describe the basic function of a SCADA system.
- List four examples of SCADA systems.
- Define SCADA architecture.
- Identify seven elements in a SCADA system.
- Explain the purpose of alarm management.
- Identify three types of changes noted by alarms and events.
- List the 10 stages of an alarm management lifecycle.
- Describe how Six Sigma is applied to alarm management.
- Explain the purpose of a firewall in a SCADA system.
- Define the term SCADA security.
- Name the two most common authentication methodologies.
- Describe the benefits of SCADA simulation.

Module 9 - INTRODUCTION TO PLCs
This module provides a general overview of PLCs and their application in industry. The origins of the PLC and its evolution are covered in detail. The advantages of PLCs are also outlined, and the main components associated with PLC systems are explored. An introduction to ladder logic is presented and the most common types of PLC signals are covered with an emphasis on practical application.

Learning Outcomes:
- Describe the purpose of a control panel.
- Define a programmable controller.
- List six factors affecting the original design of programmable controllers.
- Name three advantages of PLCs compared to relay logic systems.
- List the three main components in a PLC system.
- Understand the term ladder logic.
- Describe the application of PLC signals.
- Explain the difference between a bit and a word.

Module 10 - LADDER LOGIC PROGRAMMING
This module provides an introduction to ladder logic programming techniques using laboratory simulation software. The lab component of the module provides the student with an opportunity to write ladder logic programs and test their operation through PLC simulation. Topics covered in the course include I/O instructions, safety circuitry, programming restrictions and I/O addressing.

Learning Outcomes:
- Define ladder logic.
- Convert relay logic schematics to ladder logic.
- Write a ladder logic program using PLCLogix.
- Define the terms examine on and examine off.
- Explain the purpose of a latching relay instruction.
- Differentiate between a branch and a nested branch.
- Describe the controller scan operation.
- Name two programming restrictions.
- Describe the use of Force instructions in PLC applications.
- Explain the purpose of bit status flags.

Module 11 - PLC TIMERS
This module is intended to provide students with an overview of PLC timers and their application in industrial control circuits. Allen-Bradley timing functions such as TON, TOF and RTO are discussed in detail and the theory is reinforced through lab projects using lab simulation software. In addition, students will learn practical programming techniques for timers including cascading and reciprocating timing circuits.

Learning Outcomes:
- Name two types of relay logic timers.
- List the four basic types of PLC timers.
- Describe the function of a time-driven circuit.
- Differentiate between an ON-delay and an OFF-delay instruction.
- Write a ladder logic program using timers.
- Describe the operating principle of retentive timers.
- Explain the purpose of cascading timers.
- Define reciprocating timers.

Module 12 - PLC COUNTERS
This module provides students with a broad overview of PLC counters and their application in control systems. Allen-Bradley counting functions such as CTU and CTD are presented in detail and the theory is reinforced through lab projects using lab simulation software. In addition, students will learn practical programming techniques for counters including cascading counters and combining counting and timing circuits.

Learning Outcomes:
- Name two types of mechanical counters.
- Define the two basic types of PLC counters.
- Write a ladder logic program using CTU, CTD and RES.
- Explain the terms underflow and overflow.
- Describe the function of an event-driven circuit.
- Design an up/down counter.
- Define cascading counters.
- Explain the advantages of combining timers and counters.

Module 13 - PLC DATA HANDLING
This module provides students with an introduction to the principles of Logix 5000 data handling, including bits, words, and arrays. Using PLCLogix simulation, various aspects of data transfer will be demonstrated and students will program and observe transfer instructions such as MOV, FIFO and LIFO. An introduction to shift registers is also presented with an emphasis on practical applications in industrial control circuits.

Learning Outcomes:
- Name the three main data handling functions.
- Differentiate between words and arrays.
- Convert data from one form to another.
- Explain the purpose of a move instruction.
- Write a ladder logic program using an MOV instruction.
- Describe the purpose of an array to array move.
- Name two types of shift registers.
- Differentiate between FIFO and LIFO instructions.
- Transfer data between memory locations.

Module14 - PLC MATH INSTRUCTIONS
This module provides an overview of basic and advanced mathematical functions found in the Logix 5000 PLC. It provides thorough coverage of data comparison instructions such as SQR, EQU, LES, and GRT. In addition, this course provides a foundation for more advanced programming techniques including analog input and output control. Topics such as combining math functions, averaging, scaling and ramping are presented with an emphasis on practical application and are demonstrated using PLCLogix lab simulation.

Learning Outcomes:
- Name the four main PLC mathematical functions.
- List three types of data comparison.
- Add and subtract numbers using PLC instructions.
- Write a ladder logic program using MUL and DIV instructions.
- Define the terms scaling and ramping.
- Use LES, GRT, and EQU instructions in a ladder logic program.
- Write a program using the SQR instruction.
- List three advanced math operations.
- Describe the purpose of an AVE instruction.

Module 15 – INTRODUCTION TO ROBOTICS
This module is designed to introduce the student to the fundamental concepts of robotics and describe some basic applications. It covers operating principles of a manipulator and describes four types of actuators found in industry. The history of robotics is presented, as well as an overview of the main applications of industrial robots. The advantages of robots are also outlined, and the main components associated with robotic systems are explored. An introduction to robot cost/benefit analysis is presented and the most common non-industrial applications of robots are explored.

Learning Outcomes:
- List the main components of a robot.
- Describe the operating principles of a manipulator.
- Identify four types of actuators.
- Explain the role of Devol and Engelberger in robotics history.
- Define the terms ROV and TROV.
- Name the two types of robot arms.
- List five non-industrial applications of robots.
- Explain the purpose of a controller in a robotic system.
- Describe two cost/benefit analysis factors related to production volumes.
- Identify seven factors which should be considered when selecting a robot.

Module 16 – ROBOT MANIPULATORS & END EFFECTORS
This module is designed to cover the fundamentals of manipulators, links, and joints. A discussion of kinematics and haptic technology is presented, as well as dextrous manipulation, and an overview of the basic coordinate systems for a robot manipulator. The theoretical and practical aspects of manipulators and spatial analysis are introduced in this module using a combination of video, animation and a laboratory projects and featuring Robotics simulation software.

Learning Outcomes:
- Name the most common type of manipulator.
- Differentiate between robot links and joints.
- Define major axes and minor axes.
- Explain the purpose of kinematics in robotic systems.
- Describe screw theory in kinematic applications.
- Name the three types of revolute joints.
- Define haptic technology.
- List the four general categories of robotic manipulation.
- Differentiate between velocity manipulability and velocity workspace analysis.
- Describe the function of dexterous manipulation.
- Name the three basic co-ordinate systems for a robot manipulator.
- Explain the operation of a gantry robot.
- List six end effectors used in industrial robotics.
- Determine the shape of a work envelope.

Module 17 – ROBOT VISION, TOUCH & SOUND

It is in this module that the student learns the principles of robotic vision systems including cameras, frame grabbers and vision algorithms. 3D vision, photogrammetry and tactile sensing are covered with an emphasis on practical application and design. An introduction to robot inspection and speech recognition is also presented in this module. In addition, this module also provides an overview of CCD and CMOS cameras and describes their application in industrial robotics. The student will learn design techniques and the principles of F/T sensing as well as the most common characteristics of touch sensors.

Learning Outcomes:

- Explain the purpose of a robot pose.
- Name the two most important sensors for a robot.
- List five functions performed by vision and touch sensors.
- Explain the three steps required for a vision system to process data.
- Describe the two levels of world modeling.
- Define the term photogrammetry.
- Compare CCD and CMOS cameras.
- Calculate the field of view for a vision system.
- Discuss the purpose of a frame grabber in a vision system.
- List the three basic techniques used for 3D vision.
- Define the term slip sensing.
- Differentiate between touch sensing and F/T sensing.
- Name six desirable characteristics of touch sensors.
- Define robot audition.

MODULE 18 - ROBOT PROGRAMMING

This module provides an introduction to robot software, programming languages and various programming techniques associated with industrial robots. On-line and off-line programming, teach pendants and automatic programming are presented using a combination of theoretical and laboratory exercises utilizing robotics simulation software. In addition, this module also introduces the student to web-based programming and open architecture programming and provides coverage of some of the major robot programming languages and techniques.

Learning Outcomes:

- Explain the purpose of a layered system for robot programming.
- Name the two major categories of robot programming.
- List five criteria for standardized programming languages.
- Define software architecture.
- Differentiate between manual and automatic programming.
- Name three types of non-proprietary robot languages.
- Identify five types of motion instructions.
- Describe the most popular type of robot programming language.
- Explain how program touch-up is used when programming.
- List two types of simulation used in industry.
- Compare keyframing and skeletal animation in 3D modeling.
- Discuss the benefits of open-architecture programming.
- Name four characteristics of DSSP in Microsoft Robotics Studio.

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